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# **GemBuilder™ for C for GemStone/S 64 Bit™**

**Version 3.6**

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## PATENTS

GemStone software is or has been covered by U.S. Patent Number 6,256,637 "Transactional virtual machine architecture" (1998-2018), Patent Number 6,360,219 "Object queues with concurrent updating" (1998-2018), Patent Number 6,567,905 "Generational garbage collector with persistent object cache" (2001-2021), and Patent Number 6,681,226 "Selective pessimistic locking for a concurrently updateable database" (2001-2021).

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# Preface

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## About This Manual

This manual describes GemBuilder™ for C — a library of C functions that provide a bridge between your application's C code and the application's database controlled by GemStone. These functions provide your program with complete access to a GemStone database of objects, and to a virtual machine on which to execute GemStone Smalltalk code.

This manual describes the classic GemBuilder for C interface, which is not thread-safe. A newer, thread-safe interface is provided by `gcits.hf`. This is not described in this manual; see the C header file, `$GEMSTONE/include/gcits.hf`, for usage details.

## Prerequisites

This manual assumes you are familiar with the GemStone Smalltalk programming language, as described in the *Programming Guide for GemStone/S 64 Bit*. In addition, you must know the C / C++ programming language. Finally, you should be familiar with your C compiler, as described in its user documentation.

You should have the GemStone system installed as described in the *GemStone/S 64 Bit Installation Guide* for your platform.

## Terminology Conventions

The term “GemStone” is used to refer to the server products GemStone/S 64 Bit and GemStone/S, and the GemStone family of products; the GemStone Smalltalk programming language; and may also be used to refer to the company, now GemTalk Systems, previously GemStone Systems, Inc. and a division of VMware, Inc.

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#### [gemtalksystems.com](http://gemtalksystems.com)

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- ▶ **Compatibility matrices**, listing supported platforms for GemTalk product versions.

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**Website:** [techsupport.gemtalksystems.com](http://techsupport.gemtalksystems.com)

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# Introduction

---

GemBuilder™ for C is a library of C functions that provide access to the GemStone/S 64 Bit™ repository and the GemStone Smalltalk programming language from C applications, or from other environments that can invoke C functions.

The GemBuilder for C functions are provided by shared libraries that are distributed with the GemStone/S 64 Bit product. These shared libraries are used by the GemStone/S 64 Bit topaz interface, and by the GemBuilder for Smalltalk and GemBuilder for Java products. These libraries can be used from any environment that allows you to invoke C libraries, including Smalltalk implementations such as Dolphin and Pharo, and other languages such as Ruby and Python.

The GemStone object server contains your schema (class definitions) and objects (instances of those classes), while your GCI client program provides the user interface. Logic may be implemented on the client, server, or both; the GemBuilder functions allow your GCI application to create, read, and write objects in the GemStone repository either by invoking Smalltalk code or by using structural access and basic C data types.

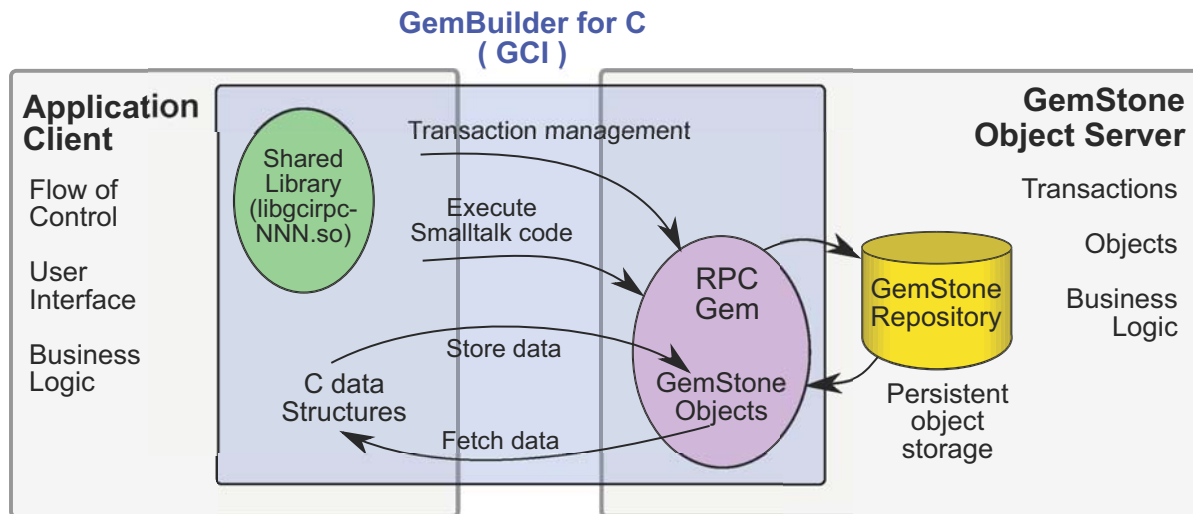
The following interfaces allow your GemStone application to invoke C functions:

- ▶ **GCI Application**—a standalone application in C, C++, or another language, in which the C API is invoked according to the rules for that environment, and the final application is compiled or packaged for use according to the rules for that language. This manual describes using C or C++ to invoke GemBuilder functions, and provides compile and link information for C/C++.
- ▶ **User Actions**—user actions provide a way for GemStone Smalltalk to invoke C/C++ code that you have compiled into shared libraries. This is similar to the concept of “user-defined primitives” offered by other object-oriented systems. The functions themselves are written as for a standalone GCI application, although there are some differences in handling objects. This manual provides information on how to define the API and compile and link User Action libraries.
- ▶ **Foreign Function Interface (FFI)**—the GemStone FFI interface allows you to interface to C/C++ libraries. This interface is designed to invoke third-party libraries, although it can be used to invoke the GemBuilder C functions. The FFI interface is described in the *Programming Guide*, and is not covered in this manual.

## 1.1 GemBuilder Application Overview

Figure 1.1 illustrates the role of GemBuilder in developing a GemStone application. In effect, developing your GCI application consists of two separate efforts: creating Smalltalk classes and methods, and interacting with C code.

**Figure 1.1 The Role of GemBuilder in Application Development**



We recommend the following steps for developing your hybrid application:

**Step 1.** Define the application's external interface.

GemBuilder-based applications must manage the user interface using language-specific modules. GemStone and GemBuilder for C have no graphical user interface.

**Step 2.** Decide where to perform the work.

Applications that are a hybrid of client-side code and GemStone Smalltalk classes pose interesting problems to the designer: Where is the best place to perform the application's work? Is it better to import the representation of an object into C data types and perform the work on the client, or to send a message which invokes a Smalltalk method on the server?

**Step 3.** Implement and debug the application.

After you've developed a satisfactory design, you can implement and test the client functions using language-specific techniques and tools.

**Step 4.** Compile and link the application.

For instructions about compiling and linking your application, please see Chapter 5, "Compiling and Linking" For full details, see your C compiler user documentation.



## 1.2 Deciding Where to Do the Work

As mentioned above, you will need to decide how much of the application's work to perform in C functions on the client and how much in Smalltalk methods on the server. The following paragraphs discuss both approaches.

### Representing GemStone Objects in C

You may choose to implement C functions that access GemStone objects for manipulation in your C program. In such cases, a representation of each object must be imported from GemStone into your C program before the C function is executed.

By import, we mean that memory is allocated within your C program to contain the C equivalent of the GemStone Smalltalk object. You could also say that these values are cached in your application; rather than having a reference to the object by identity (OOP), we have the contents of its instance variables. The object in its permanent form still exists in the repository, and the cached values in your application may become obsolete if other sessions commit changes to this object.

Exporting is the reverse of importing - you create a GemStone Smalltalk object that holds the equivalent to your C data, or update an existing GemStone Smalltalk object with the C data in your application.

GemBuilder provides functions for importing objects from GemStone to your C program, creating new GemStone objects, directly accessing and modifying the internal contents of objects, and exporting objects to the GemStone repository.

Of course, if you import an object to your C program and modify it, or if you create a new object within your C program, your application must export the new or modified object to GemStone before it can commit the changes to the repository.

Here are some advantages of using GemBuilder structural access functions to modify objects:

- ▶ It may be more efficient to perform a function in C than in Smalltalk.
- ▶ The function may need to be closely linked with I/O functions for the user interface.
- ▶ The function may already exist in a standard library. In this case, the data must be transported from GemStone to that function.

The section "Structural Access to Objects" on page 30 defines exactly how objects are represented in C as address space, and defines the GemBuilder functions for exchanging these structures between GemStone and C.

### Smalltalk Access to Objects

In many cases, you will choose to perform your GemStone work directly in Smalltalk. GemBuilder provides C functions for defining and compiling Smalltalk methods for a class, and for sending a message to an object (invoking a Smalltalk method).

Here are some advantages of writing a function directly in Smalltalk:

- ▶ The integrity of the data encapsulation provided by the object metaphor is preserved.
- ▶ Functions in Smalltalk are more easily shared among multiple applications.

- ▶ Functions in Smalltalk may be easier to implement. There is no need to worry about moving objects between C and Smalltalk or about space management.
- ▶ The overhead of transporting objects between C and Smalltalk is avoided.
- ▶ Classes or methods may already exist which exhibit behavior similar to the desired behavior. Thus, less effort will be required to implement a new function in Smalltalk.

The section “Performing work in GemStone” on page 28 defines GemBuilder functions that allow applications to send Smalltalk messages to objects and execute Smalltalk code.

## Environments

The GemStone server includes multiple execution environments, although normally Smalltalk applications exclusively use the primary environment, environment 0.

The GCI functions that support an environmentId argument include GciExecute\* and GciPerform\*, and non-blocking variants of these, that have names with a trailing underscore. These functions allow you to access other environments. These further environments were primarily intended to support Ruby applications, and are not described in this manual. Examine the header file `$GEMSTONE/include/gci.hf` for details.

## 1.3 Objects in GemStone and C data

An important feature of the GemStone data model is its ability to preserve an object’s identity distinct from its state. Within GemStone, each object is identified by a unique 64-bit object-oriented pointer, or OOP. Whenever your client application attempts to access or modify the state of a GemStone object, GemStone uses its OOP to identify it. Both the OOP and a representation of the object’s state may be imported into the client.

Your client application can only use predefined OOPs, or OOPs that it has received from the GemStone server; it cannot create new OOPs directly.

Since the client application accesses objects only via the OOP, the terms "OOP" and "Object" are used interchangeably in this manual, in function names, and in header comments. This differs from GemStone Smalltalk code and other GemTalk manuals, in which "OOP" is generally used to distinguish the numeric pointer value associated with an object from the object itself.

## 1.4 Garbage Collection

GemStone performs automatic garbage collection via several mechanisms, which are discussed more fully in the *System Administration Guide for GemStone/S 64 Bit*, in the chapter titled “Managing Growth”.

Garbage Collection includes

- ▶ in-memory garbage collection of non-persistent temporary objects in each client process
- ▶ on the server, periodic sweeps of the entire repository to detect persistent objects that are no longer referenced.

## In-memory garbage collection

In-memory garbage collection occurs regularly in the Gem process, to ensure memory is available for ongoing needs. If newly created or temporary objects are not referenced, they run the risk of being garbage collected and disappearing prematurely during in-memory garbage collection. While you may have a reference to the OOP of a temporary object from data structures in your GCI application, this does not by itself prevent the actual object in the Gem process from being garbage collected. In-memory GarbageCollection can occur at any time, particularly if the GemStone session is in active use.

To avoid this problem, GemStone uses several internal sets in the Gem process, including the *PureExportSet* and the *GciTrackedObjs* set, that hold objects that need to be preserved from garbage collection. Before removing any objects, the GemStone in-memory garbage collector checks the *PureExportSet* and the *GciTrackedObjs* sets in the Gem's workspace. Any object in these sets is considered to be referenced. User actions maintain their own export set, and objects in that set are also protected.

The garbage collector does not remove objects that are in these sets, and it also does not remove objects that are referenced by objects in these sets or by persistent object. Garbage Collection does not remove objects for which there is a reference path from an object that cannot itself be garbage collected.

When you execute a GemBuilder function that creates an object, the newly created object is automatically added to the *PureExportSet*, or in a user action, to the user action's export set, to avoid any risk of it being garbage collected before it can be used.

Objects are automatically added to an export set in these cases:

- ▶ The results of **GciNew\***, **GciCreate\***, **GciSend\***, **GciPerform\***, **GciExecute\*** and **GciResolve\*** calls are automatically added to the export set.
- ▶ Objects returned in the report buffer of a **GciFetchObjectInfo** or **GciClampedTrav**, when `GCI_RETRIEVE_EXPORT` flag is set, will be added to the export set.
- ▶ When the function **GciErr**(GciErrSType \*errorReport) returns TRUE, values of type OopType in the \*errorReport are added to the export set.

Objects that are the contents of instance variables, such as objects returned from a call to **GciFetchOops**, are not added to the export set. These are already referenced from the object with the instance variables. However, these objects are cached in your C code, and the values may no longer be valid if the referencing object becomes dirty due to an abort or commit.

GemBuilder does not automatically add other objects to the export sets. If you have temporary objects that should not disappear, the application must be careful to explicitly call **GciSaveObjs** or **GciSaveGlobalObjs** function when it needs to be sure to retain an object that is not already in an export set.

While code that is invoked from a GCI application automatically puts objects in the *PureExportSet*, code that is executed from within a user action has somewhat different requirements, and use the user action export set, rather than the *PureExportSet*, to preserve objects from garbage collection. When the user action comes to an end, the user action's export set ceases to exist and the objects it contained may be garbage collected. This avoids the risk of objects not being released and holding on to memory; for example if the user action exits with an unexpected error. User actions can call **GciSaveObjs** to explicitly add objects to their export set, or **GciSaveGlobalObjs** to add specifically add them to the *PureExportSet*.

## Tracked Objects

Another way to preserve objects from garbage collection is to add them to the tracked objects set. Use of this set requires calling `GciTrackedObjsInit` to initialize, and objects are explicitly added by passing them to `GciSaveAndTrackOops`.

## Unreferenced persistent object garbage collection

In-memory garbage collection cleans up objects in session memory, and newly created objects or modified objects are put in the export set (or tracked objects set) to ensure that they are not garbage collected before the changes are committed.

When an existing persistent object (that is, an object that has references from other persistent objects, such as a collection) is no longer referenced, they also are subject to garbage collection. `markForCollection` and epoch garbage collection scan the repository and will dispose of persistent objects that have no reference chain from the repository root.

If the session commits changes that remove a persistent reference to an object, then that object may be at risk of persistent object garbage collection. If the session will be doing further work with that object, it should be added to the exported or tracked objects set, which protect objects from persistent as well as in-memory garbage collection.

Once a persistent object is disposed, its OOP may be reused for another objects. If a session did not add the object to the export set, in a busy application there is a chance that the next GemBuilder call specifying that object will either encounter an object does not exist error, or the object will be an entirely different one than expected.

## Releasing Objects

Preserving objects from garbage collection is critical, however, these objects use memory and too many of them will impact performance.

Once the objects in the `PureExportSet` are no longer needed, the application can improve performance and avoid out of memory issues by calling one of the `GciRelease...` functions, to reduce the size of the set and permit garbage collection of obsolete temporaries.

# Interacting with GemBuilder

---

This chapter describes how GemBuilder C functions are used to interact between a client application using a C API and the GemStone server's Smalltalk environment.

**Session Control** (page 21)

Logging in to acquire a session, and committing and aborting.

**Representing Objects in C** (page 24)

How Smalltalk objects are handled in C and GemStone server data types.

**Performing work in GemStone** (page 28)

How to execute code in GemStone or send messages to GemStone objects.

**Structural Access to Objects** (page 30)

How to update GemStone objects by fetching from and storing to objects according to their implementation.

**Nonblocking Functions** (page 36)

Using the non-blocking GCI calls

**Operating System Considerations for C Applications** (page 37)

How to handle requirements from the operating system.

**Error Handling and Recovery** (page 39)

Handling Errors in your application

## 2.1 Session Control

All interactions with the GemStone repository monitor occur within the scope of a user's GemStone session, which may encapsulate one or more individual transactions. GemBuilder provides functions for obtaining and managing GemStone repository sessions, such as logging in and logging out, committing and aborting transactions, and connecting to a different session.

## Prepare for Login

Before you can login, you need a running GemStone repository Stone and, usually, a NetLDI process. Setting up the repository and NetLDI, the options for RPC vs. linked logins, and the login parameters to login a Gem session process for either kind of login, is described in the *System Administration Guide for GemStone/S 64 Bit*.

While linked logins may have performance advantages under some circumstances, RPC logins have advantages, and are required when the application is on a different node than the Stone, and RPC logins avoid the risk of invalid memory references causing repository corruption. While performing development and debugging you should log in RPC, to avoid the risk of repository corruption. This discussion will primarily describe the process for RPC logins.

As described in the *System Administration Guide for GemStone/S 64 Bit*, you will need to determine the following:

- ▶ Network Resource Syntax (NRS) for the Stone. By default, this is `gs64stone`.
- ▶ NRS for the Gem. This is not set for a linked login, and may be `'gemnetobject'` for a local RPC login.
- ▶ Authentication information for the Stone (GemStone `userId` and password).
- ▶ Authentication information for the NetLDI (UNIX username and password). This is not required if the NetLDI is running in guest mode.

## Logging In and Out

The functions **GciInitAppName** and **GciInit** initialize GemBuilder. When it is used, your application should call **GciInitAppName** before calling **GciInit**. Your C application must not call any GemBuilder functions other than this until it calls **GciInit**.

The **GciSetNet** or **GciSetNetEx** functions set the values for the Stone and Gem NRS, and NetLDI authentication information if required.

Then, to do any useful repository work, you must create a session with the GemStone system by calling **GciLogin**, **GciLoginEx**, or **GciNbLoginEx**; these functions have arguments for providing the GemStone username and password.

The **\*Ex** variants support encrypting passwords before passing these from the GCI application to the Gem, which is useful if you are operating over an unsecure network. Encryption is done using the **GciEncrypt** function.

If your application calls **GciLogin** again after you are already logged in, GemBuilder will create an additional, independent, GemStone session for you. Multiple sessions can be attached to the same GemStone repository, or they can be attached to different repositories. The maximum number of sessions that may be logged in at one time depends upon your version of GemStone and the terms of your license agreement.

From the point of view of GemBuilder's classic API, only a single session is active at any one time. It is known as the *current session*. Any time you execute code that communicates with the repository, it talks to the current session only. Other sessions are unaffected.

Each session is assigned a number by GemBuilder as it is created. Your application can call **GciGetSessionId** to inquire about the number of the current session, or **GciSetSessionId** to make another session the current one. The GemBuilder for C functions operate on the current session, and if you login multiple sessions, your application is responsible for treating each session distinctly.

An application can terminate a session by calling **GciLogout**. After that call returns, the current session no longer exists.

## Transaction Management

### Committing a Transaction

The GemStone repository proceeds from one stable state to the next by committing a series of sequentialized transactions. In Smalltalk, the message `System commitTransaction` attempts to commit changes to the repository. Similarly, when your C application calls the function **GciCommit**, GemStone will attempt to commit any changes to objects occurring within the current session.

A session within a transaction views the repository as it existed when the transaction started. By the time you are ready to commit a transaction, other sessions or users may have changed the state of the repository through intervening commit operations. If other sessions have made changes, your attempt to commit may conflict, and the commit will therefore fail. If an attempt to commit fails, your application must call **GciAbort** to discard the transaction.

As mentioned earlier, if your client code has created any new objects or has modified any objects whose representation you have imported, those objects must be exported to the GemStone repository in their new state before the transaction is committed. This ensures that the committed repository properly reflects the intended state.

### Aborting a Transaction

By calling **GciAbort**, an application can discard from its current session all the changes to persistent objects that were made since the last successful commit or since the beginning of the session (whichever is later). This has exactly the same effect as sending the Smalltalk message

```
System abortTransaction.
```

After the application aborts a transaction, it must reread any object whose state has changed.

### Controlling Transactions Manually

Under automatic transaction control, which is the default, a transaction is started when a user logs in to the repository. The transaction then continues until it is either committed or aborted. The call to **GciAbort** or **GciCommit** automatically starts a new transaction when it finishes processing the previous one. Thus, the user is always operating within a transaction.

Automatic transaction control is the default control mode in GemStone. However, there is some overhead associated with transactions that an application can avoid by changing the transaction mode to `manualBegin`. For example:

```
// set aSession in manual transaction mode
GciExecuteStr("System transactionMode: #manualBegin", OOP_NIL);

// set aSession in automatic transaction mode
GciExecuteStr("System transactionMode: #autoBegin", OOP_NIL);
```

In manual mode, the application starts a new transaction manually by calling the **GciBegin** function. The **GciAbort** and **GciCommit** functions complete the current transaction, but do not start a new transaction. Thus, they leave the user session operating outside of a transaction, without its attendant overhead. The session views the repository as it was when the last transaction was completed, or when the mode was last reset, whichever is later.

Since automatic transaction control is the default, a transaction is always started when a user logs in. To operate outside a transaction initially, an application must explicitly set the mode to `manualBegin`.

For a list of functions that are useful for managing sessions, see Table 7.1 on page 81.

## 2.2 Representing Objects in C

The GemStone data model provides each object with an object-oriented pointer (OOP), a 64-bit integer. This OOP preserves an object's identity distinct from its state.

In your client application, the OOP is represented in variables of type **OopType**. Whenever the client attempts to access or modify the state of a GemStone object, it uses the OOP to identify that object. Both the OOP and a representation of the object's state may be imported into the client application.

The GemBuilder include file `gci.ht` defines type **OopType**, along with other types used by GemBuilder functions. For more information, see Chapter 6, "GemBuilder for C Files and Data Structures", starting on page 65.

Your C program can only use predefined OOPs, or OOPs that it has received from the GemStone. Your C program cannot create new OOPs directly – it must ask GemStone to create new OOPs for it.

The state of the GemStone object – the data in its instance variables – can be imported into the C application in a number of ways, depending on the specific type of data.

### GemStone-Defined Object Macros

The GemBuilder include file `gcioop.ht` defines macros for a number of frequently-used objects, such as the GemStone objects *nil*, *true*, and *false*, and kernel classes in the GemStone repository.

In addition, it defines `OOP_ILLEGAL`. This represents a value that will never be used to represent any object in the repository. You can thus initialize the state of an OOP variable to `OOP_ILLEGAL`, and test later in your program to see if that variable contains valid information.

### GemStone Object Implementation Types

Objects in GemStone can be divided up into four different types, based on the internal implementation. These are handled and structure internally differently, and handled differently by some GemBuilder functions. These types are Special, Byte, Pointer, and NSC.

More detail is provided in the *GemStone Programming Guide*.



## Special

Special objects are those in which the OOP itself encodes the value. These objects are fast, canonical (each is identical to another of the same value), and do not use repository space. Specials include:

- ▶ SmallInteger objects (for example, the number 5)
- ▶ SmallDouble objects (for example, the number 0.5)
- ▶ SmallFraction objects (for example, the number 1/3)
- ▶ Character (for example, the letter 'b')
- ▶ Boolean values (true and false)
- ▶ The instance of class UndefinedObject (nil)

You cannot create new Specials, nor update instances of specials. Conversion between a special and a C data type does not require making a call to the GemStone server.

## Byte

Byte classes are collection classes (classes with indexed, unnamed instance variables) that contain objects that use one byte of storage space. The most obvious is String. Strings that require more than one byte of storage or individual characters are byte objects, but two or more bytes are logically required for elements stored in the collection. Byte objects do not have named instance variables.

## Pointer

Pointer classes are collection classes that contain objects (such as Array) that have an internal ordering, and ordinary classes with instance variables. Pointer objects use 8 bytes of space per element.

## NSC

NSC - Non-sequential collection, instances of the Smalltalk class UnorderedCollection - are stored internally in specialized leaf structures, are unordered, and may also have instance variables.

## GemStone Data Types

When moving data between GemStone and your C application, the GemStone object representation must be converted to structures consisting of C data types.

For basic data types such as integers, floating points, and strings, you must convert between the OOP representation in GemStone and the basic C data type.

GemBuilder provides a number of functions that allow you to test for the type of data and perform conversion. These are listed in Table 7.7, "Functions and Macros for Testing and Converting Objects and Values" on page 86.

In Example 2.1, assume that you have defined a Smalltalk class called Address that represents a mailing address. If the class has five instance variables, the OOPs of one instance of Address can be imported into a C array called *address*. Assume that the fifth instance variable represents the zip code of the address.

The fifth element of *address* is the OOP of the SmallInteger object that represents the zip code, not the zip code itself. Example 2.1 imports the value of the zip code object to the C variable *zip*.

### Example 2.1

---

```
int64 example_zipcode(OopType addressId)
{
    // returns the zipcode or -1 if an error occurred,

    enum { addr_num_instVars = 5 };

    OopType instVars[addr_num_instVars];

    int numRet = GciFetchOops(addressId, 1, instVars,
        addr_num_instVars);
    if (numRet != (int)addr_num_instVars)
        return -1;

    BoolType conversionError = FALSE;
    int64 zip = GciOopToI64_(instVars[4], &conversionError);
    if (! conversionError)
        return -1;

    // zip now contains an integer that has the same
    // value as the GemStone object represented by address[4]

    return zip;
}
```

---

## Integers

Integer types in Smalltalk are either SmallIntegers, which have the range  $-2^{60}$  to  $2^{60}-1$ , or LargeIntegers. SmallIntegers are specials, but LargeIntegers have OOPs and must be resolved using a GemStone call.

For convenience, *gcioop.ht* defines a number of SmallInteger mnemonics, including *OOP\_Zero*, *OOP\_One*, *OOP\_Two*, and *OOP\_MinusOne*. See *gcioop.ht* for all mnemonics.

## Floating Points

Floating point types in Smalltalk are either SmallDouble or Floats. SmallDoubles are specials and can represent C doubles that have value zero or that have exponent bits in range 0x381 to 0x3ff, which corresponds to about  $5.0e-39$  to  $6.0e38$ ; approximately the range of C 4-byte floats. While SmallDouble are specials, Float have OOPs and must be resolved using a GemStone call.

### Byte-Swizzling of Binary Floating-Point Values

If an application is running on a different machine than its Gem, the byte ordering of binary floating-point values may differ on the two machines. To ensure the correct

interpretation of non-special floating-point objects when they are transferred between such machines, the bytes need to be reordered (*swizzled*) to match the machine to which they are transferred.

Binary floats other than SmallDouble are represented in GemStone as 8-byte instances of Float or 4-byte instances of SmallFloat. The programmer must supply all the bytes, or provide a C double, to create or store a Float or SmallFloat.

Creating Floats or SmallDoubles using **GciFltToOop** or **Gci\_doubleToSmallDouble** and fetched using **GciOopToFlt** avoids byte order problems.

Most GemBuilder functions provide automatic byte swizzling for instances of Float and SmallFloat, or raise an error. **GciFetchBytes\_** does not raise an error, but it also does not provide automatic byte swizzling. It is intended primarily for use with other kinds of byte objects, such as strings.

## Other Numeric Types

Smalltalk also includes a number of other non-integer numerical types, including SmallFraction and Fraction, DecimalFloats, ScaledDecimals, and others. These require additional effort to represent in C, similar to how application objects are handled.

## Character

Character types in Smalltalk are specials, with the full Unicode range. Conversions to C are to int types to allow the full range of Unicode characters.

## Boolean

Booleans — true and false — are specials in Smalltalk. GemStone uses BoolType to represent these in C. true and false defined by the macros OOP\_TRUE and OOP\_FALSE.

## Nil/null

The Smalltalk special nil is an instance of the class UndefinedObject, and is equivalent to NULL. This is defined by the macro OOP\_NIL.

## Strings

GemStone provides a number of classes to support working with collections of characters, particularly to support UTF-8 encoding.

- ▶ Traditional strings include String (Characters requiring 8 bits), DoubleByteString (16 bits), and QuadByteString (32 bits).
- ▶ Unicode Strings rely on the ICU libraries, and include Unicode7 (7 bits), Unicode16 (16 bits) and Unicode32 (32 bits).
- ▶ Traditional and Unicode strings can be encoded to UTF-8 and put into instances of Utf8, a specialized subclass of ByteArray.
- ▶ Symbols are canonical CharacterCollections, and include Symbol, DoubleByteSymbol and QuadByteSymbol.

GemBuilder provides the following functions to create a variety of String object from a C string, and to fetch the contents. See **Functions for Creating and Initializing Objects** (page 85) and **Structural Access Functions and Macros** (page 89).

## Object Creation

The following GemBuilder functions allow your C program to create one or more new instances of one or more Smalltalk classes:

**GciNewOop** (page 274)

**GciNewOops** (page 275)

**GciNewOopUsingObjRep** (page 277)

Once your application has created a new object, it can export the object to the repository by making sure some committed object in the repository references the new object. For example, add the object to a collection, or set the value of an instance variable in an existing object. This can be done with a call to one of the **GciStore...** functions.

Your C application may also create a new object by executing Smalltalk code, and create the reference from a persistent object in Smalltalk code.

Once the new object is created and the reference is committed, the object has been exported to the repository.

## 2.3 Performing work in GemStone

GemBuilder provides functions that allow C applications to execute Smalltalk code in the repository, and to send messages directly to GemStone objects.

You can also compile Smalltalk methods using **GciCompileMethod**, **GciClassMethodForClass** or **GciInstMethodForClass**; and the function **GciStoreTravDoTravRefs\_** includes a way to perform code execution.

Functions to perform Smalltalk code execution include:

**Table 2.1 Summary of functions to execute in Smalltalk**

|                                                   |                                                                       |
|---------------------------------------------------|-----------------------------------------------------------------------|
| <b>GciExecute*</b> and <b>GciNbExecute*</b>       | Execute Smalltalk code that is contained in a GemStone string object. |
| <b>GciExecuteStr*</b> and <b>GciNbExecuteStr*</b> | Execute Smalltalk code that is contained in a C string.               |
| <b>GciPerform*</b> and <b>GciNbPerform*</b>       | Send a message to a GemStone Object                                   |

### Executing Smalltalk Code in GemStone

Your C application can perform Smalltalk code execution using the GemBuilder functions since as **GciExecute\*** and **GciExecuteStr\***.

The Smalltalk code may be a message expression, a statement, or a series of statements; any self-contained section of code that you could, for example, execute within a Topaz **run** command. The code can be in a GemStone string object and executed using a **GciExecute** function, or a C string and performed using a **GciExecuteStr** function.

These functions expect a SymbolList, which is used to bind any symbols contained in the Smalltalk source. If the symbol list is OOP\_NIL, GemStone uses the symbol list associated with the currently logged-in user.

Example 2.2 demonstrates the use of **GciExecuteStr**.

**Example 2.2**


---

```

OopType example_execute(void)
{
    // Pass the String to GemStone for compilation and execution.
    // If it succeeds, return the result of the expression
    // otherwise OOP_NIL will be returned.

    OopType result = GciExecuteStr("Globals keys size", OOP_NIL);
    return result;
}

```

---

Your Smalltalk code has the same format as a method, and may include temporaries. You may include a caret in the smalltalk code to indicate an explicit return, but this is not required. GemStone returns the result of the last Smalltalk statement executed.

There are a number of variants of **GciExecute**, including ones that return specific types of results, and nonblocking variants. See Table 7.4, "Functions for Compiling and Executing Smalltalk Code in the Database" on page 84

**Sending Messages to GemStone Objects**

To send a message to a GemStone object, use **GciPerform** or one of its variants. **GciPerform** takes a object, a selector, and arguments; when GemStone receives this, it invokes and executes the method associated with that message.

Code execution occurs in the repository server, not in the application.

The following example shows two statements, one using **GsExecuteStr** and the other using **GsPerform**.

**Example 2.3**


---

```

void example_messageSends(void)
{
    OopType userGlobals = GciResolveSymbol("UserGlobals", OOP_NIL);
    OopType aKey = GciNewSymbol("myNumber");
    OopType aValue = GciI32ToOop(55);

    OopType argList[2];
    argList[0] = aKey;
    argList[1] = aValue;

    // both the following have the same effect

    GciExecuteStr("UserGlobals at: #myNumber put: 55", OOP_NIL);

    GciPerform(userGlobals, "at:put:", argList, 2);
}

```

---

**GciPerform** is useful when your C code already has GemStone objects that it is manipulating, and when you have specific selectors and arguments to send.

## Interrupting GemStone Execution

You can interrupt GemBuilder execution in two different ways:

- ▶ **GciSoftBreak** sends a *soft break*, which interrupts the Smalltalk virtual machine only. The GemBuilder functions that can recognize a soft break are **GciPerform**, **GciContinue**, **GciExecute**, **GciExecuteFromContext**, **GciExecuteStr**, and **GciExecuteStrFromContext**.
- ▶ **GciHardBreak** sends a *hard break*, which interrupts the Gem process itself, and is not trappable through Smalltalk exception handlers.

Issuing a soft break may be desirable if, for example, your application is executing code in Smalltalk, and enters an infinite loop.

In order for GemBuilder functions in your program to recognize interrupts, your program usually needs a signal handler that can call the functions **GciSoftBreak** and **GciHardBreak**. Since GemBuilder generally does not relinquish control to an application until it has finished its processing, soft and hard breaks are then initiated from an interrupt service routine. Alternatively, if you are calling the non-blocking GemBuilder functions, you can service interrupts directly within your event loop, while awaiting the completion of a function.

If GemStone is executing when it receives the break, it replies with an error message. If it is not executing, it ignores the break.

## 2.4 Structural Access to Objects

As mentioned earlier in this chapter, GemBuilder provides a set of C functions that enable you to do the following:

- ▶ Import objects from GemStone to your C program
- ▶ Create new GemStone objects
- ▶ Directly access and modify the internal contents of objects through their C representations
- ▶ Export objects from your C program to the GemStone repository

You may need to use GemBuilder's "structural access" functions for either of two reasons:

- ▶ **Speed**  
Because they call on GemStone's internal object manager without using the Smalltalk virtual machine, the structural access functions provide the most efficient possible access to individual objects.

- ▶ **Generality**

If your C application must handle GemStone objects that it did not create, using the structural access functions may be the only way you can be sure that the components of those objects will be accessible to the application. A user might, for example, define a subclass of Array in which `at:` and `at:put:` were disallowed or given new

meanings. In that case, your C application could not rely on the standard GemStone kernel class methods to read and manipulate the contents of such a collection.

Despite their advantages, you should use these structural access functions *only* if you've determined that Smalltalk message-passing won't do the job at hand. GemBuilder's structural access functions violate the principles of abstract data types and encapsulation, and they bypass the consistency checks encoded in the Smalltalk kernel class methods. If your C application unwisely alters the structure of a GemStone object (by, for example, storing bytes directly into a floating-point number), the object will behave badly and your application will break.

For security reasons, the GemStone object AllUsers cannot be modified using structural access. If you attempt to do so, GemStone raises the RT\_ERR\_OBJECT\_PROTECTED error.

## Direct Access to Metadata

Your C program can use GemBuilder's structural access functions to request certain data about an object:

### ▶ Class

Each object is an instance of some class. The class defines the behavior of its instances. To find an object's class, call **GciFetchClass**.

### ▶ Format

GemStone represents the state of an object in one of four different implementations (formats): byte, pointer, NSC (non-sequence able collection), or special, specified as GC\_FORMAT\_OOP, GC\_FORMAT\_BYTE, GC\_FORMAT\_NSC, and GC\_FORMAT\_SPECIAL. Data types are described under "GemStone Object Implementation Types" on page 24. To find an object's implementation, call **GciFetchObjImpl**.

### ▶ Size

The function **GciFetchNamedSize** returns the number of named instance variables in an object, while **GciFetchVaryingSize\_** returns the number of unnamed instance variables. **GciFetchSize\_** returns the object's complete size (the sum of its named and unnamed variables).

The result of **GciFetchSize\_** depends on the object's implementation format. For byte objects (such as instances of String or Float), **GciFetchSize\_** returns the number of bytes in the object's representation. For pointer and NSC objects, this function returns the number of OOPs that represent the object. For "special" objects (see page 25), the size is always 0.

## Byte Objects

GemStone byte objects (for example, instances of class String or Symbol) can be manipulated in C as arrays of characters. The following GemBuilder functions enable your C program to store into, or fetch from, GemStone byte objects such as Strings:

**GciAppendBytes** (page 101)

**GciAppendChars** (page 102)

**GciFetchByte** (page 165)

**GciFetchBytes\_** (page 166)

**GciFetchChars\_** (page 168)

**GciStoreByte** (page 367)

**GciStoreBytes** (page 368)

**GciStoreChars** (page 372)

Although instances of Float are implemented within GemStone as byte objects, you should not use the above functions to fetch and store values; use the functions **GciOopToFlt** and **GciFltToOop** to convert between floating point objects and their equivalent C values.

Example 2.4 demonstrates importing a String to a C variable. This code assumes that the C variable *suppId* contains an OOP representing an object of class String, and imports it into *suppName*.

#### Example 2.4

---

```
void example_fetchBytes(OopType aGsString)
{
    char supplierName[1025];
    int64 size = GciFetchBytes_(aGsString, 1,
        (ByteType*)supplierName,
        sizeof(supplierName) - 1);
    supplierName[size] = '\0';

    // supplierName now contains the bytes of the GemStone object
    // aGsString, or the first 1024 bytes.
}
```

---

## Pointer Objects

In your C program, a GemStone pointer object is represented as an array of OOPs. The order of the OOPs within the GemStone pointer object is preserved in the C array. GemStone represents the following kinds of objects as arrays of OOPs:

### Objects with Named Instance Variables

Any object with one or more named instance variables is represented as an array of OOPs. You can fetch one or more values by the index of the instance variable, using **GciFetchNamedOop\*** or **GciFetchOop\***, and store them using **GciStoreNamedOop\*** or **GciStoreOop\***.

### Indexable Objects

Any indexable object not implemented as a byte object is represented as an array of OOPs. You can fetch one or more unnamed (indexable) instance variable values using **GciFetchVaryingOop\***, and store them using **GciStoreIdxOop\***.

If the indexable object also has instance variables, then you can access both named and unnamed (varying or indexable) instance variables using **GciFetchOop\*** and **GciStoreOop\***. Using these functions, pointers to the named instance variables precede pointers to the indexable instance variables.

For example, assume that the C variable *currSup* contains an OOP representing an object of class Supplier (which defines seven named instance variables). Example 2.5 imports the



state of the Supplier object (that is, the OOPs of its component instance variables) into the C variable *instVar*.

### Example 2.5

---

```
void example_fetchOops(OopType currSup)
{
    enum { num_ivs = 7 };
    OopType instVars[num_ivs];

    int numRet = GciFetchNamedOops(currSup, 1L, instVars, num_ivs);
    if (numRet == 7) {
        // instVars now contains the OOPs of the seven instance
        // variables of the GemStone object referenced by currSup
    } else {
        // error occurred or currSup is not of expected class or size
    }
}
```

---

## Nonsequenceable Collections (NSC Objects)

NSC objects (for example, instances of class IdentityBag and IdentitySet) reference other objects in a manner similar to pointer objects, except that the notion of order is not preserved when objects are added to or removed from the collection.

To fetch the contents of an NSC, you may use **GciFetchOops**. While this provides an ordered array, GemStone preserves the position of objects in an NSC only until the NSC is modified, or until the session is terminated (whichever comes first).

While you can access named instance variables of NSC objects as you would any other object, and retrieve the contents, you must use special functions to add or remove elements from the collection:

**GciAddOopToNsc** (page 94)

**GciAddOopsToNsc** (page 95)

**GciRemoveOopFromNsc** (page 334)

**GciRemoveOopsFromNsc** (page 335)

## Efficient Fetching and Storing with Object Traversal

The functions described in the preceding sections allow your C program to import and export the components of a single GemStone object. When your application needs to obtain information about multiple objects in the repository, it can minimize the number of network calls by using GemBuilder's object traversal functions.

Suppose, for example, that you had created a GemStone Employee class like the one in Example 2.6.

### Example 2.6

```
Object subclass: 'Employee'
  instVarNames: #( 'name' 'empNum' 'jobTitle'
                  'department' 'address' 'favoriteTune')
  classVars: #()
  classInstVars: #()
  poolDictionaries: #()
  inDictionary: UserGlobals
```

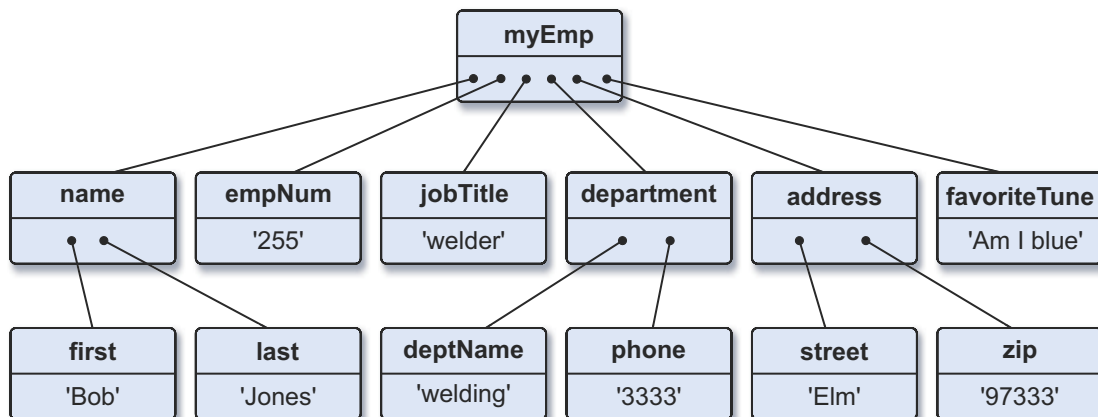
Imagine that you needed to write C code to make a two-column display of job titles and favorite tunes. By using GemBuilder's "object traversal" functions, you can minimize the number of network fetches and avoid running the Smalltalk virtual machine.

### How Object Traversal Works

To understand the object traversal mechanism, think of each GemStone pointer object as the root of a tree (for now, ignore the possibility of objects containing themselves). The branches at the first level go to the object's instance variables, which in turn are connected to their own instance variables, and so on.

Figure 2.1 illustrates a piece of the tree formed by an instance of Employee.

Figure 2.1 Object Traversal and Paths



In a single call, GemStone's internal object traversal function walks such a tree post-depth-first to some specified level, building up a "traversal buffer" that is an array of "object reports" describing the classes of the objects encountered and the values of their contents. It then returns that traversal buffer to your application for selective extraction and processing of the contents.

Thus, to make your list of job titles and favorite tunes with the smallest possible amount of network traffic per employee processed, you could ask GemStone to traverse each employee to two levels (the first level is the Employee object itself and the second level is that object's instance variables). You could then pick out the object reports describing *jobTitle* and *favoriteTune*, and extract the values stored by those reports (*welder* and *Am I Blue* respectively).

This approach would minimize network traffic to a single round trip.

One further optimization is possible: instead of fetching each employee and traversing it individually to level two, you could ask GemStone to begin traversal at the *collection* of employees and to descend three levels. That way, you would get information about the whole collection of employees with just a single call over the network.

## The Object Traversal Functions

The function **GciTraverseObjs** traverses object trees rooted at a collection of one or more GemStone objects, gathering object reports on the specified objects into a traversal buffer.

- ▶ *Traversal buffers* are instances of the C++ class `GciTravBufType`, which is defined in `$GEMSTONE/include/gcicmn.ht`. (For details about `GciTravBufType`, see “Traversal Buffer - `GciTravBufType`” on page 78.)
- ▶ *Object reports* within the traversal buffer are described by the C++ classes `GciObjRepSType` and `GciObjRepHdrSType`, which are defined in `$GEMSTONE/include/gci.ht`. (For details about these classes, see “Object Report Structure - `GciObjRepSType`” on page 71.)

Each object report provides information about an object’s identity (its OOP), class, size (the number of instance variables, named plus unnamed), object security policy id, implementation (byte, pointer, NSC, or special), and the values stored in its instance variables.

When the amount of information obtained in a traversal exceeds the amount of available memory, your application can break the traversal into manageable amounts of information by issuing repeated calls to **GciMoreTraversal**. Generally speaking, an application can continue to call **GciMoreTraversal** until it has obtained all requested information.

Your application can call **GciFindObjRep** to scan a traversal buffer for an individual object report. Before it allocates memory for a copy of the object report, your program can call **GciObjRepSize\_** to obtain the size of the report.

The function **GciStoreTrav** allows you to store values into any number of existing GemStone objects in a single network round trip. That function takes a traversal buffer of object reports as its argument.

Functions such as **GciStoreTravDo\_** and **GciStoreTravDoTrav\_** are even more parsimonious of network resources. In a single network round trip, you can store values into any number of existing GemStone objects, then execute some code; the function returns a pointer to the resulting object. These functions takes a structure as an argument, which defines traversal buffer of object reports and an execution string or message. After the function has completed, the structure also contains information describing the GemStone objects that have changed.

## Efficient Fetching And Storing with Path Access

As you’ve seen, object traversal is a powerful tool for fetching information about multiple objects efficiently. But writing the code for parsing traversal buffers and object reports may not always be simple. And even if you can afford the memory for importing unwanted information, the processing time spent in parsing that information into object reports may be unacceptable.

Consider the Employee object illustrated in the Figure 2.1. If your job were to extract a list of job titles and favorite tunes from a set of such Employees, it would be reasonable to use

GemBuilder's object traversal functions (as described above) to get the needed information. The time spent in building up object reports for the unwanted portions would probably be negligible. Suppose, however, that there were an additional 200 instance variables in each Employee. Then the time used in processing wasted object reports would far exceed the time spent in useful work.

Therefore, GemBuilder provides a set of path access functions that can fetch or store multiple objects at selected positions in an object tree with a single call across the network, bringing only the desired information back. The function **GciFetchPaths** lets you fetch selected components from a large set of objects with only a single network round trip. Similarly, your program can call **GciStorePaths** to store new values into disparate locations within a large number of GemStone objects.

## 2.5 Nonblocking Functions

Under most circumstances, when an application calls a GemBuilder function, the operation that the function specifies is completed before the function returns control to the application. That is, the GemBuilder function *blocks* the application from proceeding until the operation is finished. This effect guarantees a strict sequence of execution.

Nevertheless, in most cases a GemBuilder function calls upon GemStone (that is, the Gem) to perform some work. If the Gem and the application are running in different processes, especially on different machines, blocking implies that only one process can accomplish work at a time. GemBuilder's *nonblocking functions* were designed to take advantage of the opportunity for concurrent execution in separate Gem and application processes.

The results of performing an operation through a blocking function or through its nonblocking twin are always the same. The difference is that the nonblocking function does not wait for the operation to complete before it returns control to the session. Since the results of the operation are probably not ready when a nonblocking function returns, all nonblocking functions but one (**GciNbEnd**) return void.

While a nonblocking operation is in progress an application can do any kind of work that does not require GemBuilder. In fact, it can also call a limited set of GemBuilder functions, listed as follows:

- GciCallInProgress**
- GciErr**
- GciGetSessionId**
- GciHardBreak**
- GciNbEnd**
- GciSetSessionId**
- GciShutdown**
- GciSoftBreak**

If the application first changes sessions, and that session has no nonblocking operation in progress, then the application can call any GemBuilder function, including a nonblocking function. GemBuilder supports one repository request at a time, per session. However, nonblocking functions do not implement threads, meaning that you cannot have multiple concurrent repository requests in progress within a single session. If an application calls any GemBuilder function besides those listed here while a nonblocking operation is in progress in the current session, the error `GCI_ERR_OP_IN_PROGRESS` is generated.

Once a nonblocking operation is in progress, an application must call **GciNbEnd** at least once to determine the operation's status. Repeated calls are made if necessary, until the operation is complete. When it is complete, **GciNbEnd** hands the application a pointer to the result of the operation, the same value that the corresponding blocking call would have returned directly.

Nonblocking functions are not truly nonblocking if they are called from a linkable GemBuilder session, because the Gem and GemBuilder are part of the same process. However, those functions can still be used in linkable sessions. If they are, **GciNbEnd** must still be called at least once per nonblocking call, and it always indicates that the operation is complete.

All error-handling features are supported while nonblocking functions are used. Errors may be signalled either when the nonblocking function is called or later when **GciNbEnd** is called.

## 2.6 Operating System Considerations for C Applications

Like your C application, GemBuilder for C is, in itself, a body of C code. Some aspects of the interface must interact with the surrounding operating system. The purpose of this section is to point out a few places where you must code with caution in order to avoid conflicts.

### Signal Handling in Your GemBuilder Application

Under UNIX, it is important that signals be enabled when your code calls GemBuilder functions. Disabling signals has the effect of disabling much of the error handling within GemBuilder. Because signal handlers can execute at arbitrary points during execution of your application, your signal handling code should not call any GemBuilder functions other than **GciSoftBreak**, **GciHardBreak**, or **GciCallInProgress**.

**GciInit** always installs a signal handler for SIGIO. This handler chains to any previous handler. *Do not, under any circumstances, turn off SIGIO.*

In the linkable (GciLnk) configuration, **GciInit** also does the following:

- ▶ Installs handlers to service and ignore these signals (if no previous handler is found): SIGPIPE, SIGHUP, SIGDANGER
- ▶ Installs handlers to treat the following signals as fatal errors if they are defined by the operating system: SIGTERM, SIGXCPU, SIGABRT, SIGXFSZ, SIGXCPU, SIGEMT, SIGLOST
- ▶ Installs a handler for SIGUSR1. If you have a valid linkable session, SIGUSR1 will cause the Smalltalk interpreter to print the current Smalltalk stack to stdout or to the Topaz output file. This handler chains to any previous handler.
- ▶ Installs a handler for SIGUSR2, which is used internally by a Gemstone session. This handler chains to any previous handler.
- ▶ Installs a handler to gracefully handle SIGCHLD if no previous handler is found.
- ▶ Installs a handler to treat SIGFPE as a fatal error if no previous handler is found.
- ▶ Installs handlers for SIGILL and SIGBUS. If the program counter is found to be in libgci\*.so code, or if no previous handler is available to chain to, these are fatal errors.

- ▶ Installs a handler for SIGSEGV. A Smalltalk stack overflow produces a SIGSEGV, which is translated to a Smalltalk stack overflow error. If the program counter is found to be in `libgci*.so` code, or if no previous handler is available to chain to, SEGV is a fatal error.

If your application installs a handler for SIGIO after calling **GciInit**, your handler must chain to the previously existing handler.

If your application uses Linkable GCI and installs any signal handlers after calling **GciInit**, you must chain to the previously existing handlers. If you install handlers for SIGSEGV, SIGILL or SIGBUS, your handler must determine if the program counter at the point of the signal is in your own C or C++ code and if not, must chain to the previously existing handler. You must only treat these signals as fatal if the program counter is in your own code.

SIGVTALRM is used by the ProfMonitor class. Similar chaining is required for SIGVTALRM if you intend to use ProfMonitor.

If you are linking with other shared libraries, it is recommended that **GciInit** be called after all other libraries are loaded.

## Executing Host File Access Methods

If you use any of the **GciPerform\*** or **GciExecute\*** functions to execute a Smalltalk host file access method (as listed below), and you do not supply a full file pathname as part of the method argument, the default directory for the Smalltalk method depends on if you are running linked or RPC GemBuilder.

With GciLnk, the default directory is the directory in which the Gem (GemStone session) process was started. With GciRpc, the default directory is the home directory of the host user account, or the `#dir` specification of the network resource string.

The Smalltalk methods that are affected include `System class>>performOnServer:` and the file accessing methods implemented in `GsFile`. See the file I/O information in the *Programming Guide*.

## Writing Portable Code

If you want to produce code that can run in both 32-bit and 64-bit environments, observe the following guidelines:

- ▶ Don't hard-code size computations. Instead, use `sizeof` operations, so that if some structure changes, your code will still return the correct values.
- ▶ If you are using `printf` strings to print 64-bit integers, you might find it convenient to use the `FMT_*` macros in `$GEMSTONE/include/gci.ht`. Those macros help you to compose a format string for a `printf` that will be portable. In particular, use of the `FMT_*` macros make the printing of 64-bit integers portable between Windows and UNIX. These macros are recommended:

```
OopType - FMT_OID
int64 - FMT_I64
uint64 - FMT_U64
intptr_t - FMT_PTR_T
uintptr_t - FMT_UPTR_T
```

- ▶ To avoid discrepancies between 32-bit and 64-bit environments, avoid the use of `long` or `unsigned long` in your code. Instead, you can use the type `intptr_t`, which makes the variable the same size as a pointer, regardless whether your application is running in 32-bit or 64-bit. Alternatively, you can use `int64` or `int` to fix the size of the variable explicitly.

## 2.7 Error Handling and Recovery

Your C program is responsible for processing any errors generated by GemBuilder function calls.

The GemBuilder include file `gcierr.ht` documents and defines mnemonics for all GemStone errors. Search the file for the mnemonic name or error number to locate an error in the file. The errors are divided into five groups: compiler, run-time (virtual machine), aborting, fatal, and event.

GemBuilder provides functions that allow you to poll for errors or to use error jump buffers. The following paragraphs describe both of these techniques.

### Polling for Errors

Each call to GemBuilder can potentially fail for a number of reasons. Your program can call **GciErr** to determine whether the previous GemBuilder call resulted in an error. If so, **GciErr** will obtain full information about the error. If an error occurs while Smalltalk code is executing (in response to **GciPerform** or one of the **GciExecute...** functions), your program may be able to continue Smalltalk execution by calling **GciContinue**.

If you are in a `UserAction` and want to pass the error back to the Smalltalk client, you must execute **GciRaiseException**.

### Error Jump Buffers

When your program makes three or more GemBuilder calls in sequence, jump buffers provide significantly faster performance than polling for errors.

When your C program calls **Gci\_SETJMP**, the context of the current C environment is saved in a jump buffer designated by your program. GemBuilder maintains a stack of up to 20 error jump buffers. A buffer is pushed onto the stack when **GciPushErrJump** is called, and popped when **GciPopErrJump** is called. When an error occurs during a GemBuilder call, the GemBuilder implementation calls **GciLongJump** using the buffer currently at the top of GemBuilder's error jump stack, and pops that buffer from the stack.

For functions with local error recovery, your program can call **GciSetErrJump** to temporarily disable the **GciLongJump** mechanism (and to re-enable it afterwards).

Whenever the jump stack is empty, the application must use **GciErr** to poll for any GemBuilder errors.

### The Call Stack

The Smalltalk virtual machine creates and maintains a *call stack* that provides information about the state of execution of the current Smalltalk expression or sequence of expressions. The call stack includes an ordered list of activation records related to the methods and

blocks that are currently being executed. The virtual machine ordinarily clears the call stack before each new expression is executed.

If a soft break or an unexpected error occurs, the virtual machine suspends execution, creates a Process object, and raises an error. The Process object represents both the Smalltalk call stack when execution was suspended and any information that the virtual machine needs to resume execution. If there was no fatal error, your program can call **GciContinue** to resume execution. Call **GciClearStack** instead if there was a fatal error, or if you do not want your program to resume the suspended execution.

## GemStone System Errors

If your application receives a GemStone system error while linked with GciLnk, relink your application with GciRpc and run it again with an uncorrupted copy of your repository. Your GemStone system administrator can refer to the repository backup and recovery procedures in the *System Administration Guide for GemStone/S 64 Bit*.

If the error can be reproduced, contact GemStone Customer Support. Otherwise, the error is in your application, and you need to debug your application before using GciLnk again.



# Building GCI Applications

---

This chapter explains how to use GemBuilder for C to build your C application. Your application will provide the main program and API. When linking your compiled code, you will link the GemBuilder for C libraries that allow you to make GemBuilder function calls.

## 3.1 Environment

There are a number of GemStone configuration parameters and environment variables that affect your session. In particular, GemStone allows many ways to configure processes to be distributed over multiple hosts, which require specific details in the login parameters. Also, there are a number of configuration parameters that affect your session, such as the amount of memory it can use. Refer to the *System Administration Guide for GemStone/S 64 Bit* for details on both how to use Network Resource String syntax in login parameters, and how to setup configuration files for use by Gems.

There are several environment variables that are normally set during application development, but may not be needed for your GCI application, depending on how you are configuring your environment.

**GEMSTONE** – May be set to the full pathname to your GemStone installation directory. GCI applications can run without the \$GEMSTONE environment variable, provided all the required GemStone libraries are located in the same directory as the executable containing the main() function of the GCI application.

**PATH** – Adding the \$GEMSTONE/bin directory to your path allows you to easily execute GemStone utilities.

## 3.2 RPC and Linked applications

The GemBuilder for C interface provide two versions: Remote Procedure Call (RPC) and linked.

- ▶ In an RPC application, your application exists in a process separate from the Gem. The two processes communicate through remote procedure calls. This interprocess communication requires a small overhead associated with each GemBuilder call, independent of whatever object access is performed or Smalltalk code is executed.
- ▶ In a linked application, your application and Gem (the GemStone session) exist as a single process. Your application is expected to provide the main entry point.

A linked application can also run RPC Gems, in addition to its linked Gem. An RPC application cannot have a linked Gem.

The function **GciIsRemote** reports whether your application was linked with the RPC version or Linked version of the GemBuilder interface.

### RPC for Debugging

When debugging a new application, you must use the RPC interface. You should use **GciLnk** *only* after your application has been completely debugged and thoroughly tested, to avoid the risk of errors corrupting your repository.

When using an RPC Gem, you may achieve better performance by using functions such as **GciTraverseObjs**, **GciStoreTrav**, and **GciFetchPaths**. Those functions are designed to reduce the number of network round-trips by combining functions that are commonly used in sequence.

### Linked for Performance

You can use a linked, single-Gem configuration to enhance performance. In a linked application, a GemBuilder function call is a machine-instruction procedure call rather than a remote call over the network to a different process.

*WARNING!*

*Before using GciLnk, debug your C code in a process that does not include a Gem!  
For more information, see section "Risk of Database Corruption" on page 59.*

In a linked application, you may achieve better performance by using the simple **GciFetch...** and **GciStore...** functions instead of the complex object traversal functions. This has the advantage of making the application easier to write, depending on your requirements. However, if your application will login to GemStone multiple times, any sessions after the first will be RPC gems and you should design your application accordingly.

## The GemBuilder for C Shared Libraries

The two versions of GemBuilder are provided as a set of shared libraries. A *shared library* is a collection of object modules that can be bound to an executable, usually at run time. The contents of a shared library are not copied into the executable. Instead, the library's main function loads all of its functions. Only one copy is loaded into memory, even if multiple client processes use the library at the same time. Thus, they "share" the library.

The GemBuilder library files `libgcilnk.*` and `libgcirpc.*`, and other required files, are provided in the GemStone distribution under `$GEMSTONE/lib`.

## 3.3 GemBuilder Applications that load Shared Libraries

Most applications will load shared libraries at run time. The binding is done by code that is part of the application. If that code is not executed, the shared library is not loaded. With this type of binding, applications can decide at run time which GemBuilder library to use. They can also unbind at run time and rebind to the same or different shared libraries. The code is free to handle a run-time-bind error however it sees fit.

### Building the Application

To build an application that loads GemBuilder shared libraries:

1. Include `gci.hf` and `gcirtl.hf` in the C source code.

```
#include "gci.hf"
#include "gcirtl.hf"
```

However, applications are free to use their own run-time-bind interface instead of `gcirtl`, which is meant to be used from C. For example, a Smalltalk application would use the mechanism provided by the Smalltalk vendor to call a shared library.

2. Call **GciRtlLoad** (page 342) to load the RPC GemBuilder.

To load the RPC version, pass **true** as the first argument; to load the linked version, pass in **false**.

Call **GciRtlLoad** before any other GemBuilder calls. To unload the GemBuilder libraries, call **GciRtlUnload**. The **GciRtlIsLoaded** function can be used to determine if an interface is loaded or not.

3. When linking, include `gcirtlobj.o`, not one of the GemBuilder libraries (`libgcirpc.*` and `libgcilnk.*`).

Chapter 5, "Compiling and Linking" tells how to compile and link your application, and provides specific details for what should be included in the compile and link operations.

### Searching for the Library

At run time the `gcirtl` code searches for the GemBuilder library in the following places:

1. Any directories specified by the application in the argument to **GciRtlLoad**.
2. The `$GEMSTONE/lib` directory.

3. The normal operating system search, as described in the following sections.

### How UNIX Matches Search Names with Shared Library Files

The UNIX operating system loader searches the following directories for matching file names, in this order:

1. Any path specified by the environment variable `LD_LIBRARY_PATH`.
2. Any path recorded in the executable when it was built.
3. The global directory `/usr/lib`.

## 3.4 Building Statically Linked Applications

Normally, applications will load shared libraries at runtime. However, it is also possible to statically link GemBuilder applications, which in some cases may improve performance.

In a statically linked application, the executable is linked to the GemBuilder library archive file when the executable is built. When the executable runs, it automatically loads the library. Unlike when loading a shared library, your code cannot programmatically determine which library to load. For example, with run-time loading, your code can determine which version of the GemBuilder libraries to load, but this must be determined ahead of time for a statically linked application.

Static linking is only possible with the RPC shared libraries.

To build an application that build-time-binds to GemBuilder:

1. Include `gci.h` in the C source code.
2. When linking, include the RPC GemBuilder library (`libgcirpc.*`).

GemBuilder finds build-time-bound shared libraries by using the normal operating system searches described in “Searching for the Library” on page 43. If a library cannot be found, the operating system returns an error.

# Writing User Actions

---

Within a GemStone Smalltalk-based application, you may choose to write a C function for certain operations, rather than to perform the work in GemStone. For example, operations that are computationally intensive can be written as C functions and called from within a Smalltalk method (whose high-level structure and control is written in Smalltalk). This approach is similar to the concept of “user-defined primitives”.

This chapter describes how to implement C user action functions that can be called from GemStone, and how to call those functions from a GemBuilder application or a Gem (GemStone session) process.

Some of the functionality provided by User Action libraries can instead be supported using the Foreign Function Interface (FFI) in GemStone Smalltalk, which allows you to invoke functions in C libraries directly from Smalltalk, without compiling C code. The FFI is described in *Programming Guide*.

## 4.1 Shared User Action Libraries

Although user actions can be linked directly into an application, they are usually placed in shared libraries so they can be loaded dynamically. The contents of a library are not copied into the executable. Instead, the library’s main function loads all of its user actions. Only one copy is loaded into memory, even if multiple client processes use the library.

User action libraries are used in two ways: They can be *application user actions*, which are loaded by the application process, or *session user actions*, which are loaded by the Gem session process. The libraries themselves are the same for both, it is the operation that is used to load the library determines which type it is.

Application user actions are the traditional GemStone user actions. They are used by the application for communication with the Gem or for an interactive interface to the user.

Session user actions add new functionality to the Gem, something like the traditional custom Gem. The difference here is that you only need one Gem, which can customize itself at run time. It loads the appropriate libraries for the code it is running. The decisions are made automatically within GemStone Smalltalk, rather than requiring the users to decide what Gem they need before they start their session.

## 4.2 How User Actions Work

User Actions are invoked from GemStone Smalltalk. This can be done from GemStone Smalltalk application code, topaz execution, etc, or using GemBuilder for C by calling a function such as **GciExecuteStr** or **GciPerform**.

Before it can be used, the user action library must be loaded and initialized; see “Loading User Actions” on page 50.

1. GemStone Smalltalk code invokes a user action function (written in C) by sending a message of the form:

```
System userAction: aSymbol with: args
```

The *args* arguments are passed to the C user action function named *aSymbol*.

2. The C user action function can call any GemBuilder functions and any C functions provided in the application or the libraries loaded by the application (for application user actions), or provided in the libraries loaded by the Gem (for session user actions).

If a GemBuilder or other GemStone error is encountered during execution of the user action, control is returned to the Gem or your GemBuilder application as if the error had occurred during the call to execute the code.

3. The C user action function must return an **OopType** as the function result, and must return control directly to the Smalltalk method from which it was called.

*NOTE:*

*Results are unpredictable if the C function uses **GCI\_LONGJMP** instead of returning control to the GemStone Smalltalk virtual machine.*

## 4.3 Developing User Actions

For your GemStone application to take advantage of user action functions, you do the following:

**Step 1.** Determine which operations to perform in C user action functions rather than in Smalltalk, and write the user action functions.

**Step 2.** Create a user action library to package the functions.

**Step 3.** Provide the code to load the user action library.

If the application is to load the library, add the loading code to your application.

If the session is to load the library, use the GemStone Smalltalk method

```
System class>>loadUserActionLibrary: for loading.
```

**Step 4.** Write the Smalltalk code that calls your user action. Commit it to your GemStone repository.

**Step 5.** Debug your user action.

The following sections describe each of these steps.

## 1. Write the User Action Functions

Writing a C function to install as a user action called from Smalltalk is much the same as writing other C functions. However, since the application that called the user action (whether written in C, Java, or Smalltalk) controls the export set – the set of OOPs to save after execution completes – user actions do not solely control the way objects are preserved from garbage collection.

For more on the issue of retaining references to newly created objects and risk of premature garbage collection, see the discussion under “Garbage Collection” on page 18.

To enable objects to be retained, user actions maintain a separate export set that is specific to the user action, in addition to the `PureExportSet`. When objects are automatically added to an export set or added using `GciSaveObjs`, they are put into the user action’s export set rather than into the `PureExportSet`.

When the user action function completes, its export set is cleared. Don’t save the OOPs in static C variables for use by a subsequent invocation of the user action or by another C function.

To make a newly created object a permanent part of the GemStone repository, the user action has two options:

- ▶ Store the OOP of the new object into an object known to be permanent, such as a persistent collection that the application looked up in the GemStone repository, or that was provided as an argument to the user action function.
- ▶ Return the OOP of the object as the function result. After a user action returns, the persistence of the new object is determined by the normal semantics of the calling application.

To create a reference that prevents garbage collection but is not shared between sessions, you may use GemStone Smalltalk code to add them to the user-definable portion of `System sessionState` using `System >> sessionStateAt:put:.` Objects referenced in this way will be preserved until the session terminates, at which point they will be subject to garbage collection if there are no other references.

## 2. Create a User Action Library

Whether you have one user action or many, the way in which you prepare and package the source code for execution has significant effects upon what uses you can make of user actions at run time. It is important to visualize your intended execution configurations as you design the way in which you package your user actions.

To build a user action library:

1. Include `gciua.hf` in your C source code.
2. Define the initialization and shutdown functions.
3. Compile with the appropriate options, as described in Chapter 5.
4. Link with `gcualib.o` and the appropriate options, as described in Chapter 5.
5. Install the library in the `$GEMSTONE/uilib` directory.

## The gciua.hf Header File

User action libraries must always include the `gciua.hf` file, rather than the `gci.hf` or `gcirtl.hf` file. Using the wrong file causes unpredictable results.

## The Initialization and Shutdown Functions

A user action library must define the initialization function `GciUserActionInit` and the shutdown function `GciUserActionShutdown`.

Do not call `GciInit`, `GciLogin`, or `GciLogout` within a user action.

## Defining the Initialization Function

Example 4.1 shows how the initialization function `GciUserActionInit` is defined, using the macro `GCIUSER_ACTION_INIT_DEF`. This macro must call `GciDeclareAction` once for each function in the set of user actions.

### Example 4.1

---

```

static OopType doParse(void)
{
    return OOP_NIL;
}
static OopType doFetch(void)
{
    return OOP_NIL;
}

GCIUSER_ACTION_INIT_DEF()
{
    GciDeclareAction("doParse", doParse, 1, 0, TRUE);
    GciDeclareAction("doFetch", doFetch, 1, 0, TRUE);
    // ...
}

```

---

`GciDeclareAction` associates the Smalltalk name of the user action function *userActionName* (a C string) with the C address of that function, *userActionFunction*, and declares the number of arguments that the function takes. A call to `GciDeclareAction` looks similar to this:

```
GciDeclareAction("userActionName", userActionFunction, 1, 0, TRUE)
```

The function installs the user action into a table of such functions that GemBuilder maintains. Once a user action is installed, it can be called from GemStone.

The name of the user action, "*userActionName*", is a case-sensitive, null-terminated string that corresponds to the symbolic name by which the function is called from Smalltalk. The name is significant to 31 characters. It is recommended that the name of the user action be the same as the C source code name for the function, *userActionFunction*.

The third argument to `GciDeclareAction` indicates how many arguments the C function accepts. This value should correspond to the number of arguments specified in the



Smalltalk message. When it is 0, the function argument is void. Similarly, a value of 1 means one argument. The maximum number of arguments is 8. Each argument is of type **OopType**.

The fourth argument to **GciDeclareAction** is rarely used. The final argument indicates whether to return an error if there is already a user action with the specified name.

Your user action library may call **GciDeclareAction** repeatedly to install multiple C functions. Each invocation of **GciDeclareAction** must specify a unique *userActionName*. However, the same *userActionFunction* argument may be used in multiple calls to **GciDeclareAction**.

## Defining the Shutdown Function

The shutdown function **GciUserActionShutdown** is defined by the **GCIUSER\_ACTION\_SHUTDOWN\_DEF** macro. **GciUserActionShutdown** is called when the user action library is unloaded. It is provided so the user action library can clean up any system resources it has allocated. Do not make GemBuilder C calls from this function, because the session may no longer exist. In fact, **GciUserActionShutdown** can be left empty. Example 4.2 shows a shutdown definition that does nothing but report that it has been called.

### Example 4.2

---

```
#include "gciuser.hf"

GCIUSER_ACTION_SHUTDOWN_DEF()
{
    /* Nothing needs to be done. */
    fprintf(stderr, "GciUserActionShutdown called.\n");
}
```

---

## Compiling and Linking Shared Libraries

Shared user actions are compiled for and linked into a shared library. See Chapter 5, “Compiling and Linking” for instructions.

Be sure to check the output from your link program carefully. Linking with shared libraries does not require that all entry points be resolved at link time. Those that are outside of each shared library await resolution until application execution time, or even until function invocation time. You may not find out about incorrect external references until run time.

## Using Existing User Actions in a User Action Library

With slight modifications, existing user action code can be used in a user action library. You need to include `gciua.hf` instead of `gci.hf` or `gcirtl.hf`. Define a **GciUserActionShutdown**, and a **GciUserActionInit**, if it is not already present. Compile, link, and install according to the instructions for user action libraries.

## Using Third-party C Code with a User Action Library

Third-party C code has to reside in the same process as the C user action code. Link the third-party code into the user action library itself, and then you can call that code. It doesn't matter where you call it from.

## 3. Loading User Actions

GemBuilder does not support the loading of any default user action library. Applications and Gems must include code that specifically loads the libraries they require.

### Loading User Action Libraries At Run Time

Dynamic run-time loading of user action libraries requires some planning to avoid name conflicts. If an executable tries to load a library with the same name as a library that has already been loaded, the operation fails.

When user actions are installed in a process, they are given a name by which GemBuilder refers to them. These names must be unique. If a user action that was already loaded has the same name as one of the user actions in the library the executable is attempting to load, the load operation fails. On the other hand, if the two libraries contain functions with the same implementation but different names, the operation succeeds.

### Application User Actions

If the application is to load a user action library, implement an application feature to load it. The GemStone interfaces provide a way to load user actions from your application.

- ▶ GemBuilder for C applications: the **GciLoadUserActionLibrary** call
- ▶ Topaz applications: the **loadua** command

The application must load application user actions after it initializes GemBuilder (**GciInit**) and before the user logs into GemStone (**GciLogin**). If the application attempts to install user actions after logging in, an error is returned.

### Session User Actions

A linked or RPC Gem process can install and execute its own user action libraries. To cause the Gem to do this, use the `System class>>loadUserActionLibrary:` method in your GemStone Smalltalk application code. A session user action library stays loaded until the session logs out.

The session must load its user actions after the user logs into GemStone (**GciLogin**). At that time, any application user actions are already loaded. If a session tries to load a library that the application has already defined, it gets an error. The loading code can be written to handle the error appropriately. Two sessions can load the same user action library without conflict.

### Specifying the User Action Library

When writing scripts or committing to the database, you can specify the user action library as a full path or a simple base name; it is recommended to use the base name. The code that GemBuilder uses to load a user action library expands the base name `<ua>` to a valid shared

library name for the current platform. For example, the base name `custreport` would be expanded to `libcustreport.so` on many UNIX platforms.

The code for loading searches for the file in the following places in the specified order:

- ▶ The current directory of the application or Gem.
- ▶ The directory the executable is in, if it can be determined.
- ▶ The `$GEMSTONE/uilib` directory.
- ▶ The normal operating system search, as described in “Searching for the Library” on page 43.

## Creating User Actions in Your C Application

Loading user action libraries at run time is the preferred behavior for GemBuilder applications. For application user actions, however, you have the option to create the user actions directly in your C application, not as part of a library. When you implement user actions this way, include `gcirtl.hf` or `gci.hf` in your C source code, instead of `gciua.hf`. (Your C source code should include *exactly* one of these three include files.)

The `GciUserActionInit` and `GciUserActionShutdown` functions are not required, but the application must call `GciDeclareAction` once for each function in the set of user actions.

After your application has successfully logged in to GemStone (via `GciLogin`), it may not call `GciDeclareAction`. If your application attempts to install user actions after logging in, an error will be returned.

## Verify That Required User Actions Have Been Installed

After logging in to GemStone, your application can test for the presence of specific user actions by sending the following Smalltalk message:

```
System hasUserAction: aSymbol
```

This method returns *true* if your C application has loaded the user action named *aSymbol*, *false* otherwise.

For a list of all the currently available user actions, send this message:

```
System userActionReport
```

## 4. Write the Code That Calls Your User Actions

Once your application or Gem has a way to access the user action library, your GemStone Smalltalk code invokes a user action function by sending a message to the GemStone system. The message can take one of the following forms:

```
System userAction: aSymbol
System userAction: aSymbol with:arg1 [with:arg2] ...
System userAction: aSymbol withArgs:anArrayOfUpTo8Args
```

You can use the *with* keyword from zero to seven times in a message. The *aSymbol* argument is the name of the user action function, significant to 31 characters. Each method returns the function result.

Notice that these methods allow you to pass up to eight arguments to the C user action function. If you need to pass more than eight objects to a user action, you can create a

Collection (for example, an instance of Array), store the objects into the Collection, and then pass the Collection as a single argument object to the C user action function:

```
| myArray |  
myArray := Array new: 10.
```

```
"populate myArray, then send the following message"
```

```
System userAction: #doSomething with: myArray.
```

### Limit on Circular Calls Among User Actions and Smalltalk

From Smalltalk you can invoke a user action, and within the user action you can do a **GciSend**, **GciPerform**, or **GciExecute**, that may in turn invoke another user action. This kind of circular function calling is limited; no more than 2 user actions may be active at any one time on the current Smalltalk stack. If the limit is exceeded, GemStone raises an error.

## 5. Debug the User Action

Even if you intend to use your library only as session user actions, test them first as application user actions with an RPC Gem. As with applications, never debug user actions with linked versions.

#### CAUTION

*Debug your C code in a process that does not include a Gem.*

*For more information, see "Risk of Database Corruption" on page 59.*

Use the instructions for user actions in Chapter 5, "Compiling and Linking" to compile and link the user action library. Then load the user actions from the RPC version of your application or Topaz. To load from Topaz, use the **loadua** command.

When an error in a user actions is handled by an `on:do:` block in Smalltalk by default trims the stack on return from the user action. You can set the runtime configuration parameter `GemDebuggerActive`, to fetch the stack for the error in the user action.

## 4.4 Executing User Actions

User actions can be executed either in the GemBuilder application (client) process or in a Gem (server) process, or in both.

### Choosing Between Session and Application User Actions

The distinction between application user actions that execute in the application and session user actions that execute in the Gem is interesting primarily when the two processes are running remotely, or when the application has more than one Gem process.

#### Remote Application and Gem Processes

When the application and Gem run on different machines and the Gem calls an application user action, the call is made over the network. Computation is done by the application where the application user action is running, and the result is returned across the network. Using a session user action eliminates this network traffic.

On the other hand, for overall efficiency you also need to consider which machine is more suitable for execution of the user action. For example, assume that your application acquires data from somewhere and wishes to store it in GemStone. You could write a user action to create GemStone objects from the data and then store the objects. It might make more sense to execute the user action in the application process rather than transport the raw data to the Gem.

Alternatively, assume there is a GemStone object that could require processing before the application could use it, like a matrix on which you need to perform a Fast Fourier Transform (FFT). If the Gem runs on a more powerful machine than the client, you may wish to run an FFT user action in the Gem process and send the result to your application.

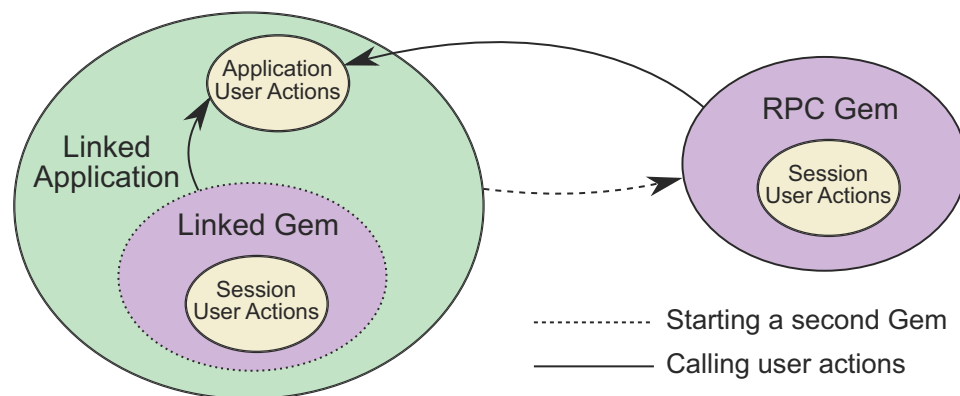
## Applications With Multiple Gems

In most situations, session user actions are preferable, because the Gem does not have to make calls to the application. In the case of a linked application, however, an application user action is just as efficient for the linked Gem, because the Gem and application run as one process. Using an application user action guarantees that if any new sessions are created, they will have access to the same user action functions as the first session.

Every Gem can access its own session user actions and the application user actions loaded by its application. A Gem cannot access another Gem's session user actions, however, even when the Gems belong to the same application.

Although a linked application and its first Gem run in the same process, that process can have session and application user actions, as in Figure 4.1. Application user actions, loaded by the application's loading function, are accessible to all the Gems. Session user actions in the same process, loaded by the `System class>>loadUserActionLibrary:` method, are not accessible to the RPC Gem. Conversely, the RPC Gem's user actions are not accessible to the linked Gem.

**Figure 4.1 Access to Application and Session User Actions**



The following sections discuss the various possible configurations in detail.

## Running User Actions with Applications

User actions can be executed in the user application process under two configurations of GemStone processes. The configurations differ depending upon whether the application is linked or RPC.

### With an RPC Application

In an RPC configuration, the application runs in a separate process from any Gem. Each time the application calls a GemBuilder C function, the function uses remote procedure calls to communicate with a Gem. The remote procedure calls are used whether the Gem is running on the same machine as the application, or on another machine across the network.

The user actions run in the same process as the application. If they call GemBuilder functions, those functions also use remote procedure calls to communicate with the Gem. In this configuration, all your code executes as a GemStone client (on the application side). It can thus execute on any GemStone client platform; it is not restricted to GemStone server platforms. Care should be taken in coding to minimize remote procedure call overhead and to avoid excessive transportation of GemStone data across the network. The following list enumerates some of the conditions in which you may find occasion to use this configuration:

- ▶ The application and/or the user action needs to be debugged or tested.
- ▶ The user action depends on facilities or implement capabilities for the application environment. Screen management, GUI operations, and control of specialized hardware are possibilities.
- ▶ The application acquires data from somewhere and wishes to store it in GemStone. The user action creates the requisite GemStone objects from the data and then commits them to the repository.

*NOTE:*

*You can run RPC Topaz as the C application in this configuration for debugging to perform unit testing of user action libraries. Apply a source-level debugger to the Topaz executable, load the libraries with the Topaz **loadua** command, then call the user actions directly from GemStone Smalltalk.*

### With a Linked Application

In a linked configuration, the application, the user actions, and one Gem all run in the same process (on the same machine). All function calls, from the application to GemBuilder and between GemBuilder and the Gem, are resolved by ordinary C-language linkage, not by remote procedure calls.

Since a Gem is required for each GemStone session, the first session uses the (linked) Gem that runs in your application process. This Gem has the advantages that it does not incur the overhead of remote procedure calls, and may not incur as much network traffic. It has the disadvantage that it must run in the same process as the Gem, so that work cannot be distributed between separate client and server processes. Since the application cannot continue processing while the Gem is at work, the non-blocking GemBuilder functions provide no benefit here.

If a linked application user logs in to GemStone more than once, GemStone creates a new RPC Gem process for each new session. If one of these sessions invokes a user action, the user action executes in the same process as the application. If the user action then calls a GemBuilder function, that call is serviced by the linked Gem, not by the Gem from which the user action was invoked.

In this configuration, your code executes only on GemStone server platforms. It cannot execute on client-only platforms because a Gem is part of the same process. The occasions for using this configuration are much the same as those for running user actions with an RPC application, except that you should not use this one for debugging.

*CAUTION*

*Debug your user actions in a process that does not include a Gem. For more information, see "Risk of Database Corruption" on page 59.*

## Running User Actions with Gems

Just as with applications, there are two forms of Gems: linked and RPC. The linked Gem is embedded in the `gcilnk` library and is only used with linked applications.

An RPC Gem executes in a separate process that can install and execute its own user actions. The RPC Gem is RPC because it communicates by means of remote procedure calls, through an RPC GemBuilder, with an application in another process.

However, it is also a separate C program. The Gem itself also uses GemBuilder directly, to interact with the database. That is the reason why the RPC Gem is linked with the `gcilnk` library. The user action in this configuration executes in the same process as the Gem, with the GemBuilder that does *not* use remote procedure calls.

*CAUTION*

*Debug your user actions in a process that does not include a Gem. For more information, see "Risk of Database Corruption" on page 59.*

The following list enumerates some of the conditions in which you may find occasion to use this configuration:

- ▶ You wish to execute the user action from a Smalltalk application using GemBuilder for Smalltalk. This configuration is required for that purpose.
- ▶ You wish the user action to be available to all or many other C applications.
- ▶ The user action is called frequently from GemStone. This configuration eliminates network traffic between GemBuilder and GemStone.
- ▶ The user action makes many calls to GemBuilder. This configuration avoids remote procedure call overhead.
- ▶ You have a GemStone object or objects that you wish to process first, and your application needs the result. The processing may be substantial. Your GemStone server machine may be more powerful than your client machine and could do it more quickly, or it might have specialized software the user action needs. Also, the result might be smaller and could reduce network traffic.





# Compiling and Linking

This chapter describes how to compile and link your C/C++ applications and user actions. The focus is directly on operations for each compiling or linking alternative on each GemStone platform. It is assumed that you already know which alternatives you want to use, and why, and when. Those topics are part of the application design and code implementation, which are described in other chapters of this manual.

All operations are illustrated as though you are issuing commands at a command-line prompt. You may choose to take advantage of your system's programming aids, such as the UNIX **make** utility and predefined environment variables, to simplify compilation and linking. Whatever you choose, be sure that you designate options and operations that are equivalent to those shown here.

#### NOTE

*Much of the material in this chapter is system-specific and, therefore, subject to change by compiler vendors and hardware manufacturers. Please check your GemStone/S 64 Bit Release Notes, Installation Guide, and vendor publications for possible updates.*

## 5.1 Development Environment and Standard Libraries

Set the GEMSTONE environment variable to your GemStone installation directory; the command lines shown in this chapter assume that this has been done. No other environment variables are required to find the GemStone C++ libraries.

GemStone requires linking with certain architecture-specific "standard" C and C++ libraries on some platforms. The order in which these libraries are specified can be significant; be sure to retain the ordering given in the example command lines.

The environment of the supported Unix platforms is System V. On these platforms, the `/usr/bin` directory should be present in the PATH environment variable. If `/usr/ucb` is also present in PATH, then it should come after `/usr/bin`. The System V "standard" C/C++ libraries (*not* Berkeley) should be used in linking.

## 5.2 Compiling and Linking C Source Code for GemStone

The following information includes the requirements and recommendations for compiling C applications or user actions for GemStone. Your C code may have additional requirements, such as compile options or environment variables.

### Compiling

#### The C++ Compiler

C applications and user actions must be compiled and linked with a compiler that is compatible with GemStone libraries and object code. This chapter assumes that a compatible compiler has been installed and is in your path.

The C++ compilers listed in section 5.3 were used to produce the GemStone product, and have been tested for producing C/C++ applications and user action libraries. Other compilers, such as ANSI C++ compilers, are assumed to work, but have not been tested.

#### Compilation Options

Compiling user actions and GCI applications use the same compilation options.

When you compile, specify each directory that is to be searched for include files separately by repeating the `-I` option. At a minimum, you must specify the GemStone `include` directory, but it is likely you will have other include file directories.

For simplicity in compiling code for user actions, the `.c` file is assumed to be a library containing both the source code for one set of user actions and the implementation of the function that installs them all with GemStone.

The `-c` option inhibits the “load and go” operation, so compilation ends when the compiler has produced an object file.

If you have multiple application or user action files, they should all be compiled under these same basic conditions.

For more information and details on the compiler options and other compiler flags, please consult your compiler documentation.

### Linking

Use the same C++ compiler to link your GemStone C/C++ code as you use to compile it.

#### Link options

Linking user actions and GCI applications require different link options.

There is no difference in the link options for applications that will login linked or RPC. The run-time binding is done by code that is part of the application. The same application can use either the RPC or linked GemBuilder libraries with this type of binding.

Linking with shared libraries does not require that all entry points be resolved at link time. Those that are outside of each shared library await resolution until application execution time, or even until function invocation time.

*NOTE*

*When you link a user action shared library, be aware of the dangers of incorrect*

*unresolved external references. If you misspell a function call, you may not find out about it until run-time, when your process dies with an unresolved external reference error. Be sure to check your link program's output carefully.*

The `-o` option designates the path of the executable file produced by the link operation.

Be sure to employ at the appropriate times the link option that designates symbolic debugging (often `-g`).

For information on most options, please consult your linker documentation.

If you have multiple application or user action files, they should all be linked under the same basic conditions.

## Risk of Database Corruption

### CAUTION

*Debug your C/C++ code in a process that does not include a Gem.*

*Do not log into GemStone in a linked application or run a Gem with your user actions until your C/C++ code has been properly debugged.*

When your C/C++ code executes in the same process as a Gem, it shares the same address space as the GemStone database buffers and object caches that are part of the Gem. If that C code has not yet been debugged, there is a danger that it might use a C pointer erroneously. Such an error could overwrite the Gem code or its data, with unpredictable and disastrous results. It is conceivable that such corruption of the Gem could lead it to perform undesired GemStone operations that might then leave your database irretrievably corrupt. The only remedy then is to restore the database from a backup.

There are three circumstances under which this risk arises:

- ▶ You are running your linked application and you have logged into GemStone.
- ▶ You are running any linked application and you are executing one of your user actions from the application.
- ▶ You are running any Gem, even a remote Gem, and you are executing one of your user actions from the Gem.

To avoid the risk, you must run your C code in some process that does not include a Gem. If the Gem is in a separate process, it has a separate address space that your C code should not be able to access. Use the RPC version of an application, and run any user actions from the application.

## 5.3 Platform Specific versions and example options

The compile command lines for each platform illustrate how to compile a simple application program or user action file named *userCode*, whose source contains one code file, *userCode.c*. Its result is one object file, *userCode.o*.

For simplicity in compiling code for user actions, this file is assumed to be a library containing both the source code for one set of user actions and the implementation of the function that installs them all with GemStone.

The link command lines illustrate

- ▶ how to link a user action object file named *userCode.o* with GemStone libraries to produce a user action library named *libuserAct.so* or *libuserAct.dylib*, depending on your platform.
- ▶ how to link a simple application program with one application object file, *userCode.o*. Its result is one executable file, *userAppl*.

Use the same C++ compiler to link your GemStone C/C++ code as you used to compile it.

## Linux Compile and Link Information

### Compiler version

Red Hat Linux ES 8.1: gcc/g++ 8.3.1

Red Hat Linux ES 7.x: gcc/g++ 4.8.5

Ubuntu 20.04 LTS: gcc/g++ 9.3.0

Ubuntu 18.04 LTS: gcc/g++ 8.4.0

Ubuntu 16.04 LTS: gcc/g++ 5.4.0

### Listing the Compiler Version

```
% g++ -v
```

### Debugger version

Red Hat Linux ES 8.1: gdb 8.2-11

Red Hat Linux ES 7.4: gdb 7.6.1-100

Ubuntu 20.04 LTS: gdb 9.1

Ubuntu 18.04 LTS: gdb 8.2.50

Ubuntu 16.04 LTS: gdb 8.2.50

### Compiling a user action or GCI application

```
g++ -fmessage-length=0 -fcheck-new -O3 -ggdb -m64 -pipe
    -D_REENTRANT -D_GNU_SOURCE -pthread -fPIC -fno-strict-aliasing
    -fno-exceptions -I$GEMSTONE/include -x c++ -c userCode.c
    -o userCode.o
```

The following warn flags are recommended for compilation:

```
-Wformat -Wtrigraphs -Wcomment -Wtrigraphs
-Wno-aggregate-return -Wswitch -Wshadow -Wunused-value
-Wunused-variable -Wunused-label -Wno-unused-function
-Wchar-subscripts -Wmissing-braces -Wmissing-declarations
-Wmultichar -Wparentheses -Wsign-compare -Wsign-promo
-Wwrite-strings -Wreturn-type -Wno-format-truncation
-Wuninitialized
```

If you want to stop the compilation process when any of the above warnings are encountered, use the following flag:

```
-Werror
```

To allow debugging of the resulting library, also include the optional `-g` flag and omit the optimization flag `-O3`.

### Linking a user action library

```
g++ -shared -Wl,-hlibuserAct.so userCode.o $GEMSTONE/lib/gciualib.o
-o libuserAct.so -m64 -Wl,-Bdynamic,--no-as-needed -lpthread
-Wl,--as-needed -lcrypt -ldl -lc -lm -lrt
```

### Linking a GCI application

```
g++ userCode.o $GEMSTONE/lib/gcirtlobj.o -m64
-Wl,-Bdynamic,--no-as-needed -lpthread -Wl,--as-needed -lcrypt
-ldl -lc -lm -lrt -Wl,-traditional -Wl,-z,lazy -o userAppl
```

## Solaris on x86 Compile and Link Information

### Compiler version

```
CC: Studio 12.5 Sun C++ 5.14 SunOS_i386 2016/05/31
```

### Listing the Compiler Version

```
% CC -V
```

### Debugger version

```
Sun DBX Debugger 7.7 SunOS_i386 2009/06/03
```

### Compiling a user action or GCI application

```
CC -xO4 -m64 -xarch=generic -Kpic -mt -D_REENTRANT
-D_POSIX_PTHREAD_SEMANTICS -I$GEMSTONE/include
-features=no%except -c userCode.c -o userCode.o
```

To allow debugging of the resulting library, include the optional `-g` flag and omit the optimization flag `-xO4`.

### Linking a user action library

```
CC -m64 -xarch=generic -G -h libuserAct.so -i userCode.o
$GEMSTONE/lib/gciualib.o -o libuserAct.so -Bdynamic -lc
-lpthread -ldl -lrt -lsocket -lnsl -lm -lpam -lCrun -lsendfile
-z nodefs
```

### Linking a GCI application

```
CC -xildoff -m64 -xarch=generic -i userCode.o
$GEMSTONE/lib/gcirtlobj.o -z nodefs -Bdynamic -lc -lpthread
-ldl -lrt -lsocket -lnsl -lm -lpam -lCrun -lsendfile -o userAppl
```

## AIX Compile and Link Information

### Compiler version

IBM XL C/C++ for AIX, V16.1

### Listing the Compiler Version

```
% /usr/vacpp/bin/xlC_r -qversion
```

### Debugger version

dbx

### Compiling a user action or GCI application

```
xlC_r -O3 -qstrict -qalias=noansi -q64 -+ -qpic
-qthreaded -qarch=pwr6 -qtune=balanced -D_LARGEFILE64_SOURCE
-DFLG_AIX_VERSION=version -D_REENTRANT -D_THREAD_SAFE
-qminimaltoc -qlist=offset -qmaxmem=-1 -qsuppress=1500-010:1500
-029:1540-1103:1540-2907:1540-0804:1540-1281:1540-1090:1540-2988
-qnoeh -I$GEMSTONE/include -c userCode.c -o userCode.o
```

Depending on your version of AIX, you need to include `-DFLG_AIX_VERSION=71` or `-DFLG_AIX_VERSION=72`.

Also note that there is no space in the `-qsuppress` arguments that are continued on the following line.

To allow debugging of the resulting library, also include the optional `-g`, `-qdbxextra` and `-qfullpath` flags, and omit the optimization flag `-O3`.

### Linking a user action library

```
xlC_r -G -Wl,-bdatapsize:64K -Wl,-btextpsize:64K
-Wl,-bstackpsize:64K -q64 userCode.o $GEMSTONE/lib/gciualib.o
-o libuserAct.so -e GciUserActionLibraryMain -L/usr/vacpp/lib
-lpthreads -lc_r -lC_r -lm -ldl -lbsd -lpam -Wl,-berok
```

### Linking a GCI application

```
xlC_r -Wl,-bdatapsize:64K -Wl,-btextpsize:64K
-Wl,-bstackpsize:64K -q64 userCode.o $GEMSTONE/lib/gcirtlobj.o
-Wl,-berok -L/usr/vacpp/lib -lpthreads -lc_r -lC_r -lm -ldl
-lbsd -lpam -Wl,-brtllib -o userAppl
```

## DARWIN Compile and Link Information

### Compiler version

Apple clang version 11.0.3 (clang-1103.0.32.62)

## Listing the Compiler Version

```
% g++ -v
```

## Debugger version

```
lldb-1000.0.38.2, Swift-4.2
```

## Compiling a user action or GCI application

```
g++ -fmessage-length=0 -O3 -ggdb -m64 -pipe -fPIC  
-fno-strict-aliasing -D_LARGEFILE64_SOURCE -D_XOPEN_SOURCE  
-D_REENTRANT -D_GNU_SOURCE -I$GEMSTONE/include -x c++  
-c userCode.c -o userCode.o
```

The following warn flags are recommended for compilation:

```
-Wno-format -Wtrigraphs -Wcomment -Wsystem-headers -Wtrigraphs  
-Wno-aggregate-return -Wswitch -Wshadow -Wunused-value  
-Wunused-variable -Wunused-label -Wno-unused-function  
-Wchar-subscripts -Wno-conversion -Wmissing-braces -Wmultichar  
-Wparentheses -Wsign-compare -Wsign-promo -Wwrite-strings  
-Wreturn-type -Wno-nullability-completeness  
-Wno-expansion-to-defined
```

To allow debugging of the resulting library, also include the optional `-g` flag and omit the optimization flag `-O3`.

## Linking a user action library

```
g++ -dynamiclib userCode.o $GEMSTONE/lib/gciualib.o  
-o libuserAct.dylib -m64 -lpthread -ldl -lc -lm -lpam -undefined  
dynamic_lookup
```

## Linking a GCI application

```
g++ userCode.o $GEMSTONE/lib/gcirtlobj.o -undefined dynamic_lookup  
-m64 -lpthread -ldl -lc -lm -lpam -o userAppl
```

## Windows Compile and Link Information

GemStone/S 64 Bit supports Windows only as a client platform. You may compile and link GCI applications, but not user actions, on Windows.

## Compiler/Debugger version

Microsoft Visual Studio 2010 Version 10.0.30319.1 RTMRel

Microsoft Visual C++ 2010 01021-532-2002102-70611

## Compiling a GCI application

```
cl /W3 /Zi /MD /O2 /Oy- -DNDEBUG /TP /nologo /D_LP64 /D_AMD64_
  /D_CONSOLE /D_DLL /DWIN32_LEAN_AND_MEAN /
  D_CRT_SECURE_NO_WARNINGS /EHsc
  /DNATIVE /I 'VisualStudioInstallPath\atlmfc\include'
  /I 'VisualStudioInstallPath\VC\include'
  /I 'C:\Program Files (x86)\Microsoft
  SDKs\Windows\v7.0A\Include'
  /I '%GEMSTONE%\include' -c userCode.c -FouserCode.obj
```

## Linking a GCI application

```
link /LIBPATH:"VisualStudioInstallPath\VC\lib\amd64"
  /LIBPATH:"C:\Program Files (x86)\Microsoft
  SDKs\Windows\v7.0A\Lib\x64" -RELEASE
  /OPT:REF /INCREMENTAL:NO /MAP /nologo /MANIFEST
  /MANIFESTFILE:userAppl.exe.manifest
  /MANIFESTUAC:"level='asInvoker'" userCode.obj
  %GEMSTONE%\lib\gcirpc.lib ws2_32.lib netapi32.lib advapi32.lib
  comdlg32.lib user32.lib gdi32.lib kernel32.lib winspool.lib
  Secur32.lib /out:userAppl.exe
```



# GemBuilder for C Files and Data Structures

This chapter describes the GemBuilder for C include files, data structures, and other reference information that may be useful when writing your application.

## 6.1 GemBuilder for C Include Files

The following include files are provided for use with GemBuilder for C functions. These files are in the `$GEMSTONE/include` directory.

Your C source code should include one of these include files:

|                       |                                                                                                                                            |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| <code>gci.hf</code>   | Forward references to the GemBuilder functions. Use when creating GCI applications.                                                        |
| <code>gciua.hf</code> | Forward references to the GemBuilder functions that includes definitions to support user actions. Include this when creating user actions. |

Using the GemStone C Statistics Interface (GCSI), as described in Chapter 8, “GemStone C Statistics Interface”, starting on page 417, include the following:

|                            |                                                                                                                                                                      |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>shrpcstats.ht</code> | Defines all cache statistics. (For a list of cache statistics, refer to the “Monitoring GemStone” chapter of the System Administration Guide for GemStone/S 64 Bit.) |
| <code>gcsi.hf</code>       | Prototypes for all GCSI functions.                                                                                                                                   |
| <code>gcsierr.ht</code>    | GCSI error numbers.                                                                                                                                                  |

The following include files are included by `gciua.hf` and/or `gci.hf`; you do not need to explicitly include any other files in order to use the GCI functions:

|                           |                                                                                                                                |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| <code>gcirtl.hf</code>    | Forward references to the GemBuilder functions that perform run time loading.                                                  |
| <code>flag.ht</code>      | Contains host-specific C definitions for compilation.                                                                          |
| <code>gciemn.ht</code>    | Defines common C types and macros.                                                                                             |
| <code>gcierr.ht</code>    | Defines mnemonics for all GemStone errors.                                                                                     |
| <code>gcifloat.ht</code>  | Macros, constants and functions for accessing the bodies of instances of GemStone classes Float and SmallFloat.                |
| <code>gci.ht</code>       | Defines C types for use by GemBuilder functions.                                                                               |
| <code>gcilegacy.ht</code> | Definitions that are used by <code>gci.hf</code> ; they are in a distinct file since they are not used by the thread-safe GCI. |
| <code>gciooc.ht</code>    | Defines C mnemonics for sizes and offsets into objects.                                                                        |
| <code>gcioop.ht</code>    | Defines C mnemonics for predefined GemStone objects.                                                                           |
| <code>gciuser.ht</code>   | Defines a macro to be used to install user actions; loaded by <code>gciua.hf</code> , not by <code>gci.hf</code> .             |
| <code>version.ht</code>   | Defines C mnemonics for version-dependent strings.                                                                             |

## 6.2 Reserved Oops

The GemStone/S 64 Bit distribution includes the file `gcioop.ht`, which defines C macros that define the OOPs of certain commonly used GemStone objects. Your code can compare these with any value of type `OopType`.

Note that the actual definition of these macros is subject to change without notice in future software releases. Your C application should refer to the OOPs of predefined GemStone objects *by defined macro name only*.

The following are some of the names for predefined GemStone objects Refer to `$(GEMSTONE)/include/gcioop.ht` for a complete list.

- ▶ A value that, strictly speaking, is not an object at all, but that represents a value that is never used to represent any object in the database. You can use this to test whether or not an OOP is valid.

`OOP_ILLEGAL`

- ▶ Boolean and nil objects

`OOP_NIL` (*nil*)

`OOP_FALSE` (*FALSE*)

`OOP_TRUE` (*true*)

- ▶ Instances of SmallInteger
  - OOP\_MinusOne
  - OOP\_MinusTwo
  - OOP\_Zero
  - OOP\_One
  - OOP\_Two
  - OOP\_Three
  - OOP\_Four
  - MAX\_SMALL\_INT
  - MIN\_SMALL\_INT
- ▶ Instances of Character
  - OOP\_ASCII\_NUL represents the first ASCII character OOP. Other Characters have specific OOPs, but no macros.
- ▶ The GemStone Smalltalk kernel classes
  - OOP\_CLASS\_ *className*, where *className* is the name of a class (which may be uppercase or camelcase) Refer to `gci.oop.ht` for specific names.
  - OOP\_LAST\_KERNEL\_OOP (which has the same value as the last class)

## 6.3 GemBuilder Data Types

The following C types/C++ classes are used by GemBuilder functions. The file `$/GEMSTONE/include/gci.ht` defines each of the GemBuilder types.

|                         |                                                                                 |
|-------------------------|---------------------------------------------------------------------------------|
| BoolType                | An integer.                                                                     |
| ByteType                | An unsigned 8-bit integer.                                                      |
| OopType                 | Object-oriented pointer, an unsigned 32-bit integer.                            |
| FloatKindEType          | Enumerated type that defines the possible kinds of an IEEE binary float.        |
| GciClampedTravArgsSType | A C++ class for clamped traversal arguments.                                    |
| GciDateTimeSType        | A structure for representing GemStone DateTimes.                                |
| GciDateAndTime          | A structure for representing GemStone DateAndTimes.                             |
| GciPosixDateAndTime     | A structure for representing GemStone DateAndTimes in posix form.               |
| GciDbgFuncType          | The type of C function called by <b>GciDbgEstablish</b> .                       |
| GciErrSType             | A GemStone error report; see “Error Report Structure - GciErrSType” on page 69. |
| GciJumpBufSType         | Error jump buffer.                                                              |

|                         |                                                                                                                        |
|-------------------------|------------------------------------------------------------------------------------------------------------------------|
| GciObjInfoSType         | A C++ class for a GemStone object information report; see “Object Information Structure - GciObjInfoSType” on page 70. |
| GciObjRepHdrSType       | A C++ class for an object report header; see “Object Report Header - GciObjRepHdrSType” on page 71.                    |
| GciObjRepSType          | A C++ class for an object report; see “Object Report Structure - GciObjRepSType” on page 71.                           |
| GciSessionIdType        | A signed 32-bit integer.                                                                                               |
| GciStoreTravDoArgsSType | A C++ class for store traversal arguments.                                                                             |
| GciTravBufType          | A traversal buffer; see “Traversal Buffer - GciTravBufType” on page 78.                                                |
| GciUserActionSType      | A structure for describing a user action (see “User Action Information Structure - GciUserActionSType” on page 79).    |

## Date/Time Structures

### GciDateTimeSType

GemBuilder includes some functions to facilitate access to objects of type `DateTime`. These functions also make use of the C representation for time, `time_t`.

The class `GciDateTimeSType` has the following fields:

```
int year;           // 1901..1000000
int dayOfYear;     // 1..366
int milliseconds; // ms since midnight
OopType timeZone; // oop of the time zone
```

### GciDateAndTime

The class `GciDateAndTime` has the following fields:

```
int64 microseconds; // posixMicroseconds if year is -1
int offsetSeconds;
int year;           // Gregorian year per DateAndTime
int dayOfYear;     // 1..366; or -1, meaning microseconds are
                  // posix and year is not used.
```

### GciPosixDateAndTime

The class `GciPosixDateAndTime` has the following fields:

```
int64 microseconds; // UTC since 1970
int offset;
```

### GCI\_SECONDS\_PER\_DAY

A C constant encoding the number of seconds in a day.

```
enum { GCI_SECONDS_PER_DAY = 86400 };
```

## Error Report Structure - GciErrSType

An error report is a C++ class named GciErrSType. This includes the following fields:

|               |                                        |                                                                                                                                                                                                                                                                                                                                                                           |
|---------------|----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| OopType       | <i>category</i>                        | Deprecated. The value is always OOP_GEMSTONE_ERROR_CAT.                                                                                                                                                                                                                                                                                                                   |
| OopType       | <i>context</i>                         | The OOP of a GsProcess that provides the state of the virtual machine for use in debugging. This GsProcess can be used as the argument to <b>GciContinue</b> or <b>GciClearStack</b> . If the virtual machine was not running, then <i>context</i> is OOP_NIL. If you are not interested in debugging or in continuing from an error, your program can ignore this value. |
| OopType       | <i>exceptionObj</i>                    | Either an instance of Exception or nil (if the error was not signaled from Smalltalk execution).                                                                                                                                                                                                                                                                          |
| OopType       | <i>args</i> [GCI_MAX_ERR_ARGS]         | An optional array of error arguments. In this release, GCI_MAX_ERR_ARGS is defined to be 10.                                                                                                                                                                                                                                                                              |
| int           | <i>number</i>                          | The GemStone error number (a positive integer).                                                                                                                                                                                                                                                                                                                           |
| int           | <i>argCount</i>                        | The number of arguments in the args array.                                                                                                                                                                                                                                                                                                                                |
| unsigned char | <i>fatal</i>                           | Nonzero if this error is fatal.                                                                                                                                                                                                                                                                                                                                           |
| char          | <i>message</i> [GCI_ERR_STR_SIZE + 1]  | The null-terminated Utf8 containing the error message. In this release, GCI_ERR_STR_SIZE is defined to be 1024.                                                                                                                                                                                                                                                           |
| char          | <i>reason</i> [GCI_ERR_reasonSize + 1] | The null-terminated Utf8 reason. GCI_ERR_reasonSize is defined to be the same as GCI_ERR_STR_SIZE.                                                                                                                                                                                                                                                                        |

The arguments (*args*) are specific to the error encountered. See the `gcierr.ht` file for a full list of errors and their arguments.

In the case of a compiler error, this is a single argument – the OOP of an array of error identifiers. Each identifier is an Array with three elements: (1) the error number (a SmallInteger); (2) the offset into the source string at which the error occurred (also a SmallInteger); and (3) the text of the error message (a String).

In the case of a fatal error, *fatal* is set to nonzero (TRUE). Your connection to GemStone is lost, and the current session ID (from **GciGetSessionId**) is reset to GCI\_INVALID\_SESSION\_ID.

## Object Information Structure - GciObjInfoSType

Object information is placed in a C++ class named `GciObjInfoSType`. Object information access functions provide information about objects in the database. These functions offer C-style access to much information that would otherwise be available only through calls to GemStone. For more information about the `GciObjInfoSType` structured type, refer to `GciFetchObjImpl` (page 185).

|                |                               |                                                                                                      |
|----------------|-------------------------------|------------------------------------------------------------------------------------------------------|
| OopType        | <i>objId</i>                  | OOP of the object.                                                                                   |
| OopType        | <i>objClass</i>               | Class of the object.                                                                                 |
| int64          | <i>objSize</i>                | Object's total size in bytes or OOPs; see <code>GciFetchSize_</code> (page 194).                     |
| int            | <i>namedSize</i>              | Number of named instance variables in the object.                                                    |
| unsigned short | <i>objectSecurityPolicyId</i> | The ID of the object's security policy.                                                              |
| unsigned short | <i>_bits</i>                  | Bits indicating the implementation format and mask. See <code>gci.hf</code> for the bit definitions. |

### Functions

The object information class `GciObjInfoSType` provides the following functions:

```
unsigned char isInvariant( );
```

Returns non-zero if this object is invariant. Returns zero otherwise.

```
unsigned char isIndexable( );
```

Returns non-zero if this object is indexable. Returns zero otherwise.

```
unsigned char isPartial( );
```

Returns non-zero if the value buffer does not contain the entire object; that is, the operation truncated the object's instance variables. Returns zero otherwise.

```
unsigned char isOverlaid( );
```

Returns non-zero if overlay semantics were used on this operation. Returns zero otherwise. When the traversal is overlaid, you can use `OOP_ILLEGAL` to mask out instance variables that you don't want to modify, and then store into the remaining instance variables.

```
unsigned char objImpl( );
```

Returns an unsigned char in the range 0..3 that corresponds to the object's implementation format. The mnemonics for these values are:

```
GC_FORMAT_OOP
GC_FORMAT_BYTE
GC_FORMAT_NSC
GC_FORMAT_SPECIAL
```

For bit functions, see `gci.hf`.

## Object Report Structure - GciObjRepSType

Each object report has two parts: a fixed-size header (as defined in the C++ class `GciObjRepHdrSType`) and a variable-size value buffer (an array of the values of the object's instance variables):

```
class GciObjRepSType {
public:
    GciObjRepHdrSType hdr;          /* object report header */
    union {
        ByteType      bytes[1];    /* Byte objects */
        OopType       oops[1];    /* Pointer objects */
    } u;
};
```

### Functions

The object report class `GciObjRepSType` provides these functions:

```
int64 usedBytes();
```

When constructing an object report buffer, returns the size of the object report, including any alignment considerations.

```
GciObjRepHdrSType* nextReport();
```

Given a pointer to an object report in a traversal buffer, this function increments the pointer by *usedBytes* (the size of the object report).

```
ByteType* valueBufferBytes();
```

Returns a pointer to the start of the body, as bytes.

```
OopType* valueBufferOops();
```

Returns a pointer to the start of the body, as OOPs.

## Object Report Header - GciObjRepHdrSType

An object report header is a C++ class named `GciObjRepHdrSType`. This class holds a general description of an object, and contains the following fields:

|                |                               |                                                                                                                                                                |
|----------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| int            | <i>valueBuffSize</i>          | Size (in bytes) of the object's value buffer.                                                                                                                  |
| short          | <i>namedSize</i>              | Number of named instance variables in the object.                                                                                                              |
| unsigned short | <i>objectSecurityPolicyId</i> | The ID of the object's security policy.                                                                                                                        |
| OopType        | <i>objId</i>                  | OOP of the object.                                                                                                                                             |
| OopType        | <i>oclass</i>                 | Class of the object.                                                                                                                                           |
| int64          | <i>firstOffset</i>            | Offset of first value to fetch or store; 1 means first <i>instVar</i> is the first named <i>instVar</i> .                                                      |
| unit64         | <i>_idxSizeBits</i>           | 40 bits size, 8 bits dynamic inst var size, 6 bits unused, 2 bits swizzle, 8 bits implementation format and mask. See <i>gicmn.hf</i> for the bit definitions. |

## Functions

The object report header class `GciObjRepHdrSType` provides the following functions:

```
int64 idxSize();
    Returns the number of indexable or varying instance variables.

void setIdxSize(int64 size);
    Sets the number of indexable or varying instance variables.

void setIdxSizeBits(int64 size, unsigned char bits);
    Sets both the indexable size and the eight bits defined by the enum of the mask values.
    Intended for GemStone use only.

int objImpl( );
    Returns an integer in the range 0..3 that corresponds to the object's implementation
    format. See the description on page 73.

int setObjImpl(int impl);
    Defines the object's implementation format. The argument must be an integer in the
    range 0..3 corresponding to the implementation format. You may use the mnemonics
    GC_FORMAT_OOP, GC_FORMAT_BYTE, GC_FORMAT_NSC, and
    GC_FORMAT_SPECIAL.

int64 objSize( );
    Returns the total number of instance variables in the object (both indexable and
    named).

void clearBits( );
    Sets indexable, invariable, partial, overlaid, non-readable, and clamped to FALSE.

unsigned char isClamped( );
    Returns non-zero if this object report is clamped. Returns zero otherwise.

unsigned char noReadAuthorization( );
    Returns non-zero if this object report is not readable. Returns zero otherwise.

unsigned char isInvariant( );
    Returns non-zero if this object report is invariant. Returns zero otherwise.

unsigned char isIndexable( );
    Returns non-zero if this object report is indexable. Returns zero otherwise.

unsigned char isPartial( );
    Returns non-zero if the value buffer does not contain the entire object; that is, the
    traversal operation truncated the object's instance variables. Returns zero otherwise.

unsigned char isOverlaid( );
    Returns non-zero if overlay semantics were used on this store traversal operation.
    Returns zero otherwise. When the traversal is overlaid, you can use OOP_ILLEGAL
    to mask out instance variables that you don't want to modify, and then store into the
    remaining instance variables.

void setIsClamped(unsigned char val);
    If val is non-zero, make this object report clamped.

void setNoReadAuth(unsigned char val);
    If val is non-zero, make this object report non-readable.
```



```
void setInvariant(unsigned char val);
    If val is non-zero, make this object report invariant.

void setIndexable(unsigned char val);
    If val is non-zero, make this object report indexable.

void setOverlaid(unsigned char val);
    If val is non-zero, use overlay semantics on this store traversal.

ByteType* valueBufferBytes() ;
    Returns a pointer to the start of the body, as bytes.

OopType* valueBufferOops()
    Returns a pointer to the start of the body, as OOPs.

int64 usedBytes() ;
    Returns the size (in bytes) of this object report, including the size of the header, value
    buffer, and any padding bytes needed at the end of the report so that the next report in
    the buffer begins on an address that is a multiple of 8.

GciObjRepHdrSType * nextReport() ;
    Given a pointer to an object report in a traversal buffer, this function increments the
    pointer by usedBytes (the size of the object report).
```

### Description

During a store traversal operation, if the specified *idxSize* is inadequate to accommodate the contents of the value buffer (the values in *u.bytes* or *u.oops*), the store operation will automatically increase *idxSize* (the number of the object's indexed variables) as needed. If the specified *objClass* is not indexable, then the *idxSize* is ignored; in addition, if there are more OOPs in the value buffer than there are named instance variables, and the object is not an NSC, an error will be generated.

During a store traversal operation, the *firstOffset* indicates where to begin storing values into the object's array of instance variables. In that array, the object's named instance variables are followed by its unnamed variables. If *firstOffset* is not 1, all instance variables (named or indexed) up to the *firstOffset* will be initialized to nil or 0. The *firstOffset* must be in the range (1, *objSize*+1).

The *isInvariant()* value is true if the object itself is invariant. This can happen in one of three ways:

- ▶ The application program sends the message *immediateInvariant* to the object.
- ▶ The application program explicitly executes *setInvariant()* in the report header and then uses that report header in a call to **GciStoreTrav**.

The object's class was created with *instancesInvariant: true* and the object has been committed.

### Object implementation

The *gcio.c.ht* include file defines four mnemonics that can be of assistance when you are handling the object implementation field (*objImpl*): *GC\_FORMAT\_OOP*, *GC\_FORMAT\_BYTE*, *GC\_FORMAT\_NSC*, and *GC\_FORMAT\_SPECIAL*. These mnemonics, and no other values, should be used to supply values for *objImpl*, or to test its contents. However, the *gcio.c.ht* file also defines other mnemonics that can be used in other contexts related to object implementations, indexability, and invariance.

An object's implementation may restrict the number of its named instance variables (*namedSize*) and its indexed instance variables (*idxSize*), as contained in the object report header.

- ▶ If the object implementation is `GC_FORMAT_OOP`, the object can have both named and unnamed instance variables.
- ▶ If the object implementation is `GC_FORMAT_BYTE`, the object can only have indexed instance variables, and its *namedSize* is always zero.
- ▶ If the object implementation is `GC_FORMAT_NSC`, the object can have both named and unnamed instance variables. (The NSC's *idxSize* reports the number of unnamed instance variables, even though they are unordered, not indexed.)
- ▶ If the object implementation is `GC_FORMAT_SPECIAL`, the object cannot have any instance variables, and the number of both its named and unnamed variables is always zero.

**Table 6.1 Object Implementation Restrictions on Instance Variables**

| Object Implementation | Named Instance Variables OK? | Unnamed Instance Variables OK? |
|-----------------------|------------------------------|--------------------------------|
| 0=Pointer             | YES                          | YES (always indexed)           |
| 1=Byte                | NO                           | YES (always indexed)           |
| 2=NSC                 | YES                          | YES (always unordered)         |
| 3=Special             | NO                           | NO                             |

For more information about object implementation types, see "Structural Access to Objects" on page 30.

## Store Traversal Arguments - GciStoreTravDoArgsSType

**GciStoreTravDoArgsSType** holds traversal arguments, and is described in `$GEMSTONE/include/gcicmn.ht`. It contains the following fields:

|                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GciTravBufType* | <i>storeTravBuff</i>  | The traversal buffer. For details, see “Traversal Buffer - GciTravBufType” on page 78.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| int             | <i>storeTravFlags</i> | <p>Flag bits that determines how the objects should be handled.</p> <p>GCI_STORE_TRAV_DEFAULT = 0<br/>           Default behavior: use "add" semantics for varying instvars of Nsc's; if object to be stored into does not exist, give error.</p> <p>GCI_STORE_TRAV_NSC_REP = 0x1,<br/>           Use REPLACE semantics for varying instvars of NSCs.</p> <p>GCI_STORE_TRAV_CREATE = 0x2<br/>           If an object to be stored into does not exist, create the new object and add it to the PureExportSet .</p> <p>GCI_STORE_TRAV_FINISH_UPDATES = 0x8<br/>           After processing the last object report in the traversal buffer, execute GciProcessDeferredUpdates.</p> <p>GCI_STORE_TRAV_SWIZZLE_IN_PLACE = 0x10<br/>           if swizzling by the client is being done for transmit to a server with opposite byte order, this flag says it is ok to swizzle the caller's buffer in place before transmitting. Reduces client memory access footprint of a large store traversal</p> |
| int             | <i>doPerform</i>      | <ul style="list-style-type: none"> <li>▶ If this field is 0, this function executes a string using <i>args-&gt;u.executestr</i>, with the semantics of “GciExecute” on page 153.</li> <li>▶ If this field is 1, then executes a perform using <i>args-&gt;u.perform</i>, with the semantics of “GciPerform” on page 307.</li> <li>▶ If this field is 2, execute a string that is the source code for a Smalltalk block using <i>stdArgs-&gt;u.executestr</i>, passing the block arguments in <i>execBlock_args</i>.</li> <li>▶ If this field is 3, perform no server Smalltalk execution, but traverse the object specified in <i>stdArgs-&gt;u.perform.receiver</i> as if it was the results of execution.</li> <li>▶ If this field is 4, resume execution of a suspended Smalltalk Process using <i>stdArgs-&gt;u.continueArgs</i>, with the semantics of “GciContinueWith” on page 123.</li> </ul>                                                                                            |

|          |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| int      | <i>doFlags</i>          | Flags to disable or permit asynchronous events and debugging in Smalltalk. These flags apply whatever the value of <i>doPerform</i> . <ul style="list-style-type: none"> <li>▶ 0 (default) disables the debugger during execution.</li> <li>▶ <code>GCI_PERFORM_FLAG_ENABLE_DEBUG = 1</code> allows debugging, making this function behave like <code>GciPerform</code>.</li> <li>▶ <code>GCI_PERFORM_FLAG_DISABLE_ASYNC_EVENTS = 2</code> disables asynchronous events.</li> <li>▶ <code>GCI_PERFORM_FLAG_SINGLE_STEP = 3</code> places a single-step breakpoint at the start of the method to be performed, and then executes to hit that breakpoint.</li> </ul> |
| union    | <i>u</i>                | One of three structures containing appropriate input fields for the specified operation. <ul style="list-style-type: none"> <li>▶ The structure <i>u.perform</i> should be used when <i>doPerform</i> is set to 1 or 3,</li> <li>▶ <i>u.executestr</i> should be used when <i>doPerform</i> is set to 0 or 2</li> <li>▶ <i>u.continueArgs</i> should be used when <i>doPerform</i> is set to 4.</li> </ul> For more information on these structs and how to use them, see <code>gcicmn.ht</code> .                                                                                                                                                                 |
| OopType* | <i>alteredTheOops</i>   | An array allocating memory for OOPs of objects that will be modified as a consequence of executing the specified code.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| int      | <i>alteredNumOops</i>   | The number of OOPs in <i>alteredTheOops</i> . On input, the caller must set this to the maximum number of OOPs that will fit in <i>alteredTheOops</i> . Upon completion, this field indicates the number of OOPs actually written to <i>alteredTheOops</i> .                                                                                                                                                                                                                                                                                                                                                                                                       |
| BoolType | <i>alteredCompleted</i> | Upon output, TRUE if the <i>alteredTheOops</i> contains the complete set of objects modified as a result of executing the specified code; false otherwise. If FALSE, call <b>GciAlteredObjs</b> for the rest of the modified objects.                                                                                                                                                                                                                                                                                                                                                                                                                              |

*perform* has the following fields:

|                |                 |                                                      |
|----------------|-----------------|------------------------------------------------------|
| OopType        | <i>receiver</i> |                                                      |
| char           | <i>pad[24]</i>  | Make later elements same offset as <i>executestr</i> |
| const char*    | <i>selector</i> | 1 byte per character                                 |
| const OopType* | <i>args</i>     |                                                      |

|        |                      |  |
|--------|----------------------|--|
| int    | <i>numArgs</i>       |  |
| ushort | <i>environmentId</i> |  |

*executeStr* has the following fields:

|                |                      |                                                 |
|----------------|----------------------|-------------------------------------------------|
| OopType        | <i>contextObject</i> |                                                 |
| OopType        | <i>sourceClass</i>   | String, Utf8 or Unicode7 or DoubleByteString    |
| OopType        | <i>symbolList</i>    |                                                 |
| int64          | <i>sourceSize</i>    |                                                 |
| const char*    | <i>source</i>        | 1 or 2 bytes per char, client-native byte order |
| const OopType* | <i>args</i>          | ignored unless ExecuteBlock                     |
| int            | <i>numArgs</i>       | ignored unless ExecuteBlock                     |
| ushort         | <i>environmentId</i> |                                                 |

*continueArgs* has the following fields:

|         |                          |  |
|---------|--------------------------|--|
| OopType | <i>process</i>           |  |
| OopType | <i>replaceTopOfStack</i> |  |

## Clamped Traversal Arguments - GciClampedTravArgsSType

GciClampedTravArgsSType holds the arguments for clamped traversal, and includes the following fields:

|         |                  |                                                                                                                                                                                                                                                                                                                        |
|---------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| OopType | <i>clampSpec</i> | The OOP of the Smalltalk ClampSpecification to be used, or OOP_NIL, if the traversal is to operate without clamping.                                                                                                                                                                                                   |
| int     | <i>level</i>     | Maximum traversal depth. When the level is 1, an object report is written to the traversal buffer for each element in theOops. When the level is 2, an object report is also obtained for the instance variables of each level-1 object. When the level is 0, the number of levels in the traversal is not restricted. |

|                  |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GciTravBufType * | <i>travBuff</i>       | A pointer to the traversal buffer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| int              | <i>retrievalFlags</i> | <p>The value of retrievalFlags should be given by using the following mnemonics:</p> <p>GCI_RETRIEVE_DEFAULT and GCI_RETRIEVE_EXPORT Causes results to automatically be added to an export set using GciSaveObjs semantics.</p> <p>GCI_CLEAR_EXPORT Causes traverse to clear the export set using GciReleaseAllOops before filling traversal buffer.</p> <p>GCI_COMPRESS_TRAV Compress traversal buffers before transmissions between gem and rpc gci client, including the store traversal of this call, and any GciMoreTraversal calls used to finish this call.</p> <p>GCI_NOKILL_TRAV Start a traversal that will allow other GCI calls to precede GciMoreTraversal calls that are part of this traversal. Only the start of another traversal will kill this traversal.</p> <p>GCI_TRAV_REFS_EXCLUDE_RESULT_OBJ Exclude execution result * from the traversal result.</p> <p>GCI_TRAV_REFS_EXCLUDE_EXPORTED_RESULT_OBJ Only give report for execution result if not already exported. Has no effect if GCI_TRAV_REFS_EXCLUDE_RESULT_OBJ is set..</p> |

## Traversal Buffer - GciTravBufType

The C++ class **GciTravBufType** describes a traversal buffer, and defines the following fields:

|          |                       |                                                                                                                                   |
|----------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| uint     | <i>allocatedBytes</i> | The allocated size of the body.                                                                                                   |
| uint     | <i>usedBytes</i>      | The used bytes of the body.                                                                                                       |
| ByteType | <i>body[8]</i>        | The actual body size is variable, with a minimum of GCI_MIN_TRAV_BUFF_SIZE. Maximum size is 4GB, or, if compression is used, 2GB. |

To create a new instance of GciTravBufType, use the function **GciAllocTravBuf** (page 98).

## Functions

The traversal buffer class **GciTravBufType** provides these functions:

```
GciObjRepSType* firstReport();
```

Returns a pointer to the first object report in the buffer.

```
GciObjRepSType* readLimit();
```

Used when reading object reports out of a buffer. Returns a pointer past the end of last object report in the buffer. If `readLimit()==firstReport()`, the buffer is empty.

`GciObjRepSType* writeLimit();`  
 Used when composing a buffer. Returns a pointer one byte past the end of the allocated buffer.

`GciObjRepHdrSType* firstReportHdr();`  
 Returns a pointer to the first object report in the buffer.

`GciObjRepHdrSType* readLimitHdr();`  
 Used when reading object reports out of a buffer. Returns a pointer past the end of last object report in the buffer.

`GciObjRepHdrSType* writeLimitHdr();`  
 Used when composing a buffer. Returns a pointer one byte past the end of the allocated buffer.

## User Action Information Structure - `GciUserActionSType`

The structured type `GciUserActionSType` describes a user action function. It defines the following fields:

|                                 |                                                    |                                                                                                                                           |
|---------------------------------|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| char                            | <code>userActionName[GCI_MAX_ACTION_NAME+1]</code> | The user action name (a case-insensitive, null-terminated string). In this release, <code>GCI_MAX_ACTION_NAME</code> is defined to be 31. |
| int                             | <code>userActionNumArgs</code>                     | The number of arguments in the C function.                                                                                                |
| <code>GciUserActionFType</code> | <code>userAction</code>                            | A pointer to the C user action function.                                                                                                  |
| unsigned int                    | <code>userActionFlags</code>                       | For internal use.                                                                                                                         |





# GemBuilder C Function Reference

This chapter describes the GemBuilder functions that may be called by your C application program.

## 7.1 Function Summary Tables

Tables 7.1 through 7.10 summarize the GemBuilder C functions and the services that they provide to your application.

**Table 7.1 Functions for Controlling Sessions and Transactions**

|                           |                                                                            |
|---------------------------|----------------------------------------------------------------------------|
| GciAbort,<br>GciNbAbort   | Abort the current transaction.                                             |
| GciBegin,<br>GciNbBegin   | Begin a new transaction.                                                   |
| GciCommit,<br>GciNbCommit | Write the current transaction to the database.                             |
| GciDeclareAction          | An alternative way to associate a C function with a Smalltalk user action. |
| GciEncrypt                | Encrypt a password string.                                                 |
| GciGetSessionId           | Find the ID number of the current user session.                            |
| GciInit                   | Initialize GemBuilder.                                                     |
| GciInitAppName            | Override the default application configuration file name.                  |
| GciInstallUserAction      | Associate a C function with a Smalltalk user action.                       |
| GciIsRemote               | Determine whether the application is running linked or remotely.           |
| GciLoadUserActionLibrary  | Load an application user action library.                                   |

**Table 7.1 Functions for Controlling Sessions and Transactions (Continued)**

|                                          |                                                                                 |
|------------------------------------------|---------------------------------------------------------------------------------|
| GciLogin,<br>GciLoginEx,<br>GciNbLoginEx | Start a user session.                                                           |
| GciLogout                                | End the current user session.                                                   |
| GciNbEnd,<br>GciNbEndPoll                | Test the status of nonblocking call in progress for completion.                 |
| GciProcessDeferredUpdates_               | Process deferred updates to objects that do not allow direct structural update. |
| GciRtlIsLoaded                           | Report whether a GemBuilder library is loaded.                                  |
| GciRtlLoad                               | Load a GemBuilder library.                                                      |
| GciRtlUnload                             | Unload a GemBuilder library.                                                    |
| GciServerIsBigEndian                     | Determine whether or not the server process is big-endian.                      |
| GciSessionIsRemote                       | Determine whether or not the current session is using a Gem on another machine. |
| GciSetCacheName_                         | Set the name that a linked application will be known by in the shared cache.    |
| GciSetNet,<br>GciSetNetEx                | Set network parameters for connecting the user to the Gem and Stone processes.  |
| GciSetSessionId                          | Set an active session to be the current one.                                    |
| GciShutdown                              | Logout from all sessions and deactivate GemBuilder.                             |
| GciUserActionInit                        | Declare user actions for GemStone.                                              |
| GciUserActionShutdown                    | Enable user-defined clean-up for user actions.                                  |

**Table 7.2 Functions for Handling Errors and Interrupts and for Debugging**

|                                      |                                                                                                     |
|--------------------------------------|-----------------------------------------------------------------------------------------------------|
| GciCallInProgress                    | Determine if a GemBuilder call is currently in progress.                                            |
| GciClearStack                        | Clear the Smalltalk call stack.                                                                     |
| GciContinue,<br>GciNbContinue        | Continue code execution in GemStone after an error.                                                 |
| GciContinueWith<br>GciNbContinueWith | Continue code execution in GemStone after an error.                                                 |
| GciDbgEstablish                      | Specify the debugging function for GemBuilder to execute before most calls to GemBuilder functions. |
| GciDbgEstablishToFile                | Write trace information for most GemBuilder functions to a file.                                    |
| GciDbgLogString                      | Pass a message to a trace function.                                                                 |
| GciEnableSignaledErrors              | Establish or remove GemBuilder visibility to signaled errors from GemStone.                         |

**Table 7.2 Functions for Handling Errors and Interrupts and for Debugging**

|                   |                                                                                                 |
|-------------------|-------------------------------------------------------------------------------------------------|
| GciErr            | Prepare a report describing the most recent GemBuilder error.                                   |
| GciInUserAction   | Determine whether or not the current process is executing a user action.                        |
| GciHardBreak      | Interrupt GemStone and abort the current transaction.                                           |
| GciLongJmp        | Provides equivalent functionality to the corresponding longjmp() or _longjmp() function.        |
| GciPollForSignal  | Poll GemStone for signal errors without executing any Smalltalk methods.                        |
| GciPopErrJump     | Discard a previously saved error jump buffer.                                                   |
| GciPushErrJump    | Associate GemBuilder error handling with a jump buffer by pushing a jump buffer onto the stack. |
| GciRaiseException | Signal an error, synchronously, within a user action.                                           |
| GciSetErrJump     | Enable or disable the current error handler.                                                    |
| GciSetHaltOnError | Halt the current session when a specified error occurs.                                         |
| Gci_SETJMP        | (MACRO) Save a jump buffer in GemBuilder's error jump stack.                                    |
| GciSoftBreak      | Interrupt the execution of Smalltalk code, but permit it to be restarted.                       |
| GciStep           | Continue code execution in GemStone with specified single-step semantics.                       |

**Table 7.3 Functions for Managing Object Bitmaps**

|                         |                                                                                                                                                          |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| GciAlteredObjs          | Find all exported or dirty objects that have changed and are therefore in the ExportedDirtyObjs or TrackedDirtyObjs sets.                                |
| GciDirtyExportedObjs    | Find all objects in the ExportedDirtyObjs set.                                                                                                           |
| GciDirtyObjsInit        | Begin tracking which objects in the session workspace change.                                                                                            |
| GciDirtySaveObjs        | Find all exported or tracked objects that have changed and are therefore in the ExportedDirtyObjs or TrackedDirtyObjs sets.                              |
| GciDirtyTrackedObjs     | Find all tracked objects that have changed and are therefore in the TrackedDirtyObjs set.                                                                |
| GciHiddenSetIncludesOop | Determines whether the given OOP is present in the specified hidden set.                                                                                 |
| GciReleaseAllGlobalOops | Remove all OOPS from the PureExportSet, making these objects eligible for garbage collection.                                                            |
| GciReleaseAllOops       | Remove all OOPS from the PureExportSet, or if in a user action, from the user action's export set, making these objects eligible for garbage collection. |

**Table 7.3 Functions for Managing Object Bitmaps (Continued)**

|                              |                                                                                                                                                                              |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GciReleaseAllTrackedObjects  | Clear the GciTrackedObjs set, making all tracked OOPs eligible for garbage collection.                                                                                       |
| GciReleaseGlobalObjs         | Remove an array of GemStone OOPs from the PureExportSet, making them eligible for garbage collection.                                                                        |
| GciReleaseObjs               | Remove an array of GemStone OOPs from the PureExportSet, or if in a user action, remove them from the user action's export set, making them eligible for garbage collection. |
| GciReleaseTrackedObjs        | Remove an array of OOPs from the GciTrackedObjs set, making them eligible for garbage collection.                                                                            |
| GciSaveAndTrackObjs          | Add objects to GemStone's internal GciTrackedObjs set to prevent them from being garbage collected.                                                                          |
| GciSaveGlobalObjs            | Add an array of OOPs to the PureExportSet, making them ineligible for garbage collection.                                                                                    |
| GciSaveObjs                  | Add an array of OOPs to the PureExportSet, or if in a user action to the user action's export set, making them ineligible for garbage collection.                            |
| GciTrackedObjsFetchAll-Dirty | Find all exported or tracked objects that have changed and are therefore in the ExportedDirtyObjs or TrackedDirtyObjs sets.                                                  |
| GciTrackedObjsInit           | Reinitialize the set of tracked objects maintained by GemStone.                                                                                                              |

**Table 7.4 Functions for Compiling and Executing Smalltalk Code in the Database**

|                                                                   |                                                                                                                     |
|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| GciClassMethodForClass                                            | Compile a class method for a class.                                                                                 |
| GciClassRemoveAll-Methods                                         | Remove all methods from the method dictionary of a class.                                                           |
| GciCompileMethod                                                  | Compile a method.                                                                                                   |
| GciExecute,<br>GciNbExecute                                       | Execute a Smalltalk expression contained in a GemStone String or Utf8 object.                                       |
| GciExecuteFromContext                                             | Execute a Smalltalk expression contained in a String or Utf8 object as if it were a message sent to another object. |
| GciExecuteStr,<br>GciNbExecuteStr                                 | Execute a Smalltalk expression contained in a C string.                                                             |
| GciExecuteStrFetchBytes,<br>GciNbExecuteStrFetch-Bytes            | Execute a Smalltalk expression contained in a C string, returning byte-format results.                              |
| GciExecuteStrFromCon-<br>text,<br>GciNbExecuteStrFromCon-<br>text | Execute a Smalltalk expression contained in a C string as if it were a message sent to an object.                   |

**Table 7.4 Functions for Compiling and Executing Smalltalk Code in the Database**

|                                           |                                                                                     |
|-------------------------------------------|-------------------------------------------------------------------------------------|
| GciInstMethodForClass                     | Compile an instance method for a class.                                             |
| GciPerform,<br>GciNbPerform               | Send a message to a GemStone object.                                                |
| GciPerformNoDebug,<br>GciNbPerformNoDebug | Send a message to a GemStone object, and temporarily disable debugging.             |
| GciPerformSymDbg                          | Send a message to a GemStone object, using a String object as a selector.           |
| GciPerformTraverse                        | First send a message to a GemStone object, then traverse the result of the message. |

**Table 7.5 Functions for Accessing Symbol Dictionaries**

|                                |                                                                                                                                           |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| GciResolveSymbol               | Find the OOP of the object to which a symbol name C string refers, in the context of the current session's user profile.                  |
| GciResolveSymbolObj            | Find the OOP of the object to which a symbol name String or MultiByteString refers, in the context of the current session's user profile. |
| GciStrKeyValueDictAt           | Find the value in a symbol KeyValue dictionary at the corresponding string key.                                                           |
| GciStrKeyValueDictAt<br>Obj    | Find the value in a symbol KeyValue dictionary at the corresponding object key.                                                           |
| GciStrKeyValueDictAt<br>ObjPut | Store a value into a symbol KeyValue dictionary at the corresponding object key.                                                          |
| GciStrKeyValueDictAtP<br>ut    | Store a value into a symbol KeyValue dictionary at the corresponding string key.                                                          |
| GciSymDictAt                   | Find the value in a symbol dictionary at the corresponding string key.                                                                    |
| GciSymDictAtObj                | Find the value in a symbol dictionary corresponding to the key object.                                                                    |
| GciSymDictAtObjPut             | Store a value into a symbol dictionary at the corresponding object key.                                                                   |
| GciSymDictAtPut                | Store a value into a symbol dictionary at the corresponding string key.                                                                   |
| GciTraverseObjs                | Traverse an array of GemStone objects.                                                                                                    |

**Table 7.6 Functions for Creating and Initializing Objects**

|                  |                                     |
|------------------|-------------------------------------|
| GciCreateByteObj | Create a new byte-format object.    |
| GciCreateOopObj  | Create a new pointer-format object. |
| GciGetFreeOop    | Allocate an OOP.                    |
| GciGetFreeOops   | Allocate multiple OOPs.             |

**Table 7.6 Functions for Creating and Initializing Objects (Continued)**

|                         |                                                                             |
|-------------------------|-----------------------------------------------------------------------------|
| GciGetFreeOopsEncoded   | Allocate multiple OOPs.                                                     |
| GciNewByteObj           | Create and initialize a new byte object.                                    |
| GciNewCharObj           | Create and initialize a new character object.                               |
| GciNewDateTime          | Create and initialize a new instance of DateTime or a subclass of DateTime. |
| GciNewDateAndTime       | Create and initialize a new instance of DateAndTime.                        |
| GciNewDateAndTimePosix  | Create and initialize a new instance of DateAndTime.                        |
| GciNewOop               | Create a new GemStone object.                                               |
| GciNewOops              | Create multiple new GemStone objects.                                       |
| GciNewOopUsingObjReport | Create a new GemStone object from an existing object report.                |
| GciNewString            | Create a new String object from a C character string.                       |
| GciNewSymbol            | Create a new Symbol object from a C character string.                       |
| GciNewUtf8String        | Create a new Unicode string object from a UTF-8 encoded C character string. |

**Table 7.7 Functions and Macros for Testing and Converting Objects and Values**

|                          |                                                                                                |
|--------------------------|------------------------------------------------------------------------------------------------|
| GCL_BOOL_TO_OOP          | (MACRO) Convert a C Boolean value to a GemStone Boolean object.                                |
| GciByteArrayToPointer    | Given a result from GciPointerToByteArray, return a C pointer.                                 |
| GCL_CHR_TO_OOP           | (MACRO) Convert a 32 bit C character value to a GemStone Character object.                     |
| GciCTimeToDateTime       | Convert a C date-time representation to the equivalent GemStone representation.                |
| GciDateTimeToCTime       | Convert a GemStone date-time representation to the equivalent C representation.                |
| Gci_doubleToSmallDouble  | Convert a C double to a SmallDouble object.                                                    |
| GciFetchDateTime         | Convert the contents of a DateTime object and place the results in a C structure.              |
| GciFetchDateAndTime      | Convert the contents of a DateAndTime object and place the results in a C structure.           |
| GciFetchDateAndTimePosix | Convert the contents of a DateAndTime object and place the results in a C structure.           |
| GciFetchUtf8Bytes_       | Encode a String, MultiByteString, or Uft8 as UTF-8, and fetch the bytes of the encoded result. |
| GciFloatKind             | Obtain the float kind corresponding to a C double value.                                       |

**Table 7.7 Functions and Macros for Testing and Converting Objects and Values**

|                               |                                                                                             |
|-------------------------------|---------------------------------------------------------------------------------------------|
| GciFltToOop                   | Convert a C double value to a SmallDouble or Float object.                                  |
| GCI_I64_IS_SMALL_INT          | (MACRO) Determine whether or not a 64-bit C integer is in the SmallInteger range.           |
| GciI32ToOop                   | Convert a C 32-bit integer value to a GemStone object.                                      |
| GciI64ToOop                   | Convert a C 64-bit integer value to a GemStone object.                                      |
| GCI_OOP_IS_BOOL               | (MACRO) Determine whether or not a GemStone object represents a GemStone Smalltalk Boolean. |
| GCI_OOP_IS_CHAR               | (MACRO) Determine whether or not a GemStone object represents a Character.                  |
| GCI_OOP_IS_SmallDate          | (MACRO) Determine whether or not a GemStone object represents a SmallDate.                  |
| GCI_OOP_IS_SmallDateAndTime   | (MACRO) Determine whether or not a GemStone object represents a SmallDateAndTime.           |
| GCI_OOP_IS_SMALL_DOUBLE       | (MACRO) Determine whether or not a GemStone object represents a SmallDouble.                |
| GCI_OOP_IS_SMALL_FRACTION     | (MACRO) Determine whether or not a GemStone object represents a SmallFraction.              |
| GCI_OOP_IS_SMALL_INT          | (MACRO) Determine whether or not a GemStone object represents a SmallInteger.               |
| GCI_OOP_IS_SmallScaledDecimal | (MACRO) Determine whether or not a GemStone object represents a SmallScaledDecimal.         |
| GCI_OOP_IS_SmallTime          | (MACRO) Determine whether or not a GemStone object represents a SmallTime.                  |
| GCI_OOP_IS_SPECIAL            | (MACRO) Determine whether or not a GemStone object has a special representation.            |
| GciOopToBool                  | Convert a Boolean object to a C Boolean value.                                              |
| GCI_OOP_TO_BOOL               | (MACRO) Convert a Boolean object to a C Boolean value.                                      |
| GciOopToChar16                | Convert a Character object to a 16-bit C character value.                                   |
| GciOopToChar32                | Convert a Character object to a 32-bit C character value.                                   |
| GciOopToChr                   | Convert a Character object to a C character value.                                          |
| GCI_OOP_TO_CHR                | (MACRO) Convert a Character object to a C character value.                                  |
| GciOopToFlt                   | Convert a SmallDouble, Float, or SmallFloat object to a C double.                           |
| GciOopToI32                   | Convert a GemStone object to a C 32-bit integer value.                                      |
| GciOopToI64                   | Convert a GemStone object to a C 64-bit integer value.                                      |
| GciPointerToByteArray         | Given a C pointer, return a SmallInteger or ByteArray containing the value of the pointer.  |

**Table 7.7 Functions and Macros for Testing and Converting Objects and Values**

|                    |                                                                       |
|--------------------|-----------------------------------------------------------------------|
| GciStringToInteger | Convert a C string to a GemStone SmallInteger or LargeInteger object. |
|--------------------|-----------------------------------------------------------------------|

**Table 7.8 Object Traversal and Path Functions and Macros**

|                                                          |                                                                                                                                                                                                                  |
|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GCI_ALIGN                                                | (MACRO) Align an address to a word boundary.                                                                                                                                                                     |
| GciClampedTrav,<br>GciNbClampedTrav                      | Traverse an array of objects, subject to clamps.                                                                                                                                                                 |
| GciExecuteStrTrav,<br>GciNbExecuteStrTrav                | Execute a string and traverse the result of the execution.                                                                                                                                                       |
| GciFetchPaths                                            | Fetch selected multiple OOPs from an object tree.                                                                                                                                                                |
| GciFindObjRep                                            | Fetch an object report in a traversal buffer.                                                                                                                                                                    |
| GciMoreTraversal,<br>GciNbMoreTraversal                  | Continue object traversal, reusing a given buffer.                                                                                                                                                               |
| GciObjRepSize_                                           | Find the number of bytes in an object report.                                                                                                                                                                    |
| GciPerformTrav<br>GciNbPerformTrav                       | First send a message to a GemStone object, then traverse the result of the message.                                                                                                                              |
| GciPerformTraverse                                       | First send a message to a GemStone object, then traverse the result of the message.                                                                                                                              |
| GciSetTraversalBufSwizzli<br>ng                          | Control swizzling of the traversal buffers.                                                                                                                                                                      |
| GciStorePaths                                            | Store selected multiple OOPs into an object tree.                                                                                                                                                                |
| GciStoreTrav<br>GciNbStoreTrav                           | Store multiple traversal buffer values in objects.                                                                                                                                                               |
| GciStoreTravDo_<br>GciNbStoreTravDo_                     | Store multiple traversal buffer values in objects, execute the specified code, and return the resulting object.                                                                                                  |
| GciStoreTravDoTrav_<br>GciNbStoreTravDoTrav_             | Combine in a single function the calls to GciStoreTravDo_ and GciClampedTrav, to store multiple traversal buffer values in objects, execute specified code, and traverse the result object.                      |
| GciStoreTravDoTravRefs_<br>GciNbStoreTravDoTravRef<br>s_ | Combine in a single function modifications to session sets, traversal of objects to the server, optional Smalltalk execution, and traversal to the client of changed objects and (optionally) the result object. |
| GciTraverseObjs,<br>GciNbTraverseObjs                    | Traverse an array of GemStone objects.                                                                                                                                                                           |

**CAUTION**

*Exercise caution when using the following structural access functions. Although they can improve the speed of GemStone database operations, these functions bypass GemStone's message-sending metaphor. That is, structural access functions may bypass any checking that might be coded into your application's methods. In using structural access functions, you implicitly assume full responsibility for safeguarding the integrity of your system.*



*Note, however, that structural access functions do not bypass checks on authorization violations or concurrency conflicts.*

**Table 7.9 Structural Access Functions and Macros**

|                      |                                                                                                   |
|----------------------|---------------------------------------------------------------------------------------------------|
| GciAddOopToNsc       | Add an OOP to the unordered variables of a nonsequenceable collection.                            |
| GciAddOopsToNsc      | Add multiple OOPs to the unordered variables of a nonsequenceable collection.                     |
| GciAppendBytes       | Append bytes to a byte object.                                                                    |
| GciAppendChars       | Append a C string to a byte object.                                                               |
| GciAppendOops        | Append OOPs to the unnamed variables of a collection.                                             |
| GciClassNamedSize    | Find the number of named instance variables in a class.                                           |
| GciFetchByte         | Fetch one byte from an indexed byte object.                                                       |
| GciFetchBytes_       | Fetch multiple bytes from an indexed byte object.                                                 |
| GciFetchChars_       | Fetch multiple ASCII characters from an indexed byte object.                                      |
| GciFetchClass        | Fetch the class of an object.                                                                     |
| GciFetchNamedOop     | Fetch the OOP of one of an object's named instance variables.                                     |
| GciFetchNamedOops    | Fetch the OOPs of one or more of an object's named instance variables.                            |
| GciFetchNamedSize    | Fetch the number of named instance variables in an object.                                        |
| GciFetchNameOfClass  | Fetch the class name object for a given class.                                                    |
| GciFetchObjImpl      | Fetch the implementation of an object.                                                            |
| GciFetchOop          | Fetch the OOP of one instance variable of an object.                                              |
| GciFetchOops         | Fetch the OOPs of one or more instance variables of an object.                                    |
| GciFetchSize_        | Fetch the size of an object.                                                                      |
| GciFetchVaryingOop   | Fetch the OOP of one unnamed instance variable from an indexable pointer object or NSC.           |
| GciFetchVaryingOops  | Fetch the OOPs of one or more unnamed instance variables from an indexable pointer object or NSC. |
| GciFetchVaryingSize_ | Fetch the number of unnamed instance variables in a pointer object or NSC.                        |
| GciIsKindOf          | Determine whether or not an object is some kind of a given class or class history.                |
| GciIsKindOfClass     | Determine whether or not an object is some kind of a given class.                                 |
| GciIsSubclassOf      | Determine whether or not a class is a subclass of a given class or class history.                 |
| GciIsSubclassOfClass | Determine whether or not a class is a subclass of a given class.                                  |

**Table 7.9 Structural Access Functions and Macros (Continued)**

|                         |                                                                                     |
|-------------------------|-------------------------------------------------------------------------------------|
| GciLvNameToIdx          | Fetch the index of an instance variable name.                                       |
| GciNscIncludesOop       | Determines whether the given OOP is present in the specified unordered collection.  |
| GciObjExists            | Determine whether or not a GemStone object exists.                                  |
| GciObjInCollection      | Determine whether or not a GemStone object is in a Collection.                      |
| GciObjIsCommitted       | Determine whether or not an object is committed.                                    |
| GciRemoveOopFromNsc     | Remove an OOP from an NSC.                                                          |
| GciRemoveOopsFromNsc    | Remove one or more OOPs from an NSC.                                                |
| GciReplaceOops          | Replace all instance variables in a GemStone object.                                |
| GciReplaceVaryingOops   | Replace all unnamed instance variables in an NSC object.                            |
| GciSetVaryingSize       | Set the size of a collection.                                                       |
| GciStoreByte            | Store one byte in a byte object.                                                    |
| GciStoreBytes           | (MACRO) Store multiple bytes in a byte object.                                      |
| GciStoreBytesInstanceOf | Store multiple bytes in a byte object.                                              |
| GciStoreChars           | Store multiple ASCII characters in a byte object.                                   |
| GciStoreIdxOop          | Store one OOP in an indexable pointer object's unnamed instance variable.           |
| GciStoreIdxOops         | Store one or more OOPs in an indexable pointer object's unnamed instance variables. |
| GciStoreNamedOop        | Store one OOP into an object's named instance variable.                             |
| GciStoreNamedOops       | Store one or more OOPs into an object's named instance variables.                   |
| GciStoreOop             | Store one OOP into an object's instance variable.                                   |
| GciStoreOops            | Store one or more OOPs into an object's instance variables.                         |

**Table 7.10 Utility Functions**

|                          |                                                                               |
|--------------------------|-------------------------------------------------------------------------------|
| GciAll7Bit               | Determine if a String contains only 7-bit ASCII characters.                   |
| GciCompress              | Compress the supplied data, which can be uncompressed with GciUncompress.     |
| GciDecodeOopArray        | Decode an OOP array that was previously run-length encoded.                   |
| GciDecSharedCounter      | Decrement the value of a shared counter.                                      |
| GciEnableFreeOopEncoding | Enable encoding of free OOPs sent between the client and the RPC Gem.         |
| GciEnableFullCompression | Enable full compression between the client and the RPC version of GemBuilder. |
| GciEncodeOopArray        | Encode an array of OOPs, using run-length encoding.                           |

Table 7.10 Utility Functions (Continued)

|                                   |                                                                                               |
|-----------------------------------|-----------------------------------------------------------------------------------------------|
| GciFetchNumEncodedOoops           | Obtain the size of an encoded OOP array.                                                      |
| GciFetchNumSharedCounters         | Obtain the number of shared counters available on the shared page cache used by this session. |
| GciFetchSharedCounterValuesNoLock | Fetch the value of multiple shared counters without locking them.                             |
| GciIncSharedCounter               | Increment the value of a shared counter.                                                      |
| GciProduct                        | Return an 8-bit unsigned integer that indicates the GemStone/S product.                       |
| GciReadSharedCounter              | Lock and fetch the value of a shared counter.                                                 |
| GciReadSharedCounterNoLock        | Fetch the value of a shared counter without locking it.                                       |
| GciSetSharedCounter               | Set the value of a shared counter.                                                            |
| GciUncompress                     | Uncompress the supplied data, assumed to have been compressed with GciCompress.               |
| GciVersion                        | Return a string that describes the GemBuilder version.                                        |

## 7.2 Executing the examples

The following topaz input defines classes and objects that are used in some of the examples for functions.

```
run
Array subclass: #Account
  instVarNames: #( #id #customer #salesRep) inDictionary: UserGlobals.
Object subclass: #Customer
  instVarNames: #( #name #address) inDictionary: UserGlobals.
Object subclass: #Address
  instVarNames: #( #street #city #state) inDictionary: UserGlobals.
%

run
Account compileMissingAccessingMethods.
Customer compileMissingAccessingMethods.
Address compileMissingAccessingMethods.
%

method: Address
asString
^ self street, ' ', self city, ', ', self state
%
method: Customer
asString
^ self name, ', ', self address asString.
```

```
%
method: Account
asString
^'Account ', self id asString, ' for ', self customer asString
%

run
UserGlobals at: #AllAccounts put: IdentityBag new.
%

run
| createBlk |
createBlk := [:data | | addr cust acct |
  addr := Address new street: (data at: 2); city: (data at: 3);
  state: (data at: 4); yourself.
  cust := Customer new name: (data at: 1); address: addr;
  yourself.
  acct := Account new id: (data at: 5); customer: cust;
  salesRep: (data at: 6); yourself.
  acct addAll: (data at: 6).
  acct].
{
{'Sam Houston' . '2321 Walnut Dr' . 'Myrtle Point' .
 'OR' . 7212. 'Mark Rabinowitz'. { 'GS64' . 'GBS/VA'} } .
{'Maya Johnson' . '12 Main Str' . 'Ashland' . 'OR' .
 2323. 'Mark Rabinowitz' . {'GS64' . 'GBS/VW' . 'GemConnect'}} .
{'Mario Harar' . '12 N. First Str' . 'Washougal' . 'WA' .
 10073. 'Linda Waffle'. { 'GS64' } } }
do:
  [:dataArr | AllAccounts add: (createBlk value: dataArr)].
System commitTransaction.
%
```

# GciAbort

Abort the current transaction.

## Syntax

```
void GciAbort()
```

## Description

This function causes the GemStone system to abort the current transaction. All changes to persistent objects that were made since the last committed transaction are lost, and the application is connected to the most recent version of the database. Your application must fetch again from GemStone any changed persistent objects, to refresh the copies of these objects in your C program. Use the **GciDirtySaveObjs** function to determine which of the fetched objects were also changed.

This function has the same effect as issuing a hard break, or the function call `GciExecuteStr("System abortTransaction", OOP_NIL)`.

## See Also

[“Interrupting GemStone Execution”](#) on page 30

[GciCommit](#) on page 117

[GciNbAbort](#) on page 240

## GciAddOopToNsc

Add an OOP to the unordered variables of a nonsequenceable collection.

### Syntax

```
void GciAddOopToNsc(  
    OopType          theNsc,  
    OopType          theOop );
```

### Arguments

*theNsc* The OOP of the NSC from which to remove the object *theOop*.

*theOop* The OOPs to be added.

### Description

This function adds an OOP to the unordered variables of an NSC, using structural access.

### Example

```
OopType GciAddOopToNsc_example(void)  
{  
    // return an IdentityBag containing the SmallIntegers with value 0..99  
  
    OopType oNsc = GciNewOop(OOP_CLASS_IDENTITY_BAG);  
    for (int i = 0; i < 100; i ++ ) {  
        OopType oNum = GciI32ToOop(i);  
        GciAddOopToNsc(oNsc, oNum);  
    }  
    return oNsc;  
}
```

### See Also

[GciAddOopsToNsc](#) on page 95

[GciNscIncludesOop](#) on page 282

[GciRemoveOopFromNsc](#) on page 334

[GciRemoveOopsFromNsc](#) on page 335

## GciAddOopsToNsc

Add multiple OOPs to the unordered variables of a nonsequenceable collection.

### Syntax

```
void GciAddOopsToNsc(
    OopType          theNsc,
    const OopType    theOops[],
    int              numOops );
```

### Arguments

*theNsc* The OOP of the NSC to which to add the OOPs.

*theOops* The array of OOPs to be added to the NSC.

*numOops* The number of OOPs to add.

### Description

This function adds multiple OOPs to the unordered variables of an NSC, using structural access.

### Example

```
OopType GciAddOopsToNsc_example(void)
{
    // return an IdentityBag containing the SmallIntegers with value 0..99

    enum { AddOopsToNsc_SIZE = 100 };

    OopType oNsc = GciNewOop(OOP_CLASS_IDENTITY_BAG);

    OopType values[AddOopsToNsc_SIZE];
    for (int i = 0; i < AddOopsToNsc_SIZE; i ++) {
        values[i] = GciI32ToOop(i);
    }
    GciAddOopsToNsc(oNsc, values, AddOopsToNsc_SIZE);
    return oNsc;
}
```

### See Also

[GciAddOopToNsc](#) on page 94  
[GciNscIncludesOop](#) on page 282  
[GciRemoveOopFromNsc](#) on page 334  
[GciRemoveOopsFromNsc](#) on page 335

## GCI\_ALIGN

(MACRO) Align an address to a word boundary.

### Syntax

```
uintptr_t * GCI_ALIGN(argument)
```

### Arguments

*argument* The pointer or integer to be aligned.

### Return Value

The first multiple of 8 that is greater than or equal to the input *argument*.

### Description

This macro can be used to round up a pointer or size to be a multiple of `sizeof(OopType)`.

Provided for compatibility. New code should use the accessor functions in `GciObjRepHdrSType`; see "Object Report Header - `GciObjRepHdrSType`" on page 71.



## GciAll7Bit

Determine if a String contains only 7-bit ASCII characters.

### Syntax

```
BoolType GciAll7Bit(  
    const char *          aString,  
    size_t *             stringLength);
```

### Arguments

*aString* A null-terminated string.

*stringLength* Returns the length of *aString*, computed by `strlen(aString)`.

### Return Value

Returns TRUE if each character in *aString* is in the 7-bit ASCII range, that is, a value  $\leq 127$ ; FALSE if any characters have values of 128 or higher.

### Description

The function **GciAll7Bit** is used to test if a String is in the ASCII range, which will not involve encoding to UTF-8 for storage.

### See Also

[GciFetchUtf8Bytes\\_](#) on page 196

## GciAllocTravBuf

Allocate and initialize a new GciTravBufType structure.

### Syntax

```
(GciTravBufType *) GciAllocTravBuf(  
    size_t          allocationSize);
```

### Arguments

*allocationSize* The size of the traversal buffer.

### Description

This function allocates and initializes a new GciTravBufType structure.

### See Also

“Traversal Buffer - GciTravBufType” on page 78

## GciAlteredObjs

Find all exported or dirty objects that have changed and are therefore in the ExportedDirtyObjs or TrackedDirtyObjs sets.

### Syntax

```
BoolType GciAlteredObjs(  
    OopType          theOops [ ],  
    int *            numOops );
```

### Arguments

- theOops* An array for the of OOPs of the objects in the ExportedDirtyObjs or TrackedDirtyObjs sets.
- numOops* Pointer to the maximum number of OOPs that can be returned in this call, that is, the size (in OOPs) of the buffer specified by *theOops*; on return, the number of actual OOPs in the *theOops* result.

### Return Value

The function result indicates whether all dirty objects have been returned. If the operation is not complete, **GciAlteredObjs** returns FALSE, and it is expected that the application will make repeated calls to this function until it returns TRUE, indicating that all of the dirty objects have been returned. If repeated calls are not made, then the unreturned objects persist in the list until the next time **GciAlteredObjs**, or another call that destructively accesses the ExportedDirtyObjs or TrackedDirtyObjs sets, is called.

### Description

Typically, a GemStone C application program caches some database objects in its local object space, generally in the PureExportSet or if in a user action, in the user action's export set (see **GciSaveObjs** on page 347). It may also track them by storing them in the GciTrackedObjs set (see **GciSaveAndTrackObjs** on page 345). After an abort or a successful commit, the user's session is resynchronized with the most recent version of the database. The values of instance variables cached in your C program may no longer accurately represent the corresponding GemStone objects. In such cases, your C program must update its representation of those objects. The function **GciAlteredObjs** permits you to determine which objects your application needs to reread from the database.

This function returns a list of all objects that are in the PureExportSet *and* are “dirty”. An object is considered dirty (changed) under one or more of the following conditions:

- The object was changed by Smalltalk execution from this session.
- The object was changed by a call from this session to any GemBuilder function from within a user action.
- The object was changed by a call from this session to one or more of the following functions: **GciStorePaths**, **GciSymDictAtObjPut**, **GciSymDictAtPut**, **GciStrKeyValueDictAtObjPut**, or **GciStrKeyValueDictAtPut**.
- The object was read by this session, and after this session did a commit, begin, or abort transaction, the session now has visibility to changes to the object committed by another session.
- The object is persistent, and this session aborted its changes to the object, thus rolling back the Smalltalk in-memory state to the previously committed state.

Calls to **GciStore...** (other than **GciStorePaths**), **GciAppend...**, **GciReplace...**, and **GciCreate...** do not put the modified object into the set of dirty objects (unless the call is from within a user action). The assumption is that the client does not want the dirty set to include modifications that the client has explicitly made.

You must call **GciDirtyObjsInit** once after **GciLogin** before you can use **GciAlteredObjs**.

Note that **GciAlteredObjs** removes OOPs from the ExportedDirtyObjs set and TrackedDirtyObjs sets as it enumerates.

## See Also

**GciDirtyObjsInit** on page 140

**GciReleaseAllOops** on page 328

**GciReleaseOops** on page 331

**GciSaveAndTrackObjs** on page 345

**GciSaveObjs** on page 347

# GciAppendBytes

Append bytes to a byte object.

## Syntax

```
void GciAppendBytes(  
    OopType          theObject,  
    int64            numBytes,  
    const ByteType * theBytes );
```

## Arguments

*theObject* A byte object, to which bytes are appended.

*numBytes* The number of bytes to be appended.

*theBytes* A pointer to the bytes to be appended.

## Description

This function appends *numBytes* bytes to byte object *theObject*. Its effect is equivalent to `GciStoreBytes(x, GciFetchSize_(x)+1, theBytes, numBytes)`.

**GciAppendBytes** raises an error if *theObject* is a Float or SmallFloat. Float and SmallFloat objects are of a fixed and unchangeable size.

## See Also

**GciAppendChars** on page 102

**GciStoreBytes** on page 368

# GciAppendChars

Append a C string to a byte object.

## Syntax

```
void GciAppendChars(  
    OopType          theObject,  
    const char *    aString );
```

## Arguments

*theObject* A byte object, to which the string is appended.

*aString* A pointer to the string to be appended.

## Description

This function appends the characters of *aString* to byte object *theObject*.

## See Also

[GciAppendBytes](#) on page 101

[GciStoreChars](#) on page 372

# GciAppendOops

Append OOPs to the unnamed variables of a collection.

## Syntax

```
void GciAppendOops(  
    OopType          theObject,  
    int              numOops,  
    const OopType*   theOops );
```

## Arguments

*theObject* A collection object, to which additional OOPs are appended.

*numOops* The number of OOPs to be appended.

*theOops* A pointer to the OOPs to be appended.

## Description

Appends *numOops* OOPs to the unnamed variables of the collection *theObject*. If the collection is indexable, this is equivalent to:

```
GciStoreOops(theObject, GciFetchSize_(theObject)+1, theOops, numOops);
```

If the collection is an NSC, this is equivalent to:

```
GciAddOopsToNsc(theObject, theOops, numOops);
```

If the object is neither indexable nor an NSC, an error is generated.

## See Also

[GciAddOopsToNsc](#) on page 95

[GciStoreOops](#) on page 382

# GciBegin

Begin a new transaction.

## Syntax

```
void GciBegin()
```

## Description

This function begins a new transaction. If there is a transaction currently in progress, it aborts that transaction. Calling **GciBegin** is equivalent to the function call `GciExecuteStr("System beginTransaction", OOP_NIL)`.

## See Also

**GciAbort** on page 93

**GciCommit** on page 117

**GciNbBegin** on page 241



# GCI\_BOOL\_TO\_OOP

(MACRO) Convert a C Boolean value to a GemStone Boolean object.

## Syntax

```
OpType GCI_BOOL_TO_OOP(aBoolean)
```

## Arguments

*aBoolean* The C Boolean value to be translated into a GemStone object.

## Return Value

The OOP of the GemStone Boolean object that is equivalent to *aBoolean*.

## Description

This macro translates a C Boolean value into the equivalent GemStone Boolean object. A C value of 0 translates to the GemStone Boolean object *false* (OOP\_FALSE). Any other C value translates to the GemStone Boolean object *true* (OOP\_TRUE).

## Example

```
OpType GCI_BOOL_TO_OOP_example(void)
{
    // zero returns OOP_FALSE
    OpType result = GCI_BOOL_TO_OOP( 0 );
    if ( ! result == OOP_FALSE)
        { return false; }

    // any non-zero argument returns OOP_TRUE
    result = GCI_BOOL_TO_OOP( 99 );
    if ( ! result == OOP_TRUE)
        { return false; }

    return true;
}
```

## See Also

[GciOopToBool](#) on page 297,  
[GCI\\_OOP\\_TO\\_BOOL](#) on page 298

## GciByteArrayToPointer

Given a result from `GciPointerToByteArray`, return a C pointer.

### Syntax

```
void * GciByteArrayToPointer(  
    OopType          arg );
```

### Arguments

*arg* A GemStone SmallInteger or ByteArray that was returned by `GciPointerToByteArray`.

### Description

Given an argument that was the result of `GciPointerToByteArray`, this function returns the corresponding C pointer.

### See Also

`GciPointerToByteArray` on page 317

## GciCallInProgress

Determine if a GemBuilder call is currently in progress.

### Syntax

```
BoolType GciCallInProgress()
```

### Return Value

This function returns TRUE if a GemBuilder call is in progress, and FALSE otherwise.

### Description

This function is intended for use within signal handlers. It can be called any time after **GciInit**.

**GciCallInProgress** returns FALSE if the process is currently executing within a user action and the user action's code is not within a GemBuilder call. It considers the highest (most recent) call context only.

### See Also

**GciInUserAction** on page 224

# GciCheckAuth

Gather the current authorizations for an array of database objects.

## Syntax

```
void GciCheckAuth(  
    const OopType          oopArray[ ];  
    ArraySizeType         arraySize;  
    unsigned char          authCodeArray[ ] );
```

## Arguments

- oopArray* An array of OOPs of objects for which the user's authorization level is to be ascertained. The caller must provide these values.
- arraySize* The number of OOPs in *oopArray*.
- authCodeArray* The resulting array, having at least *arraySize* elements, in which the authorization values of the objects in *oopArray* are returned as 1-byte integer values.

## Description

**GciCheckAuth** checks the current user's authorization for each object in *oopArray* up to *arraySize*, returning each authorization code in the corresponding element of *authCodeArray*. The calling context is responsible for allocating enough space to hold the results.

Authorization levels are:

- 1 - No authorization
- 2 - Read authorization
- 3 - Write authorization

Special objects, such as instances of *SmallInteger*, are reported as having read authorization.

Authorization values returned are those that have been committed to the database; they do not reflect changes you might have made in your local workspace. To query the local workspace, send an authorization query message to a particular object security policy using **GciPerform**.

If any member of *oopArray* is not a legal OOP, **GciCheckAuth** generates the error OBJ\_ERR\_DOES\_NOT\_EXIST. In that case, the contents of *authCodeArray* are undefined.

# GCI\_CHR\_TO\_OOP

## GCI\_CHR\_TO\_OOP\_

(MACRO) Convert a 32 bit C character value to a GemStone Character object.

### Syntax

```
OopType GCI_CHR_TO_OOP(uint aChar)
```

```
OopType GCI_CHR_TO_OOP_(uint aChar)
```

### Arguments

*aChar* The C uint value to be translated into a GemStone object.

### Return Value

The OOP of the GemStone Character object that is equivalent to *aChar*. If unit is larger than 0x10FFFF, then **GCI\_CHR\_TO\_OOP\_** returns OOP\_ILLEGAL, while **GCI\_CHR\_TO\_OOP** returns the Character with codePoint 0x10FFFF.

### Description

This macro translates a 32-bit C character value into the equivalent GemStone Character object.

The variants differ according to how they handle out of range input arguments.

### Example

```
OopType GCI_CHR_TO_OOP_example(void)
{
    // return the OOP for the ASCII character 'a'
    OopType theOop = GCI_CHR_TO_OOP('a');
    return theOop;
}
```

### See Also

[GciOopToChr](#) on page 301

## GciClampedTrav

Traverse an array of objects, subject to clamps.

### Syntax

```
BoolType GciClampedTrav(
    const OopType *      theOops,
    int                  numOops,
    GciClampedTravArgsSType *travArgs );
```

### Arguments

*theOops* An array of OOPs representing the objects to traverse.

*numOops* The number of elements in *theOops*.

*travArgs* Pointer to an instance of **GciClampedTravArgsSType**. See “Clamped Traversal Arguments - GciClampedTravArgsSType” on page 77 for details on the specific fields: the OOP for a ClampSpecification, traversal depth, traversal buffer, and retrieval flags.

On return, **GciClampedTravArgsSType**->*travBuff* is updated.

The first element placed in the buffer is the *actualBufferSize*, an integer that indicates how many bytes were actually stored in the buffer by this function. The remainder of the traversal buffer consists of a series of object reports, each of which is of type **GciObjRepSType**.

### Return Value

Returns FALSE if the traversal is not yet completed. Returns TRUE if there are no more objects to be returned by subsequent calls to **GciMoreTraversal** (that is, an object report was constructed for each object, minus the special objects).

### Description

**GciClampedTrav** initiates a traversal of the specified objects, subject to the clamps in the specified ClampSpecification. In order to guarantee that the root object of the traversal will always have an entry in the traversal buffer, the root object is not subject to the specified clamps. Refer to “GciTraverseObjs” on page 407 for a detailed discussion of object traversal.

GemBuilder clamped traversal functions are used by the GemBuilder for Smalltalk implementation of object replication and are intended for similar sophisticated client applications.

### See Also

**GciMoreTraversal** on page 238

**GciSaveObjs** on page 347

# GciClassMethodForClass

Compile a class method for a class.

## Syntax

```
OopsType GciClassMethodForClass(  
    OopsType          source,  
    OopsType          aClass,  
    OopsType          category,  
    OopsType          symbolList );
```

## Arguments

- source* The OOP of a Smalltalk string to be compiled as a class method.
- aClass* The OOP of the class with which the method is to be associated.
- category* The OOP of a Smalltalk string, which contains the name of the category to which the method is added. If the category is nil (OOP\_NIL), the compiler adds this method to the category "(as yet unclassified)".
- symbolList* The OOP of a GemStone symbol list, or OOP\_NIL. Smalltalk resolves symbolic references in source code by using symbols that are available from *symbolList*. A value of OOP\_NIL means to use the default symbol list for the current GemStone session (`System myUserProfile symbolList`).

## Return Value

Returns OOP\_NIL, unless there were compiler warnings (such as variables declared but not used, etc.), in which case the return will be the OOP of a string containing the warning messages.

## Description

This function compiles a class method for the given class. You may not compile any method whose selector begins with an underscore (\_) character. Such selectors are reserved for use by the GemStone development team as private methods.

In addition, the Smalltalk virtual machine optimizes a small number of selectors. You may not compile any methods with any of those selectors. See the *Programming Guide* for a list of the optimized selectors.

To *remove* a class method, use **GciExecuteStr** (page 157) to execute Smalltalk code in GemStone, or **GciClassRemoveAllMethods** (page 114) to remove all methods.

## Example

See “Executing the examples” on page 91 for the Smalltalk code that defines the classes and objects that support the examples.

```
void GciClassMethodForClass_example(void)
{
    // Assumes the setup code has been executed.

    OopType theClass = GciResolveSymbol("Customer", OOP_NIL);
    OopType oCateg = GciNewString("instance creation");
    OopType oMethodSrc = GciNewString(
        "newNamed: aName address: anAddress.
        | n | n := self new. n name: aName. n address: anAddress. ^ n");

    GciClassMethodForClass(oMethodSrc, theClass, oCateg, OOP_NIL);
    GciErrSType errInfo;
    if (GciErr(&errInfo)) {
        printf("error category "FMT_OID" number %d, %s\n",
            errInfo.category, errInfo.number, errInfo.message);
    }
}
```

## See Also

[GciCompileMethod](#) on page 118

[GciInstMethodForClass](#) on page 222



## GciClassNamedSize

Find the number of named instance variables in a class.

### Syntax

```
int GciClassNamedSize(  
    OopType          aClass);
```

### Arguments

*aClass* The OOP of the class from which to obtain information about instance variables. For reserved OOPs for Smalltalk kernel classes, see `$GEMSTONE/include/gcioop.ht`.

### Return Value

Returns the number of named instance variables in the class, or zero if an error occurs.

### Description

This function returns the number of named instance variables for the specified class, including those inherited from superclasses.

### Example

```
int namedSizeExample(void)  
{  
    // find the class named Employee in the current symbolList  
    OopType empClass = GciResolveSymbol("Employee", OOP_NIL);  
    if (empClass == OOP_NIL) {  
        return -1; // class not found or other error.  
    }  
  
    int numIvs = GciClassNamedSize(empClass);  
    GciErrSType errInfo;  
    if (GciErr(&errInfo)) {  
        return -1; // error occurred  
    }  
  
    // return the number of named instance variables which will  
    // be >= 0  
    return numIvs;  
}
```

### See Also

[GciIvNameToIdx](#) on page 230

# GciClassRemoveAllMethods

## GciClassRemoveAllMethods\_

Remove all methods from the method dictionary of a class.

### Syntax

```
void GciClassRemoveAllMethods(  
    OopType          aClass);  
  
void GciClassRemoveAllMethods_(  
    OopType          aClass,  
    ushort          environmentId );
```

### Arguments

*aClass* The OOP of the class from which to remove the methods.  
*environ-mentId* The compilation environment from which to remove methods.

### Description

**GciClassRemoveAllMethods** removes all methods from the method dictionary of the specified class, within environment 0, the default Smalltalk environment. To remove methods in other environments, use **GciClassRemoveAllMethods\_**.

To remove an individual method, use **GciExecuteStr** (page 157) to execute Smalltalk code in GemStone.

# GciClearStack

Clear the Smalltalk call stack.

## Syntax

```
void GciClearStack(
    OopType          gsProcess );
```

## Arguments

*gsProcess* The OOP of a GsProcess object (obtained as the value of the *context* field of an error report returned by **GciErr**).

## Description

Whenever a session executes a Smalltalk expression or sequence of expressions, the virtual machine creates and maintains a call stack that provides information about its state of execution. The call stack includes an ordered list of activation records related to the methods and blocks that are currently being executed.

If a soft break or an unexpected error occurs, the virtual machine suspends execution, creates a GsProcess object, and raises an error. The GsProcess object represents both the call stack when execution was suspended and any information that the virtual machine needs to resume execution. If there was no fatal error, your program can call **GciContinue** to resume execution. Call **GciClearStack** instead if there was a fatal error, or if you do not want your program to resume the suspended execution.

## Example

The following example shows how an application can handle an error and either continue or terminate Smalltalk execution.

```
void clearStackExample(void)
{
    OopType result = GciExecuteStr(
        "| a | a := 10 + 10. nil halt . ^ a + 100",
        OOP_NIL/*use default symbolList for execution*/);

    // halt method is expected to generate error number
        RT_ERR_GENERIC_ERROR
    GciErrSType errInfo;
    if (! GciErr(&errInfo)) {
        printf("expected an error but none found\n");
        return;
    }
    if (errInfo.number == ERR_Halt) {
        // now continue the execution to finish the computation
        result = GciContinue(errInfo.context);
    } else {
        // FMT_OID format string is defined in gci.ht
```

```
    printf("unexpected error category \"FMT_OID\" number %d, %s\n",
        errInfo.category, errInfo.number, errInfo.message);
    // terminate the execution
    GciClearStack(errInfo.context);
    return;
}
int val = GciOopToI32(result);
if (GciErr(&errInfo)) {
    printf("unexpected error category \"FMT_OID\" number %d, %s\n",
        errInfo.category, errInfo.number, errInfo.message);
} else {
    if (val != 120) {
        printf("Wrong answer = %d\n", val);
    } else {
        printf("result = %d\n", val);
    }
}
}
```

## See Also

**GciContinue** on page 122

**GciSoftBreak** on page 364

# GciCommit

Write the current transaction to the database.

## Syntax

```
BoolType GciCommit()
```

## Return Value

Returns TRUE if the transaction committed successfully. Returns FALSE if the transaction fails to commit due to a concurrency conflict or in case of error.

## Description

The **GciCommit** function attempts to commit the current transaction to the GemStone database.

**GciCommit** ignores any commit pending action that may be defined in the current GemStone session state.

## Example

```
void GciCommit_example(void)
{
    // Call GciCommit and see if there was an error
    if ( ! GciCommit() ) {
        GciErrSType errInfo;
        if (GciErr(&errInfo)) {
            printf("commit failed with error %d , %s \n",
                errInfo.number, errInfo.message );
        } else {
            printf("commit failed due to transaction conflicts\n");
        }
    }
}
```

## See Also

**GciAbort** on page 93

**GciBegin** on page 104

**GciNbCommit** on page 243

# GciCompileMethod

Compile a method.

## Syntax

```

OopType GciCompileMethod(
  OopType      source,
  OopType      aClass,
  OopType      category,
  OopType      symbolList,
  OopType      overrideSelector,
  int          compileFlags,
  ushort      environmentId );

```

## Arguments

- source* The OOP of a Smalltalk string to be compiled as a method.
- aClass* The OOP of the class with which the method is to be associated.
- category* The OOP of a Smalltalk string, which contains the name of the category to which the method is added. If the category is nil (OOP\_NIL), the compiler adds this method to the category "(as yet unclassified)".
- symbolList* The OOP of a GemStone symbol list, or OOP\_NIL. Smalltalk resolves symbolic references in source code by using symbols that are available from *symbolList*. A value of OOP\_NIL means to use the default symbol list for the current GemStone session (`System myUserProfile symbolList`).
- overrideSelector* If not OOP\_NIL, this is a string that is converted to a symbol and used in precedence to the selector pattern in the method source when installing the method in the method dictionary. Sending 'selector' to the resulting method will also reflect the *overrideSelector* argument.
- compileFlags* Compiler flags. GCI\_COMPILE\_CLASS\_METH means compile a class method. These are listed in `gcicmn.ht`.
- environmentId* The compilation environment for method lookup, normally 0.

## Return Value

Returns OOP\_NIL, unless there were compiler warnings (such as variables declared but not used, etc.), in which case the return will be the OOP of a string containing the warning messages.

## Description

This function is used for compiling a method. Replaces both `GciInstMethodForClass` and `GciClassMethodForClass`, and adds the `environmentId` argument.

This function compiles a method for the given class. You may not compile any method whose selector begins with an underscore (`_`) character. Such selectors are reserved for use by the GemStone development team as private methods.

In addition, the Smalltalk virtual machine optimizes a small number of selectors. You may not compile any methods with any of those selectors. See the *Programming Guide* for a list of the optimized selectors.

To *remove* a method, use **GciExecuteStr** instead.

## See Also

**GciClassMethodForClass** on page 111

**GciInstMethodForClass** on page 222

## GciCompress

Compress the supplied data, which can be uncompressed with **GciUncompress**.

### Syntax

```
int GciCompress(
    char *                dest,
    uint *                destLen,
    const char *          source,
    uint                  sourceLen );
```

### Arguments

- dest* Pointer to the buffer that will hold the resulting compressed data.
- destLen* Length, in bytes, of the buffer intended to hold the compressed data.
- source* Pointer to the source data to compress.
- sourceLen* Length, in bytes, of the source data.

### Return Value

**GciCompress** returns `Z_OK` (equal to 0) if the compression succeeded, or various error values if it failed; see the documentation for the `compress` function in the GNU `zlib` library at <http://www.gzip.org>.

### Description

**GciCompress** passes the supplied inputs unchanged to the `compress` function in the GNU `zlib` library Version 1.2.3, and returns the result exactly as the GNU `compress` function returns it.

### Example

```
#include <limits.h>

OopType compressByteArray(OopType byteArray)
{
    // given an input ByteArray, return a new ByteArray with
    // the contents of the input compressed .

    if (!GciIsKindOfClass(byteArray, OOP_CLASS_BYTE_ARRAY) )
        return OOP_NIL; /* error: input arg is not a ByteArray */

    int64 inputSize = GciFetchSize_(byteArray);
    if (inputSize > INT_MAX) {
        return OOP_NIL; // GciCompress supports max 2G bytes input
    }

    int64 outputSize = inputSize;
```



```
ByteType *inputBuffer = (ByteType*)malloc( inputSize);
if (inputBuffer == NULL) {
    return OOP_NIL; // malloc failure
}
ByteType *outputBuffer = (ByteType*)malloc( outputSize);
if (outputBuffer == NULL) {
    free(inputBuffer);
    return OOP_NIL; // malloc failure
}

OopType resultOop = OOP_NIL;

int64 numRet = GciFetchBytes_(byteArray, 1/* start at first element */,
    inputBuffer, inputSize /* max bytes to fetch */ );
if (numRet == inputSize) {
    uint compressedSize;
    int status = GciCompress( (char *)outputBuffer,
        &compressedSize,
        (char *) inputBuffer, inputSize);
    if (status == 0) {
        // compress ok
        resultOop = GciNewByteObj(OOP_CLASS_BYTE_ARRAY,
            outputBuffer, (int64)compressedSize );
    } else {
        // compress failed
    }
} else {
    // error during FetchBytes
}
free(inputBuffer);
free(outputBuffer);
return resultOop;
}
```

## See Also

[GciUncompress](#) on page 410

# GciContinue

Continue code execution in GemStone after an error.

## Syntax

```
OopsType GciContinue(  
    OopsType          gsProcess );
```

## Arguments

*gsProcess* The OOP of a GsProcess object (obtained as the value of the context field of an error report returned by GciErr).

## Return Value

Returns the OOP of the result of the Smalltalk code that was executed. Returns OOP\_NIL in case of error.

## Description

The **GciContinue** function attempts to continue Smalltalk execution sometime after it was suspended. It is most useful for proceeding after GemStone encounters a pause message, a soft break (**GciSoftBreak**), or an application-defined error, since continuation is always possible after these events. Because **GciContinue** calls the virtual machine, the application user can also issue a soft break while this function is executing. For more information, see “Interrupting GemStone Execution” on page 30.

It may also be possible to continue Smalltalk execution if the virtual machine detects a nonfatal error during a **GciExecute...** or **GciPerform** call. You may then want to use structural access functions to investigate (or modify) the state of the database before you call **GciContinue**.

## Example

See the example for **GciClearStack** on page 115.

## See Also

**GciClearStack** on page 115  
**GciContinueWith** on page 123  
**GciErr** on page 152  
**GciNbContinue** on page 244  
**GciSoftBreak** on page 364

# GciContinueWith

Continue code execution in GemStone after an error.

## Syntax

```
OopsType GciContinueWith (  
    OopsType          gsProcess,  
    OopsType          replaceTopOfStack,  
    int               flags,  
    GciErrSType *    continueWithError );
```

## Arguments

- gsProcess* The OOP of a GsProcess object (obtained as the value of the context field of an error report returned by GciErr).
- replaceTopOfStack* f not OOP\_ILLEGAL, replace the value at the top of the Smalltalk evaluation stack with this value before continuing. If OOP\_ILLEGAL, the evaluation stack is not changed.
- flags* Flags to disable or permit asynchronous events and debugging in Smalltalk, as defined for **GciPerformNoDebug** on page 311.
- continueWithError* If not NULL, continue execution by signalling this error. This argument takes precedence over *replaceTopOfStack*.

## Return Value

Returns the OOP of the result of the Smalltalk code that was executed. In case of error, this function returns OOP\_NIL.

## Description

This function is a variant of the **GciContinue** function, except that it allows you to modify the call stack and the state of the database before attempting to continue the suspended Smalltalk execution. This feature is typically used while implementing a Smalltalk debugger.

## See Also

- GciClearStack** on page 115
- GciContinue** on page 122
- GciErr** on page 152
- GciNbContinueWith** on page 245
- GciSoftBreak** on page 364

## GciCreateByteObj

Create a new byte-format object.

### Syntax

```

OopType GciCreateByteObj(
    OopType          aClass,
    OopType          objId,
    const ByteType * values,
    int64            numValues,
    int              clusterId,
    BoolType         makePermanent );

```

### Arguments

- aClass* The OOP of the class of the new object.
- objId* The new object's OOP (obtained from **GciGetFreeOop**), or OOP\_ILLEGAL. If you are trying to create a Symbol or DoubleByteSymbol, *objId* must be OOP\_ILLEGAL. You cannot use the result of **GciGetFreeOop** to create a type of Symbol object.
- values* Array of instance variable values.
- numValues* Number of elements in *values*.
- clusterId* ID of the cluster bucket in which to place the object. If *clusterId* is 0, use the cluster bucket (System currentClusterId). Otherwise, *clusterId* must be a positive integer  $\leq$  GciFetchSize\_(OOP\_ALL\_CLUSTER\_BUCKETS).
- makePermanent* Has no effect.

### Return Value

GciCreateByteObj returns the OOP of the object it creates. The return value is the same as *objId* unless that value is OOP\_ILLEGAL, in which case GciCreateByteObj assigns and returns a new OOP itself.

### Description

Creates a new object using an object identifier (OOP) *objId* previously obtained from **GciGetFreeOop** or **GciGetFreeOops**. For more about the semantics of such object identifiers, see **GciGetFreeOop** on page 206.

The object is created in temporary object space, and the garbage collector makes it permanent if the object is referenced, or becomes referenced, by another permanent object.

Values are stored into the object starting at the first named instance variable (if any) and continuing to the indexable (or NSC) instance variables if *oclass* is indexable or NSC. The caller must initialize any unused elements of *\*values* to OOP\_NIL.

If *oclass* is an indexable or NSC class, then *numValues* may be as large or as small as desired. If *oclass* is neither indexable nor NSC, *numValues* must not exceed the number of named instance variables in the class. If *numValues* is less than number of named instance variables, then the size of the newly-created object is the number of named instance variables and any instance variables beyond *numValues* are initialized to OOP\_NIL.

For certain classes of byte format, namely DateTime, Float, and LargeInteger, additional size restrictions apply.

For an indexable object, if *numValues* is greater than zero and *values* is NULL, then the object is created of size *numValues*, and is initialized to logical size *numValues*. (This is equivalent to `new : aSize` for classes Array or String.)

If **GciCreateByteObj** is being used to create an instance of OOP\_CLASS\_FLOAT or OOP\_CLASS\_SMALL\_FLOAT, then the correct number of *value* bytes must be supplied at the time of creation.

If you are trying to create a Symbol or DoubleByteSymbol, *objId* **must** be OOP\_ILLEGAL.

## See Also

**GciCreateOopObj** on page 126

**GciGetFreeOop** on page 206

**GciGetFreeOops** on page 208

## GciCreateOopObj

Create a new pointer-format object.

### Syntax

```
OopType GciCreateOopObj(
    OopType          aClass,
    OopType          objId,
    const OopType *  values,
    int              numValues,
    int              clusterId,
    BoolType         makePermanent );
```

### Arguments

- aClass* The OOP of the class of the new object.
- objId* The new object's OOP (obtained from **GciGetFreeOop**), or OOP\_ILLEGAL.
- values* Array of instance variable values.
- numValues* Number of elements in *values*.
- clusterId* ID of the cluster bucket in which to place the object. If *clusterId* is 0, use the cluster bucket (System currentClusterId). Otherwise, *clusterId* must be a positive integer  $\leq$  GciFetchSize\_(OOP\_ALL\_CLUSTER\_BUCKETS).
- makePermanent* Has no effect.

### Return Value

**GciCreateOopObj** returns the OOP of the object it creates. The return value is the same as *objId* unless that value is OOP\_ILLEGAL, in which case **GciCreateOopObj** assigns and returns a new OOP itself.

### Description

Creates a new object using an object identifier (*objId*) previously obtained from **GciGetFreeOop** or **GciGetFreeOops**. For more about the semantics of such object identifiers, see **GciGetFreeOop** on page 206.

The object is created in temporary object space, and the garbage collector makes it permanent if the object is referenced, or becomes referenced, by another permanent object.

Values are stored into the object starting at the first named instance variable (if any) and continuing to the indexable (or NSC) instance variables if *oclass* is indexable or NSC. Values may be forward references to objects whose identifier has been allocated with **GciGetFreeOop**, but for which the object has not yet been created with **GciCreate....** The caller must initialize any unused elements of *\*values* to OOP\_NIL.

Because it is illegal to create a forward reference to a Symbol, any **GciCreate...** call that creates a Symbol will fail if the client's *objId* of the created object was already used as a forward reference.

If *oclass* is an indexable or NSC class, then *numValues* may be as large or as small as desired. If *oclass* is neither indexable nor NSC, *numValues* must not exceed the number of named instance variables in the class. If *numValues* is less than number of named instance variables, then the size of the newly-created object is the number of named instance variables and any instance variables beyond *numValues* are initialized to OOP\_NIL.

For an indexable object, if *numValues* is greater than zero and *values* is NULL, then the object is created of size *numValues*, and is initialized to logical size *numValues*. (This is equivalent to `new : aSize` for classes Array or String.)

## See Also

**GciCreateByteObj** on page 124

**GciGetFreeOop** on page 206

**GciGetFreeOops** on page 208

## GciCTimeToDateTime

Convert a C date-time representation to the equivalent GemStone representation.

### Syntax

```
BoolType GciCTimeToDateTime(  
    time_t          arg,  
    GciDateTimeSType * result );
```

### Arguments

*arg* The C time value to be converted.

*result* A pointer to the C struct for the converted value.

### Return Value

Returns TRUE if the conversion succeeds; otherwise returns FALSE.

### Description

Converts a **time\_t** value to **GciDateTimeSType**. On systems where **time\_t** is a signed value, **GciCTimeToDateTime** generates an error if *arg* is negative.

### See Also

**GciDateTimeToCTime** on page 129



## GciDateTimeToCTime

Convert a GemStone date-time representation to the equivalent C representation.

### Syntax

```
time_t GciDateTimeToCTime(  
    const GciDateTimeSType * arg );
```

### Arguments

*arg* An instance of **GciDateTimeSType** to be converted.

### Return Value

A C time value of type **time\_t**.

### Description

Converts an instance of **GciDateTimeSType** to the equivalent **time\_t** value.

### See Also

**GciCTimeToDateTime** on page 128

# GciDbgEstablish

Specify the debugging function for GemBuilder to execute before most calls to GemBuilder functions.

## Syntax

```
GciDbgFuncType * GciDbgEstablish(  
    GciDbgFuncType * newDebugFunc );
```

## Arguments

*newDebugFunc* A pointer to a C function that will be called before each subsequent GemBuilder call. Note that this function will not be called before any of the following GemBuilder functions or macros: `GCI_ALIGN`, `GCI_BOOL_TO_OOP`, `GCI_CHR_TO_OOP`, `GciErr`, or this function.

## Return Value

Returns a pointer to the *newDebugFunc* specified in the previous **GciDbgEstablish** call (if any).

## Description

This function establishes the name of a C function (most likely a debugging routine) to be called before your program calls any GemBuilder function or macro (except those named above). Before each GemBuilder call, a single argument, a null-terminated string that names the GemBuilder function about to be executed, is passed to the specified *newDebugFunc*.

The *newDebugFunc* function is passed a single null-terminated string argument, (of type `const char [ ]`), the name of the GemBuilder function about to be called.

To disable previous debugging routines, call **GciDbgEstablish** with an argument of `NULL`.

## Example

```
void traceGciFuncnt(const char* gciFname)  
{  
    printf("trace gci call %s \n", gciFname);  
}  
  
void debugEstablishExample(void)  
{  
    GciDbgEstablish(traceGciFuncnt); // enable tracing  
    GciFetchSize_(OOP_CLASS_STRING); // this call will be traced  
    GciDbgEstablish(NULL); // shut off tracing  
}
```

## See Also

**GciDbgEstablishToFile** on page 131

**GciDbgLogString** on page 132

# GciDbgEstablishToFile

Write trace information for most GemBuilder functions to a file.

## Syntax

```
BoolType GciDbgEstablishToFile(  
    const char *          fileName );
```

## Arguments

*fileName* The file to which trace information is to be written.

## Return Value

Returns TRUE if the file operation was successful.

## Description

This function causes trace information for most GemBuilder functions to be written to a file. If the file already exists, it is opened in append mode. If *fileName* is NULL and tracing to a file is not currently active, trace information will be written to stdout.

Calling **GciDbgEstablishToFile** supersedes the effect of any previous calls to **GciDbgEstablish** or **GciDbgEstablishToFile**.

To terminate tracing to an active file, call **GciDbgEstablishToFile** with an argument of NULL; alternatively, a call **GciShutdown** also teminates tracing.

For details about the trace information generated, see **GciDbgEstablish**.

## See Also

**GciDbgEstablish** on page 130

**GciDbgLogString** on page 132

## GciDbgLogString

Pass a message to a trace function.

### Syntax

```
void GciDbgLogString(  
    const char *          message);
```

### Arguments

*message* A message to be passed to **GciDbgEstablish** or **GciDbgEstablishToFile**.

### Description

If either **GciDbgEstablish** or **GciDbgEstablishToFile** has been called to activate tracing of GemBuilder calls, this function passes the argument to the trace function.

If tracing is not active, this function has no effect.

### See Also

**GciDbgEstablish** on page 130

**GciDbgEstablishToFile** on page 131

# GciDebugConnectToGem

Initiate the connection to another session for debugging.

## Syntax

```
void GciDebugConnectToGem(  
    int gemPid);
```

## Arguments

*gemPid* The ProcessId of a Gem that is listening for debug, by a setting for GEM\_LISTEN\_FOR\_DEBUG or a call to `System class >> listenForDebugConnection`.

## Description

Connect to a previous open listening debug port for a Gem that is running on localhost. For more information, see the configuration parameter GEM\_LISTEN\_FOR\_DEBUG, and the topaz DEBUGGEM command.

The call to **GciDebugConnectToGem** must be followed by a call to **GciDebugStartDebugService** to complete the connection.

## See Also

**GciDebugStartDebugService** on page 134

# GciDebugStartDebugService

Connect to another session for debugging.

## Syntax

```
void GciDebugStartDebugService(  
    uint64  
    debugToken);
```

## Arguments

*debugToken* The token returned by a previous call to **GciDebugConnectToGem**.

## Description

Must be preceded by **GciDebugConnectToGem()** which creates a GCI session.

Using a Gci session created by **GciDebugConnectToGem**, **GciDebugStartGemThread** will validate the *debugToken* argument and interrupt any Smalltalk execution in progress in the target gem by the equivalent of **GciSoftBreak**.

To continue an execution that was interrupted by this **SoftBreak** and release the target gem to continue running, execute **GciNbContinue** followed by **GciLogout\_(FALSE)**;

## See Also

**GciDebugConnectToGem** on page 133

**GciNbContinue** on page 244

**GciLogout** on page 236

# GciDeclareAction

An alternative way to associate a C function with a Smalltalk user action.

## Syntax

```
void GciDeclareAction(  
    const char*          name,  
    void*               func,  
    int                 numArgs,  
    uint                flags,  
    BoolType            errorIfDuplicate );
```

## Arguments

- name* The user action name (a case-insensitive, null-terminated string).
- func* A pointer to the C user action function.
- numArgs* The number of arguments in the C function.
- flags* Flags that apply to the declaration: primarily for internal use.
- errorIfDuplicate* If True, return an error if there is already a user action with the specified name. If False, leave the existing user action in place and ignore the current call.

## Description

This function associates a user action name (declared in Smalltalk) with a user-written C function. **GciDeclareAction** allows you to declare a user action by passing each field of the user action structure to the function as a separate argument. Because the user action structure is encapsulated within the function itself, there's no need to explicitly allocate and free memory, as is required with **GciInstallUserAction** (which uses the data structure defined by **GciUserActionSType**).

## See Also

- Chapter 4, "Writing User Actions", starting on page 45  
"User Action Information Structure - GciUserActionSType" on page 79  
**GciInstallUserAction** on page 221  
**GciInUserAction** on page 224  
**GciUserActionInit** on page 411  
**GciUserActionShutdown** on page 412

## GciDecodeOopArray

Decode an OOP array that was previously run-length encoded.

### Syntax

```
int GciDecodeOopArray(  
    OopType *          encodedOopArray,  
    const int          numEncodedOops,  
    OopType *          decodedOopArray,  
    const int          decodedOopsSize);
```

### Arguments

*encodedOopArray* An OOP array that was encoded by a call to **GciEncodeOopArray**.

*numEncodedOops* The number of OOPs in *encodedOopArray*.

*decodedOopArray* The decoded OOP array that had been run-length encoded.

*decodedOopsSize* The maximum number of OOPs in *decodedOopArray*.

### Return Value

Returns the number of OOPs placed in *decodedOopArray*.

### Description

This function decodes the OOPs in *encodedOopArray* that were run-length encoded using **GciEncodeOopArray** and places the result in *decodedOopArray*.

The *decodedOopArraySize* must be large enough to hold all decoded OOPs. If it is not, no decode is performed and *\*decodedOopArraySize* is set to -1.

### See Also

**GciFetchNumEncodedOops** on page 181

**GciEncodeOopArray** on page 149

**GciGetFreeOopsEncoded** on page 210



# GciDecSharedCounter

Decrement the value of a shared counter.

## Syntax

```
BoolType GciDecSharedCounter(  
    int64_t          counterIdx,  
    int64_t*        value,  
    int64_t*        floor);
```

## Arguments

- counterIdx* The offset into the shared counters array of the value to decrement.
- value* Pointer to a value that indicates how much to decrement the shared counter by. On return, the new value of the shared counter after the decrement.
- floor* The minimum possible value for the shared counter. The counter cannot be decremented below this value. If *floor* is NULL, then a *floor* value of INT\_MIN (-2147483647) will be used.

## Return Value

Returns a C Boolean value indicating if the shared counter was successfully decremented by the given amount. Returns TRUE if successful, FALSE if an error occurred.

## Description

This function decrements the value of a particular shared counter by a specified amount. The shared counter is specified by index. The value of this shared counter cannot be decremented to a value lower than *floor*.

This function is not supported for remote GCI interfaces, and will always return FALSE.

## See Also

- [GciFetchNumSharedCounters](#) on page 182
- [GciIncSharedCounter](#) on page 217
- [GciSetSharedCounter](#) on page 360
- [GciReadSharedCounter](#) on page 325
- [GciReadSharedCounterNoLock](#) on page 326
- [GciFetchSharedCounterValuesNoLock](#) on page 193

## GciDirtyExportedObjs

Find all objects in the ExportedDirtyObjs set.

### Syntax

```
BoolType GciDirtyExportedObjs(
    OopType          theOops[ ],
    int *            numOops );
```

### Arguments

*theOops* An array to hold the dirty exported objects.

*numOops* The maximum number of objects that can be put into *theOops* buffer. On return, the number of dirty exported objects found.

### Return Value

This function returns a C Boolean value indicating whether or not the complete set of dirty objects has been returned in *theOops* in one or more calls. TRUE indicates that the complete set has been returned, and FALSE indicates that it has not.

### Description

This function returns a list of all objects that are in the ExportedDirtyObjs set, which includes all objects in the PureExportSet that have been made “dirty” since the ExportedDirtyObjs set was last initialized or retrieved using any of the following:

**GciDirtyAlteredObjs**  
**GciDirtyExportedObjs**  
**GciDirtyObjsInit**  
**GciDirtySaveObjs**  
**GciTrackedObjsFetchAllDirty**

Object are added to the PureExportSet using **GciSaveObjs** or by other functions that invoke **GciSaveObjs**.

An object is considered dirty (changed) under one or more of the following conditions:

- The object was changed by Smalltalk execution from this session.
- The object was changed by a call from this session to any GemBuilder function from within a user action.
- The object was changed by a call from this session to one or more of the following functions: **GciStorePaths**, **GciSymDictAtObjPut**, **GciSymDictAtPut**, **GciStrKeyValueDictAtObjPut**, or **GciStrKeyValueDictAtPut**.
- The object was read by this session, and after this session did a commit, begin, or abort transaction, the session now has visibility to changes to the object committed by another session.
- The object is persistent, and this session aborted its changes to the object, thus rolling back the Smalltalk in-memory state to the previously committed state.

Calls to **GciStore...** (other than **GciStorePaths**), **GciAppend...**, **GciReplace...**, and **GciCreate...** do not put the modified object into the set of dirty objects (unless the call is from within a user action). The assumption is that the client does not want the dirty set to include modifications that the client has explicitly made.

The function **GciDirtyObjsInit** must be executed once after **GciLogin** before this function can be called, because it depends upon GemStone's set of dirty objects.

The user is expected to call this function repeatedly while it returns FALSE, until it finally returns TRUE. When this function returns TRUE, it first clears the set of dirty objects.

Note that **GciDirtyExportedObjs** removes OOPs from the ExportedDirtyObjs set as they are enumerated.

## See Also

"Garbage Collection" on page 18

**GciDirtyExportedObjs** on page 138

**GciDirtyObjsInit** on page 140

**GciDirtySaveObjs** on page 141

**GciDirtyTrackedObjs** on page 143

**GciSaveGlobalObjs** on page 346

**GciTrackedObjsFetchAllDirty** on page 404

## GciDirtyObjsInit

Begin tracking which objects in the session workspace change.

### Syntax

```
void GciDirtyObjsInit()
```

### Description

GemStone can track which objects in a session change, but doing so has a measurable cost. By default, GemStone does not do it. The **GciDirtyObjsInit** function permits an application to request GemStone to maintain that set of dirty objects, the `ExportedDirtyObjects`, when it is needed. Once initialized, GemStone tracks dirty objects until **GciLogout** is executed.

**GciDirtyObjsInit** must be called once after **GciLogin** before **GciDirtyExportedObjs**, **GciDirtySaveObjs**, or **GciTrackedObjsFetchAllDirty** in order for those functions to operate properly, because they depend upon GemStone's set of dirty objects.

An object is considered dirty (changed) under one or more of the following conditions:

- The object was changed by Smalltalk execution from this session.
- The object was changed by a call from this session to any GemBuilder function from within a user action.
- The object was changed by a call from this session to one or more of the following functions: **GciStorePaths**, **GciSymDictAtObjPut**, **GciSymDictAtPut**, **GciStrKeyValueDictAtObjPut**, or **GciStrKeyValueDictAtPut**.
- The object was read by this session, and after this session did a commit, begin, or abort transaction, the session now has visibility to changes to the object committed by another session.
- The object is persistent, and this session aborted its changes to the object, thus rolling back the Smalltalk in-memory state to the previously committed state.

### See Also

**GciDirtyExportedObjs** on page 138

**GciDirtySaveObjs** on page 141

**GciTrackedObjsFetchAllDirty** on page 404

## GciDirtySaveObjs

Find all exported or tracked objects that have changed and are therefore in the ExportedDirtyObjs or TrackedDirtyObjs sets.

### Syntax

```
BoolType GciDirtySaveObjs(
    OopType      theOops[ ],
    int *        numOops );
```

### Arguments

- theOops* An array to hold the dirty cached objects.
- numOops* The maximum number of objects that can be put into *theOops* buffer. On return, the number of dirty cached objects found

### Return Value

This function returns a C Boolean value indicating whether or not the complete set of dirty objects has been returned in *theOops* in one or more calls. TRUE indicates that the complete set has been returned, and FALSE indicates that it has not.

### Description

This function finds all objects that are in the ExportedDirtyObjs or TrackedDirtyObjs sets. The ExportedDirtyObjs set includes all objects in PureExportSet that have been made “dirty” since the ExportedDirtyObjs set was last reset, and the TrackedDirtyObjs set includes all objects in the GciTrackedObjs set that have been made “dirty” since the TrackedDirtyObjs set was last reset.

The ExportedDirtyObjs set is initialized by **GciDirtyObjsInit**.

The ExportedDirtyObjs set is cleared by calls to **GciDirtyAlteredObjs**, **GciDirtyExportedObjs**, **GciDirtySaveObjs** (this function), or **GciTrackedObjsFetchAllDirty**.

The TrackedDirtyObjs set is initialized by **GciTrackedObjsInit**.

The TrackedDirtyObjs set is cleared by calls to **GciDirtyAlteredObjs**, **GciDirtySaveObjs** (this function), **GciDirtyTrackedObjs**, or **GciTrackedObjsFetchAllDirty**.

An object is considered dirty (changed) under one or more of the following conditions:

- The object was changed by Smalltalk execution from this session.
- The object was changed by a call from this session to any GemBuilder function from within a user action.
- The object was changed by a call from this session to one or more of the following functions: **GciStorePaths**, **GciSymDictAtObjPut**, **GciSymDictAtPut**, **GciStrKeyValueDictAtObjPut**, or **GciStrKeyValueDictAtPut**.

- The object was read by this session, and after this session did a commit, begin, or abort transaction, the session now has visibility to changes to the object committed by another session.
- The object is persistent, and this session aborted its changes to the object, thus rolling back the Smalltalk in-memory state to the previously committed state.

Calls to **GciStore...** (other than **GciStorePaths**), **GciAppend...**, **GciReplace...**, and **GciCreate...** do not put the modified object into the set of dirty objects (unless the call is from within a user action). The assumption is that the client does not want the dirty set to include modifications that the client has explicitly made.

**GciDirtyObjsInit** must be called once after **GciLogin** before **GciDirtySaveObjs** can be executed, because it depends upon GemStone's set of dirty objects.

The user is expected to call **GciDirtySaveObjs** repeatedly while it returns FALSE, until it finally returns TRUE. When **GciDirtySaveObjs** returns TRUE, it first clears the set of dirty objects.

For details about the PureExportSet, see **GciSaveObjs**. For details about the GciTrackedObjs set, see **GciSaveAndTrackObjs**.

Note that **GciDirtySaveObjs** removes OOPs from the ExportedDirtyObjs and TrackedDirtyObjs sets.

## See Also

"Garbage Collection" on page 18

**GciDirtyExportedObjs** on page 138

**GciDirtyObjsInit** on page 140

**GciDirtyTrackedObjs** on page 143

**GciTrackedObjsFetchAllDirty** on page 404

**GciSaveObjs** on page 347

## GciDirtyTrackedObjs

Find all tracked objects that have changed and are therefore in the TrackedDirtyObjs set.

### Syntax

```
BoolType GciDirtyTrackedObjs(  
    OopType          theOops[ ],  
    int *            numOops );
```

### Arguments

- theOops* An array to hold the dirty tracked objects.
- numOops* The maximum number of objects that can be put into *theOops* buffer. On return, the number of dirty tracked objects found.

### Return Value

This function returns a C Boolean value indicating whether or not the complete set of dirty tracked objects has been returned in *theOops* in one or more calls. TRUE indicates that the complete set has been returned, and FALSE indicates that it has not.

### Description

This function returns a list of all objects that are in the TrackedDirtyObjs set, which includes all objects that are in the GciTrackedObjs set and have been made “dirty” since the GciTrackedObjs set was initialized or cleared. Functions that initialize or remove objects from the TrackedDirtyObjs set are **GciDirtyAlteredObjs**, **GciDirtySaveObjs**, **GciDirtyTrackedObjs** (this function), **GciTrackedObjsFetchAllDirty** and **GciTrackedObjsInit**.

An object is considered dirty (changed) under one or more of the following conditions:

- The object was changed by Smalltalk execution from this session.
- The object was changed by a call from this session to any GemBuilder function from within a user action.
- The object was changed by a call from this session to one or more of the following functions: **GciStorePaths**, **GciSymDictAtObjPut**, **GciSymDictAtPut**, **GciStrKeyValueDictAtObjPut**, or **GciStrKeyValueDictAtPut**.
- The object was read by this session, and after this session did a commit, begin, or abort transaction, the session now has visibility to changes to the object committed by another session.
- The object is persistent, and this session aborted its changes to the object, thus rolling back the Smalltalk in-memory state to the previously committed state.

Calls to **GciStore...** (other than **GciStorePaths**), **GciAppend...**, **GciReplace...**, and **GciCreate...** do not put the modified object into the set of dirty objects (unless the call is from within a user action). The assumption is that the client does not want the dirty set to include modifications that the client has explicitly made.

This function may only be called after **GciTrackedObjsInit** has been executed, because it depends upon GemStone's set of tracked objects. The user is expected to call this function repeatedly while it returns FALSE, until it finally returns TRUE. When this function returns TRUE, it first clears the set of dirty objects.

Note that **GciDirtyTrackedObjs** removes OOPs from the TrackedDirtyObjs set.

## See Also

*"Garbage Collection"* on page 18

**GciDirtyTrackedObjs** on page 143

**GciReleaseAllTrackedOops** on page 329

**GciSaveAndTrackObjs** on page 345

**GciTrackedObjsFetchAllDirty** on page 404

**GciTrackedObjsInit** on page 406



# Gci\_doubleToSmallDouble

Convert a C double to a SmallDouble object.

## Syntax

```
ObjType Gci_doubleToSmallDouble(  
    double aDouble );
```

## Arguments

*aDouble* A C double value

## Return Value

Returns the OOP of the GemStone SmallDouble object that corresponds to the C value. If the C value is not representable as a GemStone SmallDouble, return OOP\_ILLEGAL.

## Description

This function translates a C double into the equivalent GemStone SmallDouble object.

## See Also

[GciFltToOop](#) on page 205

## GciEnableFreeOopEncoding

Enable encoding of free OOPs sent between the client and the RPC Gem.

### Syntax

```
void GciEnableFreeOopEncoding()
```

### Description

This function enables run-length encoding of free OOPs sent between the Gem and the GemBuilder client.

This function increases CPU consumption on both the client and the Gem, and decreases the number of bytes passed on the network.

## GciEnableFullCompression

Enable full compression between the client and the RPC version of GemBuilder.

### Syntax

```
void GciEnableFullCompression()
```

### Description

This function enables full compression (in both directions) between the client and GciRpc (the “remote procedure call” version of GemBuilder). This function has no effect for linked sessions.

# GciEnableSignaledErrors

Establish or remove GemBuilder visibility to signaled errors from GemStone.

## Syntax

```
BoolType GciEnableSignaledErrors(  
    BoolType          BoolType          newState );
```

## Arguments

*newState* The new state of signaled error visibility: TRUE for visible.

## Return Value

This function returns TRUE if signaled errors are already visible when it is called.

## Description

GemStone permits selective response to signal errors: `RT_ERR_SIGNAL_ABORT`, `RT_ERR_SIGNAL_COMMIT`, and `RT_ERR_SIGNAL_GEMSTONE_SESSION`. The default condition is to leave them all invisible. GemStone responds to each single kind of signal error only after an associated method of class System has been executed: `enableSignaledAbortError`, `enableSignaledObjectsError`, and `enableSignaledGemStoneSessionError` respectively.

After **GciInit** executes successfully, the GemBuilder default condition also leaves all signal errors invisible. The **GciEnableSignaledErrors** function permits GemBuilder to respond automatically to signal errors. However, GemStone must respond to each kind of error in order for GemBuilder to respond to it. Thus, if an application calls **GciEnableSignaledErrors** with *newState* equal to TRUE, then GemBuilder responds automatically to exactly the same kinds of signal errors as GemStone. If GemStone has not executed any of the appropriate System methods, then this call has no effect until it does.

When enabled, GemBuilder checks for signal errors at the start of each function that accesses the database. It treats any that it finds just like any other errors, through **GciErr** or the **GciLongJump** mechanism, as appropriate.

Automatic checking for signalled errors incurs no extra runtime cost. The check is optimized into the check for a valid session. However, instead of checking automatically, these errors can be polled by calling the **GciPollForSignal** function.

**GciEnableSignaledErrors** may be called before calling **GciLogin**.

## See Also

**GciErr** on page 152

**GciPollForSignal** on page 318

# GciEncodeOopArray

Encode an array of OOPs, using run-length encoding.

## Syntax

```
int GciEncodeOopArray(  
    OopType *          oopArray,  
    const int          numOops,  
    OopType *          encodedOopArray,  
    BoolType           needsSorting );
```

## Arguments

- oopArray* An OOP array to be encoded.
- numOops* The number of OOPs in *oopArray*.
- encodedOopArray* The encoded OOP array.
- needsSorting* If *oopArray* is known to be in ascending order, set this to FALSE; otherwise set it to TRUE.

## Return Value

Returns the number of elements in the encoded array. Returns -1 indicating an error if the input array was found to be out of sequence and *needsSorting* was set to FALSE.

## Description

This function encodes the OOPs in *oopArray* using run-length encoding and places the result in *encodedOopArray*. Both *oopArray* and *encodedOopArray* must have the size *numOops*.

## See Also

- [GciDecodeOopArray](#) on page 136
- [GciFetchNumEncodedOops](#) on page 181
- [GciGetFreeOopsEncoded](#) on page 210

## GciEncrypt

Encrypt a password string.

### Syntax

```
char * GciEncrypt(  
    const char*          password,  
    char                outBuff[],  
    unsigned int         outBuffSize);
```

### Arguments

*password* String containing a password.

*outBuff* Array in which to put the encrypted password.

*outBuffSize* The maximum number of bytes to place in *outBuff*.

### Return Value

Returns a pointer to the first character of the encrypted password in *outBuff*[], or NULL if the encrypted password is larger than *outBuffSize*.

### Description

This function encrypts a host or GemStone password for use in **GciSetNetEx** or **GciLogin** with password encryption enabled.

## Example

```
BoolType login_encrypt_example(void)
{
    // assume the netldi been started with -a -g so that host
    // userId and host password are not required.
    const char* stoneName    = "gs64stone";
    const char* gemService   = "gemnetobject";
    const char* gsUserName   = "DataCurator";

    // GciInit required before first login
    if (!GciInit()) {
        printf("GciInit failed\n");
        return FALSE;
    }

    char outBuf[1024];
    char * gsPassword = GciEncrypt("swordfish", outBuf,
        sizeof(outBuf));
    if ( gsPassword == NULL ) {
        printf("password encryption failed\n");
        return FALSE;
    }

    GciSetNet(stoneName, "", "", gemService);
    BoolType success = GciLoginEx(gsUserName, gsPassword,
        GCI_LOGIN_PW_ENCRYPTED | GCI_LOGIN_QUIET, 0);
    if (! success) {
        GciErrSType errInfo;
        if (GciErr(&errInfo)) {
            printf("login encrypted password failed; error %d, %s\n",
                errInfo.number, errInfo.message);
        }
    }
    return success;
}
```

## See Also

[GciLoginEx](#) on page 234

[GciSetNetEx](#) on page 357

## GciErr

Prepare a report describing the most recent GemBuilder error.

### Syntax

```
BoolType GciErr(  
    GciErrSType *          errorReport );
```

### Arguments

*errorReport* Address of a GemBuilder error report structure.

### Return Value

TRUE indicates that an error has occurred. The *errorReport* parameter has been modified to contain the latest error information, and the internal error buffer in GemBuilder has been cleared. You can only call **GciErr** once for a given error. If **GciErr** is called a second time, the function returns FALSE.

If the result is TRUE, all objects referenced from *errorReport* have been added to the PureExportSet, unless the error occurred during a **GciStoreTravDoTravRefs\_**, in which case all objects referenced from *errorReport* have been added to the ReferencedSet rather than the PureExportSet.

FALSE indicates no error occurred, and the contents of *errorReport* are unchanged.

### Description

Your application program can call **GciErr** to determine whether or not the previous GemBuilder function call resulted in an error. If an error has occurred, this function provides information about the error and about the state of the GemStone system. In the case of a fatal error, your connection to GemStone is lost, and the current session ID (from **GciGetSessionId**) is reset to `GCL_INVALID_SESSION_ID`.

The **GciErr** function is especially useful when error traps are disabled or are not present. See “GciPopErrJump” on page 320 for information about using general-purpose error traps in GemBuilder. The section “Error Report Structure - GciErrSType” on page 69 describes the C structure for error reports.

### See Also

**GciClearStack** on page 115

**GciContinue** on page 122

**GciErr** on page 152

**GciLongJump** on page 237

**GciPopErrJump** on page 320

**GciPushErrJump** on page 323

**GciRaiseException** on page 324

**GciSetErrJump** on page 351



# GciExecute

Execute a Smalltalk expression contained in a GemStone String or Utf8 object.

## Syntax

```

OopType GciExecute(
    OopType          source,
    OopType          symbolList);

```

## Arguments

- source* The OOP of a String or Utf8 containing a sequence of one or more Smalltalk statements to be executed.
- symbolList* The OOP of a GemStone symbol list. A value of OOP\_NIL means to use the default symbol list for the current GemStone session (that is, `System myUserProfile symbolList`).

## Return Value

Returns the OOP of the execution result. In case of error, this function returns OOP\_NIL.

## Description

This function sends an expression (or sequence of expressions) to GemStone for execution. This is roughly equivalent to executing the body of a nameless procedure (method).

In most cases, you may find it more efficient to use **GciExecuteStr**. That function takes a C string as its argument, thus reducing the number of network round-trips required to execute the code. With **GciExecute**, you must first convert the source to a String or Utf8 object (see the following example.) If the source is already one of these kinds of object, however, **GciExecute** will be more efficient.

Because **GciExecute** calls the virtual machine, the user can issue a soft break while this function is executing. For more information, see "Interrupting GemStone Execution" on page 30.

## Example

```

BoolType execute_example(void)
{
    OopType oString = GciNewString(" ^ 3 + 4 ");
    OopType result = GciExecute(oString, OOP_NIL);
    if (result == OOP_NIL) {
        printf("error from execution\n");
        return false;
    }

    BoolType conversionErr = FALSE;
    int val = GciOopToI32_(result, &conversionErr);
    if (conversionErr) {
        printf("Error converting result to C int\n");
    }
}

```

```
    } else {  
        printf("result = %d\n", val);  
    }  
    return ! conversionErr;  
}
```

## See Also

**GciExecuteFromContext** on page 155  
**GciExecuteStr** on page 157  
**GciExecuteStrFetchBytes** on page 159  
**GciExecuteStrFromContext** on page 161  
**GciNbExecute** on page 249  
**GciPerform** on page 307

# GciExecuteFromContext

Execute a Smalltalk expression contained in a String or Utf8 object as if it were a message sent to another object.

## Syntax

```
OopsType GciExecuteFromContext(  
    OopsType          source,  
    OopsType          contextObject,  
    OopsType          symbolList );
```

## Arguments

- source* The OOP of a String or Utf8 containing a sequence of one or more Smalltalk statements to be executed.
- contextObject* OOP\_ILLEGAL, or the OOP of any GemStone object. The code to be executed is compiled as if it were a method in the class of *contextObject*. A value of OOP\_ILLEGAL or OOP\_NO\_CONTEXT means no context.
- symbolList* The OOP of a GemStone symbol list. A value of OOP\_NIL means to use the default symbol list for the current GemStone session (that is, `System myUserProfile symbolList`).

## Return Value

Returns the OOP of the execution result. In case of error, this function returns OOP\_NIL.

## Description

This function sends an expression (or sequence of expressions) to GemStone for execution. The source is executed as though *contextObject* were the receiver. That is, the pseudo-variable *self* will have the value *contextObject* during the execution. Messages in the source are executed as defined for *contextObject*.

For example, if *contextObject* is an instance of Association, the *source* can reference the pseudo-variables *key* and *value* (referring to the instance variables of the Association *contextObject*). If any pool dictionaries were available to Association, the *source* could reference them too.

In most cases, you may find it more efficient to use **GciExecuteStrFromContext**. That function takes a C string as its argument, thus reducing the number of network round-trips required to execute the code. With **GciExecuteFromContext**, you must first convert the source to a String or Utf8 object. If the source is already one of these kinds of object, however, **GciExecuteFromContext** will be more efficient.

Because **GciExecuteFromContext** calls the virtual machine, the user can issue a soft break while this function is executing. For more information, see "Interrupting GemStone Execution" on page 30.

## See Also

- GciExecuteStr** on page 157
- GciExecuteStrFetchBytes** on page 159
- GciExecuteStrFromContext** on page 161
- GciNbExecuteFromContextDbg\_** on page 250
- GciNbExecuteStrFromContext** on page 255
- GciPerform** on page 307

# GciExecuteStr

Execute a Smalltalk expression contained in a C string.

## Syntax

```
OopsType GciExecuteStr(  
    const char          source[ ],  
    OopsType           symbolList );
```

## Arguments

*source* A null-terminated string containing a sequence of one or more Smalltalk statements to be executed.

*symbolList* The OOP of a GemStone symbol list. A value of OOP\_NIL means to use the default symbol list for the current GemStone session (that is, `System myUserProfile symbolList`).

## Return Value

Returns the OOP of the execution result. In case of error, this function returns OOP\_NIL.

## Description

This function sends an expression (or sequence of expressions) to GemStone for execution.

If the source is already a String object, you may find it more efficient to use **GciExecute**. That function takes the OOP of a String as its argument.

Because **GciExecuteStr** calls the virtual machine, the user can issue a soft break while this function is executing. For more information, see *“Interrupting GemStone Execution”* on page 30.

## Example

```
void executeStrExample(void)
{
    // get the symbolList for UserProfile named 'romeo'
    OopType symbolList = GciExecuteStr(
        "(AllUsers userWithId: 'Newton') symbolList", OOP_NIL);

    // get the value associated with key "#GciStructsMd5" in that
    // symbolList ; expected to be a kind of String
    OopType keysum = GciExecuteStr("GciStructsMd5", symbolList);

    // fetch characters of the String
    char buf[1024];
    GciFetchChars_(keysum, 1, buf, sizeof(buf));

    GciErrSType errInfo;
    if ( GciErr(&errInfo)) {
        // FMT_OID format string is defined in gci.ht
        printf("unexpected error category \"FMT_OID\" number %d, %s\n",
            errInfo.category, errInfo.number, errInfo.message);
    } else {
        printf("#GciStructsMd5 is %s \n", buf);
    }
}
```

## See Also

**GciExecute** on page 153  
**GciExecuteStrFetchBytes** on page 159  
**GciExecuteStrFromContext** on page 161  
**GciNbExecuteStr** on page 252  
**GciPerform** on page 307

## GciExecuteStrFetchBytes

Execute a Smalltalk expression contained in a C string, returning byte-format results.

### Syntax

```
int64 GciExecuteStrFetchBytes(
    const char *      source,
    int64            sourceSize,
    OopType          sourceClass,
    OopType          contextObject,
    OopType          symbolList,
    ByteType *      result,
    int64            maxResultSize );
```

### Input

- source* A null-terminated string containing a sequence of one or more Smalltalk statements to be executed.
- sourceSize* The number of bytes in the *source*, or -1. If *sourceSize* is -1, `strlen(source)` is used.
- sourceClass* The OOP of a class to use for the compilation target for the text in *sourceStr*, typically `OOP_CLASS_STRING`, `OOP_CLASS_Utf8`, or `OOP_CLASS_Unicode7`.
- contextObject* `OOP_ILLEGAL`, or the OOP of any GemStone object. The code to be executed is compiled as if it were a method in the class of *contextObject*. A value of `OOP_ILLEGAL` or `OOP_NO_CONTEXT` means no context.
- symbolList* The OOP of a GemStone symbol list. A value of `OOP_NIL` means to use the default symbol list for the current GemStone session (that is, `System myUserProfile symbolList`).
- resultBuf* Array containing the bytes of the result of the execution.
- maxResultSize* The maximum size of the resulting string.

### Return Value

Returns the number of bytes returned in the result buffer, or -1 if an error occurred.

### Description

This function sends an expression (or sequence of expressions) to GemStone for execution. The execution result, which should be a byte format object is returned in the *\*result* buffer.

Execution is in environment 0 using `GCI_PERFORM_FLAG_ENABLE_DEBUG`.

## See Also

**GciExecute** on page 153

**GciExecuteStr** on page 157

**GciExecuteStrFromContext** on page 161

**GciNbExecuteStrFetchBytes** on page 253

**GciPerform** on page 307



## GciExecuteStrFromContext

Execute a Smalltalk expression contained in a C string as if it were a message sent to an object.

### Syntax

```

OopType GciExecuteStrFromContext(
    const char          source[ ],
    OopType             contextObject,
    OopType             symbolList);

```

### Arguments

*sourceStr* A null-terminated string containing a sequence of one or more Smalltalk statements to be executed.

*contextObject* The OOP of any GemStone object. The code to be executed is compiled as if it were a method in the class of *contextObject*. A value of OOP\_ILLEGAL or OOP\_NO\_CONTEXT means no context.

*symbolList* The OOP of a GemStone symbol list. A value of OOP\_NIL means to use the default symbol list for the current GemStone session (that is, `System myUserProfile symbolList`).

### Return Value

Returns the OOP of the execution result. In case of error, this function returns OOP\_NIL.

### Description

This function sends an expression (or sequence of expressions) to GemStone for execution. The source is executed as though *contextObject* were the receiver. That is, the pseudo-variable self will have the value *contextObject* during the execution. Messages in the source are executed as defined for *contextObject*.

For example, if *contextObject* is an instance of Association, the source can reference the pseudo-variables *key* and *value* (referring to the instance variables of the Association *contextObject*). If any pool dictionaries were available to Association, the source could reference them too.

Because **GciExecuteStrFromContext** calls the virtual machine, the user can issue a soft break while this function is executing. For more information, see "Interrupting GemStone Execution" on page 30.

### Example

```

void executeFromContextExample(void)
{
    // get the Association with key UserProfileSet in dictionary Globals
    OopType oAssoc = GciExecuteStr("Globals associationAt:
        #UserProfileSet",
        OOP_NIL);
}

```

```
OopType oResult = GciExecuteStrFromContext(" ^ value ", oAssoc,
                                           OOP_NIL);

if (oResult != OOP_CLASS_USERPROFILE_SET) {
    printf("unexpected result" FMT_OID " \n", oResult);
}
}
```

## See Also

**GciExecute** on page 153

**GciExecuteStr** on page 157

**GciExecuteStrFetchBytes** on page 159

**GciNbExecuteStrFromContext** on page 255

**GciPerform** on page 307

## GciExecuteStrTrav

First execute a Smalltalk expression contained in a C string as if it were a message sent to an object, then traverse the result of the execution.

### Syntax

```
BoolType GciExecuteStrTrav(
    const char      sourceStr[ ],
    OopType         contextObject,
    OopType         symbolList,
    GciClampedTravArgsSType *travArgs );
```

### Arguments

*sourceStr* A null-terminated string containing a sequence of one or more Smalltalk statements to be executed.

*contextObject* OOP\_ILLEGAL, or the OOP of any GemStone object. The code to be executed is compiled as if it were a method in the class of *contextObject*. A value of OOP\_ILLEGAL or OOP\_NO\_CONTEXT means no context.

*symbolList* The OOP of a GemStone symbol list. A value of OOP\_NIL means to use the default symbol list for the current GemStone session (that is, `System myUserProfile symbolList`).

*travArgs* Pointer to an instance of **GciClampedTravArgsSType**, as described under "Clamped Traversal Arguments - GciClampedTravArgsSType" on page 77. On return, the instance of **GciClampedTravArgsSType**, with **GciClampedTravArgsSType->travBuff** filled. The first element placed in the buffer is the *actualBufferSize*, an integer that indicates how many bytes were actually stored in the buffer by this function. The remainder of the traversal buffer consists of a series of object reports, each of which is of type **GciObjRepSType**.

### Return Value

Returns FALSE if the traversal is not yet completed. You can then call **GciMoreTraversal** to proceed. Returns TRUE if there are no more objects to be returned by subsequent calls to **GciMoreTraversal**.

### Description

This function is like **GciPerformTrav**, except that it first does a **GciExecuteStr** instead of a **GciPerform**.

### See Also

**GciExecute** on page 153

**GciExecuteStr** on page 157

**GciMoreTraversal** on page 238

**GciNbExecuteStrTrav** on page 256

**GciPerformTrav** on page 314

**GciPerformTraverse** on page 315

# GciFetchByte

Fetch one byte from an indexed byte object.

## Syntax

```
ByteType GciFetchByte(  
    OopType          theObject,  
    int64            atIndex );
```

## Arguments

*theObject* The OOP of the GemStone byte object.

*atIndex* The index into *theObject* of the element to be fetched. The index of the first element is 1.

## Return Value

Returns the byte value at the specified index. In case of error, this function returns zero.

## Description

This function fetches a single element from a byte object at the specified index, using structural access.

## Example

```
void fetchByteExample(void)  
{  
    OopType oString = GciNewString("abc");  
  
    ByteType theChar = GciFetchByte(oString, 2);  
    if (theChar != 'b') {  
        printf("unexpected result %d \n", theChar);  
    }  
}
```

## See Also

[GciFetchBytes\\_ on page 166](#)

[GciFetchChars\\_ on page 168](#)

[GciFetchOop on page 186](#)

[GciStoreByte on page 367](#)

## GciFetchBytes\_

Fetch multiple bytes from an indexed byte object.

### Syntax

```
int64 GciFetchBytes_(
    OopType          theObject,
    int64            startIndex,
    ByteType         theBytes[ ],
    int64            numBytes );
```

### Arguments

- theObject* The OOP of the GemStone byte object.
- startIndex* The index into *theObject* at which to begin fetching bytes. The index of the first element is 1. Note that if *startIndex* is 1 greater than the size of the object, this function returns a byte array of size 0, but no error is generated.
- theBytes* The array of fetched bytes.
- numBytes* The maximum number of bytes to return.

### Return Value

Returns the number of bytes fetched. (This may be less than *numBytes*, depending upon the size of *theObject*.) In case of error, this function returns zero.

### Description

This function fetches multiple elements from a byte object starting at the specified index, using structural access. A common application of **GciFetchBytes\_** would be to fetch a text string.

**GciFetchBytes\_** permits *theObject* to be a byte object with multiple bytes per character or digit, such as DoubleByteString, Float and LargeInteger. In this case, **GciFetchBytes\_** provides automatic byte swizzling to client native byte order. For more about byte swizzling, see "Byte-Swizzling of Binary Floating-Point Values" on page 26. For MultiByteStrings, *startIndex* must be aligned on character boundaries and *numbytes* must be a multiple of the number of bytes per character; for numeric objects *startIndex* must be one and *numBytes* the size of the numeric class.

### Example

This example will print a GemStone String of arbitrarily large size, by repeatedly fetching fixed size buffers.

```
BoolType fetchBytes_example(OopType anObj)
{
    int BUF_SIZE = 5000;
    char buff[BUF_SIZE];
    BoolType done = FALSE;
    int idx = 1;
    GciErrSType err;
```

```
while (! done) {
    int64 numRet = GciFetchBytes_(anObj, idx, (ByteType*)buff,
        BUF_SIZE - 1);
    if (numRet == 0) {
        done = TRUE; // hit end of object or error
        if (GciErr(&err)) {
            printf("error %d, %s\n", err.number, err.message);
            return false;
        }
    } else {
        buff[numRet] = '\0';
        printf("%s\n", buff);
        idx += numRet;
    }
}
return true;
}
```

## See Also

[GciFetchByte](#) on page 165  
[GciFetchChars\\_](#) on page 168  
[GciFetchOop](#) on page 186  
[GciStoreBytes](#) on page 368

## GciFetchChars\_

Fetch multiple ASCII characters from an indexed byte object.

### Syntax

```
int64 GciFetchChars_(  
    OopType          theObject,  
    int64            startIndex,  
    char *           cString,  
    int64            maxSize );
```

### Arguments

- theObject* The OOP of an object containing ASCII characters.
- startIndex* The index of the first character to retrieve.
- cString* Pointer to the location in which to store the returned string.
- maxSize* Maximum number of characters to fetch.

### Return Value

Returns the number of characters fetched.

### Description

Equivalent to **GciFetchBytes\_**, except that it is assumed that *theObject* contains ASCII text. The bytes fetched are stored in memory starting at *cString*. At most *maxSize* - 1 bytes will be fetched from the object, and a `\0` character will be stored in memory following the bytes fetched. The function returns the number of characters fetched, excluding the null terminator character, which is equivalent to `strlen(cString)` if the object does not contain any null characters. If an error occurs, the function result is 0, and the contents of *cString* are undefined.

### See Also

- GciFetchByte** on page 165
- GciFetchBytes\_** on page 166
- GciStoreChars** on page 372



# GciFetchClass

Fetch the class of an object.

## Syntax

```
OopType GciFetchClass(
    OopType          theObject);
```

## Arguments

*theObject* The OOP of the object.

## Return Value

Returns the OOP of the object's class. In case of error, this function returns OOP\_NIL.

The GemBuilder include file \$GEMSTONE/include/gcioop.ht defines a C constant for each of the Smalltalk kernel classes.

## Description

The **GciFetchClass** function obtains the class of an object from GemStone. The GemBuilder session must be valid when **GciFetchClass** is called, unless theObject is an instance of one of the following classes: Boolean, Character, JisCharacter, SmallInteger, SmallDouble, or UndefinedObject.

## Example

```
#include <stdlib.h>

void fetchClassExample(void)
{
    // random double to Oop conversion producing a Float or SmallDouble
    double rand = drand48() * 1.0e38 ;
    OopType oFltObj = GciFltToOop(rand);

    OopType oClass = GciFetchClass(oFltObj);
    const char* kind;
    if (oClass == OOP_CLASS_SMALL_DOUBLE) {
        kind = "SmallDouble";
    } else if (oClass == OOP_CLASS_FLOAT) {
        kind = "Float";
    } else {
        kind = "Unexpected";
    }
    printf("result is a %s, class oop = "FMT_OID"\n", kind, oClass);
}
```

## See Also

**GciFetchNamedSize** on page 179

**GciFetchObjImpl** on page 185

**GciFetchSize\_** on page 194

**GciFetchVaryingSize\_** on page 202

# GciFetchDateTime

Convert the contents of a DateTime object and place the results in a C structure.

## Syntax

```
void GciFetchDateTime(  
    OopType          datetimeObj,  
    GciDateTimeSType * result );
```

## Arguments

*datetimeObj* The OOP of the object to fetch.

*result* C pointer to the structure for the returned object.

## Description

Fetches the contents of a DateTime object into the specified C result. Generates an error if *datetimeObj* is not an instance of DateTime. The value that *result* points to is undefined if an error occurs. For details on GciDateTimeSType, see **GciDateTimeSType** on page 68.

## GciFetchDateAndTime

Convert the contents of a DateAndTime object and place the results in a C structure.

### Syntax

```
BoolType GciFetchDateAndTime(  
    OopType      dateAndTimeObj,  
    GciDateAndTime * result );
```

### Arguments

*dateAndTimeObj* The OOP of the object to fetch.

*result* C pointer to the structure for the returned object.

### Description

Fetches the contents of a DateAndTime object into the specified C result. Generates an error if *dateAndTimeObj* is not an instance of DateAndTime. The value that *result* points to is undefined if an error occurs. For details on GciDateAndTime, see **GciDateAndTime** on page 68.

## GciFetchDateAndTimePosix

Convert the contents of a DateAndTime object and place the results in a C structure.

### Syntax

```
void GciFetchDateAndTimePosix(  
    OopType          dateAndTimeObj,  
    GciPosixDateAndTime * result );
```

### Arguments

*dateAndTimeObj* The OOP of the object to fetch.

*result* C pointer to the structure for the returned object.

### Description

Fetches the contents of a DateAndTime object into the specified C result. Generates an error if *dateAndTimeObj* is not an instance of DateAndTime. The value that *result* points to is undefined if an error occurs. For details on GciPosixDateAndTime, see **GciPosixDateAndTime** on page 68.

## GciFetchDynamicIv

Fetch the OOP of one of an object's dynamic instance variables.

### Syntax

```
OopType GciFetchDynamicIv(  
    OopType      theObject,  
    OopType      aSymbol );
```

### Arguments

*theObject* The OOP of the object.

*aSymbol* Specifies the dynamic instance variable to fetch.

### Return Value

Returns the OOP of the specified dynamic instance variable. If no such dynamic instance variable exists in the object, this function returns OOP\_NIL.

### Description

This function fetches the contents of an object's dynamic instance variable, as specified by *aSymbol*.

### See Also

[GciFetchDynamicIvs](#) on page 175

[GciStoreDynamicIv](#) on page 373

# GciFetchDynamicIvs

Fetches the OOPs of one or more of an object's dynamic instance variables.

## Syntax

```
int GciFetchDynamicIvs(  
    OopType          theObject,  
    OopType *        buf,  
    int              numOops);
```

## Arguments

*theObject* The OOP of the object.

*buf* C pointer to the buffer that will contain the object's dynamic instance variables.

*numOops* The maximum number of elements to return.

## Return Value

Returns the number of OOPs fetched. (This may be less than *numOops*, depending upon the size of *theObject*.)

## Description

The number of dynamic instance variable pairs returned is (function result / 2). To obtain all dynamic instance variables in one call, use a buffer.

## See Also

[GciFetchDynamicIv](#) on page 174

[GciStoreDynamicIv](#) on page 373

## GciFetchNamedOop

Fetch the OOP of one of an object's named instance variables.

### Syntax

```
OopType GciFetchNamedOop(  
    OopType      theObject,  
    int          atIndex );
```

### Arguments

*theObject* The OOP of the object.

*atIndex* The index into *theObject*'s named instance variables of the element to be fetched. The index of the first named instance variable is 1.

### Return Value

Returns the OOP of the specified named instance variable. In case of error, this function returns OOP\_NIL.

### Description

This function fetches the contents of an object's named instance variable at the specified index, using structural access.

### Example

See "Executing the examples" on page 91 for the Smalltalk code that defines the classes and objects that support the examples.

```
BoolType fetchNamedOop_example(OopType anAccount)  
{  
    // fetch anAccount's salesRep, hard coding offset  
    int indexOfSalesRep = 3;  
    OopType oName1 = GciFetchNamedOop(anAccount, indexOfSalesRep);  
  
    // fetch anAccount's salesRep without hardcoding offset  
    int ivOffset = GciIvNameToIdx(GciFetchClass(anAccount), "salesRep");  
    OopType oName2 = GciFetchNamedOop(anAccount, ivOffset);  
  
    return oName1 = oName2;  
}
```

### See Also

[GciFetchNamedOops](#) on page 177

[GciFetchVaryingOop](#) on page 198

[GciIvNameToIdx](#) on page 230

[GciStoreNamedOop](#) on page 377



## GciFetchNamedOops

Fetch the OOPs of one or more of an object's named instance variables.

### Syntax

```
int GciFetchNamedOops(
    OopType          theObject,
    int              startIndex,
    OopType          theOops[],
    int              numOops);
```

### Arguments

- theObject* The OOP of the object.
- startIndex* The index into *theObject*'s named instance variables at which to begin fetching. The index of the first named instance variable is 1. Note that if *startIndex* is 1 greater than the size of the object, this function returns a byte array of size 0, but no error is generated.
- theOops* The array of fetched OOPs.
- numBytes* The maximum number of elements to return.

### Return Value

Returns the number of OOPs fetched. (This may be less than *numOops*, depending upon the size of *theObject*.) In case of error, this function returns zero.

### Description

This function uses structural access to fetch multiple values from an object's named instance variables, starting at the specified index.

### Example

See "Executing the examples" on page 91 for the Smalltalk code that defines the classes and objects that support the examples.

This example fetches an Account's id, customer, and salesRep.

```
BoolType fetchNamedOops_example(OopType anAccount)
{
    GciErrSType err;
    // fetch the number of named instvars

    int namedSize = GciFetchNamedSize(anAccount);
    if (namedSize == 0) { return false; }

    OopType *oBuffer = (OopType*) malloc( sizeof(OopType) * namedSize );
    if (oBuffer == NULL) { return false; }
```

```
int numRet = GciFetchNamedOps(anAccount, 1, oBuffer, namedSize);
if (GciErr(&err)) {
    printf("Error %d, %s\n", err.number, err.message);
    return false;
}
free(oBuffer);
return (numRet == namedSize) ;
}
```

## See Also

**GciFetchNamedOop** on page 176  
**GciFetchVaryingOops** on page 200  
**GciIvNameToIdx** on page 230  
**GciStoreNamedOops** on page 378

## GciFetchNamedSize

Fetch the number of named instance variables in an object.

### Syntax

```
int GciFetchNamedSize(  
    OopType theObject );
```

### Arguments

*theObject* The OOP of the object.

### Return Value

Returns the number of named instance variables in *theObject*. In case of error, this function returns zero.

### Description

This function returns the number of named instance variables in a GemStone object. See the example for **GciFetchNamedOops** on page 177.

## GciFetchNameOfClass

Fetch the class name object for a given class.

### Syntax

```
OopsType GciFetchNameOfClass(  
    OopsType aClass );
```

### Arguments

*aClass* The OOP of a class.

### Return Value

The OOP of the class's name, or OOP\_NIL if an error occurred.

### Description

Given the OOP of a class, this function returns the object identifier of the String object that is the name of the class.

# GciFetchNumEncodedOops

Obtain the size of an encoded OOP array.

## Syntax

```
int GciFetchNumEncodedOops(  
    OopType *          encodedOopArray,  
    const int          numEncodedOops );
```

## Arguments

*encodedOopArray* An OOP array that was encoded by a call to **GciEncodeOopArray**.

*numEncodedOops* The number of OOPs in *encodedOopArray*.

## Return Value

Returns the number of OOPs that will be decoded by a call to **GciDecodeOopArray**.

## Description

This function returns the total number of OOPs in an OOP array that was encoded by a call to **GciEncodeOopArray**.

## See Also

**GciDecodeOopArray** on page 136

**GciEnableFreeOopEncoding** on page 146

**GciEncodeOopArray** on page 149

**GciGetFreeOopsEncoded** on page 210

## GciFetchNumSharedCounters

Obtain the number of shared counters available on the shared page cache used by this session.

### Syntax

```
int GciFetchNumSharedCounters();
```

### Return Value

Returns the number of shared counters available on the shared page cache used by this session, or -1 if the session is not logged in.

### Description

This function returns the total number of shared counters available on the shared page cache used by this session.

Not supported for remote GCI interfaces.

### See Also

**GciDecSharedCounter** on page 137  
**GciIncSharedCounter** on page 217  
**GciSetSharedCounter** on page 360  
**GciReadSharedCounter** on page 325  
**GciReadSharedCounterNoLock** on page 326  
**GciFetchSharedCounterValuesNoLock** on page 193

## GciFetchObjectInfo

Fetch information and values from an object.

### Syntax

```
BoolType GciFetchObjectInfo(
    OopType      theObject,
    GciFetchObjInfoArgsSType * args );
```

### Arguments

- theObject* OOP of any object with byte, pointer, or NSC format.
- args* Pointer to an instance of **GciFetchObjInfoArgsSType** with the following argument fields:
- GciObjInfoSType \* info**  
Pointer to an instance of **GciObjInfoSType**, or NULL.
  - ByteType \* buffer**  
Pointer to an area where byte or OOP values will be returned, or NULL.
  - int64 startIndex**  
The offset in the object at which to start fetching, a 1-based offset into the named and unnamed instance variables. Ignored if *bufSize* == 0 or *buffer* == NULL.
  - int64 bufSize**  
The size in bytes of the buffer, maximum number of elements fetched for a byte object. For an OOP object, the maximum number of elements fetched for an OOP object will be *bufSize*/8. If fetching a kind of BinaryFloat and greater than zero, it must be large enough to fetch the complete object.
  - int64 numReturned**  
On return, this contains the number of logical elements (bytes or OOPs) returned in *buffer*. Note that the size of (**OopType**) is 8 bytes.
  - int retrievalFlags**  
If (*retrievalFlags* & GCI\_RETRIEVE\_EXPORT) != 0 then if *theObject* is non-special, *theObject* is automatically added to the PureExportSet or the user action's export set (see **GciSaveObjs** on page 347).

### Return Value

TRUE if successful, FALSE if an error occurs.

### Description

**GciFetchObjectInfo** fetches information and values from an object starting at the specified index using structural access. If either *info* or *buffer* is NULL, then that part of the result is not filled in. If *numReturned* is NULL, then *buffer* will not be filled in.

The offset in *startIndex* does not distinguish between named and unnamed instance variables. Indices are based at the beginning of the object's array of instance variables. In that array, any existing named instance variables are followed by any existing unnamed instance variables

If *theObject* is a byte object with multiple bytes per character or digit, such as `DoubleByteString`, `LargeInteger`, or `Float`, the results in *args->buffer* will be automatically byte swizzled to client native byte order. For more about byte swizzling, see “Byte-Swizzling of Binary Floating-Point Values” on page 26.

For `MultiByteStrings`, *args->startIndex* must be aligned on a character boundary and *args->bufSize* must be a multiple of the number of bytes per character in the string. For numeric objects, *args->startIndex* must be one and *args->bufSize* must be the size of the numeric class.

## See Also

**GciFetchOops** on page 188  
**GciFetchBytes\_** on page 166  
**GciFetchOop** on page 186  
**GciSaveObjs** on page 347



# GciFetchObjImpl

Fetch the implementation of an object.

## Syntax

```
int GciFetchObjImpl(  
    OopType theObject);
```

## Arguments

*theObject* The OOP of the object.

## Return Value

Returns an integer representing the implementation type of *theObject* (0=pointer, 1=byte, 2=NSC, or 3=special). In case of error, the return value is -1.

## Description

This function obtains the implementation of an object (pointer, byte, NSC, special) from GemStone. For more information about implementation types, see “Object implementation” on page 73.

## See Also

[GciFetchClass](#) on page 169  
[GciFetchNamedSize](#) on page 179  
[GciFetchSize\\_](#) on page 194  
[GciFetchVaryingSize\\_](#) on page 202

## GciFetchOop

Fetch the OOP of one instance variable of an object.

### Syntax

```
OopType GciFetchOop(
    OopType          theObject,
    int64            atIndex );
```

### Arguments

*theObject* The OOP of the source object.

*atIndex* The index into *theObject* of the OOP to be fetched. The index of the first OOP is 1.

### Return Value

Returns the OOP at the specified index of the source object. In case of error, this function returns OOP\_NIL.

### Description

This function fetches the OOP of a single instance variable from any object at the specified index, using structural access. It does not distinguish between named and unnamed instance variables. Indices are based at the beginning of the object's array of instance variables. In that array, any existing named instance variables are followed by any existing unnamed instance variables.

### Example

See "Executing the examples" on page 91 for the Smalltalk code that defines the classes and objects that support the examples. This example illustrates fetching one named and one unnamed instance variable from an Account.

```
BoolType fetchOop_example(OopType anAccount)
{
    GciErrSType err;
    // fetch the number of named and unnamed instvars
    int namedSize = GciFetchNamedSize(anAccount);
    int64 varyingSize = GciFetchVaryingSize_(anAccount);

    // fetch anAccount's salesRep
    int indexOfSalesRep = 3;
    if (namedSize < indexOfSalesRep) { return false; }
    OopType salesRep = GciFetchOop(anAccount, indexOfSalesRep );
    if (GciErr(&err)) {
        printf("Error %d, %s\n", err.number, err.message);
        return false; }

    // fetch the first product in the indexed variables
    if (varyingSize < 1) { return false; }
    OopType firstProduct = GciFetchOop(anAccount, namedSize + 1 );
```

```
    if (GciErr(&err)) {
        printf("Error %d, %s\n", err.number, err.message);
        return false;    }

    return true;
}
```

## See Also

**GciFetchOops** on page 188

**GciStoreOop** on page 380

**GciStoreOops** on page 382

## GciFetchOops

Fetch the OOPs of one or more instance variables of an object.

### Syntax

```
int GciFetchOops(
    OopType          theObject,
    int64            startIndex,
    OopType          theOops[ ],
    int              numOops );
```

### Arguments

- theObject* The OOP of the source object.
- startIndex* The index into *theObject*'s unnamed and named instance variables at which to begin fetching. The index of the first instance variable is 1. Note that if *startIndex* is 1 greater than the size of the object, this function returns an array of size 0, but no error is generated.
- theOops* The array of fetched OOPs.
- numOops* The maximum number of OOPs to return.

### Return Value

Returns the number of OOPs fetched. (This may be less than *numOops*, depending upon the size of *theObject*.) In case of error, this function returns zero.

### Description

This function fetches the OOPs of multiple instance variables from any object starting at the specified index, using structural access. It does not distinguish between named and unnamed instance variables. Indices are based at the beginning of the object's array of instance variables. In that array, any existing named instance variables are followed by any existing unnamed instance variables.

### Example

See "Executing the examples" on page 91 for the Smalltalk code that defines the classes and objects that support the examples.

```
BoolType fetchOops_example(OopType anAccount)
{
    GciErrSType err;
    // fetch the number of named and unnamed instvars
    int namedSize = GciFetchNamedSize(anAccount);
    int64 varyingSize = GciFetchVaryingSize_(anAccount);

    int mySize = namedSize + varyingSize;
    OopType oBuffer[mySize];
```

```
// Two ways to fetch anAccount's products list
GciFetchOops(anAccount, namedSize + 1, oBuffer, varyingSize);
GciFetchVaryingOops(anAccount, 1, oBuffer, varyingSize);

// Fetch the named instance variables PLUS the products list
GciFetchOops(anAccount, 1, oBuffer, mySize);
// oBuffer[0..namedSize-1] are named instVar values
// oBuffer[namedSize] are varying instVar values

if (GciErr(&err)) {
    printf("Error %d, %s\n", err.number, err.message);
    return false; }

return true;
}
```

## See Also

**GciFetchOops** on page 188  
**GciFetchVaryingOops** on page 198  
**GciStoreOops** on page 382

## GciFetchPaths

Fetch selected multiple OOPs from an object tree.

### Syntax

```
BoolType GciFetchPaths(
    const OopType      theOops [ ],
    int                numOops,
    const int          paths [ ],
    const int          pathSizes [ ],
    int                numPaths,
    OopType           results [ ]);
```

### Arguments

- theOops* A collection of OOPs from which you want to fetch.
- numOops* The size of *theOops*.
- paths* An array of integers. This one-dimensional array contains the elements of all constituent paths, laid end to end.
- pathSizes* An array of integers. Each element of this array is the length of the corresponding path in the *paths* array (that is, the number of elements in each constituent path).
- numPaths* The number of paths in the *paths* array. This should be the same as the number of integers in the *pathSizes* array.
- results* An array containing the OOPs that were fetched.

### Return Value

Returns TRUE if all desired objects were successfully fetched. Returns FALSE if the fetch on any path fails for any reason.

### Description

This function allows you to fetch multiple OOPs from selected positions in an object tree with a single GemBuilder call, importing only the desired information from the database.

Each path in the *paths* array is itself an array of integers. Those integers are offsets that specify a path from which to fetch objects. In each path, a positive integer *x* refers to an offset within an object's named instance variables (see **GciFetchNamedOop**), while a negative integer *-x* refers to an offset within an object's indexed instance variables (see **GciFetchVaryingOop**).

From each object in *theOops*, this function fetches the object pointed to by each element of the paths array, and stores the fetched object into the results array. The *results* array contains (*numOops* \* *numPaths*) elements, stored in the following order:

```
[ 0, 0 ] .. [ 0, numPaths-1 ] ..
[ 1, 0 ] .. [ 1, numPaths-1 ] ..
[ numOops-1, 0 ] .. [ numOops-1, numPaths-1 ]
```

That is, all paths are first applied in order to the first element of *theOops*. This step is repeated for each subsequent object, until all paths have been applied to all elements of *theOops*. The result for object *i* and path *j* is represented as:

```
results[ ((i-1) * numPaths) + (j-1) ]
```

If the fetch on any path fails for any reason, the result of that fetch is reported in the results array as OOP\_ILLEGAL. Because some path-fetching errors do not necessarily invalidate the remainder of the information fetched, the system will then attempt to continue its fetching with the remaining paths and objects.

This ability to complete a fetching sequence despite errors means that your application won't be slowed by a round-trip to GemStone on each fetch to check for errors. Instead, after a fetch is complete, you can cycle through the result and deal selectively at that time with any errors you find.

The appropriate response to an error in path fetching depends both upon the error itself and on your application. Here are some of the reasons why a fetch might not succeed:

- The user had no read authorization for some object in the path. The seriousness of this depends on your application. In some applications, you may simply wish to ignore the inaccessible data.
- The path was invalid for the object to which it was applied. This can happen if the object from which you're fetching is not of the correct class, or if the path itself is faulty for the class of the object.
- The path was valid but simply not filled out for the object being processed. This would be the case, for example, if you attempted to access *address.zip* when an *Employee's Address* instance variable contained only *nil*. This is probably the most common path fetching error, and may require only that the application program detect the condition and display some suitable indication to the user that a field is not yet filled in with meaningful data.

## Example 1: Calling sequence for a single object and a single path

See "Executing the examples" on page 91 for the Smalltalk code that defines the classes and objects that support the examples.

The first example fetches just the street address from a single Account.

```
OopType fetchPaths_example1(OopType anAccount)
{
    GciErrSType errInfo;
    int path_size = 3;
    int aPath[path_size];
    aPath[0] = 2; //name
    aPath[1] = 2; //address
    aPath[2] = 1; //street

    OopType result;
    GciFetchPaths(&anAccount, 1, aPath, &path_size, 1, &result);
    if (GciErr(&errInfo)) {
        printf("Error %d, %s\n", errInfo.number, errInfo.message);
        return OOP_NIL;
    }
    return result;
}
```

## Example 2: Calling sequence for multiple objects with a multiple paths

This example fetches the customer name, and the address city, from two separate accounts.

```
BoolType fetchPaths_example2(int numofAccounts, OopType* resultAccounts)
{
    GciErrSType errInfo;
    OopType myAccts;
    myAccts = GciExecuteStr("AllAccounts", OOP_NIL);
    if (myAccts == OOP_NIL) { return false; }

    int numRet = GciFetchVaryingOops(myAccts, 1, resultAccounts,
        numofAccounts);
    if (numRet != numofAccounts) { return false; }

    int path_segments[2];
    path_segments[0] = 2;
    path_segments[1] = 3;
    int serialPath[6]; // size is sum of path_segments
    serialPath[0] = 2; //customer
    serialPath[1] = 1; //name
    serialPath[2] = 2; //customer
    serialPath[3] = 2; //address
    serialPath[4] = 2; //city

    OopType results[2 * numofAccounts]; // size of path_segments * number
        of accounts
    GciFetchPaths(resultAccounts, numofAccounts, serialPath,
        path_segments, 2, results);

    if (GciErr(&errInfo)) {
        printf("GciFetchPaths error %d, %s\n", errInfo.number,
            errInfo.message);
        return false;
    }
    return true;
}
```

### See Also

[GciStorePaths](#) on page 384



# GciFetchSharedCounterValuesNoLock

Fetch the value of multiple shared counters without locking them.

## Syntax

```
int GciFetchSharedCounterValuesNoLock(  
    int          startIndex,  
    int64_t     buffer[ ],  
    size_t *    maxReturn);
```

## Arguments

- startIndex* The offset into the shared counters array of the first shared counter value to fetch.
- buffer* Pointer to a buffer where the shared counter values will be stored. The buffer must be at least  $8 * maxReturn$  bytes and the address must be aligned on an 8-byte boundary.
- maxReturn* Pointer to a value that indicates the maximum number of shared counters to fetch.

## Return Value

Returns an int indicating the number of shared counter values successfully stored in the buffer. Returns -1 if a bad argument is detected.

## Description

Fetch the values of multiple shared counters in a single call, without locking any of them. The values of the *maxReturn* count of shared counters starting at the offset indicated by *counterIdx* (0-based) are put into the buffer *buffer*. *buffer* must be large enough to accommodate *maxReturn* 8-byte values, and be aligned on an 8-byte boundary.

Not supported for remote GCI interfaces.

## See Also

- [GciDecSharedCounter](#) on page 137
- [GciFetchNumSharedCounters](#) on page 182
- [GciIncSharedCounter](#) on page 217
- [GciReadSharedCounter](#) on page 325
- [GciReadSharedCounterNoLock](#) on page 326
- [GciSetSharedCounter](#) on page 360

## GciFetchSize\_

Fetch the size of an object.

### Syntax

```
int64 GciFetchSize_(
    OopType          theObject );
```

### Arguments

*theObject* The OOP of the object.

### Return Value

Returns the size of *theObject*. In case of error, this function returns zero.

### Description

This function obtains the size of an object from GemStone.

The result of this function depends on the object's implementation (see **GciFetchObjImpl**). For byte objects, this function returns the number of bytes in the object. (For Strings, this is the number of Characters in the String; for Floats, the size is 23.) For pointer objects, this function returns the number of named instance variables (**GciFetchNamedSize**) plus the number of indexed instance variables, if any (**GciFetchVaryingSize\_**). For NSC objects, this function returns the cardinality of the collection. For special objects, the size is always zero.

This differs somewhat from the result of executing the Smalltalk method `Object>>size`, as shown in Table 7.11:

**Table 7.11 Differences in Reported Object Size**

| Implementation | Object>>size (Smalltalk)                                    | GciFetchSize_                                                      |
|----------------|-------------------------------------------------------------|--------------------------------------------------------------------|
| 0=Pointer      | Number of indexed elements in the object (0 if not indexed) | Number of indexed elements PLUS number of named instance variables |
| 1=Byte         | Number of indexed elements in the object                    | Same as Smalltalk message "size"                                   |
| 2=NSC          | Number of elements in the object                            | Same as Smalltalk message "size"                                   |
| 3=Special      | 0                                                           | 0                                                                  |

### Example

```
void fetchSize_example(void)
{
    const char* str = "abcdef";
    OopType oString = GciNewString(str);
```

```
int64 itsSize = GciFetchSize_(oString);
if (itsSize != (int64)strlen(str)) {
    printf("error during fetch size\n");
}
}
```

## See Also

**GciFetchClass** on page 169  
**GciFetchNamedSize** on page 179  
**GciFetchObjImpl** on page 185  
**GciFetchVaryingOop** on page 198

## GciFetchUtf8Bytes\_

## GciFetchUtf8Bytes\_\_

Encode a String, MultiByteString, or Utf8 as UTF-8, and fetch the bytes of the encoded result.

### Syntax

```
int64 GciFetchUtf8Bytes_(
    OopType          oopOfAString,
    int64            startIndex,
    ByteType *       theBytes,
    int64            numBytes,
    OopType *        utf8String,
    int              flags);

int64 GciFetchUtf8Bytes__(
    OopType          oopOfAString,
    int64            startIndex,
    ByteType *       theBytes,
    int64            numBytes,
    OopType *        utf8String,
    int              flags,
    int64            maxConvert);
```

### Arguments

- oopOfAString* The OOP of the GemStone String, MultiByteString or Utf8.
- startIndex* The index into *aString* at which to begin encoding bytes. The index of the first element is 1. Note that if *startIndex* is 1 greater than the size of the object, this function returns a byte array of size 0, but no error is generated.
- theBytes* The array of encoded bytes
- numBytes* The maximum number of bytes to return.
- utf8String* Pointer to the OOP of the encoded string.
- flags* Bits in *flags* are defined by GciFetchUtf8Flags. The options are
  - GCI\_UTF8\_FetchNormal = 0  
generate an error on illegal codePoints in the input.
  - GCI\_UTF8\_NoError = 0x2  
return a message instead of signalling Exception.
- maxConvert* The upper limit of the size in bytes of the instance of Utf8 in *\*utf8String*.

### Return Value

Returns the number of bytes fetched. (This may be less than *numBytes*, depending upon the size of *theObject*.) In case of error, this function returns zero.

## Description

This function encodes a kind of `String`, `MultiByteString`, or `Utf8` into UTF-8. The encoded bytes are placed in the buffer *theBytes*, and the OOP of the encoded object is placed at *utf8String*.

The OOP of *utf8String* is also placed in the `ExportSet`. The caller must pass the OOP of *utf8String* to **GciReleaseOops** after fetching all bytes.

If all characters in *aString* are < 128, or if the class of *aString* is `Utf8`, then the behavior is the same as **GciFetchBytes\_**. No encoding is done; the bytes of *aString* are placed in *theBytes*. *utf8String* is the same as *aString*, and is not added to the `ExportSet`.

## See Also

**GciFetchBytes\_** on page 166

**GciNewUtf8String** on page 281

## GciFetchVaryingOop

Fetch the OOP of one unnamed instance variable from an indexable pointer object or NSC.

### Syntax

```
OopType GciFetchVaryingOop(
    OopType      theObject,
    int64        atIndex );
```

### Arguments

*theObject* The OOP of the pointer or NSC object.

*atIndex* The index of the OOP to be fetched. The index of the first unnamed instance variable's OOP is 1.

### Return Value

Returns the OOP of the unnamed instance variable at index *atIndex*. In case of error, this function returns OOP\_NIL.

### Description

This function fetches the OOP of a single unnamed instance variable at the specified index, using structural access. The numerical index of any unordered variable of an NSC can change whenever the NSC is modified.

### Example

See "Executing the examples" on page 91 for the smalltalk code that supports the examples.

```
OopType fetchVaryingOop_example(OopType anAccount)
{
    GciErrSType err;
    int64 varyingSize = GciFetchVaryingSize_(anAccount);
    if (varyingSize < 1) { return OOP_NIL; }

    // fetch the first product in the indexed variables
    OopType firstProduct = GciFetchVaryingOop(anAccount, 1);
    if (GciErr(&err)) {
        printf("Error %d, %s\n", err.number, err.message);
        return OOP_NIL;    }

    return firstProduct;
}
```

### See Also

[GciFetchNamedOop](#) on page 176

[GciFetchOop](#) on page 186

**GciFetchVaryingOops** on page 200  
**GciStoreIdxOop** on page 374

## GciFetchVaryingOops

Fetch the OOPs of one or more unnamed instance variables from an indexable pointer object or NSC.

### Syntax

```
int GciFetchVaryingOops(
    OopType          theObject,
    int64            startIndex,
    OopType          theOops[ ],
    int              numOops );
```

### Arguments

- theObject* The OOP of the pointer or NSC object.
- startIndex* The index into *theObject*'s elements at which to begin fetching. The index of the first unnamed instance variable is 1. Note that if *startIndex* is 1 greater than the number of unnamed instance variables of the object, this function returns a byte array of size 0, but no error is generated.
- theOops* The array of fetched OOPs.
- numBytes* The maximum number of elements to return.

### Return Value

Returns the number of OOPs fetched. (This may be less than *numOops*, depending upon the size of *theObject*.) In case of error, this function returns zero.

### Description

This function fetches the OOPs of multiple unnamed instance variables beginning at the specified index, using structural access. The numerical index of any unordered variable of an NSC can change whenever the NSC is modified.

### Example

See "Executing the examples" on page 91 for the Smalltalk code that defines the classes and objects that support the examples.

```
BoolType fetchVaryingOops_example(OopType anAccount)
{
    GciErrSType err;
    int64 varyingSize = GciFetchVaryingSize_(anAccount);
    if (varyingSize < 1) { return false; }

    OopType oBuffer[varyingSize];

    // fetch OOPs for all indexed instvars
    int numRet = GciFetchVaryingOops(anAccount, 1, oBuffer, varyingSize);
```



```
    if (GciErr(&err)) {
        printf("Error %d, %s\n", err.number, err.message);
        return false; }

    return numRet = varyingSize;
}
```

## See Also

**GciFetchNamedOops** on page 177  
**GciFetchVaryingOop** on page 198  
**GciFetchVaryingSize\_** on page 202  
**GciStoreIdxOop** on page 374  
**GciStoreIdxOops** on page 375

## GciFetchVaryingSize\_

Fetch the number of unnamed instance variables in a pointer object or NSC.

### Syntax

```
int64 GciFetchVaryingSize_(  
    OopType          theObject );
```

### Arguments

*theObject* The OOP of the object.

### Return Value

Returns the number of unnamed instance variables in *theObject*. In case of error, this function returns zero.

### Description

This function obtains from GemStone the number of indexed variables in an indexable object or the number of unordered variables in an NSC.

### Example

See an example under **GciFetchOop** on page 186.

### See Also

**GciFetchClass** on page 169

**GciFetchNamedSize** on page 179

**GciFetchObjImpl** on page 185

**GciFetchSize\_** on page 194

**GciSetVaryingSize** on page 362

## GciFindObjRep

Fetch an object report in a traversal buffer.

### Syntax

```
GciObjRepHdrSType * GciFindObjRep(
    GciTravBufType *      travBuff,
    OopType               theObject);
```

### Arguments

*travBuff* A traversal buffer returned by a call to **GciTraverseObjs**.

*theObject* The OOP of the object to find.

### Return Value

Returns a pointer to an object report within the traversal buffer. In case of error, this function returns NULL.

### Description

This function locates an object report within a traversal buffer that was previously returned by **GciTraverseObjs**. If the report is not found within the buffer, this function generates the error GCL\_ERR\_TRAV\_OBJ\_NOT\_FOUND.

### Example

```
GciObjRepHdrSType* findObjRepExample(GciTravBufType *buf, OopType objId)
{
    GciObjRepHdrSType *theReport = GciFindObjRep(buf, objId);
    if (theReport == NULL) {
        GciErrSType errInfo;
        if (GciErr(&errInfo)) {
            printf("error category \"FMT_OID\" number %d, %s\n",
                errInfo.category, errInfo.number, errInfo.message);
        }
    }
    return theReport;
}
```

### See Also

**GciTraverseObjs** on page 407

**GciObjRepSize\_** on page 286

## GciFloatKind

Obtain the float kind corresponding to a C double value.

### Syntax

```
GciFloatKindEType GciFloatKind(  
    double          aReal );
```

### Arguments

*aReal* A floating point value.

### Return Value

Returns the type of GemStone Float object that corresponds to the C value.

### Description

This function obtains the kind of GemStone Float object that corresponds to the C floating point value *aReal*.

### See Also

[GciFltToOop](#) on page 205

[GciOopToFlt](#) on page 303

# GciFltToOop

Convert a C double value to a SmallDouble or Float object.

## Syntax

```
OopType GciFltToOop(  
    double                aDouble);
```

## Arguments

*aDouble* A C double value

## Return Value

Returns the OOP of the GemStone SmallDouble or Float object that corresponds to the C value. In case of error, this function returns OOP\_NIL.

## Description

This function translates a C double precision value into the equivalent GemStone Float object.

## Example

```
#include <stdlib.h>  
  
void fltToOopExample(void)  
{  
    // random double to Oop conversion producing a Float or SmallFloat  
    double rand = drand48() * 1.0e38 ;  
    OopType oFltObj = GciFltToOop(rand);  
  
    OopType oClass = GciFetchClass(oFltObj);  
    const char* kind;  
    if (oClass == OOP_CLASS_SMALL_DOUBLE) {  
        kind = "SmallDouble";  
    } else if (oClass == OOP_CLASS_FLOAT) {  
        kind = "Float";  
    } else {  
        kind = "Unexpected";  
    }  
    printf("result is a %s, class oop = "FMT_OID"\n", kind, oClass);  
}
```

## See Also

[GciOopToFlt](#) on page 303

[Gci\\_doubleToSmallDouble](#) on page 145

# GciGetFreeOop

Allocate an OOP.

## Syntax

```
OopType GciGetFreeOop()
```

## Return Value

Returns an unused object identifier (OOP).

You cannot use the result of **GciGetFreeOop** to create a Symbol object.

## Description

Allocates an object identifier without creating an object.

The object identifier returned from this function remains allocated to the Gci session until the session calls **GciLogout** or until the identifier is used as an argument to a function call.

If an object identifier returned from **GciGetFreeOop** is used as a value in a **GciStore...** call before it is used as the *objId* argument of a **GciCreate...** call, then an unresolved forward reference is created in object memory. This is a reference to an object that does not yet exist. This forward reference must be satisfied by using the identifier as the *objId* argument to a **GciCreate...** call before a **GciCommit** can be successfully executed.

If **GciCommit** is attempted prior to satisfying all unresolved forward references, an error is generated and **GciCommit** returns FALSE. Then **GciCreate** can be used to satisfy the forward references and **GciCommit** can be attempted again. **GciAbort** removes all unsatisfied forward references from the session's object space, just as it removes any other uncommitted modifications.

As long as it remains an unresolved forward reference, the identifier returned by **GciGetFreeOop** can be used only as a parameter to the following function calls, under the given restrictions:

- ▶ As the *objID* of the object to be created
  - GciCreateByteObj
- ▶ As the *objID* of the object to be created, or as an element of the value buffer
  - GciCreateOopObj
- ▶ As an element of the value buffer only
  - GciStoreOop
  - GciStoreOops
  - GciStoreIdxOop
  - GciStoreIdxOops
  - GciStoreNamedOop
  - GciStoreNamedOops
  - GciStoreTrav
  - GciAppendOops
  - GciAddOopToNsc
  - GciAddOopsToNsc
  - GciNewOopUsingObjRep
- ▶ As an element of *newValues* only
  - GciStorePaths

## See Also

**GciCreateByteObj** on page 124

**GciCreateOopObj** on page 126

**GciGetFreeOops** on page 208

**GciGetFreeOopsEncoded** on page 210

## GciGetFreeOops

Allocate multiple OOPs.

### Syntax

```
void GciGetFreeOops(  
    int count,  
    OopsType * resultOops );
```

### Arguments

*count* The number of OOPs to allocate. On return, the number of OOPs that were allocated.

*resultOops* An array to hold the allocated OOPs.

### Return Value

Returns an unused object identifier (OOP).

### Description

Allocates object identifiers without creating objects.

If an object identifier returned from **GciGetFreeOops** is used as a value in a **GciStore...** call before it is used as the *objld* argument of a **GciCreate...** call, then an unresolved forward reference is created in object memory. This is a reference to an object that does not yet exist. This forward reference must be satisfied by using the identifier as the *objld* argument to a **GciCreate...** call before a **GciCommit** can be successfully executed.

If **GciCommit** is attempted prior to satisfying all unresolved forward references, an error is generated and **GciCommit** returns false. In this case, **GciCreate** can be used to satisfy the forward references and **GciCommit** can be attempted again. **GciAbort** removes all unsatisfied forward references from the session's object space, just as it removes any other uncommitted modifications.



As long as it remains an unresolved forward reference, the identifier returned by **GciGetFreeOops** can be used only as a parameter to the following function calls, under the given restrictions:

- As the *objID* of the object to be created  
`GciCreateByteObj`
- As the *objID* of the object to be created, or as an element of the value buffer  
`GciCreateOopObj`
- As an element of the value buffer, only  
`GciStoreOop`  
`GciStoreOops`  
`GciStoreIdxOop`  
`GciStoreIdxOops`  
`GciStoreNamedOop`  
`GciStoreNamedOops`  
`GciStoreTrav`  
`GciAppendOops`  
`GciAddOopToNsc`  
`GciAddOopsToNsc`  
`GciNewOopUsingObjRep`
- As an element of *newValues*, only  
`GciStorePaths`

## See Also

**GciCreateByteObj** on page 124

**GciCreateOopObj** on page 126

**GciGetFreeOop** on page 206

**GciGetFreeOopsEncoded** on page 210

# GciGetFreeOopsEncoded

Allocate multiple OOPs.

## Syntax

```
void GciGetFreeOopsEncoded(  
    int *                                count,  
    OopsType *                            encodedOops );
```

## Arguments

*count* The number of OOPs to allocate. On return, the number of OOPs that were allocated.

*encodedOops* A pointer to memory for holding encoded OOPs. Must be at least the size specified by *count*.

## Description

This function is identical to **GciGetFreeOops**, except that it returns OOPs in an encoded array that is more compact for less network I/O. Before the OOPs can be used, the encoded array must be decoded by calling **GciDecodeOopArray()**.

## See Also

**GciCreateByteObj** on page 124  
**GciCreateOopObj** on page 126  
**GciDecodeOopArray** on page 136  
**GciEncodeOopArray** on page 149  
**GciFetchNumEncodedOops** on page 181  
**GciGetFreeOop** on page 206  
**GciGetFreeOops** on page 208  
**GciGetFreeOopsEncoded** on page 210  
**GciFetchNumEncodedOops** on page 181

# GciGetSessionId

Find the ID number of the current user session.

## Syntax

```
GciSessionIdType GciGetSessionId()
```

## Return Value

Returns the session ID currently being used for communication with GemStone. Returns GCI\_INVALID\_SESSION\_ID if there is no session ID (that is, if the application is not logged in).

## Description

This function obtains the unique session ID number that identifies the current user session to GemStone. An application can have more than one active session, but only one current session.

The ID numbers assigned to your application's sessions are unique within your application, but bear no meaningful relationship to the session IDs assigned to other GemStone applications that may be executing at the same time or accessing the same database.

## Example

```
void getSessionExample(const char* userId, const char* password)
{
    if (GciLogin(userId, password)) {
        GciSessionIdType sessId = GciGetSessionId();
        printf("sessionId is %d \n", sessId);
    }
    GciLogout();
    GciSessionIdType sessId = GciGetSessionId();
    if (sessId != GCI_INVALID_SESSION_ID) {
        printf("unexpected sessionId %d after logout \n", sessId);
    }
}
```

## See Also

[GciSetSessionId](#) on page 359

# GciHardBreak

Interrupt GemStone and abort the current transaction.

## Syntax

```
void GciHardBreak()
```

## Description

**GciHardBreak** sends a hard break to the current user session (set by the last **GciLogin** or **GciSetSessionId**), which interrupts Smalltalk execution.

All GemBuilder functions can recognize a hard break, so the users of your application can terminate Smalltalk execution. For example, if your application sends a message to an object (via **GciPerform**), and for some reason the invoked Smalltalk method enters an infinite loop, the user can interrupt the application. **GciHardBreak** has no effect if called from within a User Action.

In order for GemBuilder functions in your program to recognize interrupts, your program will need a signal handler that can call the functions **GciSoftBreak** and **GciHardBreak**. Since GemBuilder does not relinquish control to an application until it has finished its processing, soft and hard breaks must be initiated from a signal handler.

If GemStone is executing when it receives the break, it replies with the error message `RT_ERR_HARD_BREAK`. Otherwise, it ignores the break.

If GemStone is executing any of the following methods of class Repository, then a hard break terminates the entire session, not just Smalltalk execution:

```
fullBackupTo:  
restoreFromBackup(s):  
markForCollection  
objectAudit  
auditWithLimit:  
repairWithLimit:  
pagesWithPercentFree
```

## See Also

**GciSoftBreak** on page 364

# GciHiddenSetIncludesOop

Determines whether the given OOP is present in the specified hidden set.

## Syntax

```
BoolType GciHiddenSetIncludesOop(  
    OopType      theOop,  
    int          hiddenSetId);
```

## Arguments

*theOop* The OOP to search for.

*hiddenSetId* The index to the hidden set to search.

## Return Value

True if the OOP was found; false otherwise.

## Description

The Gem holds objects in a number of sets ordinarily hidden from the user, including the *PureExportSet* and the *GciTrackedObjs* (among others). **GciHiddenSetIncludesOop** allows you to pass in an index to a specified hidden set to determine if the set includes a specific object. For indexes of available hidden sets, see the GemStone Smalltalk method `System Class >> HiddenSetSpecifiers`.

## Example

```
OopType TrackedSetContainsOop(OopType anOop)  
{  
    if (GciHiddenSetIncludesOop(anOop, 40/* GciTrackedObjs */) )  
        return OOP_TRUE;  
    else  
        return OOP_FALSE;  
}
```

## GciI32ToOop

Convert a C 32-bit integer value to a GemStone object.

### Syntax

```
OopType GciI32ToOop(  
    int          anInt );
```

### Arguments

*anInt* A C 32-bit signed integer.

### Return Value

The **GciI32ToOop** function returns the OOP of a GemStone object whose value is equivalent to *anInt*.

### Description

The **GciI32ToOop** function translates a C 32bit integer value into the equivalent GemStone object. This function always succeeds.

### See Also

**GciI64ToOop** on page 216

**GciOopToI32** on page 305

## GCI\_I64\_IS\_SMALL\_INT

(MACRO) Determine whether or not a 64-bit C integer is in the SmallInteger range.

### Syntax

BoolType GCI\_I64\_IS\_SMALL\_INT(*anInt*)

### Arguments

*anInt* A C 64-bit signed integer.

### Return Value

Returns TRUE if the object is within the SmallInteger range, FALSE otherwise.

### Description

This macro tests to see if *anInt* is within the SmallInteger range.

A SmallInteger has a 61 bit 2's complement integer and 3 tag bits. For a positive int64 argument, top 4 bits must be 2r0000 for argument to be within SmallInteger range; for a negative int64 argument, the top 4 bits must be 2r1111 for argument to be within SmallInteger range.

### See Also

GCI\_OOP\_IS\_SMALL\_INT on page 293

## GciI64ToOop

Convert a C 64-bit integer value to a GemStone object.

### Syntax

```
OpType GciI64ToOop(  
    int64          anInt);
```

### Arguments

*anInt* A C 64-bit signed integer.

### Return Value

The **GciI64ToOop** function returns the OOP of a GemStone object whose value is equivalent to *anInt*.

### Description

The **GciI64ToOop** function translates a C 64-bit integer (`int64_t`) value into the equivalent GemStone object. If the result is not a `SmallInteger`, the result is automatically saved to the export set as described under **GciSaveObjs** on page 347.

### See Also

**GciI32ToOop** on page 214

**GciOopToI64** on page 306



# GciIncSharedCounter

Increment the value of a shared counter.

## Syntax

```
BoolType GciIncSharedCounter(  
    int64_t          counterIdx,  
    int64_t *       value);
```

## Arguments

*counterIdx* The offset into the shared counters array of the value to increment.

*value* Pointer to a value that indicates how much to increment the shared counter by. On return, this will hold the new value after the shared counter, after incrementing.

## Return Value

Returns a C Boolean value indicating if the shared counter was successfully incremented. Returns TRUE if successful, FALSE if an error occurred.

## Description

This function increments the value of a particular shared counter by a specified amount. The shared counter is specified by index. The maximum value of this shared counter is INT\_MAX (2147483647), attempts to increase a shared counter to higher values is not an error, but does not cause the value to increase further, it will remain set to INT\_MAX.

This function is not supported for remote GCI interfaces, and will always return FALSE.

## See Also

[GciDecSharedCounter](#) on page 137

[GciFetchNumSharedCounters](#) on page 182

[GciFetchSharedCounterValuesNoLock](#) on page 193

[GciReadSharedCounter](#) on page 325

[GciReadSharedCounterNoLock](#) on page 326

[GciSetSharedCounter](#) on page 360

# GciInit

Initialize GemBuilder.

## Syntax

```
BoolType GciInit();
```

## Return Value

The function **GciInit** returns TRUE or FALSE to indicate successful or unsuccessful initialization of GemBuilder.

## Description

This function initializes GemBuilder. Among other things, it establishes the default GemStone login parameters.

If your C application program is linkable, you may wish to call **GciInitAppName**, which you must do before you call **GciInit**. After **GciInitAppName**, you *must* call **GciInit** before calling any other GemBuilder functions. Otherwise, GemBuilder behavior will be unpredictable.

(Note that when doing run-time binding, you would call **GciRtlLoad** before calling **GciInit**. For details, see “Building the Application” on page 43.)

When GemBuilder is initialized on UNIX platforms, it establishes its own handler for SIGIO interrupts. See “Signal Handling in Your GemBuilder Application” on page 37 for information on **GciInit**’s handling of interrupts and pointers on making GemBuilder, application, and third-party handlers work together.

## See Also

**GciInitAppName** on page 219

# GciInitAppName

## GciInitAppName\_

Override the default application configuration file name.

### Syntax

```
void GciInitAppName(
    const char *          applicationName,
    BoolType              logWarnings );

void GciInitAppName_(
    const char *          applicationName,
    BoolType              logWarnings,
    unsigned int          gemTOCOverrideKB,
    int                   gemNativeCodeOverride );
```

### Arguments

|                              |                                                                                                                                                                                                         |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>applicationName</i>       | The application's name, as a character string.                                                                                                                                                          |
| <i>logWarnings</i>           | If TRUE, causes the configuration file parser to print any warnings to standard output at executable startup.                                                                                           |
| <i>gemTOCOverrideKB</i>      | If non-zero, defines the maximum size (in KB) of temporary object memory for this application. This value overrides any GEM_TEMPOBJ_CACHE_SIZE settings in configuration files read by <b>GciInit</b> . |
| <i>gemNativeCodeOverride</i> | If non-zero, value overrides the GEM_NATIVE_CODE_ENABLED config file settings in configuration files read by <b>GciInit</b> .                                                                           |

### Description

This function affects only linkable applications. It has no effect on RPC applications. If you do not call this function *before* you call **GciInit**, it will have no effect.

A linkable GemBuilder application reads a configuration file called *applicationName.conf* when **GciInit** is called. This file can alter the behavior of the underlying GemStone session. For complete information, please see the *System Administration Guide for GemStone/S 64 Bit*.

A linkable GemBuilder application uses defaults until it calls this function (if it does) and reads the configuration file (which it always does). For linkable GemBuilder applications, the default application name is *gci*, so the default executable configuration file is *gci.conf*. The *applicationName* argument overrides the default application name with one of your choice, which causes your linkable GemBuilder application to read its own executable configuration file.

The *logWarnings* argument determines whether or not warnings that are generated while reading the configuration file are written to standard output. If your application does not call **GciInitAppName**, the default log warnings setting is FALSE. The *logWarnings* argument resets the

default for your application, which is used in the absence of a LOG\_WARNINGS entry in the configuration file, or until that entry is read.

The **GciInitAppName\_** variant allows you to specify additional arguments that are used by the linkable GemBuilder application: the maximum temporary object cache size, and an override for the native code configuration.

Your application may not call both **GciInitAppName** and **GciInitAppName\_**.

## See Also

**GciInit** on page 218

# GciInstallUserAction

## GciInstallUserAction\_

Associate a C function with a Smalltalk user action.

### Syntax

```
void GciInstallUserAction(  
    GciUserActionSType *    userAction );  
  
void GciInstallUserAction_(  
    GciUserActionSType *    userAction,  
    BoolType                 errorIfDuplicate );
```

### Arguments

*userAction* A pointer to a C structure that describes the user-written C function.

*errorIfDuplicate* If True, return an error if there is already a user action with the specified name. If False, leave the existing user action in place and ignore the current call.

### Description

This function associates a user action name (declared in Smalltalk) with a user-written C function. Your application must call **GciInstallUserAction** before beginning any GemStone sessions with **GciLogin**. This function is typically called from **GciUserActionInit**. For more information, see Chapter 4, "Writing User Actions", starting on page 45

### See Also

Chapter 4, "Writing User Actions", starting on page 45  
"User Action Information Structure - GciUserActionSType" on page 79  
**GciDeclareAction** on page 135  
**GciInUserAction** on page 224  
**GciUserActionInit** on page 411  
**GciUserActionShutdown** on page 412

## GciInstMethodForClass

Compile an instance method for a class.

### Syntax

```

OopType GciInstMethodForClass(
    OopType          source,
    OopType          aClass,
    OopType          category,
    OopType          symbolList );

```

### Arguments

- source* The OOP of a Smalltalk string to be compiled as a instance method.
- aClass* The OOP of the class with which the method is to be associated.
- category* The OOP of a Smalltalk string, which contains the name of the category to which the method is added. If the category is nil (OOP\_NIL), the compiler adds this method to the category "(as yet unclassified)".
- symbolList* The OOP of a GemStone symbol list, or OOP\_NIL. Smalltalk resolves symbolic references in source code by using symbols that are available from *symbolList*. A value of OOP\_NIL means to use the default symbol list for the current GemStone session (`System myUserProfile symbolList`).

### Return Value

Returns OOP\_NIL, unless there were compiler warnings (such as variables declared but not used, etc.), in which case the return will be the OOP of a string containing the warning messages.

### Description

This function compiles an instance method for the given class.

Note that the Smalltalk virtual machine optimizes a small number of selectors, and you may not compile methods for any of those selectors. See the *Programming Guide* for a list of the optimized selectors.

To *remove* a class method, use **GciExecuteStr** (page 157) to execute an expression removing the method, or **GciClassRemoveAllMethods** (page 114) to remove all methods.

### Example

See "Executing the examples" on page 91 for the Smalltalk code that defines the classes and objects that support the examples.

```

void instanceMethodExample(void)
{
    // Assumes the setup code has been executed.

    OopType theClass = GciResolveSymbol("Customer", OOP_NIL);

```

```
OopType oCateg = GciNewString("Printing");

OopType oMethodSrc = GciNewString("asString ^ 'Customer named ', name
    asString") ;

GciInstMethodForClass(oMethodSrc, theClass, oCateg, OOP_NIL);
GciErrSType errInfo;
if (GciErr(&errInfo)) {
    printf("error category \"FMT_OID\" number %d, %s\n",
        errInfo.category, errInfo.number, errInfo.message);
}
}
```

## See Also

**GciCompileMethod** on page 118

**GciClassMethodForClass** on page 111

## GciInUserAction

Determine whether or not the current process is executing a user action.

### Syntax

```
BoolType GciInUserAction()
```

### Return Value

This function returns TRUE if it is called from within a user action, and FALSE otherwise.

### Description

This function is intended for use within signal handlers. It can be called any time after **GciInit**.

**GciInUserAction** returns FALSE if the process is currently executing within a GemBuilder call that was made from a user action. It considers the highest (most recent) call context only.

### See Also

**GciCallInProgress** on page 107



# GciIsKindOf

Determine whether or not an object is some kind of a given class or class history.

## Syntax

```
BoolType GciIsKindOf(  
    OopType          anObj,  
    OopType          possibleClass );
```

## Arguments

*anObject* The object to be checked.  
*possibleClass* A class or class history to check the object against.

## Return Value

**GciIsKindOf** returns TRUE when the class of *anObj* or any of its superclasses is in the class history of *possibleClass*. It returns FALSE otherwise.

## Description

**GciIsKindOf** performs structural access that is equivalent to the `isKindOf:` method of the Smalltalk class `Object`. It compares *anObj*'s class and superclasses to see if any of them are in a given class history. When *possibleClass* is simply a class (which is typical), **GciIsKindOf** uses *possibleClass*'s class history. When *possibleClass* is itself a class history, **GciIsKindOf** uses *possibleClass* directly.

Since **GciIsKindOf** does consider class histories, it *can* help to support schema modification by simplifying checks on the relationship of types when they can change over time. To accomplish a similar operation without seeing the effects of class histories, use the **GciIsKindOfClass** function.

## See Also

**GciIsKindOfClass** on page 226  
**GciIsSubclassOf** on page 228  
**GciIsSubclassOfClass** on page 229

## GciIsKindOfClass

Determine whether or not an object is some kind of a given class.

### Syntax

```
BoolType GciIsKindOfClass(  
    OopType          anObject,  
    OopType          possibleClass );
```

### Arguments

*anObject* The object to be checked.

*possibleClass* A class to check the object against.

### Return Value

**GciIsKindOfClass** returns TRUE when the class of *anObject* or any of its superclasses is *possibleClass*. It returns FALSE otherwise.

### Description

**GciIsKindOfClass** performs structural access that is equivalent to the `isKindOf:` method of the Smalltalk class `Object`. It compares *anObject*'s class and superclasses to see if any of them are the *possibleClass*.

Since **GciIsKindOfClass** does *not* consider class histories, it *cannot* help to support schema modification. To accomplish a similar operation when the relationship of types can change over time, use the **GciIsKindOf** function.

### See Also

**GciIsKindOf** on page 225

**GciIsSubclassOf** on page 228

**GciIsSubclassOfClass** on page 229

## GciIsRemote

Determine whether the application is running linked or remotely.

### Syntax

```
BoolType GciIsRemote()
```

### Return Value

Returns TRUE if this application is running with GciRpc (the remote procedure call version of GemBuilder). Returns FALSE if this application is running with GciLnk (that is, if GemBuilder is linked with your GemStone session).

### Description

This function reports whether the current application is using the GciRpc (remote procedure call) or GciLnk (linkable) version of GemBuilder.

## GciIsSubclassOf

Determine whether or not a class is a subclass of a given class or class history.

### Syntax

```
BoolType GciIsSubclassOf(  
    OopType      testClass,  
    OopType      possibleClass );
```

### Arguments

*testClass* The class to be checked.

*possibleClass* A class or class history to check the object against.

### Return Value

GciIsSubclassOf returns TRUE when *testClass* or any of its superclasses is in the class history of *possibleClass*. It returns FALSE otherwise.

### Description

**GciIsSubclassOf** performs structural access that is equivalent to the `isSubclassOf:` method of the Smalltalk class Behavior. It compares *testClass* and *testClass*'s superclasses to see if any of them are in a given class history. When *possibleClass* is simply a class (which is typical), **GciIsSubclassOf** uses *possibleClass*'s class history. When *possibleClass* is itself a class history, **GciIsSubclassOf** uses *possibleClass* directly.

Since **GciIsSubclassOf** does consider class histories, it *can* help to support schema modification by simplifying checks on the relationship of types when they can change over time. To accomplish a similar operation without seeing the effects of class histories, use the **GciIsSubclassOfClass** function.

### See Also

**GciIsKindOf** on page 225

**GciIsKindOfClass** on page 226

**GciIsSubclassOfClass** on page 229

# GciIsSubclassOfClass

Determine whether or not a class is a subclass of a given class.

## Syntax

```
BoolType GciIsSubclassOf(  
    OopType      testClass,  
    OopType      givenClass );
```

## Arguments

*testClass* The class to be checked.

*possibleClass* A class to check *testClass* against.

## Return Value

**GciIsSubclassOfClass** returns TRUE when *testClass* or any of its superclasses is *possibleClass*. It returns FALSE otherwise.

## Description

**GciIsSubclassOfClass** performs structural access that is equivalent to the `isSubclassOf:` method of the Smalltalk class Behavior. It compares *testClass* and *testClass*'s superclasses to see if any of them are the *possibleClass*.

Since **GciIsSubclassOfClass** does *not* consider class histories, it *cannot* help to support schema modification. To accomplish a similar operation when the relationship of types can change over time, use the **GciIsSubclassOf** function.

## See Also

**GciIsKindOf** on page 225

**GciIsKindOfClass** on page 226

**GciIsSubclassOf** on page 228

# GciIvNameToIdx

Fetch the index of an instance variable name.

## Syntax

```
int GciIvNameToIdx(  
    OopType          aClass,  
    const char       instVarName[ ] );
```

## Arguments

*aClass* The OOP of the class from which to obtain information about instance variables.

*instVarName* The instance variable name to search for.

## Return Value

Returns the index of *instVarName* into the array of named instance variables for the specified class. Returns 0 if the name is not found or if an error is encountered.

## Description

This function searches the array of instance variable names for the specified class (including those inherited from superclasses), and returns the index of the specified instance variable name. This index could then be used as the *atIndex* parameter in functions such as **GciFetchNamedOop** or **GciStoreNamedOop**.

## Example

```
BoolType nameToIdx_example(void)  
{  
    // Find offset for maximum in an OutOfRange exception  
    OopType theClass = GciResolveSymbol("OutOfRange", OOP_NIL);  
    int idx = GciIvNameToIdx(theClass, "maximum");  
    if (idx < 1) {  
        printf("error during GciIvNameToIdx\n");  
        return false;  
    }  
    return idx = 12;  
}
```

## See Also

**GciFetchNamedOop** on page 176

**GciFetchNamedOops** on page 177

# GciLoadUserActionLibrary

Load an application user action library.

## Syntax

```
BoolType GciLoadUserActionLibrary(  
    const char *          uaLibraryName[ ],  
    BoolType             mustExist,  
    void **              libHandlePtr,  
    char                 infoBuf[ ],  
    int64                infoBufSize );
```

## Arguments

- uaLibraryName* The name and location of the user action library file (a null-terminated string).
- mustExist* A flag to make the library required or optional.
- libHandlePtr* A variable to store the status of the loading operation.
- infoBuf* A buffer to store the name of the user action library or an error message.
- infoBufSize* The size of *infoBuf*.

## Return Value

A C Boolean value. If an error occurs, the return value is FALSE, and the error message is stored in *infoBuf*, unless *infoBuf* is NULL. Otherwise, the return value is TRUE, and the name of the user action library is stored in *infoBuf*.

## Description

This function loads a user action shared library at run time. If *uaLibraryName* does not contain a path, then a standard user action library search is done. The proper prefix and suffix for the current platform are added to the basename if necessary. For more information, see Chapter 4, "Writing User Actions", starting on page 45

If a library is loaded, *libHandlePtr* is set to a value that represents the loaded library, if *libHandlePtr* is not NULL. If *mustExist* is TRUE, then an error is generated if the library can not be found. If *mustExist* is FALSE, then the library does not need to exist. In this case, TRUE is returned and *libHandlePtr* is NULL if the library does not exist and non-NULL if it exists.

## See Also

- GciInstallUserAction** on page 221
- GciInUserAction** on page 224
- GciUserActionShutdown** on page 412

## GciLogin

Start a user session.

### Syntax

```
BoolType GciLogin(
    const char          gemstoneUsername[ ],
    const char          gemstonePassword[ ]);
```

### Arguments

*gemstoneUsername* The user's GemStone user name (a null-terminated string).

*gemstonePassword* The user's GemStone password (a null-terminated string).

### Return Value

Returns true if login succeeded, false otherwise

### Description

Users must log in before any work may be performed. This function creates a user session and its corresponding transaction workspace.

This function uses the current network parameters (as specified by **GciSetNet**) to establish the user's GemStone session.

### Example

```
BoolType login_example(void)
{
    // assume the netldi on machine lichen been started with -a -g
    // so that host userId and host password are not required.
    const char* StoneName      = "gs64stone";
    const char* HostUserId     = "";
    const char* HostPassword   = "";
    const char* GemService     = "gemnetobject";
    const char* gsUserName     = "DataCurator";
    const char* gsPassword     = "swordfish";

    // GciInit required before first login
    if (!GciInit()) {
        printf("GciInit failed\n");
        return FALSE;
    }
    GciSetNet(StoneName, HostUserId, HostPassword, GemService);
    BoolType success = GciLogin(gsUserName, gsPassword);
    if (! success) {
        GciErrSType errInfo;
        if (GciErr(&errInfo)) {
            printf("error category " FMT_OID " number %d, %s\n",

```



```
        errInfo.category, errInfo.number, errInfo.message);
    }
}
return success;
}
```

## See Also

**GciLoginEx** on page 234

**GciSetNet** on page 355

**GciSetNetEx** on page 357

## GciLoginEx

Start a user session with session configuration

### Syntax

```
BoolType GciLoginEx(
    const char          gemstoneUsername[ ],
    const char          gemstonePassword[ ],
    unsigned int        loginFlags,
    int                 haltOnErrNum);
```

### Arguments

- gemstoneUsername* The user's GemStone user name (a null-terminated string).
- gemstonePassword* The user's GemStone password (a null-terminated string).
- loginFlags* Login flags, as described below
- haltOnErrNum* A legacy error number; if nonzero, specifies a value for GEM\_HALT\_ON\_ERROR config parameter.

### Return Value

Returns true if login succeeded, false otherwise

### Description

This function creates a user session and its corresponding transaction workspace. The current network parameters, as specified by **GciSetNet**, are used to establish the user's GemStone session.

Other login attributes are provided by *loginFlags*. The value of *loginFlags* should be given using the following GemBuilder mnemonics:

- GCI\_LOGIN\_PW\_ENCRYPTED indicates the *gemstonePassword* is encrypted. When specifying this flag, you must encrypt the password using **GciEncrypt**.
- GCI\_LOGIN\_IS\_SUBORDINATE Creates the new session as a child of the current session. It will be terminated if the current session terminates. The primary use of this is for GciInterface, and is only valid for RPC sessions.
- GCI\_LOGIN\_FULL\_COMPRESSION\_ENABLED the login will use full compression.
- GCI\_LOGIN\_ERRS\_USE\_REF\_SET sets the OOPs of objects related to errors to be put into the ReferencedSet, rather than the PureExportSet.
- GCI\_LOGIN\_QUIET suppresses printing of banner information during login.
- GCI\_CLIENT\_DOES\_SESSION\_INIT after login, the session will manually execute `GciPerform(OOP_CLASS_GSCURRENT_SESSION, "initialize", NULL, 0)`; otherwise, the VM will automatically executes that code as part of login.
- GCI\_TS\_CLIENT the client will use the thread-safe API. Using this flag, GciLoginEx is equivalent to GciTsLogin, from the gcits.hf (not included in this documentation).

GCL\_PASSWORDLESS\_LOGIN specifies login using Kerberos.

GCL\_LOGIN\_SOLO specifies to login solo, which does not require a Stone to be running.

GCL\_WINDOWS\_CLIENT is use on Windows client application.

If haltOnErrNum is set to a GemStone error number, and the session encounters the error associated with that error number, the session will halt.

## Example

For an example, see **GciEncrypt** on page 150

## See Also

**GciEncrypt** on page 150

**GciLogin** on page 232

**GciSetNet** (page 355)

**GciSetNetEx** (page 357)

# GciLogout

## GciLogout\_

End the current user session.

### Syntax

```
void GciLogout();  
void GciLogout_(  
    BoolByte                getResult );
```

### Arguments

*getResult* If True, waits for a reply packet from the Gem; this is the behavior of GciLogout().  
If False, the library sends the logout command and closes the connection without waiting for a reply from the gem..

### Description

This function terminates the current user session (set by the last **GciLogin** or **GciSetSessionId**), and allows GemStone to release all uncommitted objects created by the application program in the corresponding transaction workspace. The current session ID is reset to `GCI_INVALID_SESSION_ID`, indicating that the application is no longer logged in. (See “GciGetSessionId” on page 211 for more information.)

### See Also

**GciGetSessionId** on page 211  
**GciLogin** on page 232  
**GciSetSessionId** on page 359

# GciLongJump

Provides equivalent functionality to the corresponding `longjmp()` or `_longjmp()` function.

## Syntax

```
void GciLongJump(  
    GciJumpBufSType *      jumpBuffer,  
    int                    val );
```

## Arguments

*jumpBuffer* A pointer to a jump buffer.

## Description

Except for the difference in the first argument type, the semantics of this function are the same as for `longjmp()` on Solaris and `_longjmp()` on HP-UX.

## See Also

**GciErr** on page 152  
**GciPopErrJump** on page 320  
**GciPushErrJump** on page 323  
**GciSetErrJump** on page 351  
**Gci\_SETJMP** on page 354

# GciMoreTraversal

Continue object traversal, reusing a given buffer.

## Syntax

```
BoolType GciMoreTraversal(  
    GciTravBufType *    travBuff);
```

## Arguments

*travBuff* A buffer in which the results of the traversal will be placed. For details, see “Traversal Buffer - GciTravBufType” on page 78.

## Return Value

Returns FALSE if the traversal is not yet completed, but further traversal would cause the *travBuffSize* to be exceeded. If the *travBuffSize* is reached before the traversal is complete, you can continue to call **GciMoreTraversal** to proceed from the point where *travBuffSize* was exceeded.

Returns TRUE if there are no more objects to be returned by subsequent calls to **GciMoreTraversal**.

## Description

When the amount of information obtained in a traversal exceeds the amount of memory available to the buffer (as specified with *travBuffSize*), your application can call **GciMoreTraversal** repeatedly to break the traversal into manageable amounts of information. The information returned by this function begins with the object report following where the previous unfinished traversal left off. The level value is retained from the initial **GciTraverseObjs** call.

Generally speaking, an application can continue to call **GciMoreTraversal** until it has obtained all requested information.

Naturally, GemStone will not continue an incomplete traversal if there is any chance that changes to the database in the intervening period might have invalidated the previous report or changed the connectivity of the objects in the path of the traversal. Specifically, GemStone will refuse to continue a traversal if, in the interval before attempting to continue, you:

- Modify the objects in the database directly by calling any of the **GciStore...** or **GciAdd...** functions;
- Call one of the Smalltalk message-sending functions **GciPerform**, **GciContinue**, or any of the **GciExecute...** functions.
- Abort your transaction, thus invalidating any subsequent information from that traversal.

Any attempt to call **GciMoreTraversal** after one of these events will generate an error.

Note that this holds true across multiple GemBuilder applications sharing the same GemStone session. Suppose, for example, that you were holding on to an incomplete traversal buffer and the user moved from the current application to another, did some work that required executing Smalltalk code, and then returned to the original application. You would be unable to continue the interrupted traversal.

If you attempt to call **GciMoreTraversal** when no traversal is underway, this function will generate the error GCI\_ERR\_TRAV\_COMPLETED.

During the entire sequence of **GciTraverseObjs** and **GciMoreTraversal** calls that constitute a traversal, any single object report will be returned exactly once. Regardless of the connectivity of objects in the GemStone database, only one report will be generated for any non-special object.

The section "Organization of the Traversal Buffer" on page 407 describes the organization of traversal buffers in detail.

**GciMoreTraversal** provides automatic byte swizzling, unless **GciSetTraversalBufSwizzling** is used to disable swizzling. For more about byte swizzling, see "Byte-Swizzling of Binary Floating-Point Values" on page 26.

## Example

See "Executing the examples" on page 91 for the Smalltalk code that defines the classes and objects that support the examples.

```
void moreTraversalExample(void)
{
    // Assumes setup code has been run

    OopType rootObj = GciResolveSymbol("AllAccounts", OOP_NIL);
    GciTravBufType *buf = GciTravBufType::malloc(8000);

    int totalCount = 0;
    // traverse the AllAccounts collection to 4 levels deep
    BoolType done = GciTraverseObjs(&rootObj, 1, buf, 4);
    while (! done) {
        int objCount = 0;
        GciObjRepHdrSType *rpt = buf->firstReportHdr();
        GciObjRepHdrSType *limit = buf->readLimitHdr();
        while (rpt < limit) {
            objCount++ ;
            rpt = rpt->nextReport();
        }
        totalCount += objCount;
        done = GciMoreTraversal(buf);
    }
    buf->free();
    printf("traversal returned %d total objects\n", totalCount);
}
```

## See Also

**GCI\_ALIGN** on page 96  
**GciFindObjRep** on page 203  
**GciObjRepSize\_** on page 286  
**GciNbMoreTraversal** on page 258  
**GciTraverseObjs** on page 407

# GciNbAbort

Abort the current transaction (nonblocking).

## Syntax

```
void GciNbAbort()
```

## Description

The **GciNbAbort** function is equivalent in effect to **GciAbort**. However, **GciNbAbort** permits the application to proceed with non-GemStone tasks while the transaction is aborted, and **GciAbort** does not.

## See Also

**GciAbort** on page 93

**GciBegin** on page 104

**GciNbBegin** on page 241

**GciNbCommit** on page 243



## GciNbBegin

Begin a new transaction (nonblocking).

### Syntax

```
void GciNbBegin()
```

### Description

The **GciNbBegin** function is equivalent in effect to **GciBegin**. However, **GciNbBegin** permits the application to proceed with non-GemStone tasks while a new transaction is started, and **GciBegin** does not.

### See Also

**GciBegin** on page 104

**GciNbAbort** on page 240

**GciNbCommit** on page 243

## GciNbClampedTrav

Traverse an array of objects, subject to clamps (nonblocking).

### Syntax

```
void GciNbClampedTrav(  
    const OopType *      theOops,  
    int                  numOops,  
    GciClampedTravArgsSType *travArgs );
```

### Arguments

*theOops* The array of OOPs for the objects to be traversed.

*numOops* The number of elements in *theOops*.

*travArgs* Pointer to an instance of GciClampedTravArgsSType. See **GciClampedTrav** on page 110 for documentation on the fields in *travArgs*. On return, the result is in the *travBuff* field of the *travArgs* instance of GciClampedTravArgsSType.

### Return Value

The **GciNbClampedTrav** function, unlike **GciClampedTrav**, does not have a return value. However, when the traversal operation is complete, you can access a value identical in meaning to the return value of **GciClampedTrav** by using the argument to **GciNbEnd**.

### Description

This function is equivalent in effect to **GciClampedTrav**. However, **GciClampedTrav** permits the application to proceed with non-GemStone tasks while a traversal is carried out, and **GciClampedTrav** does not.

### See Also

**GciClampedTrav** on page 110

# GciNbCommit

Write the current transaction to the database (nonblocking).

## Syntax

```
void GciNbCommit()
```

## Return Value

The **GciNbCommit** function, unlike **GciCommit**, does not have a return value. However, when the commit operation is complete, you can access a value identical in meaning to the return value of **GciCommit** by using the argument to **GciNbEnd**.

## Description

This function is equivalent in effect to **GciCommit**. However, **GciNbCommit** permits the application to proceed with non-GemStone tasks while the transaction is committed, and **GciCommit** does not.

## See Also

**GciCommit** on page 117  
**GciNbAbort** on page 240  
**GciNbBegin** on page 241

# GciNbContinue

Continue code execution in GemStone after an error (nonblocking).

## Syntax

```
void GciNbContinue(  
    OopType          gsProcess );
```

## Arguments

*gsProcess* The OOP of a GsProcess object (obtained as the value of the context field of an error report returned by **GciErr**).

## Return Value

The **GciNbContinue** function, unlike **GciContinue**, does not have a return value. However, when the continued operation is complete, you can access a value identical in meaning to the return value of **GciContinue** by using the argument to **GciNbEnd**.

## Description

The **GciNbContinue** function is equivalent in effect to **GciContinue**. However, **GciNbContinue** permits the application to proceed with non-GemStone tasks while the operation continues, and **GciContinue** does not.

## See Also

**GciContinue** on page 122

**GciNbContinueWith** on page 245

# GciNbContinueWith

Continue code execution in GemStone after an error (nonblocking).

## Syntax

```
void GciNbContinueWith (  
    OopType          process,  
    OopType          replaceTopOfStack,  
    int              flags,  
    GciErrSType *    error );
```

## Arguments

- gsProcess* The OOP of a GsProcess object (obtained as the value of the context field of an error report returned by GciErr).
- replaceTopOfStack* If not OOP\_ILLEGAL, replace the value at the top of the Smalltalk evaluation stack with this value before continuing. If OOP\_ILLEGAL, the evaluation stack is not changed.
- flags* Flags to disable or permit asynchronous events and debugging in Smalltalk, as defined for **GciPerformNoDebug** on page 311.
- continueWithError* If not NULL, continue execution by signalling this error. This argument takes precedence over *replaceTopOfStack*.

## Description

The **GciNbContinueWith** function is equivalent in effect to **GciContinueWith**. However, **GciNbContinueWith** permits the application to proceed with non-GemStone tasks while the operation continues, and **GciContinueWith** does not.

## See Also

- GciContinueWith** on page 123
- GciNbContinue** on page 244

# GciNbEnd

## GciNbEnd\_

Test the status of nonblocking call in progress for completion.

### Syntax

```
GciNbProgressEType GciNbEnd(  
    void **  
    result );  
  
GciNbProgressEType GciNbEnd_(  
    int64*  
    result);
```

### Arguments

*result* The address at which **GciNbEnd** or **GciNbEnd\_** should place a pointer to the result of the nonblocking call when it is complete. The actual result is that of the corresponding equivalent blocking GCI call.

With **GciNbEnd**, the result may be either 4 byte or 8 byte, and the caller must be aware of whether this is 4 byte or 8 byte, and dereference result accordingly on big endian machines.

**GciNbEnd\_** produces result type of the corresponding blocking GCI call, typically int, BoolType or OopType, and may be accessed by normal C casting without regard to byte order of the CPU.

### Return Value

The **GciNbEnd** function returns an enumerated type. Its value is GCI\_RESULT\_READY if the outstanding nonblocking call has completed execution and its result is ready, GCI\_RESULT\_NOT\_READY if the call is not complete and there has been no change since the last inquiry, and GCI\_RESULT\_PROGRESSED if the call is not complete but progress has been made towards its completion.

### Description

Once an application calls a nonblocking function, it must call **GciNbEnd**, **GciNbEnd\_**, or **GciNbEndPoll** at least once, and must continue to do so until that nonblocking function has completed execution. The intent of the return values is to give the scheduler a hint about whether it is calling one of these functions too often or not often enough.

Once an operation is complete, you are permitted to call **GciNbEnd** or a related function repeatedly. It returns GCI\_RESULT\_READY and a pointer to the same result each time, until you call a nonblocking function again. It is an error to call **GciNbEnd** or a related function before you call any nonblocking functions at all. Use the **GciCallInProgress** function to determine whether or not there is a GemBuilder call currently in progress.

## Example

```
void nbEnd_example(void)
{
    void *resultPtr;
    GciNbExecuteStr("Globals size", OOP_NIL);
    do {
        // wait for non-blocking result
        GciHostMilliSleep(1);
    } while (GciNbEnd(&resultPtr) != GCI_RESULT_READY);

    OopType result = *(OopType*)resultPtr;
    BoolType conversionErr = FALSE;
    int gSize = GciOopToI32_(result, &conversionErr);
    if (conversionErr) {
        printf("error in execution\n");
    } else {
        printf("Globals size = %d \n", gSize);
    }
}
```

## See Also

[GciNbEndPoll](#) on page 248

[GciCallInProgress](#) on page 107

# GciNbEndPoll

Test the status of nonblocking call in progress for completion, with timeout.

## Syntax

```
GciNbProgressEType GciNbEndPoll(  
    int64*          result,  
    int            timeoutMs);
```

## Arguments

*result* The address at which **GciNbEndPoll** should place a pointer to the result of the nonblocking call when it is complete. The actual result is that of the corresponding equivalent blocking GCI call. The result will be 8 bytes, and correct on big endian machines.

## Return Value

The **GciNbEndPoll** function returns an enumerated type. Its value is `GCI_RESULT_READY` if the outstanding nonblocking call has completed execution and its result is ready, `GCI_RESULT_NOT_READY` if the call is not complete and there has been no change since the last inquiry, and `GCI_RESULT_PROGRESSED` if the call is not complete but progress has been made towards its completion.

## Description

Once an application calls a nonblocking function, it must call **GciNbEndPoll**, **GciNbEnd**, or **GciNbEnd\_** at least once, and must continue to do so until that nonblocking function has completed execution. The intent of the return values is to give the scheduler a hint about whether it is calling **GciNbEndPoll** too often or not often enough.

**GciNbEndPoll** allows you to specify a timeout, and will wait for *timeoutMs* milliseconds before returning status. This avoids too-frequent polling for long-running code.

Once an operation is complete, you are permitted to call **GciNbEndPoll** repeatedly. It returns `GCI_RESULT_READY` and a pointer to the same result each time, until you call a nonblocking function again. It is an error to call **GciNbEndPoll** before you call any nonblocking functions at all. Use the **GciCallInProgress** function to determine whether or not there is a GemBuilder call currently in progress.

## See Also

**GciNbEnd** on page 246

**GciCallInProgress** on page 107



# GciNbExecute

Execute a Smalltalk expression contained in a String object (nonblocking).

## Syntax

```
void GciNbExecute(  
    OopType          source,  
    OopType          symbolList);
```

## Arguments

*sourceStr* The OOP of a String containing a sequence of one or more Smalltalk statements to be executed.

*symbolList* The OOP of a GemStone symbol list. A value of OOP\_NIL means to use the default symbol list for the current GemStone session (that is, `System myUserProfile symbolList`).

## Return Value

The **GciNbExecute** function, unlike **GciExecute**, does not have a return value. However, when the executed operation is complete, you can access a value identical in meaning to the return value of **GciExecute** by using the argument to **GciNbEnd**.

## Description

The **GciNbExecute** function is equivalent in effect to **GciExecute**. However, **GciNbExecute** permits the application to proceed with non-GemStone tasks while the Smalltalk expression is executed, and **GciExecute** does not.

## See Also

**GciExecute** on page 153

**GciNbEnd** on page 246

**GciNbExecuteStr** on page 252

**GciNbExecuteStrFetchBytes** on page 253

**GciNbExecuteStrFromContext** on page 255

**GciNbPerform** on page 259

## GciNbExecuteFromContextDbg\_

Execute a Smalltalk expression contained in a String object (nonblocking) as if it were a message sent to an object (nonblocking).

### Syntax

```
void GciNbExecuteFromContextDbg_(
    OopType          source,
    OopType          contextObject,
    OopType          symbolList,
    int              flags,
    ushort          environmentId);
```

### Arguments

- source* The OOP of a String or Utf8 containing a sequence of one or more Smalltalk statements to be executed.
- contextObject* The OOP of a GemStone object to use as the compilation context. If OOP\_NO\_CONTEXT, the code is compiled as an anonymous method in which self == nil. Otherwise, the compilation is done as if the code is an instance method of the class of *contextObj*.
- symbolList* The OOP of a GemStone symbol list. Smalltalk resolves symbolic references in source code by using symbols that are available from *symbolList*. A value of OOP\_NIL means to use the default symbol list for the current GemStone session (that is, `System myUserProfile symbolList`).
- flags* Values for flags are described in gciemn.ht, and can include:
- ▶ 0 (default) disables the debugger during execution.
  - ▶ GCI\_PERFORM\_FLAG\_ENABLE\_DEBUG = 1 allows debugging, making this function behave like GciPerform.
  - ▶ GCI\_PERFORM\_FLAG\_DISABLE\_ASYNC\_EVENTS = 2 disables asynchronous events.
  - ▶ GCI\_PERFORM\_FLAG\_SINGLE\_STEP = 3 places a single-step breakpoint at the start of the method to be performed, and then executes to hit that breakpoint.
- environmentId* The compilation environment for method lookup, normally 0.

### Return Value

The `GciNbExecuteFromContextDbg_` function, unlike `GciExecuteFromContext`, does not have a return value. However, when the executed operation is complete, you can access a value identical in meaning to the return value of `GciExecuteFromContext` by using the argument to `GciNbEnd`.

## Description

The **GciNbExecuteFromContextDbg\_** function is equivalent in effect to **GciExecuteFromContext**. However, **GciNbExecuteFromContextDbg\_** permits the application to proceed with non-GemStone tasks while the Smalltalk expression is executed, and **GciExecuteFromContext** does not.

## See Also

**GciExecuteFromContext** on page 155  
**GciExecuteStrFromContext** on page 161  
**GciNbEnd** on page 246  
**GciNbExecute** on page 249  
**GciNbExecuteStr** on page 252  
**GciNbExecuteStrFetchBytes** on page 253  
**GciNbPerform** on page 259

## GciNbExecuteStr

Execute a Smalltalk expression contained in a C string (nonblocking).

### Syntax

```
void GciNbExecuteStr(  
    const char          source[],  
    OopType             symbolList);
```

### Arguments

*sourceStr* A null-terminated string containing a sequence of one or more Smalltalk statements to be executed.

*symbolList* The OOP of a GemStone symbol list. Smalltalk resolves symbolic references in source code by using symbols that are available from *symbolList*. A value of OOP\_NIL means to use the default symbol list for the current GemStone session (that is, `System myUserProfile symbolList`).

### Return Value

The **GciNbExecuteStr** function, unlike **GciExecuteStr**, does not have a return value. However, when the executed operation is complete, you can access a value identical in meaning to the return value of **GciExecuteStr** by using the argument to **GciNbEnd**.

### Description

The **GciNbExecuteStr** function is equivalent in effect to **GciExecuteStr**. However, **GciNbExecuteStr** permits the application to proceed with non-GemStone tasks while the Smalltalk expression is executed, and **GciExecuteStr** does not.

### See Also

**GciExecuteStr** on page 157  
**GciNbEnd** on page 246  
**GciNbExecute** on page 249  
**GciNbExecuteStrFetchBytes** on page 253  
**GciNbExecuteStrFromContext** on page 255  
**GciNbPerform** on page 259

## GciNbExecuteStrFetchBytes

Execute a Smalltalk expression contained in a C string, returning byte-format results (nonblocking).

### Syntax

```
void GciNbExecuteStrFetchBytes(
    const char *          sourceStr,
    int64                sourceSize,
    OopType              sourceClass,
    OopType              contextObject,
    OopType              symbolList,
    ByteType*           result,
    int64                maxResultSize );
```

### Arguments

- sourceStr* A null-terminated string containing a sequence of one or more Smalltalk statements to be executed.
- sourceSize* The number of bytes in the *source*, or -1. If *sourceSize* is -1, `strlen(sourceStr)` is used.
- sourceClass* The OOP of a class to use for the compilation target for the text in *sourceStr*, typically `OOP_CLASS_STRING`, `OOP_CLASS_UNICODE7`, or `OOP_CLASS_Utf8`.
- contextObject* The OOP of a GemStone object to use as the compilation context. If `OOP_NO_CONTEXT`, the code is compiled as an anonymous method in which `self == nil`. Otherwise, the compilation is done as if the code is an instance method of the class of *contextObj*.
- symbolList* The OOP of a GemStone symbol list. Smalltalk resolves symbolic references in source code by using symbols that are available from *symbolList*. A value of `OOP_NIL` means to use the default symbol list for the current GemStone session (that is, `System myUserProfile symbolList`).
- result* Array containing the bytes of the result of the execution.
- maxResultSize* Maximum size of *result*.

### Return Value

The `GciNbExecuteStrFetchBytes` function, unlike `GciExecuteStrFetchBytes`, does not have a return value. However, when the executed operation is complete, you can access a value identical in meaning to the return value of `GciExecuteStrFetchBytes` by using the argument to `GciNbEnd`.

### Description

This function sends an expression (or sequence of expressions) to GemStone for execution. The execution result, which should be a byte format object is returned in the *\*result* buffer.

## See Also

- GciExecuteStrFetchBytes** on page 159
- GciNbEnd** on page 246
- GciNbExecute** on page 249
- GciNbExecuteStr** on page 252
- GciNbExecuteStrFromContext** on page 255
- GciNbPerform** on page 259

## GciNbExecuteStrFromContext

Execute a Smalltalk expression contained in a C string as if it were a message sent to an object (nonblocking).

### Syntax

```
void GciNbExecuteStrFromContext(  
    const char          sourceStr[ ],  
    OopType             contextObject,  
    OopType             symbolList);
```

### Arguments

- sourceStr* A null-terminated string containing a sequence of one or more Smalltalk statements to be executed.
- contextObject* The OOP of a GemStone object to use as the compilation context. If OOP\_NO\_CONTEXT, the code is compiled as an anonymous method in which self == nil. Otherwise, the compilation is done as if the code is an instance method of the class of *contextObj*.
- symbolList* The OOP of a GemStone symbol list. Smalltalk resolves symbolic references in source code by using symbols that are available from *symbolList*. A value of OOP\_NIL means to use the default symbol list for the current GemStone session (that is, System myUserProfile *symbolList*).

### Return Value

The **GciNbExecuteStrFromContext** function, unlike **GciExecuteStrFromContext**, does not have a return value. However, when the executed operation is complete, you can access a value identical in meaning to the return value of **GciExecuteStrFromContext** by using the argument to **GciNbEnd**.

### Description

The **GciNbExecuteStrFromContext** function is equivalent in effect to **GciExecuteStrFromContext**. However, **GciNbExecuteStrFromContext** permits the application to proceed with non-GemStone tasks while the Smalltalk expression is executed, and **GciExecuteStrFromContext** does not.

### See Also

- GciExecuteStrFromContext** on page 161
- GciNbEnd** on page 246
- GciNbExecute** on page 249
- GciNbExecuteStr** on page 252
- GciNbExecuteStrFetchBytes** on page 253
- GciNbPerform** on page 259

## GciNbExecuteStrTrav

First execute a Smalltalk expression contained in a C string as if it were a message sent to an object, then traverse the result of the execution (nonblocking).

### Syntax

```
void GciNbExecuteStrTrav(
    const char          sourceStr[ ],
    OopType             contextObject,
    OopType             symbolList,
    GciClampedTravArgsSType *travArgs );
```

### Arguments

- sourceStr* A null-terminated string containing a sequence of one or more Smalltalk statements to be executed.
- contextObject* The OOP of a GemStone object to use as the compilation context. If OOP\_NO\_CONTEXT or OOP\_ILLEGAL, the code is compiled as an anonymous method in which self == nil. Otherwise, the compilation is done as if the code is an instance method of the class of *contextObj*.
- symbolList* The OOP of a GemStone symbol list. Smalltalk resolves symbolic references in source code by using symbols that are available from *symbolList*. A value of OOP\_NIL means to use the default symbol list for the current GemStone session (that is, System myUserProfile *symbolList*).
- travArgs* Pointer to an instance of GciClampedTravArgsSType. See **GciExecuteStrTrav** on page 163 for field definitions.

### Return Value

The **GciNbExecuteStrTrav** function, unlike **GciExecuteStrTrav**, does not have a return value. However, when the traversal operation is complete, you can access a value identical in meaning to the return value of **GciExecuteStrTrav** by using the argument to **GciNbEnd**.

### Description

The **GciNbExecuteStrTrav** function is equivalent in effect to **GciExecuteStrTrav**. However, **GciNbExecuteStrTrav** permits the application to proceed with non-GemStone tasks while the traversal is completed, and **GciExecuteStrTrav** does not.

### See Also

- GciExecuteStrTrav** on page 163 includes information details on traversal.
- GciNbEnd** on page 246
- GciNbExecute** on page 249
- GciPerformTraverse** on page 315



# GciNbLoginEx

Start a user session with session configuration (nonblocking)

## Syntax

```
BoolType GciNbLoginEx(  
    const char          gemstoneUsername[ ],  
    const char          gemstonePassword[ ],  
    unsigned int        loginFlags,  
    int                 haltOnErrNum);
```

## Arguments

- gemstoneUsername* The user's GemStone user name (a null-terminated string).
- gemstonePassword* The user's GemStone password (a null-terminated string).
- loginFlags* Login flags, as described below
- haltOnErrNum* A legacy error number; if nonzero, specifies a value for GEM\_HALT\_ON\_ERROR config parameter.

## Return Value

Returns true if login succeeded, false otherwise

## Description

This function creates a user session and its corresponding transaction workspace. The current network parameters, as specified by **GciSetNet**, are used to establish the new GemStone session.

Other login attributes are provided by *loginFlags*. The value of *loginFlags* should be given using the GemBuilder mnemonics described under **GciLoginEx** on page 234.

If *haltOnErrNum* is set to a GemStone error number, and the session encounters the error associated with that error number, the new session will halt.

Once this call is invoked, the current session is set to the not-yet-logged in session. Calls to **GciNbEnd** apply to the not-yet-logged in session.

## See Also

**GciLoginEx** on page 234

**GciNbEnd** on page 246

# GciNbMoreTraversal

Continue object traversal, reusing a given buffer (nonblocking).

## Syntax

```
void GciNbMoreTraversal(  
    GciTravBufType *      travBuff);
```

## Arguments

*travBuff* A buffer in which the results of the traversal will be placed. For details, see “Traversal Buffer - GciTravBufType” on page 78.

## Return Value

The **GciNbMoreTraversal** function, unlike **GciMoreTraversal**, does not have a return value. However, when the traversal operation is complete, you can access a value identical in meaning to the return value of **GciMoreTraversal** by using the argument to **GciNbEnd**.

## Description

The **GciNbMoreTraversal** function is equivalent in effect to **GciMoreTraversal**. However, **GciNbMoreTraversal** permits the application to proceed with non-GemStone tasks while the traversal is completed, and **GciMoreTraversal** does not.

**GciNbMoreTraversal** provides automatic byte swizzling, unless **GciSetTraversalBufSwizzling** is used to disable swizzling. For more about byte swizzling, see “Byte-Swizzling of Binary Floating-Point Values” on page 26.

## See Also

**GciMoreTraversal** on page 238  
**GciNbTraverseObjs** on page 268  
**GciObjRepSize\_** on page 286  
**GciTraverseObjs** on page 407

# GciNbPerform

Send a message to a GemStone object (nonblocking).

## Syntax

```
void GciNbPerform(  
    OopType          receiver,  
    const char       selectorStr[ ],  
    const OopType    args[ ],  
    int              numArgs );
```

## Arguments

- receiver* The OOP of the receiver of the message.
- selectorStr* A string that defines the message selector. For keyword selectors, all keywords are concatenated in the string. (For example, `at : put :`).
- args* An array of OOPs. Each element in the array corresponds to an argument for the message. If there are no message arguments, use a dummy OOP here.
- numArgs* The number of arguments to the message. For unary selectors (messages with no arguments), *numArgs* is zero.

## Return Value

The **GciNbPerform** function, unlike **GciPerform**, does not have a return value. However, when the performed operation is complete, you can access a value identical in meaning to the return value of **GciPerform** by using the argument to **GciNbEnd**.

## Description

The **GciNbPerform** function is equivalent in effect to **GciPerform**. However, **GciNbPerform** permits the application to proceed with non-GemStone tasks while the message is executed, and **GciPerform** does not.

## See Also

- GciNbEnd** on page 246
- GciNbExecute** on page 249
- GciNbPerformNoDebug** on page 261
- GciNbPerformTrav** on page 262
- GciPerform** on page 307

## GciNbPerformFetchBytes

Send a message to a GemStone object, returning byte results (nonblocking).

### Syntax

```
void GciNbPerformFetchBytes(  
    OopType          receiver,  
    const char       selector[ ],  
    const OopType    args[ ],  
    int              numArgs,  
    ByteType *       result,  
    ssize_t          maxResultSize);
```

### Arguments

- receiver* The OOP of the receiver of the message.
- selector* A string that defines the message selector. For keyword selectors, all keywords are concatenated in the string. (For example, at : put :).
- args* An array of OOPs. Each element in the array corresponds to an argument for the message. If there are no message arguments, use a dummy OOP here.
- numArgs* The number of arguments to the message. For unary selectors (messages with no arguments), *numArgs* is zero.
- result* Array containing the bytes of the result of the execution.
- maxResultSize* Maximum size of *result*.

### Return Value

The **GciNbPerformFetchBytes** function, unlike **GciPerformFetchBytes**, does not have a return value. However, when the executed operation is complete, you can access a value identical in meaning to the return value of **GciPerformFetchBytes** by using the argument to **GciNbEnd**.

### Description

This function sends a message (that is, the selector along with any keyword arguments and their corresponding values) to the specified receiver (an object in the GemStone database), and puts the result, which should be a byte format object, in the \*result buffer.

### See Also

- GciNbExecuteStrFetchBytes** on page 253
- GciNbPerform** on page 259

# GciNbPerformNoDebug

Send a message to a GemStone object, and temporarily disable debugging (nonblocking).

## Syntax

```
void GciNbPerformNoDebug(  
    OopType          receiver,  
    const char       selector[ ],  
    const OopType    args[ ],  
    int              numArgs,  
    int              flags );
```

## Arguments

- receiver* The OOP of the receiver of the message.
- selector* A string that defines the message selector. For keyword selectors, all keywords are concatenated in the string. (For example, at : put :).
- args* An array of OOPs. Each element in the array corresponds to an argument for the message. If there are no message arguments, use a dummy OOP here.
- numArgs* The number of arguments to the message. For unary selectors (messages with no arguments), *numArgs* is zero.
- flags* Flags to disable or permit asynchronous events and debugging in Smalltalk. Use one or more of the GemBuilder mnemonics described under **GciPerformNoDebug** on page 311.

## Return Value

The **GciNbPerformNoDebug** function, unlike **GciPerformNoDebug**, does not have a return value. However, when the performed operation is complete, you can access a value identical in meaning to the return value of **GciPerformNoDebug** by using the argument to **GciNbEnd**.

## Description

The **GciNbPerformNoDebug** function is equivalent in effect to **GciPerformNoDebug**. However, **GciNbPerformNoDebug** permits the application to proceed with non-GemStone tasks while the message is executed, and **GciPerformNoDebug** does not.

## See Also

- GciNbEnd** on page 246
- GciNbExecute** on page 249
- GciNbPerform** on page 259
- GciPerformNoDebug** on page 311

## GciNbPerformTrav

First send a message to a GemStone object, then traverse the result of the message (nonblocking).

### Syntax

```
void GciNbPerformTrav(  
    OopType          receiver,  
    const char *     selector,  
    const OopType *  args,  
    int              numArgs,  
    GciClampedTravArgsSType *travArgs );
```

### Arguments

- receiver* The OOP of the receiver of the message.
- selector* A string that defines the message selector. For keyword selectors, all keywords are concatenated in the string. (For example, `at:put:`).
- args* An array of OOPs. Each element in the array corresponds to an argument for the message. If there are no message arguments, use a dummy OOP here.
- numArgs* The number of arguments to the message. For unary selectors (messages with no arguments), *numArgs* is zero.
- travArgs* Pointer to an instance of `GciClampedTravArgsSType`. See **GciClampedTrav** on page 110 for documentation of the fields in *travArgs*. On return, the results are in the first object in the resulting *travBufs* field.

### Return Value

The **GciNbPerformTrav** function, unlike **GciPerformTrav**, does not have a return value. However, when the traversal operation is complete, you can access a value identical in meaning to the return value of **GciPerformTrav** by using the argument to **GciNbEnd**.

### Description

The **GciNbPerformTrav** function is equivalent in effect to **GciPerformTrav**. However, **GciNbStoreTrav** permits the application to proceed with non-GemStone tasks while the traversal is done, and **GciPerformTrav** does not.

### See Also

- GciPerformTrav** on page 314
- GciNbPerform** on page 259
- GciClampedTrav** on page 110

## GciNbStoreTrav

Stores multiple traversal buffer values in objects (nonblocking).

### Syntax

```
void GciNbStoreTrav(  
    GciTravBufType *      travBuff,  
    int                   behaviorFlag );
```

### Arguments

- travBuff* A buffer that contains the object reports to be stored. The first element in the buffer is an integer that indicates how many bytes are stored in the buffer. The remainder of the traversal buffer consists of a series of object reports, each of which is of type **GciObjRepSType**.
- behaviorFlag* A flag specifying whether the values returned by **GciStoreTrav** should be added to the values in the traversal buffer or should replace the values in the traversal buffer.
- Flag values, defined in the `gci.h` header file, are `GCI_STORE_TRAV_NSC_ADD` (add to the traversal buffer) and `GCI_STORE_TRAV_NSC_REP` (replace traversal buffer contents).

### Description

The **GciNbStoreTrav** function is equivalent in effect to **GciStoreTrav**. However, **GciNbStoreTrav** permits the application to proceed with non-GemStone tasks while the traversals are stored, and **GciStoreTrav** does not.

**GciNbStoreTrav** provides automatic byte swizzling, unless **GciSetTraversalBufSwizzling** is used to disable swizzling. For more about byte swizzling, see “Byte-Swizzling of Binary Floating-Point Values” on page 26.

### See Also

- GciNbEnd** on page 246
- GciNbMoreTraversal** on page 258
- GciNbStoreTrav** on page 263
- GciNbStoreTravDoTrav\_** on page 265
- GciNbTraverseObjs** on page 268
- GciStoreTrav** on page 387

## GciNbStoreTravDo\_

Store multiple traversal buffer values in objects, execute the specified code, and return the resulting object (non-blocking).

### Syntax

```
void GciNbStoreTravDo_(  
    GciStoreTravDoArgsSType * storeTravArgs);
```

### Arguments

*storeTravArgs* An instance of **GciStoreTravDoArgsSType**. For details, refer to the discussion of **GciStoreTravDo\_** on page 390

### Return Value

Unlike **GciStoreTravDo\_**, the **GciNbStoreTravDo\_** function does not have a return value. However, when the traversal operation is complete, you can access a value identical in meaning to the return value of **GciStoreTravDo\_** by using the argument to **GciNbEnd**.

### Description

The **GciNbStoreTravDo\_** function is equivalent in effect to **GciStoreTravDo\_**. However, **GciNbStoreTravDo\_** permits the application to proceed with non-GemStone tasks while the traversal is done, and **GciStoreTravDo\_** does not.

### See Also

**GciNbEnd** on page 246  
**GciNbMoreTraversal** on page 258  
**GciNbStoreTrav** on page 263  
**GciNbStoreTravDoTrav\_** on page 265  
**GciStoreTravDo\_** on page 390



## GciNbStoreTravDoTrav\_

Combine in a single function the calls to **GciNbStoreTravDo\_** and **GciNbClampedTrav**, to store multiple traversal buffer values in objects, execute the specified code, and traverse the result object (non-blocking).

### Syntax

```
void GciNbStoreTravDoTrav_(  
    GciStoreTravDoArgsSType * storeTravArgs,  
    GciClampedTravArgsSType * clampedTravArgs );
```

### Arguments

- storeTravArgs* An instance of **GciStoreTravDoArgsSType**. For details, refer to the discussion of **GciStoreTravDo\_** on page 390.
- clampedTravArgs* An instance of **GciClampedTravArgsSType**. For details, refer to the discussion of **GciClampedTrav** on page 110.

### Return Value

The **GciNbStoreTravDoTrav\_** function, unlike **GciStoreTravDoTrav\_**, does not have a return value. However, when the traversal operation is complete, you can access a value identical in meaning to the return value of **GciStoreTravDoTrav\_** by using the argument to **GciNbEnd**.

### Description

This function allows the client to execute behavior on the Gem and return the traversal of the result object in a single network round-trip.

The **GciNbStoreTravDoTrav\_** function is equivalent in effect to **GciStoreTravDoTrav\_**. However, **GciNbStoreTravDoTrav\_** permits the application to proceed with non-GemStone tasks while the traversals are stored, and **GciStoreTravDoTrav\_** does not.

### See Also

- GciNbEnd** on page 246
- GciNbMoreTraversal** on page 258
- GciNbStoreTrav** on page 263
- GciNbStoreTravDo\_** on page 264
- GciNbStoreTravDoTravRefs\_** on page 266
- GciStoreTravDoTrav\_** on page 392

## GciNbStoreTravDoTravRefs\_

Combine in a single function modifications to session sets, traversal of objects to the server, optional Smalltalk execution, and traversal to the client of changed objects and (optionally) the result object (non blocking).

### Syntax

```
void GciNbStoreTravDoTravRefs_(
    const OopType *      oopsNoLongerReplicated,
    int                  numNotReplicated,
    const OopType *      oopsGcedOnClient,
    int                  numGced,
    GciStoreTravDoArgsSType * storeTravArgs,
    GciClampedTravArgsSType * clampedTravArgs );
```

### Arguments

- oopsNoLongerReplicated* An Array of objects to be removed from the PureExportSet and added to the ReferencedSet.
- numNotReplicated* The number of elements in *oopsNoLongerReplicated*.
- oopsGcedOnClient* An Array of objects to be removed from both the PureExportSet and ReferencedSet.
- numGced* The number of elements in *oopsGcedOnClient*.
- storeTravArgs* An instance of **GciStoreTravDoArgsSType**. For details, refer to the discussion of **GciStoreTravDo\_** on page 390.
- clampedTravArgs* An instance of **GciClampedTravArgsSType**. For details, see the discussion of **GciClampedTrav** on page 110.

### Return Value

The **GciNbStoreTravDoTravRefs\_** function, unlike **GciStoreTravDoTravRefs\_**, does not have a return value. However, when the traversal operation is complete, you can access a value identical in meaning to the return value of **GciStoreTravDoTravRefs\_** by using the argument to **GciNbEnd**

### Description

This function allows the client to modify the PureExportSet and ReferencedSet, modify or create any number of objects on the server, execute behavior on the Gem, and return the traversal of the result object, all in a single network round-trip.

The **GciNbStoreTravDoTravRefs\_** function is equivalent in effect to **GciStoreTravDoTravRefs\_**. However, **GciNbStoreTravDoTravRefs\_** permits the application to proceed with non-GemStone tasks while the traversals are stored, and **GciStoreTravDoTravRefs\_** does not.

## See Also

- [GciNbEnd](#) on page 246
- [GciNbMoreTraversal](#) on page 258
- [GciNbStoreTrav](#) on page 263
- [GciNbStoreTravDo\\_](#) on page 264
- [GciNbStoreTravDoTrav\\_](#) on page 265
- [GciStoreTravDoTravRefs\\_](#) on page 393

## GciNbTraverseObjs

Traverse an array of GemStone objects (nonblocking).

### Syntax

```
void GciNbTraverseObjs(
    const OopType          theOops [ ],
    int                    numOops,
    GciTravBufType *      travBuff,
    int                    level );
```

### Arguments

*theOops* An array of OOPs representing the objects to be traversed.

*numOops* The number of elements in *theOops*.

*travBuff* A buffer in which the results of the traversal will be placed. For details, see “Traversal Buffer - GciTravBufType” on page 78.

*level* Maximum traversal depth. When the level is 1, an object report is written to the traversal buffer for each element in theOops. When level is 2, an object report is also obtained for the instance variables of each level-1 object. When level is 0, the number of levels in the traversal is not restricted.

### Return Value

The **GciNbTraverseObjs** function, unlike **GciTraverseObjs**, does not have a return value. However, when the traversal operation is complete, you can access a value identical in meaning to the return value of **GciTraverseObjs** by using the argument to **GciNbEnd**.

### Description

The **GciNbTraverseObjs** function is equivalent in effect to **GciTraverseObjs**. However, **GciNbTraverseObjs** permits the application to proceed with non-GemStone tasks while the traversal is completed, and **GciTraverseObjs** does not.

**GciNbTraverseObjs** provides automatic byte swizzling, unless **GciSetTraversalBufSwizzling** is used to disable swizzling. For more about byte swizzling, see “Byte-Swizzling of Binary Floating-Point Values” on page 26.

### See Also

**GciNbEnd** on page 246  
**GciNbMoreTraversal** on page 258  
**GciNbStoreTrav** on page 263  
**GciNbStoreTravDo\_** on page 264  
**GciNbStoreTravDoTrav\_** on page 265  
**GciTraverseObjs** on page 407

# GciNewByteObj

Create and initialize a new byte object.

## Syntax

```
OopsType GciNewByteObj(  
    OopsType          aClass,  
    const ByteType * value,  
    int64             valueSize );
```

## Arguments

*aClass* The OOP of the class of which the new object is an instance. *aClass* must be a class whose format is BYTE.

*value* Pointer to an array of byte values to be stored in the newly-created object.

*valueSize* The number of byte values in *value*.

## Return Value

The OOP of the newly created object.

## Description

Returns a new instance of *aClass*, of size *valueSize*, and containing a copy of the bytes located at *value*. Equivalent to **GciNewOop** followed by **GciStoreBytes**. *aClass* must be a class whose format is Bytes.

## See Also

**GciNewCharObj** on page 270

**GciNewOop** on page 274

**GciNewString** on page 279

## GciNewCharObj

Create and initialize a new character object.

### Syntax

```
OopsType GciNewCharObj(  
    OopsType          aClass,  
    const char *      cString );
```

### Arguments

*aClass* The OOP of the class of which the new object is an instance. *aClass* must be a class whose format is BYTE.

*cString* Pointer to an array of characters to be stored in the newly-created object. The terminating '\0' character is not stored.

### Return Value

The OOP of the newly-created object.

### Description

Returns a new instance of *aClass* which has been initialized to contain the bytes of *cString*, excluding the null terminator.

### See Also

[GciNewByteObj](#) on page 269

[GciNewOop](#) on page 274

[GciNewString](#) on page 279

# GciNewDateTime

Create and initialize a new instance of `DateTime` or a subclass of `DateTime`.

## Syntax

```
OopsType GciNewDateTime(  
    OopsType theClass,  
    const GciDateTimeSType * datetimeVal );
```

## Arguments

*theClass* The class of the object to be created, which must be `OOP_CLASS_DATE_TIME` or a subclass.

*datetimeVal* The time value to be assigned to the newly-created object.

## Return Value

Returns the OOP of the newly-created object. If an error occurs, returns `OOP_ILLEGAL`.

## Description

Creates a new instance of *theClass* having the value that *timeVal* points to. For details on `GciDateTimeSType`, see **GciDateTimeSType** on page 68.

## See Also

**GciNewDateAndTime** on page 272

**GciNewDateAndTimePosix** on page 273

## GciNewDateAndTime

Create and initialize a new instance of DateAndTime.

### Syntax

```
OopType GciNewDateTime(  
    const GciDateAndTime*    dateAndTimeVal );
```

### Arguments

*dateAndTimeVal* The date and time value to be assigned to the newly-created object.

### Return Value

Returns the OOP of the newly-created object. If an error occurs, returns OOP\_ILLEGAL.

### Description

Creates a new instance of DateAndTime having the value that *dateAndTimeVal* points to. For details on GciDateAndTime, see **GciDateAndTime** on page 68.

### See Also

**GciNewDateTime** on page 271

**GciNewDateAndTimePosix** on page 273



# GciNewDateAndTimePosix

Create and initialize a new instance of DateAndTime.

## Syntax

```
OopType GciNewDateTimePosix(  
    int64          microseconds,  
    int           offsetSeconds);
```

## Arguments

*microseconds* The number of microseconds UTC since the start of January 1, 1900

*offsetSeconds* The number of seconds of the offset from UTC (timezone)

## Return Value

Returns the OOP of the newly-created object. If an error occurs, returns OOP\_ILLEGAL.

## Description

Creates a new instance of DateAndTime with the given posix seconds and offset.

## See Also

[GciNewDateTime](#) on page 271

[GciNewDateAndTime](#) on page 272

# GciNewOop

Create a new GemStone object.

## Syntax

```
oopType GciNewOop(
    oopType          aClass );
```

## Arguments

*aClass* The OOP of the class of which the new object is an instance. This may be the OOP of a class that you have created, or it may be one of the Smalltalk kernel classes, such as OOP\_CLASS\_STRING for an object of class String. It may not be Symbol or DoubleByteSymbol. See \$GEMSTONE/include/gcioop.ht for the C constants that are defined for GemStone kernel classes.

## Return Value

Returns the OOP of the new object. In case of error, this function returns OOP\_NIL.

## Description

This function creates a new object of the specified class and returns the object's OOP. It cannot be used to create instances of Symbol or DoubleByteSymbol.

## Example

```
oopType newOop_example(void)
{
    // create a new instance of String
    oopType result = GciNewOop(OOP_CLASS_STRING);
    return result;
}
```

## See Also

**GciNewOop** on page 274

**GciNewString** on page 279

**GciNewSymbol** on page 280

**GciNewUtf8String** on page 281

## GciNewOops

Create multiple new GemStone objects.

### Syntax

```
void GciNewOops(
    int                numOops,
    const OopType     classes[ ],
    const int64       idxSize[ ],
    OopType           result[ ]);
```

### Arguments

- numOops* The number of new objects to be created.
- classes* An Array of the OOPs of the classes of each new object, of which the new object is an instance. This may be the OOP of a class that you have created, or it may be one of the Smalltalk kernel classes, such as OOP\_CLASS\_STRING for an object of class String. It may not be Symbol or DoubleByteSymbol. See \$GEMSTONE/include/gcioop.ht for the C constants that are defined for GemStone kernel classes.
- idxSize* For each new object, the number of its indexed variables. If the specified oclass of an object is not indexable, its *idxSize* is ignored.
- result* An array of the OOPs of the new objects created with this function.

### Return Value

If an error is encountered, this function will stop at the first error and the contents of the *result* array will be undefined.

### Description

This function creates multiple objects of the specified classes and sizes, and returns the OOPs of the new objects.

Each OOP in *classes* may be the OOP of a class that you have created, or it may be one of the Smalltalk kernel classes, such as OOP\_CLASS\_STRING for an object of class String. This function cannot be used to create instances of Symbol or DoubleByteSymbol. If *classes* contains the OOP of a class with special implementation (such as Boolean), then the corresponding element in *result* is OOP\_NIL. See \$GEMSTONE/include/gcioop.ht for the C constants that are defined for GemStone kernel classes.

**GciNewOops** generates an error when either of the following conditions is TRUE for any object:

- *idxSize* < 0
- (*idxSize* + number\_of\_named\_instance\_variables) > maxSmallInt

## Example

```
void newOops_example(void)
{
    enum { num_objs = 3 };
    OopType classes[num_objs];
    classes[0] = OOP_CLASS_STRING;
    classes[1] = OOP_CLASS_IDENTITY_SET;
    classes[2] = OOP_CLASS_ARRAY;

    int64 sizes[num_objs];
    sizes[0] = 50;
    sizes[1] = 0; /* ignored for NSCs anyway */
    sizes[2] = 3;

    OopType newObjs[num_objs];

    GciNewOops(num_objs, classes, sizes, newObjs);
    GciErrSType errInfo;
    if (GciErr(&errInfo)) {
        printf("error category "FMT_OID" number %d, %s\n",
            errInfo.category, errInfo.number, errInfo.message);
    } else {
        printf("objIds of new objects are "FMT_OID" "FMT_OID" "FMT_OID"\n",
            newObjs[0], newObjs[1], newObjs[2]);
    }
}
```

## See Also

[GciNewOop](#) on page 274

[GciNewString](#) on page 279

[GciNewSymbol](#) on page 280

[GciNewUtf8String](#) on page 281

# GciNewOopUsingObjRep

Create a new GemStone object from an existing object report.

## Syntax

```
void GciNewOopUsingObjRep(  
    GciObjRepSType *      anObjectReport );
```

## Arguments

*anObjectReport* Pointer to an object report, which will be modified to contains the OOP of the new object (*hdr.objId*), the ID of the object's security policy (*hdr.objectSecurityPolicyId*), the number of named instance variables in the object (*hdr.namedSize*), the updated number of the object's indexed variables (*hdr.idxSize*), and the object's complete size (the sum of its named and unnamed variables, *hdr.objSize*).

## Description

This function allows you to submit an object report that creates a GemStone object and specifies the values of its instance variables. You can use this function to define a String, pointer, or NSC object with known OOPs.

The object report consists of two parts: a header (a **GciObjRepHdrSType** structure) followed by a value buffer (an array of values of the object's instance variables). For more information on object reports, see "Object Report Structure - GciObjRepSType" on page 71.

**GciNewOopUsingObjRep** provides automatic byte swizzling for Float and SmallFloat objects. (For more about byte swizzling, see "Byte-Swizzling of Binary Floating-Point Values" on page 26.)

## Error Conditions

In addition to general GemBuilder error conditions, this function generates an error if any of the following conditions exist:

- If (*idxSize* < 0)
- If (*idxSize* + *namedSize*) > *maxSmallInt*
- If *firstOffset* > (*objSize* + 1)
- For pointer objects and NSCs, if *valueBuffSize* is not divisible by 4
- If the specified *oclass* is not the OOP of a Smalltalk class object
- If the specified *oclass* and implementation (*objImpl*) do not agree
- If *objId* is a Float or SmallFloat, then *startIndex* must be one and *valueBuffSize* must be the actual size for the class of *objId*.

Note that you cannot use this function to create new special objects (instances of SmallInteger, Character, Boolean, SmallDouble, or UndefinedObject).

## Example

```
void newOopUsingObjRep_example(void)
```

```
{
  int arrSize = 100;
  size_t bodySize = sizeof(OopType) * arrSize ;
  size_t rptSize = GCI_ALIGN(sizeof(GciObjRepSType) + bodySize );
  GciObjRepSType *rpt = (GciObjRepSType*) malloc(rptSize);
  if (rpt == NULL) {
    printf("malloc failure\n");
    return;
  }
  rpt->hdr.objId = OOP_NIL; // ignored by GciNewOopUsingObjRep
  rpt->hdr.oclass = OOP_CLASS_ARRAY;
  rpt->hdr.setObjImpl(GC_FORMAT_OOP);
  rpt->hdr.segmentId = WORLD_RW_SEGMENT_ID ;
  rpt->hdr.firstOffset = 1;
  rpt->hdr.namedSize = 0; // ignored by GciNewOopUsingObjRep
  rpt->hdr.setIdxSize( arrSize );
  rpt->hdr.valueBuffSize = bodySize ;

  OopType *body = rpt->valueBufferOops();
  for (int i = 0; i < arrSize; i += 1) {
    body[i] = GciI32ToOop(i);
  }
  GciNewOopUsingObjRep(rpt);

  GciErrSType errInfo;
  if (GciErr(&errInfo)) {
    printf("error category "FMT_OID" number %d, %s\n",
          errInfo.category, errInfo.number, errInfo.message);
  }
}
```

## See Also

[GciNewOops](#) on page 275

[GciNewString](#) on page 279

[GciNewSymbol](#) on page 280

[GciNewUtf8String](#) on page 281

[GciNewString](#) on page 279

# GciNewString

Create a new String object from a C character string.

## Syntax

```
oopType GciNewString(  
    const char *          cString );
```

## Arguments

*cString* Pointer to a character string.

## Return Value

The OOP of the newly created object.

## Description

Returns a new instance of OOP\_CLASS\_STRING with the value that *cString* points to.

# GciNewSymbol

Create a new Symbol object from a C character string.

## Syntax

```
oopType GciNewSymbol(  
    const char *      cString );
```

## Arguments

*cString* Pointer to a character string.

## Return Value

The OOP of the newly-created object.

## Description

Returns a new instance of OOP\_CLASS\_SYMBOL with the value that *cString* points to.



# GciNewUtf8String

## GciNewUtf8String\_

Create a new Unicode string object from a UTF-8 encoded C character string.

### Syntax

```
OopsType GciNewUtf8String(  
    const char *          unicodeCString,  
    BoolType              utf8OrUnicode);  
  
OopsType GciNewUtf8String_(  
    const char *          unicodeCString,  
    size_t                nBytes,  
    BoolType              utf8OrUnicode);
```

### Arguments

- unicodeCString* Pointer to a null-terminated UTF-8 encoded character string.
- nBytes* The length in bytes of the UTF-8 encoded character string.
- utf8OrUnicode* Boolean indicating whether to create an instance of Utf8 or of a Unicode class. If *utf8OrUnicode* = 0, return an instance of Utf8. If *utf8OrUnicode*=1, return an instance of Unicode7, Unicode16, or Unicode32, the minimal character size required to represent *unicodeCString*.

### Return Value

The OOP of the newly created object.

### Description

Returns a new instance of Utf8, Unicode7, Unicode16, or Unicode32, with the value that the UTF-8 encoded *unicodeCString* points to.

With the **GciNewUtf8String\_** option, you provide the length of the C string; with **GciNewUtf8String**, `strlen()` is used to compute the size.

## GciNscIncludesOop

Determines whether the given OOP is present in the specified unordered collection.

### Syntax

```
BoolType GciNscIncludesOop(  
    OopType          theNsc,  
    OopType          theOop );
```

### Arguments

*theNsc* The unordered collection in which to search.

*theOop* The OOP to search for.

### Return Value

True if the OOP was found; false otherwise.

### Description

**GciNscIncludesOop** searches the specified unordered collection to determine if it includes the specified object. It is equivalent to the GemStone Smalltalk method `UnorderedCollection >> includesIdentical:.`

### Example

```
BoolType nscIncludesOop_example(OopType nscOop, OopType anOop)  
{  
    if (!GciIsKindOfClass(nscOop, OOP_CLASS_IDENTITY_BAG) ) {  
        printf("first argument is not an Nsc\n");  
        return FALSE; /* error: nscOop is not an NSC */  
    }  
  
    return GciNscIncludesOop(nscOop, anOop);  
}
```

### See Also

[GciAddOopToNsc](#) on page 94

[GciAddOopsToNsc](#) on page 95

[GciRemoveOopFromNsc](#) on page 334

[GciRemoveOopsFromNsc](#) on page 335

## GciObjExists

Determine whether or not a GemStone object exists.

### Syntax

```
BoolType GciObjExists(  
    OopType theObject );
```

### Arguments

*theObject* The OOP of an object.

### Return Value

Returns TRUE if *theObject* exists, FALSE otherwise.

### Description

This function tests an OOP to see if the object to which it points is a valid object.

## GciObjInCollection

Determine whether or not a GemStone object is in a Collection.

### Syntax

```
BoolType GciObjInCollection(  
    OopType          anObj,  
    OopType          aCollection );
```

### Arguments

*anObj* The OOP of an object for which to check.

*aCollection* The OOP of a collection.

### Return Value

Returns TRUE if *anObj* exists in *aCollection*, FALSE otherwise.

### Description

Searches the specified collection for the specified object. If *aCollection* is an NSC (such as a Bag or Set), this is a tree lookup. If *aCollection* is a kind of Array or String, this is a sequential scan. This function is equivalent to the GemStone Smalltalk method `Object >> in:`.

# GciObjIsCommitted

Determine whether or not an object is committed.

## Syntax

```
BoolType GciObjIsCommitted(  
    OopType theOop );
```

## Arguments

*theOop* The OOP of an object.

## Return Value

**GciObjIsCommitted** returns TRUE if the object *theOop* is committed, FALSE otherwise.

## Description

The **GciObjIsCommitted** function determines if the given object is committed or not.

## See Also

**GciObjExists** on page 283

## GciObjRepSize\_

Find the number of bytes in an object report.

### Syntax

```
size_t GciObjRepSize_(anObjectReport)
    const GciObjRepHdrSType * anObjectReport;
```

### Arguments

*anObjectReport* A pointer to an object report returned by **GciFindObjRep**.

### Return Value

Returns the size of the specified object report.

### Description

This function calculates the number of bytes in an object report. Before your application allocates memory for a copy of the object report, it can call this function to obtain the size of the report.

### Example

See “Executing the examples” on page 91 for the Smalltalk code that defines the classes and objects that support the examples.

```
void objRepSize_example(void)
{
    OopType rootObj = GciResolveSymbol("AllAccounts", OOP_NIL);
    GciTravBufType *buf = GciAllocTravBuf(8000);

    GciTraverseObjs(&rootObj, 1, buf, 10);
    GciObjRepHdrSType *rpt = buf->firstReportHdr();
    GciObjRepHdrSType *limit = buf->readLimitHdr();
    if (rpt < limit) {
        size_t reportSize = GciObjRepSize_(rpt);
        printf("size of first report is %ld bytes\n", reportSize);
    } else {
        printf("error, GciTraverseObjs returned empty buffer\n");
    }
}
```

### See Also

**GciFindObjRep** on page 203  
**GciMoreTraversal** on page 238  
**GciTraverseObjs** on page 407

## GCI\_OOP\_IS\_BOOL

(MACRO) Determine whether or not a GemStone object represents a GemStone Smalltalk Boolean.

### Syntax

BoolType GCI\_OOP\_IS\_BOOL(*theOop*)

### Arguments

*theOop* The OOP of the object to test.

### Return Value

A C Boolean value. Returns TRUE if the object represents a Boolean, FALSE otherwise.

### Description

This macro tests to see if *theOop* represents a Boolean object.

### See Also

GCI\_OOP\_IS\_CHAR on page 288  
GCI\_OOP\_IS\_SmallDate on page 289  
GCI\_OOP\_IS\_SmallDateAndTime on page 290  
GCI\_OOP\_IS\_SMALL\_DOUBLE on page 291  
GCI\_OOP\_IS\_SMALL\_FRACTION on page 292  
GCI\_OOP\_IS\_SMALL\_INT on page 293  
GCI\_OOP\_IS\_SmallScaledDecimal on page 294  
GCI\_OOP\_IS\_SmallTime on page 295  
GCI\_OOP\_IS\_SPECIAL on page 296

## GCI\_OOP\_IS\_CHAR

(MACRO) Determine whether or not a GemStone object represents a Character.

### Syntax

BoolType **GCI\_OOP\_IS\_CHAR**(*theOop*)

### Arguments

*theOop* The OOP of the object to test.

### Return Value

A C Boolean value. Returns TRUE if the object represents a GemStone Character, FALSE otherwise.

### Description

This macro tests to see if *theOop* represents a Character.

### See Also

**GCI\_OOP\_IS\_BOOL** on page 287  
**GCI\_OOP\_IS\_SmallDate** on page 289  
**GCI\_OOP\_IS\_SmallDateAndTime** on page 290  
**GCI\_OOP\_IS\_SMALL\_DOUBLE** on page 291  
**GCI\_OOP\_IS\_SMALL\_FRACTION** on page 292  
**GCI\_OOP\_IS\_SMALL\_INT** on page 293  
**GCI\_OOP\_IS\_SmallScaledDecimal** on page 294  
**GCI\_OOP\_IS\_SmallTime** on page 295  
**GCI\_OOP\_IS\_SPECIAL** on page 296



## GCI\_OOP\_IS\_SmallDate

(MACRO) Determine whether or not a GemStone object represents a SmallDate.

### Syntax

BoolType `GCI_OOP_IS_SmallDate`(*theOop*)

### Arguments

*theOop* The OOP of the object to test.

### Return Value

A C Boolean value. Returns TRUE if the object represents a SmallDate, FALSE otherwise.

### Description

This macro tests to see if *theOop* represents a SmallDate.

### See Also

`GCI_OOP_IS_BOOL` on page 287  
`GCI_OOP_IS_CHAR` on page 288  
`GCI_OOP_IS_SmallDateAndTime` on page 290  
`GCI_OOP_IS_SMALL_DOUBLE` on page 291  
`GCI_OOP_IS_SMALL_FRACTION` on page 292  
`GCI_OOP_IS_SMALL_INT` on page 293  
`GCI_OOP_IS_SmallScaledDecimal` on page 294  
`GCI_OOP_IS_SmallTime` on page 295  
`GCI_OOP_IS_SPECIAL` on page 296

## GCI\_OOP\_IS\_SmallDateAndTime

(MACRO) Determine whether or not a GemStone object represents a SmallDateAndTime.

### Syntax

```
BoolType GCI_OOP_IS_SmallDateAndTime(theOop)
```

### Arguments

*theOop* The OOP of the object to test.

### Return Value

A C Boolean value. Returns TRUE if the object represents a SmallDateAndTime, FALSE otherwise.

### Description

This macro tests to see if *theOop* represents a SmallDateAndTime.

### See Also

GCI\_OOP\_IS\_BOOL on page 287  
GCI\_OOP\_IS\_CHAR on page 288  
GCI\_OOP\_IS\_SmallDate on page 289  
GCI\_OOP\_IS\_SMALL\_DOUBLE on page 291  
GCI\_OOP\_IS\_SMALL\_FRACTION on page 292  
GCI\_OOP\_IS\_SMALL\_INT on page 293  
GCI\_OOP\_IS\_SmallScaledDecimal on page 294  
GCI\_OOP\_IS\_SmallTime on page 295  
GCI\_OOP\_IS\_SPECIAL on page 296

# GCI\_OOP\_IS\_SMALL\_DOUBLE

(MACRO) Determine whether or not a GemStone object represents a SmallDouble.

## Syntax

BoolType GCI\_OOP\_IS\_SMALL\_DOUBLE(*theOop*)

## Arguments

*theOop* The OOP of the object to test.

## Return Value

A C Boolean value. Returns TRUE if the object represents a SmallDouble, FALSE otherwise.

## Description

This macro tests to see if *theOop* represents a SmallDouble.

## See Also

GCI\_OOP\_IS\_BOOL on page 287  
GCI\_OOP\_IS\_CHAR on page 288  
GCI\_OOP\_IS\_SmallDate on page 289  
GCI\_OOP\_IS\_SmallDateAndTime on page 290  
GCI\_OOP\_IS\_SMALL\_FRACTION on page 292  
GCI\_OOP\_IS\_SMALL\_INT on page 293  
GCI\_OOP\_IS\_SmallScaledDecimal on page 294  
GCI\_OOP\_IS\_SmallTime on page 295  
GCI\_OOP\_IS\_SPECIAL on page 296

# GCI\_OOP\_IS\_SMALL\_FRACTION

(MACRO) Determine whether or not a GemStone object represents a SmallFraction.

## Syntax

```
BoolType GCI_OOP_IS_SMALL_FRACTION(theOop)
```

## Arguments

*theOop* The OOP of the object to test.

## Return Value

A C Boolean value. Returns TRUE if the object represents a SmallFraction, FALSE otherwise.

## Description

This macro tests to see if *theOop* represents a SmallFraction.

## See Also

- GCI\_OOP\_IS\_BOOL on page 287
- GCI\_OOP\_IS\_CHAR on page 288
- GCI\_OOP\_IS\_SmallDate on page 289
- GCI\_OOP\_IS\_SmallDateAndTime on page 290
- GCI\_OOP\_IS\_SMALL\_DOUBLE on page 291
- GCI\_OOP\_IS\_SMALL\_INT on page 293
- GCI\_OOP\_IS\_SmallScaledDecimal on page 294
- GCI\_OOP\_IS\_SmallTime on page 295
- GCI\_OOP\_IS\_SPECIAL on page 296

# GCI\_OOP\_IS\_SMALL\_INT

(MACRO) Determine whether or not a GemStone object represents a SmallInteger.

## Syntax

BoolType GCI\_OOP\_IS\_SMALL\_INT(*theOop*)

## Arguments

*theOop* The OOP of the object to test.

## Return Value

A C Boolean value. Returns TRUE if the object represents a SmallInteger, FALSE otherwise.

## Description

This macro tests to see if *theOop* represents a SmallInteger.

## See Also

GCI\_OOP\_IS\_BOOL on page 287  
GCI\_OOP\_IS\_CHAR on page 288  
GCI\_OOP\_IS\_SmallDate on page 289  
GCI\_OOP\_IS\_SmallDateAndTime on page 290  
GCI\_OOP\_IS\_SMALL\_DOUBLE on page 291  
GCI\_OOP\_IS\_SMALL\_FRACTION on page 292  
GCI\_OOP\_IS\_SmallScaledDecimal on page 294  
GCI\_OOP\_IS\_SmallTime on page 295  
GCI\_OOP\_IS\_SPECIAL on page 296

# GCI\_OOP\_IS\_SmallScaledDecimal

(MACRO) Determine whether or not a GemStone object represents a SmallScaledDecimal.

## Syntax

BoolType GCI\_OOP\_IS\_SmallScaledDecimal(*theOop*)

## Arguments

*theOop* The OOP of the object to test.

## Return Value

A C Boolean value. Returns TRUE if the object represents a SmallScaledDecimal, FALSE otherwise.

## Description

This macro tests to see if *theOop* represents a SmallScaledDecimal.

## See Also

GCI\_OOP\_IS\_BOOL on page 287  
GCI\_OOP\_IS\_CHAR on page 288  
GCI\_OOP\_IS\_SmallDate on page 289  
GCI\_OOP\_IS\_SmallDateAndTime on page 290  
GCI\_OOP\_IS\_SMALL\_DOUBLE on page 291  
GCI\_OOP\_IS\_SMALL\_FRACTION on page 292  
GCI\_OOP\_IS\_SMALL\_INT on page 293  
GCI\_OOP\_IS\_SmallTime on page 295  
GCI\_OOP\_IS\_SPECIAL on page 296

# GCI\_OOP\_IS\_SmallTime

(MACRO) Determine whether or not a GemStone object represents a SmallTime.

## Syntax

```
BoolType GCI_OOP_IS_SmallTime(theOop)
```

## Arguments

*theOop* The OOP of the object to test.

## Return Value

A C Boolean value. Returns TRUE if the object represents a SmallTime, FALSE otherwise.

## Description

This macro tests to see if *theOop* represents a SmallTime.

## See Also

- GCI\_OOP\_IS\_BOOL on page 287
- GCI\_OOP\_IS\_CHAR on page 288
- GCI\_OOP\_IS\_SmallDate on page 289
- GCI\_OOP\_IS\_SmallDateAndTime on page 290
- GCI\_OOP\_IS\_SMALL\_DOUBLE on page 291
- GCI\_OOP\_IS\_SMALL\_FRACTION on page 292
- GCI\_OOP\_IS\_SMALL\_INT on page 293
- GCI\_OOP\_IS\_SmallScaledDecimal on page 294
- GCI\_OOP\_IS\_SPECIAL on page 296

## GCI\_OOP\_IS\_SPECIAL

(MACRO) Determine whether or not a GemStone object has a special representation.

### Syntax

BoolType **GCI\_OOP\_IS\_SPECIAL**(*theOop*)

### Arguments.

*theOop* The OOP of the object to test.

### Return Value

A C Boolean value. Returns TRUE if the object has a special representation, FALSE otherwise.

### Description

This macro tests to see if *theOop* has a special representation. GemStone specials are objects in which the OOP encodes the value, including Boolean, Character, SmallInteger, SmallDouble, and SmallFraction.

### See Also

**GCI\_OOP\_IS\_BOOL** on page 287  
**GCI\_OOP\_IS\_CHAR** on page 288  
**GCI\_OOP\_IS\_SmallDate** on page 289  
**GCI\_OOP\_IS\_SmallDateAndTime** on page 290  
**GCI\_OOP\_IS\_SMALL\_DOUBLE** on page 291  
**GCI\_OOP\_IS\_SMALL\_FRACTION** on page 292  
**GCI\_OOP\_IS\_SMALL\_INT** on page 293  
**GCI\_OOP\_IS\_SmallScaledDecimal** on page 294  
**GCI\_OOP\_IS\_SmallTime** on page 295



# GciOopToBool

Convert a Boolean object to a C Boolean value.

## Syntax

```
BoolType GciOopToBool(  
    OopType          theOop );
```

## Arguments

*theOop* The OOP of the Boolean object to be translated into a C Boolean value.

## Return Value

Returns the C Boolean value that corresponds to the GemStone object. In case of error, this function returns FALSE.

## Description

This function translates a GemStone Boolean object into the equivalent C Boolean value.

## Example

```
BoolType oopToBoolExample(OopType anObj)  
{  
    BoolType aBool = GciOopToBool(anObj);  
  
    GciErrSType errInfo;  
    if (GciErr(&errInfo)) {  
        // argument was not a Boolean  
        printf("error category \"FMT_OID\" number %d, %s\n",  
            errInfo.category, errInfo.number, errInfo.message);  
        return 0;  
    }  
    return aBool;  
}
```

## See Also

[GCI\\_BOOL\\_TO\\_OOP](#) on page 105

## GCI\_OOP\_TO\_BOOL

(MACRO) Convert a Boolean object to a C Boolean value.

### Syntax

```
GCI_OOP_TO_BOOL(theOop)
```

### Arguments

*theOop* The OOP of the Boolean object to be translated into a C Boolean value.

### Return Value

A C Boolean value. Returns the C Boolean value that corresponds to the GemStone object. In case of error, this macro returns FALSE.

### Description

This macro translates a GemStone Boolean object into the equivalent C Boolean value.

Provided for compatibility only. New code should use **GciOopToBool** on page 297. For the definition of GCI\_OOP\_TO\_BOOL, see \$GEMSTONE/include/gcicmn.ht

### See Also

GCI\_BOOL\_TO\_OOP on page 105

# GciOopToChar16

Convert a Character object to a 16-bit C character value.

## Syntax

```
unsigned int GciOopToChar16(  
    OopType          theOop );
```

## Arguments

*theOop* The OOP of the Character object to be translated into a 16-bit C character value.

## Return Value

Returns the 16-bit C character value that corresponds to the GemStone object. In case of error, this function returns zero.

## Description

This function translates a GemStone Character object into the equivalent 16-bit C character value.

## See Also

[GciOopToChar32](#) on page 300

[GciOopToChr](#) on page 301

## GciOopToChar32

Convert a Character object to a 32-bit C character value.

### Syntax

```
unsigned int GciOopToChar32(  
    OopType          theOop);
```

### Arguments

*theOop* The OOP of the Character object to be translated into a 32-bit C character value.

### Return Value

Returns the 32-bit C character value that corresponds to the GemStone object. In case of error, this function returns zero.

### Description

This function translates a GemStone Character object into the equivalent 32-bit C character value.

### See Also

[GciOopToChar16](#) on page 299

[GciOopToChr](#) on page 301

# GciOopToChr

Convert a Character object to a C character value.

## Syntax

```
char GciOopToChr(  
    OopType          theOop );
```

## Arguments

*theOop* The OOP of the Character object to be translated into a C character value.

## Return Value

Returns the C character value that corresponds to the GemStone object. In case of error, this function returns zero.

Attempting to convert a GemStone Character that is outside the range of C characters will result in an error.

## Description

This function translates a GemStone Character object into the equivalent C character value.

## Example

```
BoolType oopToChr_example(void)  
{  
    OopType theOop = GCI_CHR_TO_OOP('a');  
    int aChar = GciOopToChr(theOop);  
    if ( aChar == 0 ) {  
        printf("GciOopToChr failed\n");  
        return false;  
    }  
    return (aChar == (int) 'a');  
}
```

## See Also

[GCI\\_CHR\\_TO\\_OOP](#) on page 109

[GciOopToChar16](#) on page 299

[GciOopToChar32](#) on page 300

[GCI\\_OOP\\_TO\\_CHR](#) on page 302

## GCI\_OOP\_TO\_CHR

(MACRO) Convert a Character object to a C character value.

### Syntax

```
GCI_OOP_TO_CHR(theOop)
```

### Arguments

*theOop* The OOP of the Character object to be translated into a C character value.

### Return Value

The **GCI\_OOP\_TO\_CHR** macro returns the C character value that corresponds to the GemStone object. In case of error, it returns zero.

### Description

Provided for compatibility only. New code should use **GciOopToChr** or **GciOopToChar16**.

### See Also

**GciOopToChar16** on page 299

**GciOopToChr** on page 301

## GciOopToFlt

Convert a SmallDouble, Float, or SmallFloat object to a C double.

### Syntax

```
double GciOopToFlt(
    OopType          theObject);
```

### Arguments

*theObject* The OOP of the specified SmallDouble, Float, or SmallFloat object.

### Return Value

Returns the C double precision value that corresponds to the GemStone object. In case of any error other than `HOST_ERR_INEXACT_PRECISION`, this function returns a PlusQuietNaN.

### Description

This function translates a GemStone Float object into the equivalent C double precision value.

If your C compiler's floating point package doesn't have a representation that corresponds to one of the values listed below, **GciOopToFlt** may generate the following errors when converting GemStone Float objects into C values:

`HOST_ERR_INEXACT_PRECISION`

when called to convert a number whose precision exceeds that of the C double type

`HOST_ERR_MAGNITUDE_OUT_OF_RANGE`

when called to convert a number whose exponent is too large (or small) to be held in a C double precision value

`HOST_ERR_NO_PLUS_INFINITY`

when called to convert a value of positive infinity

`HOST_ERR_NO_MINUS_INFINITY`

when called to convert a value of negative infinity

`HOST_ERR_NO_PLUS_QUIET_NAN`

when called to convert a positive quiet NaN

`HOST_ERR_NO_MINUS_QUIET_NAN`

when called to convert a negative quiet NaN

`HOST_ERR_NO_PLUS_SIGNALING_NAN`

when called to convert a positive signaling NaN

`HOST_ERR_NO_MINUS_SIGNALING_NAN`

when called to convert a negative signaling NaN

### Example

```
double oopToFlt_example(OopType arg)
{
```

```
double d = GciOopToFlt(arg);

GciErrSType errInfo;
if (GciErr(&errInfo)) {
    // argument was not a Float, SmallFloat or SmallDouble
    printf("error category "FMT_OID" number %d, %s\n",
        errInfo.category, errInfo.number, errInfo.message);
    return 0.0 ;
}
return d;
}
```

## See Also

[GciFltToOop](#) on page 205

[Gci\\_doubleToSmallDouble](#) on page 145



# GciOopToI32

## GciOopToI32\_

Convert a GemStone object to a C 32-bit integer value.

### Syntax

```
int GciOopToI32(  
    OopType          theObject );  
  
int GciOopToI32_(  
    OopType          theObject,  
    BoolType *      error );
```

### Arguments

*theObject* The OOP of the specified Integer object.

*error* TRUE if *theObject* does not fit in the result type or is not an Integer, otherwise unchanged.

### Return Value

The **GciOopToI32** and **GciOopToI32\_** functions return the C 32-bit integer value that is equivalent to the value of *theObject*.

### Description

The **GciOopToI32** and **GciOopToI32\_** functions translate a GemStone object into the equivalent C 32-bit integer value. The GemStone object must be a SmallInteger within the range of C integers.

Otherwise, **GciOopToI32** generates an error; **GciOopToI32\_** does not generate an error, but places a boolean in the error argument.

### See Also

**GciOopToI64** on page 306

# GciOopToI64

## GciOopToI64\_

Convert a GemStone object to a C 64-bit integer value.

### Syntax

```
int64 GciOopToI64(  
    OopType          theObject );
```

```
int64 GciOopToI64_(  
    OopType          theObject,  
    BoolType *      error );
```

### Arguments

*theObject* The OOP of the Integer object.

*error* TRUE if *theObject* does not fit in the result type or is not an Integer, otherwise unchanged.

### Return Value

The **GciOopToI64** and **GciOopToI64\_** functions return the C int64\_t value that is equivalent to the value of *theObject*.

### Description

The **GciOopToI64** and **GciOopToI64\_** functions translate a GemStone object into the equivalent C 64-bit integer value.

The object identified by *theObject* must be a SmallInteger or a LargeInteger. If the object is not one of these kinds, **GciOopToI64** generates an error; **GciOopToI64\_** places a boolean in the argument error.

### See Also

**GciOopToI32** on page 305

## GciPerform

Send a message to a GemStone object.

### Syntax

```

OopType GciPerform(
    OopType          receiver,
    const char       selector[ ],
    const OopType    args[ ],
    int              numArgs );

```

### Arguments

- receiver* The OOP of the receiver of the message.
- selector* A string that defines the message selector. For keyword selectors, all keywords are concatenated in the string. (For example, `at:put:`).
- args* An array of OOPs. Each element in the array corresponds to an argument for the message. If there are no message arguments, use a dummy OOP here.
- numArgs* The number of arguments to the message. For unary selectors (messages with no arguments), *numArgs* is zero.

### Return Value

Returns the OOP of the result of Smalltalk execution. In case of error, this function returns OOP\_NIL.

### Description

This function sends a message (that is, the selector along with any keyword arguments and their corresponding values) to the specified receiver (an object in the GemStone database). Because **GciPerform** calls the virtual machine, you can issue a soft break while this function is executing. For more information, see “Interrupting GemStone Execution” on page 30.

### Example

```

BoolType perform_example()
{
    GciErrSType errInfo;
    OopType userGlobals = GciResolveSymbol("UserGlobals", OOP_NIL);

    OopType argList[2];
    argList[0] = GciNewSymbol("myNumber");
    argList[1] = GciI32ToOop(55);

    OopType result = GciPerform(userGlobals, "at:put:", argList, 2);
    if (result == OOP_NIL) {
        if (GciErr(&errInfo)) {

```

```
        printf("GciPerform failed; error %d, %s\n", errInfo.number,
              errInfo.message);
        return false;
    }
}
BoolType err = false;
int64 val = GciOopToI64_(result, &err);
if (err) {
    printf("GciOopToI64 failed\n");
    return false;
}
return (val = 55);
}
```

## See Also

**GciExecuteStr** on page 157

**GciNbPerform** on page 259

**GciPerformNoDebug** on page 311

**GciPerformSymDbg** on page 313

**GciPerformTrav** on page 314

**GciPerformTraverse** on page 315

# GciPerformFetchBytes

Send a message to a GemStone object, returning byte results.

## Syntax

```
OopsType GciPerformFetchBytes(  
    OopsType          receiver,  
    const char        selector[ ],  
    const OopsType    args[ ],  
    int               numArgs,  
    ByteType *        result,  
    ssize_t           maxResultSize);
```

## Arguments

- receiver* The OOP of the receiver of the message.
- selector* A string that defines the message selector. For keyword selectors, all keywords are concatenated in the string. (For example, at : put :).
- args* An array of OOPs. Each element in the array corresponds to an argument for the message. If there are no message arguments, use a dummy OOP here.
- numArgs* The number of arguments to the message. For unary selectors (messages with no arguments), *numArgs* is zero.
- result* Array containing the bytes of the result of the execution.
- maxResultSize* Maximum size of *result*.

## Return Value

Returns number of bytes returned in *\*result*, or -1 if an error is available to be fetched with GciErr.

## Description

This function sends a message (that is, the selector along with any keyword arguments and their corresponding values) to the specified receiver (an object in the GemStone database), and puts the result, which should be a byte format object, in the *\*result* buffer.

Because **GciPerformFetchBytes** calls the virtual machine, you can issue a soft break while this function is executing.

## See Also

- GciExecuteStrFetchBytes** on page 159
- GciNbPerformFetchBytes** on page 260
- GciPerform** on page 307
- GciPerformTrav** on page 314
- GciPerformTraverse** on page 315



## GciPerformNoDebug

Send a message to a GemStone object, and temporarily disable debugging.

### Syntax

```

OopType GciPerformNoDebug(
    OopType          receiver,
    const char       selector[ ],
    const OopType    args[ ],
    int              numArgs,
    int              flags );

```

### Arguments

- receiver* The OOP of the receiver of the message.
- selector* A string that defines the message selector. For keyword selectors, all keywords are concatenated in the string. (For example, `at:put:`).
- args* An array of OOPs. Each element in the array corresponds to an argument for the message. If there are no message arguments, use a dummy OOP here.
- numArgs* The number of arguments to the message. For unary selectors (messages with no arguments), *numArgs* is zero.
- flags* Flags to disable or permit asynchronous events and debugging in Smalltalk. Use one or more of the GemBuilder mnemonics described below.

### Return Value

Returns the OOP of the result of Smalltalk execution. In case of error, this function returns OOP\_NIL.

### Description

This function is a variant of **GciPerform** that is identical to it except for just one difference. **GciPerformNoDebug** disables any breakpoints and single step points that currently exist in GemStone while the message is executing. This feature is typically used while implementing a Smalltalk debugger.

Values for flags are described in `gicmn.ht`, and can include:

- 0 (default) disables the debugger during execution.
- `GCI_PERFORM_FLAG_ENABLE_DEBUG = 1` allows debugging, making this function behave like `GciPerform`.
- `GCI_PERFORM_FLAG_DISABLE_ASYNC_EVENTS = 2` disables asynchronous events.
- `GCI_PERFORM_FLAG_SINGLE_STEP = 3` places a single-step breakpoint at the start of the method to be performed, and then executes to hit that breakpoint.

## See Also

- GciExecuteStr** on page 157
- GciNbPerformNoDebug** on page 261
- GciPerform** on page 307
- GciPerformSymDbg** on page 313
- GciPerformTrav** on page 314
- GciPerformTraverse** on page 315



# GciPerformSymDbg

Send a message to a GemStone object, using a String object as a selector.

## Syntax

```
OopType GciPerformSymDbg(  
    OopType receiver,  
    OopType selector,  
    const OopType args[ ],  
    int numArgs,  
    int flags );
```

## Arguments

- receiver* The OOP of the receiver of the message.
- selector* The OOP of a string object that defines the message selector. For keyword selectors, all keywords are concatenated in the string. (For example, at : put :).
- args* An array of OOPs. Each element in the array corresponds to an argument for the message. If there are no message arguments, use a dummy OOP here.
- numArgs* The number of arguments to the message. For unary selectors (messages with no arguments), *numArgs* is zero.
- flags* Flags to disable or permit asynchronous events and debugging in Smalltalk.

## Return Value

Returns the OOP of the result of Smalltalk execution. In case of error, this function returns OOP\_NIL.

## Description

If the isNoDebug flag is FALSE, this function is a variant of **GciPerform**; if the flag is TRUE, this function is a variant of **GciPerformNoDebug**. In either case, its operation is identical to the other function. The difference is that **GciPerformSymDbg** takes an OOP as its selector instead of a C string.

## See Also

- GciExecute** on page 153
- GciPerform** on page 307

## GciPerformTrav

First send a message to a GemStone object, then traverse the result of the message.

### Syntax

```
BoolType GciPerformTrav(  
    OopType receiver,  
    const char * selector,  
    const OopType * args,  
    int numArgs,  
    GciClampedTravArgsSType *travArgs );
```

### Arguments

- receiver* The OOP of the receiver of the message.
- selector* A pointer to a character collection that defines the message selector. For keyword selectors, all keywords are concatenated in the string. (For example, at : put :).
- args* An array of OOPs. Each element in the array corresponds to an argument for the message. If there are no message arguments, use a dummy OOP here.
- numArgs* The number of arguments to the message. For unary selectors (messages with no arguments), *numArgs* is zero.
- travArgs* Pointer to an instance of GciClampedTravArgsSType. See **GciClampedTrav** on page 110 for documentation of the fields in *travArgs*. The result of the **GciPerform** is the first object in the resulting *travBuff* field in *travArgs*.

### Return Value

Returns TRUE if the result is complete and no errors occurred. Returns FALSE if the traversal is not yet completed. You can then call **GciMoreTraversal** to proceed, if there is no GciError.

### Description

This function does the equivalent of a **GciPerform** using the first four arguments, and then performs a **GciClampedTrav**, starting from the result of the perform, and doing a traversal as specified by *travArgs*. In all GemBuilder traversals, objects are traversed post depth first.

### See Also

- GciClampedTrav** on page 110
- GciNbPerformTrav** on page 262
- GciPerform** on page 307
- GciPerformTraverse** on page 315

# GciPerformTraverse

First send a message to a GemStone object, then traverse the result of the message.

## Syntax

```
BoolType GciPerformTraverse(
    OopType          receiver,
    const char       selector[ ],
    const OopType    args[ ],
    int              numArgs,
    GciTravBufType * travBuff,
    int              level );
```

## Arguments

- receiver* The OOP of the receiver of the message.
- selector* A string that defines the message selector. For keyword selectors, all keywords are concatenated in the string. (For example, at : put :).
- args* An array of OOPs. Each element in the array corresponds to an argument for the message. If there are no message arguments, use a dummy OOP here.
- numArgs* The number of arguments to the message. For unary selectors (messages with no arguments), *numArgs* is zero.
- travBuff* A traversal buffer in which the results of the traversal are placed.
- level* Maximum traversal depth. When the level is 1, an object report is written to the traversal buffer for each element in theOops. When level is 2, an object report is also obtained for the instance variables of each level-1 object. When level is 0, the number of levels in the traversal is not restricted.

## Return Value

Returns FALSE if the traversal is not yet completed, but further traversal would cause the *travBuffSize* to be exceeded. If the *travBuffSize* is reached before the traversal is complete, you can then call **GciMoreTraversal** to proceed from the point where *travBuffSize* was exceeded.

Returns TRUE if there are no more objects to be returned by subsequent calls to **GciMoreTraversal**.

## Description

This function does a perform, then traverses the result of the perform.

**GciPerformTraverse** provides automatic byte swizzling, unless **GciSetTraversalBufSwizzling** is used to disable swizzling. For more about byte swizzling, see “Byte-Swizzling of Binary Floating-Point Values” on page 26.

## Example

The following two functions are equivalent:

```
BoolType performTraverse_example1(void)
{
    OopType receiver = GciResolveSymbol("AllUsers", OOP_NIL);
    OopType arg = GciI32ToOop(1);
    GciTravBufType *buf = GciAllocTravBuf(80000);

    BoolType atEnd = GciPerformTraverse(receiver, "at:", &arg, 1, buf, 2);
    return atEnd;
}
BoolType performTraverse_example2(void)
{
    OopType receiver = GciResolveSymbol("AllUsers", OOP_NIL);
    OopType arg = GciI32ToOop(1);
    OopType obj = GciPerform(receiver, "at:", &arg, 1);

    GciTravBufType *buf = GciAllocTravBuf(80000);
    BoolType atEnd = GciTraverseObjs(&obj, 1, buf, 2);
    return atEnd;
}
```

## See Also

- [GciClampedTrav](#) on page 110
- [GciMoreTraversal](#) on page 238
- [GciNbPerformTrav](#) on page 262
- [GciPerform](#) on page 307
- [GciPerformTrav](#) on page 314
- [GciTraverseObjs](#) on page 407

## GciPointerToByteArray

Given a C pointer, return a SmallInteger or ByteArray containing the value of the pointer.

### Syntax

```
ObjType GciPointerToByteArray(  
    void * pointer );
```

### Arguments

*pointer* A C pointer.

### Return Value

Returns a GemStone SmallInteger or ByteArray containing the value of the pointer.

If the argument is a 64-bit pointer aligned on an 8-byte boundary, or is a 32-bit pointer, the result is a SmallInteger. Otherwise, the result is a ByteArray.

### Description

The result has a machine-dependent byte order and is not intended to be committed.

### See Also

[GciByteArrayToPointer](#) on page 106

# GciPollForSignal

Poll GemStone for signal errors without executing any Smalltalk methods.

## Syntax

```
BoolType GciPollForSignal()
```

## Return Value

This function returns TRUE if a signal error or an asynchronous error exists, and FALSE otherwise.

## Description

GemStone permits selective response to signal errors: RT\_ERR\_SIGNAL\_ABORT, RT\_ERR\_SIGNAL\_COMMIT, and RT\_ERR\_SIGNAL\_GEMSTONE\_SESSION. The default condition is to leave them all invisible. GemStone responds to each single kind of signal error only after an associated method of class System has been executed: `enableSignaledAbortError`, `enableSignaledObjectsError`, and `enableSignaledGemStoneSessionError` respectively.

After **GciInit** executes successfully, the GemBuilder default condition also leaves all signal errors invisible. The **GciPollForSignal** function permits GemBuilder to check signal errors manually. However, GemStone must respond to each kind of error in order for GemBuilder to respond to it. Thus, if an application calls **GciPollForSignal**, then GemBuilder can check exactly the same kinds of signal errors as GemStone responds to. If GemStone has not executed any of the appropriate System methods, then this call has no effect until it does.

GemBuilder treats any signal errors that it finds just like any other errors, through **GciErr** or the **GciLongjmp** mechanism, as appropriate. Instead of checking manually, these errors can be checked automatically by calling the **GciEnableSignaledErrors** function.

**GciPollForSignal** also detects any asynchronous errors whenever they occur, including but not limited to the following errors: ABORT\_ERR\_LOST\_OT\_ROOT, GS\_ERR\_SHRPC\_CONNECTION\_FAILURE, GS\_ERR\_STN\_NET\_LOST, GS\_ERR\_STN\_SHUTDOWN, and GS\_ERR\_SESSION\_SHUTDOWN.

## See Also

**GciEnableSignaledErrors** on page 148

**GciErr** on page 152

# GciPollSocketForRead

Wait for the specified socket to be read-ready.

## Syntax

```
int GciPollSocketForRead(  
    int          socketFd,  
    int          timeoutMs);
```

## Arguments

*socketFd* A file descriptor for a socket.

*timeoutMs* Milliseconds to wait for a response before timing out and returning 0.

## Return Value

This function returns 0 if timed out, 1 if socket is ready for read, and an int < 0 if an error occurred. The result in this cases is the negated errno value.

## Description

Wait *timeoutMs* milliseconds for the specified socket to be read-ready or to have an error.

This function retries the poll on EINTR , even if a SIGTERM was received.

This is a thread safe function, and has no relationship to the current GCI session .

## GciPopErrJump

Discard a previously saved error jump buffer.

### Syntax

```
void GciPopErrJump(  
    GciJmpBufSType *      jumpBuffer );
```

### Arguments

*jumpBuffer* A pointer to a jump buffer specified in an earlier call to **GciPushErrJump**.

### Description

This function discards one or more jump buffers that were saved with earlier calls to **GciPushErrJump**. Your program must call this function when a saved execution environment is no longer useful for error handling.

GemBuilder maintains a stack of error jump buffers. After your program calls **GciPopErrJump**, the jump buffer at the top of the stack will be used for subsequent GemBuilder error handling. If no jump buffers remain, your program will need to call **GciErr** and test for errors locally.

To pop multiple jump buffers in a single call to **GciPopErrJump**, specify the *jumpBuffer* argument from an earlier call to **GciPushErrJump**. See the following example.

### Example

```
void popErr_example(void)  
{  
    GciJmpBufSType jumpBuff1, jumpBuff2, jumpBuff3, jumpBuff4;  
  
    GciPushErrJump(&jumpBuff1);  
  
    GciPushErrJump(&jumpBuff2);  
  
    GciPushErrJump(&jumpBuff3);  
  
    GciPushErrJump(&jumpBuff4);  
  
    GciPopErrJump(&jumpBuff1); /* pops buffers 1-4 */  
}
```

### See Also

**GciErr** on page 152  
**GciPushErrJump** on page 323  
**GciSetErrJump** (page 351)  
**GciLongJmp** on page 237



## GciProcessDeferredUpdates\_

Process deferred updates to objects that do not allow direct structural update.

### Syntax

```
int64 GciProcessDeferredUpdates_()
```

### Return Value

Returns the number of objects that had deferred updates.

### Description

This function processes updates to instances of classes that have the `noStructuralUpdate` bit set, including `AbstractDictionary`, `Bag`, `Set`, and their subclasses. After operations that modify an instance of one of these classes, either **GciProcessDeferredUpdates\_** must be called, or the final **GciStoreTrav** must have `GCI_STORE_TRAV_FINISH_UPDATES` set.

The following GemBuilder calls operate on instances whose classes have `noStructuralUpdate` set: **GciCreateOopObj**, **GciStoreTrav**, **GciStore...Oops**, **GciAdd...Oops**, **GciReplace...Oops**. Behavior of other GemBuilder update calls on such instances is undefined.

An attempt to commit automatically executes a deferred update.

Executing a deferred update before all forward references are resolved can produce errors that require the application to recover by doing a **GciAbort** or **GciLogout**.

An OOP buffer used to update the varying portion of an object with `noStructuralUpdate` must contain the OOPs to be added to the varying portion of the object, with two exceptions:

- If the object is a kind of `KeyValueDictionary` that does not store `Associations`, the buffer must contain (key, value) pairs.
- If the object is a kind of `AbstractDictionary` that stores `Associations` or (key, `Association`) pairs, the value buffer must contain `Associations`.

### See Also

**GciStoreTrav** on page 387

## GciProduct

Return an 8-bit unsigned integer that indicates the GemStone/S product.

### Syntax

```
unsigned char GciProduct();
```

### Return Value

Returns an 8-bit unsigned integer indicating the GemStone/S product to which the client library belongs. This will always return 3 in GemStone/S 64 Bit.

### Description

GciProduct allows a GemBuilder client to determine which GemStone/S product it is talking to. Combined with **GciVersion**, it allows the client to adapt to differences between GemBuilder features across different products and versions.

Currently-defined integers are:

- 1 – 32-bit GemStone/S
- 2 – GemStone/S 2G (discontinued product)
- 3 – GemStone/S 64 Bit

Any future products in the GemStone/S line will be assigned integers beginning with 4.

The integer zero is reserved, and will never be assigned to any product.

### See Also

**GciVersion** on page 414

## GciPushErrJump

Associate GemBuilder error handling with a jump buffer by pushing a jump buffer onto the stack.

### Syntax

```
void GciPushErrJump(  
    GciJumpBufSType *      jumpBuffer );
```

### Arguments

*jumpBuffer* A pointer to a jump buffer, as described below. The *jumpBuffer* must have been initialized by passing it as the argument to the macro `Gci_SETJMP`.

### Description

Associate GemBuilder error handling with a jump buffer by pushing a jump buffer onto the stack.

This function allows your application program to take advantage of the `setjmp/longjmp` style of error-handling mechanism from within any GemBuilder function call. However, you cannot use this mechanism to handle errors within **GciPushErrJump** itself, or within the related functions **GciPopErrJump** and **GciSetErrJump**.

Rather than using `setjmp` and `longjmp` directly, this style of error handling in GemBuilder requires you to use **Gci\_SETJMP** and **GciLongJump**.

When your program calls **Gci\_SETJMP**, the context of the C environment is saved in a jump buffer that you designate. To associate subsequent GemBuilder error handling with that jump buffer, you would then call **GciPushErrJump**.

GemBuilder maintains a stack of up to 20 error jump buffers. A buffer is pushed onto the stack when **GciPushErrJump** is called, and popped when **GciPopErrJump** is called. When an error occurs during a GemBuilder call, the GemBuilder implementation calls **GciLongJump** using the buffer currently at the top of GemBuilder's error jump stack, and pops that buffer from the stack.

For functions with local error recovery, your program can call **GciSetErrJump** to temporarily disable the **GciLongJump** mechanism (and to re-enable it afterwards).

Whenever the jump stack is empty, the application must use **GciErr** to poll for GBC errors.

### Example

For an example of how **GciPushErrJump** is used, see **GciPopErrJump** on page 320.

### See Also

**GciErr** on page 152  
**GciLongJump** on page 237  
**GciPopErrJump** on page 320  
**GciSetErrJump** on page 351  
**Gci\_SETJMP** on page 354

## GciRaiseException

Signal an error, synchronously, within a user action.

### Syntax

```
void GciRaiseException(  
    const GciErrSType *    error);
```

### Arguments

*error* A pointer to the error type to raise.

### Description

When executed from within a user action, this function raises an exception and passes the given error to the error signaling mechanism, causing control to return to Smalltalk. In order to signal an error on the Smalltalk client, this function must be invoked.

This function has no effect when executed outside of a user action.

### Example

```
OopType res = GciNewOop(anOopClass);  
GciErrSType theErr;  
// the term res==OOP_NIL is a performance optimization  
if (res == OOP_NIL && GciErr(&theErr)) {  
    GciRaiseException(&theErr);  
}
```

# GciReadSharedCounter

Lock and fetch the value of a shared counter.

## Syntax

```
BoolType GciReadSharedCounter(  
    int counterIdx,  
    int64_t * value);
```

## Arguments

*counterIdx* The offset into the shared counters array of the value to fetch.

*value* Pointer to a value for this shared counter.

## Return Value

Returns a C Boolean value indicating whether the value was successfully read. Returns TRUE if successful, FALSE if an error occurred.

## Description

Lock the shared counter indicated by *counterIdx*, and fetch its value. The contents of the *value* pointer will be set to the value of the shared counter.

Not supported for remote GCI interfaces.

## See Also

[GciDecSharedCounter](#) on page 137

[GciFetchNumSharedCounters](#) on page 182

[GciFetchSharedCounterValuesNoLock](#) on page 193

[GciIncSharedCounter](#) on page 217

[GciReadSharedCounterNoLock](#) on page 326

[GciSetSharedCounter](#) on page 360

# GciReadSharedCounterNoLock

Fetch the value of a shared counter without locking it.

## Syntax

```
BoolType GciReadSharedCounterNoLock(  
    int          counterIdx,  
    int64_t *    value);
```

## Arguments

*counterIdx* The offset into the shared counters array of the value to fetch.

*value* Pointer to a value for this shared counter.

## Return Value

Returns a C Boolean value indicating whether the value was successfully read. Returns TRUE if successful, FALSE if an error occurred.

## Description

Fetch the value of the shared counter indicated by *counterIdx*. The contents of the *value* pointer will be set to the value of the shared counter. This function is faster than **GciReadSharedCounter**, but may be less accurate.

Not supported for remote GCI interfaces.

## See Also

**GciDecSharedCounter** on page 137  
**GciFetchNumSharedCounters** on page 182  
**GciFetchSharedCounterValuesNoLock** on page 193  
**GciIncSharedCounter** on page 217  
**GciReadSharedCounter** on page 325  
**GciSetSharedCounter** on page 360

# GciReleaseAllGlobalOops

Remove all OOPS from the PureExportSet, making these objects eligible for garbage collection.

## Syntax

```
void GciReleaseAllGlobalOops()
```

## Description

The **GciReleaseAllGlobalOops** function removes all OOPs from the PureExportSet, thus permitting GemStone to consider removing them as a result of garbage collection. Objects that are referenced from persistent objects are not removed during garbage collection, even if they are not in PureExportSet. If invoked from a user action, this function does not affect the user action's export set.

**GciReleaseAllGlobalOops** is similar to **GciReleaseAllOops**, with the exception that OOPs are removed from the PureExportSet regardless of whether it is called from within a user action or not.

The **GciSaveGlobalObjs** or **GciSaveGlobalObjs** functions may be used to make objects ineligible for garbage collection. Note that results of the **GciNew...**, **GciCreate...**, **GciPerform...**, and **GciExecute...** functions are automatically added to the PureExportSet. You must release those objects explicitly if they are to be eligible for garbage collection.

### CAUTION

*Before releasing all objects, be sure that you will not need any of them again.*

## See Also

"Garbage Collection" on page 18  
**GciReleaseAllGlobalOops** on page 327  
**GciReleaseAllOops** on page 328  
**GciReleaseGlobalOops** on page 330  
**GciReleaseOops** on page 331  
**GciSaveObjs** on page 347

## GciReleaseAllOops

Remove all OOPS from the PureExportSet, or if in a user action, from the user action's export set, making these objects eligible for garbage collection.

### Syntax

```
void GciReleaseAllOops()
```

### Description

The **GciReleaseAllOops** function removes all OOPs from the applicable export set, thus permitting GemStone to consider removing them as a result of garbage collection. If called from within a user action, **GciReleaseAllOops** releases only those objects that have been saved since the beginning of the user action and are therefore in the user action's export set. If not called from within a user action, **GciReleaseAllOops** removes all OOPs from the PureExportSet. To remove all objects from the PureExportSet, regardless of user action context, use **GciReleaseAllGlobalOops**.

Objects that are referenced by persistent objects are not removed during garbage collection, even if they are not in an export set. It is typical usage to call **GciReleaseAllOops** after successfully committing a transaction.

The **GciSaveObjs** or **GciSaveGlobalObjs** functions may be used to make objects ineligible for garbage collection. Note that results of the **GciNew...**, **GciCreate...**, **GciPerform...**, and **GciExecute...** functions are automatically ineligible. You must release those objects explicitly if they are to be eligible.

#### CAUTION

*Before releasing all objects, be sure that you will not need any of them again.*

### See Also

“Garbage Collection” on page 18  
**GciReleaseAllGlobalOops** on page 327  
**GciReleaseGlobalOops** on page 330  
**GciReleaseOops** on page 331  
**GciSaveGlobalObjs** on page 346  
**GciSaveObjs** on page 347



## GciReleaseAllTrackedOops

Clear the GciTrackedObjs set, making all tracked OOPs eligible for garbage collection.

### Syntax

```
void GciReleaseAllTrackedOops()
```

### Description

The **GciReleaseAllTrackedOops** function removes all OOPs from the user session's GciTrackedObjs set, thus making them eligible to be garbage collected. This function does not affect the export sets; objects that are also in an export set will remain protected from garbage collection.

*CAUTION*

*Before releasing any of your objects, be sure that you will not need them again.*

### See Also

**GciReleaseAllGlobalOops** on page 327

**GciReleaseOops** on page 331

**GciReleaseTrackedOops** on page 333

**GciSaveAndTrackObjs** on page 345

## GciReleaseGlobalOops

Remove an array of GemStone OOPs from the PureExportSet, making them eligible for garbage collection.

### Syntax

```
void GciReleaseGlobalOops(  
    const OopType      theOops [ ],  
    int                numOops );
```

### Arguments

*theOops* An array of OOPs. Each element of the array corresponds to an object to be released.

*numOops* The number of elements in *theOops*.

### Description

The **GciReleaseGlobalOops** function removes the specified OOPs from the PureExportSet, thus making them eligible to be garbage collected.

This function differs from **GciReleaseOops** in that it operates the same if invoked from within a user action or not.

The **GciSaveObjs** or **GciSaveGlobalObjs** functions may be used to make objects ineligible for garbage collection. Note that results of the **GciNew...**, **GciCreate...**, **GciPerform...**, and **GciExecute...** functions are automatically ineligible. You must release those objects explicitly if they are to be eligible.

#### CAUTION

*Before releasing any of your objects, be sure that you will not need them again.*

### See Also

“Garbage Collection” on page 18

**GciReleaseAllGlobalOops** on page 327

**GciReleaseOops** on page 331

**GciSaveGlobalObjs** on page 346

## GciReleaseOops

Remove an array of GemStone OOPs from the PureExportSet, or if in a user action, remove them from the user action's export set, making them eligible for garbage collection.

### Syntax

```
void GciReleaseOops(
    const OopType      theOops[ ],
    int                numOops );
```

### Arguments

*theOops* An array of OOPs. Each element of the array corresponds to an object to be released.

*numOops* The number of elements in *theOops*.

### Description

The **GciReleaseOops** function removes the specified OOPs from the applicable export set, thus making them eligible to be garbage collected. If invoked from within a user action, the specified OOPs are removed from the user action's export set, otherwise the OOPs are removed from the PureExportSet.

To remove OOPs from the PureExportSet, regardless of user action context, use **GciReleaseGlobalOops**.

The **GciSaveObjs** or **GciSaveGlobalObjs** functions may be used to make objects ineligible for garbage collection. Note that results of the **GciNew...**, **GciCreate...**, **GciPerform...**, and **GciExecute...** functions are automatically ineligible. You must release those objects explicitly if they are to be eligible.

#### CAUTION

*Before releasing any of your objects, be sure that you have other references, or will not need them again.*

### Example

```
void releaseOops_example(void)
{
    OopType oArray = GciExecuteStr("UserGlobals at: #myArray put: (Array
        new: 5)", OOP_NIL);

    OopType ivs[3];
    ivs[0] = GciNewString("This is a string");
    ivs[1] = GciI32ToOop(5699); // a SmallInteger; don't need to release
    ivs[2] = GciFltToOop(9.0e6); // a Float or SmallDouble
    GciStoreOops(oArray, 1, ivs, 3);

    // release newly created objects, so that if oArray is removed from
    // UserGlobals by other application code, these new objects can
```

```
// be garbage collected.
OopType releaseBuf[3];
releaseBuf[0] = ivs[0]; // a String
releaseBuf[1] = ivs[2]; // might be a Float
releaseBuf[2] = oArray; // the array instance
GciReleaseOops(releaseBuf, 3);
GciErrSType err;
if (GciErr(&err)) {
    printf("Error %d, %s\n", err.number, err.message); }
}
```

## See Also

“Garbage Collection” on page 18  
**GciReleaseAllGlobalOops** on page 327  
**GciReleaseAllOops** on page 328  
**GciSaveGlobalObjs** on page 346  
**GciSaveObjs** on page 347

## GciReleaseTrackedOops

Remove an array of OOPs from the GciTrackedObjs set, making them eligible for garbage collection.

### Syntax

```
void GciReleaseTrackedOops(  
    const OopType    theOops [ ],  
    int              numOops );
```

### Arguments

*theOops* An array of OOPs. Each element of the array corresponds to an object to be released.

*numOops* The number of elements in *theOops*.

### Description

The **GciReleaseTrackedOops** function removes the specified OOPs from the user session's GciTrackedObjs set, thus making them eligible to be garbage collected. This function does not affect the export sets; objects that also appear in an export set will remain protected from garbage collection.

#### CAUTION

*Before releasing any of your objects, be sure that you will not need them again.*

### See Also

**GciReleaseAllTrackedOops** on page 329

**GciSaveAndTrackObjs** on page 345

**GciTrackedObjsInit** on page 406

# GciRemoveOopFromNsc

Remove an OOP from an NSC.

## Syntax

```
BoolType GciRemoveOopFromNsc(  
    OopType      theNsc,  
    OopType      theOop );
```

## Arguments

*theNsc* The OOP of the NSC from which to remove the OOP.

*theOop* The OOP of the object to be removed from the NSC.

## Return Value

Returns FALSE if *theOop* was not present in the NSC. Returns TRUE if *theOop* was present.

## Description

This function removes an OOP from the unordered variables of an NSC, using structural access.

## Example

See “Executing the examples” on page 91 for the Smalltalk code that defines the classes and objects that support the examples.

```
BoolType removeOopFromNsc_example(void)  
{  
    OopType anAccount = GciExecuteStr("AllAccounts detect: [:ea | ea  
        id=1073", OOP_NIL);  
    OopType aColl = GciResolveSymbol("AllAccounts", OOP_NIL);  
  
    BoolType wasPresent = GciRemoveOopFromNsc(aColl, anAccount);  
  
    /* release because it is the result from an execute */  
    GciReleaseOops(&anAccount, 1);  
    return wasPresent;  
}
```

## See Also

[GciAddOopToNsc](#) on page 94  
[GciAddOopsToNsc](#) on page 95  
[GciNscIncludesOop](#) on page 282  
[GciRemoveOopsFromNsc](#) on page 335

## GciRemoveOopsFromNsc

Remove one or more OOPs from an NSC.

### Syntax

```
BoolType GciRemoveOopsFromNsc(
    OopType          theNsc,
    const OopType    theOops[],
    int              numOops );
```

### Arguments

- theNsc* The OOP of the NSC from which the OOPs will be removed.
- theOops* The array of OOPs to be removed from the NSC.
- numOops* The number of OOPs to remove.

### Return Value

Returns FALSE if any element of *theOops* was not present in the NSC. Returns TRUE if all elements of *theOops* were present in the NSC.

### Description

This function removes multiple OOPs from the unordered variables of an NSC, using structural access. If any individual OOP is not present in the NSC, this function returns FALSE, but it still removes all OOPs that it finds in the NSC.

### Example

See “Executing the examples” on page 91 for the Smalltalk code that defines the classes and objects that support the examples.

```
BoolType removeOopsFromNsc_example(void)
{
    OopType subColl = GciExecuteStr(
        "AllAccounts select:[ea|ea id > 2000 ]", OOP_NIL);

    OopType buf[10];
    int numRet = GciFetchVaryingOops(subColl, 1, buf, 10);
    /* buf contains at most 10 accounts with ids > 2000 */

    OopType aColl = GciResolveSymbol("AllAccounts", OOP_NIL);
    BoolType allPresent = GciRemoveOopsFromNsc(aColl, buf, numRet);

    /* release because it is the result from an execute */
    GciReleaseOops(&subColl, 1);
    return allPresent;
}
```

## See Also

**GciAddOopToNsc** on page 94

**GciAddOpsToNsc** on page 95

**GciNscIncludesOop** on page 282

**GciRemoveOopFromNsc** on page 334



# GciReplaceOops

Replace all instance variables in a GemStone object.

## Syntax

```
void GciReplaceOops(  
    OopsType          theObj,  
    const OopsType    theOops[],  
    int                numOops);
```

## Arguments

*theObj* The object whose instance variables are to be replaced.

*theOops* An array of OOPs used as the replacements.

*numOops* The number of elements in *theOops*.

## Description

**GciReplaceOops** uses structural access to replace *all* the instance variables in the object. However, it does so in a context that is external to the object. Hence, it completely ignores private named instance variables in its operation.

If *theObj* is of fixed size, then it is an error for *numOops* to be of a different size. If *theObj* is of a variable size, then it is an error for *numOops* to be of a size smaller than the number of named instance variables (*namedSize*) of the object. For variable-sized objects, **GciReplaceOops** resets the number of unnamed variables to  $numOops - namedSize$ .

**GciReplaceOops** is not recommended for use with variable-sized objects unless they are indexable or are NSCs. Other variable-sized objects, such as KeyValue dictionaries, do not store values at fixed offsets.

## See Also

**GciReplaceVaryingOops** on page 338

**GciStoreIdxOops** on page 375

**GciStoreNamedOops** on page 378

**GciStoreOops** on page 382

## GciReplaceVaryingOops

Replace all unnamed instance variables in an NSC object.

### Syntax

```
void GciReplaceVaryingOops(  
    OopType          theNsc,  
    const OopType    theOops[ ],  
    int              numOops );
```

### Arguments

*theNsc* The NSC object whose unnamed instance variables are replaced.

*theOops* An array of OOPs used as the replacements.

*numOops* The number of elements in *theOops*.

### Description

**GciReplaceVaryingOops** uses structural access to replace all unnamed instance variables in the NSC object.

### See Also

**GciReplaceOops** on page 337

**GciStoreIdxOops** on page 375

**GciStoreNamedOops** on page 378

**GciStoreOops** on page 382

# GciResolveSymbol

Find the OOP of the object to which a symbol name C string refers, in the context of the current session's user profile.

## Syntax

```
OopType GciResolveSymbol(  
    const char *      cString,  
    OopType           symbolList);
```

## Arguments

- cString* The name of a Symbol as a C character string.
- symbolList* The OOP of a GemStone symbol list, an instances of OOP\_CLASS\_SYMBOL\_LIST. A value of OOP\_NIL means to use the default symbol list for the current GemStone session (that is, `System myUserProfile symbolList`).

## Return Value

The OOP of the object that corresponds to the specified string.

## Description

Attempts to resolve the symbol name *cString* using symbol list *symbolList*. If *symbolList* is OOP\_NIL, this function searches the symbol list in the user's UserProfile. If the symbol is not found or an error is generated, the result is OOP\_ILLEGAL. If result is OOP\_ILLEGAL and **GciErr** reports no error, then the symbol could not be resolved using the given *symbolList*. If an error such as an authorization error occurs, the result is OOP\_ILLEGAL and the error is accessible by **GciErr**.

This function is similar to **GciResolveSymbolObj**, except that the symbol argument is a C string instead of an object identifier.

## See Also

**GciResolveSymbolObj** on page 340

## GciResolveSymbolObj

Find the OOP of the object to which a symbol name String or MultiByteString refers, in the context of the current session's user profile.

### Syntax

```
OopType GciResolveSymbolObj(  
    OopType          aStringObj,  
    OopType          symbolList );
```

### Arguments

- aStringObj* The OOP of a kind of String or MultiByteString.
- symbolList* The OOP of a GemStone symbol list, an instances of OOP\_CLASS\_SYMBOL\_LIST. A value of OOP\_NIL means to use the default symbol list for the current GemStone session (that is, `System myUserProfile symbolList`).

### Return Value

The OOP of the Symbol that corresponds to the specified String.

### Description

Attempts to resolve *aStringObj* using symbol list *symbolList*. If *symbolList* is OOP\_NIL, this function searches the symbol list in the user's UserProfile. If the symbol is not found or an error is generated, the result is OOP\_ILLEGAL. If the result is OOP\_ILLEGAL and **GciErr** reports no error, then the symbol could not be resolved using the given *symbolList*. If an error such as an authorization error occurs, the result is OOP\_ILLEGAL and the error is accessible by **GciErr**.

This function is similar to **GciResolveSymbol**, except that the symbol argument is an object identifier for a String instead of a C string.

### See Also

**GciResolveSymbol** on page 339

## GciRtlIsLoaded

Report whether a GemBuilder library is loaded.

### Syntax

```
BoolType GciRtlIsLoaded()
```

### Return Value

Returns TRUE if a GemBuilder library is loaded and FALSE if not.

### Description

The **GciRtlIsLoaded** function reports whether an executable has loaded one of the versions of GemBuilder. The GemBuilder library files are dynamically loaded at run time. See “The GemBuilder for C Shared Libraries” on page 43 for more information.

### See Also

**GciRtlLoad** on page 342

**GciRtlUnload** on page 344

# GciRtlLoad

Load a GemBuilder library.

## Syntax

```
BoolType GciRtlLoad(  
    BoolType          useRpc,  
    const char *      path,  
    char              errBuf[ ],  
    size_t            errBufSize );
```

## Arguments

- useRpc* A flag to specify the RPC or linked version of GemBuilder.
- path* A list of directories (separated by ;) to search for the GemBuilder library.
- errBuf* A buffer to store any error message.
- errBufSize* The size of *errBuf*.

## Return Value

Returns TRUE if a GemBuilder library loads successfully. If the load fails, the return value is FALSE, and a null-terminated error message is stored in *errBuf*, unless *errBuf* is NULL.

## Description

The **GciRtlLoad** function attempts to load one of the GemBuilder libraries. If *useRpc* is TRUE, the RPC version of GemBuilder is loaded. If *useRpc* is FALSE, the linked version of GemBuilder is loaded. See “The GemBuilder for C Shared Libraries” on page 43 for more information.

If *path* is not NULL, it must point to a list of directories to search for the library to load. If *path* is NULL, then a default path is searched: the appropriate subdirectory of \$GEMSTONE, depending on the platform and if it is 32-bit or 64-bit.

If a GemBuilder library is already loaded, the call fails.

## Example

```
void load_library(void)  
{  
    char errBuf[1024];  
    BoolType result = GciRtlLoad(true, "$GEMSTONE/lib", errBuf,  
                                sizeof(errBuf));  
    if (result == FALSE)  
        printf("Library load failed, %s\n", errBuf);  
}
```

## See Also

**GciRtlIsLoaded** on page 341

**GciRtlUnload** on page 344

## GciRtlUnload

Unload a GemBuilder library.

### Syntax

```
void GciRtlUnload()
```

### Description

The **GciRtlUnload** function causes the library loaded by **GciRtlLoad** to be unloaded. Once the current library is unloaded, **GciRtlLoad** can be called again to load a different GemBuilder library. See “The GemBuilder for C Shared Libraries” on page 43 for more information.

### See Also

**GciRtlIsLoaded** on page 341

**GciRtlLoad** on page 342



## GciSaveAndTrackObjs

Add objects to GemStone's internal GciTrackedObjs set to prevent them from being garbage collected.

### Syntax

```
void GciSaveAndTrackObjs(  
    const OopType    theOops [ ],  
    int              numOops );
```

### Arguments

*theOops* An array of OOPs.

*numOops* The number of elements in *theOops*.

### Description

The **GciSaveAndTrackObjs** function adds the specified OOPS to GemStone's GciTrackedObjs set. This prevents the GemStone garbage collector from causing the objects to disappear during a session if they become unreferenced, and enables changes to these objects to show up in the TrackedDirtyObjs set.

This function does *not* cause the objects to be referenced from a permanent object; there is no guarantee that they will be saved to disk at commit.

The results of **GciNew...**, **GciCreate...**, **GciSend...**, **GciPerform...**, and **GciExecute...** calls are automatically added to the export set, which also prevents them from being garbage collected.

This function may only be called after **GciTrackedObjsInit** has been executed.

You can use **GciReleaseTrackedOops** or **GciReleaseAllTrackedOops** calls to cancel the effect of a **GciSaveAndTrackObjs** call, thereby making objects eligible for garbage collection. Objects that have been added to the GciTrackedObjs set and have been modified can be retrieved using **GciTrackedDirtyObjs**, **GciDirtySaveObjs**, or **GciTrackedObjsFetchAllDirty**.

### See Also

"Garbage Collection" on page 18

**GciDirtyTrackedObjs** on page 143

**GciReleaseAllOops** on page 328

**GciReleaseAllTrackedOops** on page 329

**GciReleaseTrackedOops** on page 333

**GciSaveObjs** on page 347

**GciTrackedObjsInit** on page 406

**GciTrackedObjsFetchAllDirty** on page 404

**GciDirtySaveObjs** on page 141

**GciDirtyTrackedObjs** on page 143

## GciSaveGlobalObjs

Add an array of OOPs to the PureExportSet, making them ineligible for garbage collection.

### Syntax

```
void GciSaveGlobalObjs(  
    const OopType      theOops [ ],  
    int                numOops );
```

### Arguments

*theOops* An array of OOPs.

*numOops* The number of elements in *theOops*.

### Description

The **GciSaveGlobalObjs** function places the specified OOPs in the PureExportSet, thus preventing GemStone from removing them as a result of garbage collection. **GciSaveGlobalObjs** can add any OOP to the PureExportSet. It differs from **GciSaveObjs** in that OOPs are placed in the PureExportSet regardless of user action context.

The **GciSaveGlobalObjs** function does *not* itself make objects persistent, and it does *not* create a reference to them from a persistent object so that the next commit operation will try to do so either. It only protects them from garbage collection.

Note that results of the **GciNew...**, **GciCreate...**, **GciPerform...**, **GciExecute...**, and **GciResolve...** functions are automatically added to the export set. The **GciRelease...** functions may be used to make objects eligible for garbage collection.

### See Also

“Garbage Collection” on page 18  
**GciReleaseAllGlobalOops** on page 327  
**GciReleaseAllOops** on page 328  
**GciReleaseGlobalOops** on page 330  
**GciReleaseOops** on page 331  
**GciSaveObjs** on page 347

## GciSaveObjs

Add an array of OOPs to the PureExportSet, or if in a user action to the user action's export set, making them ineligible for garbage collection.

### Syntax

```
void GciSaveObjs(  
    const OopType      theOops [ ],  
    int                numOops );
```

### Arguments

*theOops* An array of OOPs.

*numOops* The number of elements in *theOops*.

### Description

The **GciSaveObjs** function places the specified OOPs in the applicable export set, thus preventing GemStone from removing them as a result of garbage collection. If invoked from within a user action, the OOPs are added to the user action's export set; otherwise the OOPs are added to the PureExportSet. To add OOPS to the PureExportSet, regardless of the user action context, use **GciSaveGlobalObjs**. **GciSaveObjs** can add any OOP to the export set.

The **GciSaveObjs** function does *not* itself make objects persistent, and it does *not* create a reference to them from a persistent object so that the next commit operation will try to do so either. It only protects them from garbage collection.

Note that results of the **GciNew...**, **GciCreate...**, **GciPerform...**, **GciExecute...**, and **GciResolve...** functions are automatically added to the export set. The **GciRelease...** functions may be used to make objects eligible for garbage collection.

### See Also

"Garbage Collection" on page 18

**GciReleaseAllGlobalOops** on page 327

**GciReleaseAllOops** on page 328

**GciReleaseGlobalOops** on page 330

**GciReleaseOops** on page 331

**GciSaveGlobalObjs** on page 346

## GciServerIsBigEndian

Determine whether or not the server process is big-endian.

### Syntax

```
BoolType GciServerIsBigEndian();
```

### Return Value

Returns TRUE if the session is RPC and the server process is big-endian, or if the session is linked and this process is big-endian. Returns FALSE otherwise.

### Description

This function determines whether the server process is big-endian. If the current session is invalid, this generates an error.

## GciSessionIsRemote

Determine whether or not the current session is using a Gem on another machine.

### Syntax

```
BoolType GciSessionIsRemote()
```

### Return Value

Returns TRUE if the current GemBuilder session is connected to a remote Gem. It returns FALSE if the current GemBuilder session is connected to a linked Gem.

**GciSessionIsRemote** raises an error if the current session is invalid.

## GciSetCacheName\_

Set the name that a linked application will be known by in the shared cache.

### Syntax

```
BoolType GciSetCacheName_(  
    char * name );
```

### Arguments

*name* The processName reported by System cacheStatistics.

### Return Value

Returns FALSE if called before GciInit and GciIsRemote returns FALSE.

### Description

This function sets the name that a linked application will be known by in the shared cache. This function has no effect if GciIsRemote returns TRUE.

## GciSetErrJump

Enable or disable the current error handler.

### Syntax

```
BoolType GciSetErrJump(
    BoolType          aBoolean );
```

### Arguments

*aBoolean* TRUE enables error jumps to the execution environment saved by the most recent **GciPushErrJump**; FALSE disables error jumps.

### Return Value

Returns TRUE if error handling was previously enabled for the jump buffer at the top of the error jump stack. Returns FALSE if error handling was previously disabled. If your program has no buffers saved in its error jump stack, this function returns FALSE. (This function cannot generate an error.)

For most GemBuilder functions, calling **GciErr** after a successful function call will return zero (that is, false). In such cases, the **GciErrSType** error report structure will contain some default values. (See **GciErr** on page 152 for details.) However, a successful call to **GciSetErrJump** does not alter any previously existing error report information. That is, calling **GciErr** after a successful call to **GciSetErrJump** will return the same error information that was present before this function was called.

### Description

This function enables or disables the error handler at the top of GemBuilder's error jump stack.

### Example

```
void setErrJump_example(void)
{
    GciJumpBufSType jumpBuf1;
    GciPushErrJump(&jumpBuf1);

    if (Gci_SETJMP(&jumpBuf1)) {
        GciErrSType errInfo;
        if (GciErr(&errInfo)) {
            printf("LONGJMP, error category \"FMT_OID\" number %d, %s\n",
                errInfo.category, errInfo.number, errInfo.message);
        } else {
            printf("GCI longjmp, but no error found\n"); // should not happen
        }
        GciPopErrJump(&jumpBuf1);
        return;
    }
    BoolType prevVal = GciSetErrJump(FALSE); // disable error jumps
```

```
printf("error jumps previously %s\n", prevVal ? "enabled" :
      "disabled");

OopType oRcvr = GciI32ToOop(3);
GciPerform(oRcvr, "frob", NULL, 0); // expect does-not-understand
      error
GciErrSType errInfo;
if (GciErr(&errInfo)) {
    printf("error category "FMT_OID" number %d, %s\n",
          errInfo.category, errInfo.number, errInfo.message);
} else {
    printf("expected error but found none\n");
}

GciSetErrJump(TRUE);
GciPerform(oRcvr, "frob", NULL, 0); // expect a longjmp

printf("GCI longjmp did not happen\n"); // should not reach here
}
```

## See Also

**GciErr** on page 152

**GciLongJump** on page 237

**GciPopErrJump** on page 320

**GciPushErrJump** on page 323

**GciSetErrJump** on page 351



# GciSetHaltOnError

Halt the current session when a specified error occurs.

## Syntax

```
int GciSetHaltOnError(  
    int errNum );
```

## Arguments

*errNum* When this error occurs, halt the current session.

## Return Value

Returns the previous error number on which the session was to halt.

## Description

The **GciSetHaltOnError** function causes the current session to halt for internal debugging when the specified GemBuilder error occurs.

To unset after a previous call to **GciSetHaltOnError**, invoke this function with an *errNum* of zero.

## See Also

**GciContinue** on page 122

**GciDbgEstablish** on page 130

## Gci\_SETJMP

(MACRO) Save a jump buffer in GemBuilder's error jump stack.

### Syntax

```
void Gci_SETJMP(  
    GciJumpBufSType *      jumpBuffer );
```

### Arguments

*jumpBuffer* A pointer to a jump buffer.

### Description

When your program calls this macro, the context of the C environment is saved in a jump buffer that you designate. GemBuilder maintains a stack of up to 20 error jump buffers.

### See Also

**GciErr** on page 152  
**GciLongImp** on page 237  
**GciPopErrJump** on page 320  
**GciPushErrJump** on page 323  
**GciSetErrJump** on page 351

## GciSetNet

Set network parameters for connecting the user to the Gem and Stone processes.

### Syntax

```
void GciSetNet(
    const char          stoneNameNrs[ ],
    const char          hostUserId[ ],
    const char          hostPassword[ ],
    const char          gemServiceNrs[ ] );
```

### Arguments

- stoneNameNrs* The NRS for the Stone repository to login into.
- hostUserId* UNIX host login user Id. This may be NULL or an empty string if the Gem will run using the *userId* of the NetLDI process .
- hostPassword* Password of the UNIX user, or NULL if not specifying *hostUserId*.
- gemServiceNrs* The NRS for the GemService, gemnetobject or a custom gem script. If an empty string, specifies a linked login.

### Description

Your application, your GemStone session (Gem), and the database monitor (Stone) can all run in separate processes, on separate machines in your network. **GciSetNet** specifies the network parameters that are used to connect the current user to GemStone on the host, whenever **GciLogin** is called. Network resource strings specify the information needed to establish communications between these processes . See the *System Administration Guide for GemStone/S 64 Bit* for complete information on NRS Syntax and the network environment.

*stoneNameNrs* identifies the name and network location of the database monitor process (Stone), which is the final arbiter of all sessions that access a specific database.

A Stone process called "gs64stone" on node "lichen" could be described in a network resource string as:

```
!@lichen!gs64stone
```

A Stone of the same name that is running on the same machine as the application could be described in shortened form simply as:

```
gs64stone
```

*gemServiceNrs* identifies the name and network location of the GemStone service that creates a session process (Gem), which then arbitrates data access between the database and the application. Every GemStone session requires a Gem. In linked applications, one Gem is present within the same process as the application; in remote applications the Gem is a separate process specific to that login session. Each time an application user logs in to GemStone (after the first time in linked applications), the GemStone service must create a new Gem. *gemServiceNrs* is required except in the special case of a linked application that limits itself to one GemStone login per application process. In this special case, specify *gemServiceNrs* as an empty string.

For most installations, the GemStone service name is *gemnetobject*. Specify, for example:

```
!@lichen!gemnetobject
```

*HostUserId* and *HostPassword* are your login name and password, respectively, on the machines that host the Gem and Stone processes. Do not confuse these values with your GemStone username and password - the GemStone username and password will be provided as arguments to **GciLogin**. *HostUserId* and *HostPassword* provide authentication for such tasks as creating a Gem and establishing communications with a Stone, and are optional in some configuration. When such authentication is required, an application user cannot login to GemStone until the host login is verified for the machine running the Stone or Gem, in addition to the GemStone login itself.

Authentication is always required if the NetLDI process that is related to the Stone is running in secure mode. In this case, it makes no difference whether the application is linked or remote. Authentication is also required to create a remote Gem, unless the NetLDI process is running in guest mode.

If the *HostUserId* argument is set to an empty C string or a NULL pointer, GemBuilder will try to find a username and password for authentication on a host machine in your network initialization file. To prevent GemBuilder from looking for authentication information in the network initialization file, supply a valid non-empty C string for the *HostUserId* argument, and a non-empty string for the *HostPassword* argument to provide a password. An empty string and a NULL pointer both mean that no password will be used for authentication.

## Example

For an example of how **GciSetNet** is used, see the example for **GciLogin** on page 232.

## See Also

**GciEncrypt** on page 150

**GciLogin** on page 232

**GciLoginEx** on page 234

**GciSetNetEx** on page 357

## GciSetNetEx

### GciSetNetEx\_

Set network parameters for connecting the user to the Gem and Stone processes, allowing encryption.

#### Syntax

```
void GciSetNetEx(
    const char      stoneNameNrs[ ],
    const char      hostUserId[ ],
    const char      hostPassword[ ],
    const char      gemServiceNrs[ ],
    BoolType        hostPasswordIsEncrypted);

BoolType GciSetNetEx_(
    const char      StoneNameNrs[ ],
    const char      hostUserId[ ],
    const char      hostPassword[ ],
    const char      gemServiceNrs[ ],
    BoolType        hostPasswordIsEncrypted,
    char *          errString,
    size_t          maxErrSize);
```

#### Arguments

- stoneNameNrs* The NRS for the Stone repository to login into.
- hostUserId* UNIX host login user Id. This may be NULL or an empty string if the Gem will run using the userId of the NetLDI process .
- hostPassword* Password of the UNIX user, or NULL if not specifying *hostUserId*.
- gemServiceNrs* The NRS for the GemService, gemnetobject or a custom gem script. If an empty string, specifies a linked login.
- hostPwIsEncrypted* TRUE if the value for *hostPassword* has been encrypted using **GciEncrypt**.
- errString* If there is a syntax error in the NRS for the *StoneName* or *GemService*, GciSetNetEx\_ returns FALSE and sets *errString* to the details of the error.
- maxErrSize* Maximum number of bytes of error message to return.

#### Return Value

**GciSetNetEx** has no return value. **GciSetNetEx\_** returns TRUE if the network parameters were set correctly, FALSE if there was a syntax error in *stoneNameNrs* or *gemServiceNrs*.

## Description

This function is similar to **GciSetNet**, but allows specifying additional behavior. For details on how to specify the StoneName and GemService using NRS, and the requirements for HostUserId, HostPassword, see **GciSetNet** on page 355.

**GciSetNetEx** allows you to specify that the host password you send is encrypted. The host password may be encrypted using **GciEncrypt**. To encrypt the GemStone password, use **GciLoginEx** and specify the associated login flag.

## Example

For an example of how **GciSetNet** is used, see **GciLogin** on page 232.

## See Also

**GciEncrypt** on page 150

**GciLogin** on page 232

**GciLoginEx** on page 234

**GciSetNet** on page 355

# GciSetSessionId

Set an active session to be the current one.

## Syntax

```
void GciSetSessionId(  
    GciSessionIdType    sessionId );
```

## Arguments

*sessionId* The session ID of an active (logged-in) GemStone session.

## Description

This function can be used to switch between multiple GemStone sessions in an application program with multiple logins.

## See Also

[GciGetSessionId](#) on page 211

[GciLogin](#) on page 232

# GciSetSharedCounter

Set the value of a shared counter.

## Syntax

```
BoolType GciSetSharedCounter(  
    int          counterIdx,  
    int64_t *    value);
```

## Arguments

*counterIdx* The offset into the shared counters array of the value to modify.

*value* Pointer to a value that containing the new value for this shared counter.

## Return Value

Returns a C Boolean value indicating whether the value was successfully changed. Returns TRUE if the modification succeeded, FALSE if it failed.

## Description

Set the value of the shared counter indicated by *counterIdx*. The contents of the *value* pointer indicate the new value of the shared counter.

Not supported for remote GCI interfaces.

## See Also

[GciDecSharedCounter](#) on page 137  
[GciFetchNumSharedCounters](#) on page 182  
[GciFetchSharedCounterValuesNoLock](#) on page 193  
[GciIncSharedCounter](#) on page 217  
[GciReadSharedCounter](#) on page 325  
[GciReadSharedCounterNoLock](#) on page 326



# GciSetTraversalBufSwizzling

Control swizzling of the traversal buffers.

## Syntax

```
BoolType GciSetTraversalBufSwizzling(  
    BoolType          enabled );
```

## Arguments

*enabled* If TRUE, enable normal byte-order swizzling of traversal buffers for the current RPC session. This is the default state for a session created by successful **GciLogin**.  
If FALSE, the application program is responsible for subsequent swizzling of traversal buffers if needed.

## Return Value

Returns the previous value of swizzling of traversal buffers. When called on a linkable session, returns FALSE and has no effect. If the current session is invalid, generates an error and returns FALSE.

## Description

**GciSetTraversalBufSwizzling** controls swizzling of the traversal buffers used by these calls in an RPC session:

**GciStoreTrav, GciNbStoreTrav**  
**GciStoreTravDo\_, GciNbStoreTravDo\_**  
**GciStoreTravDoTrav\_, GciNbStoreTravDoTrav\_**  
**GciClampedTrav, GciNbClampedTrav**  
**GciMoreTraversal, GciNbMoreTraversal**  
**GciPerformTrav, GciNbPerformTrav**  
**GciExecuteStrTrav, GciNbExecuteStrTrav**

For more information on swizzling, see “Byte-Swizzling of Binary Floating-Point Values” on page 26.

## GciSetVaryingSize

Set the size of a collection.

### Syntax

```
void GciSetVaryingSize(  
    OopType      collection,  
    int64        size );
```

### Arguments

*collection* The OOP of the collection whose size you are specifying.

*size* The desired number of elements in the collection.

### Description

**GciSetVaryingSize** changes the size of a collection, adding nils to grow it, or truncating it, as necessary. It is equivalent to the Smalltalk method `Object >> size:`. It does not change the number of any named instance variables.

### Example

```
void setVaryingSize_example(void)  
{  
    OopType oArr = GciNewOop(OOP_CLASS_ARRAY); // create new Array of size 0  
  
    GciSetVaryingSize(oArr, 1000000);  
    // logical size now 1 million  
  
    GciStoreOop(oArr, 500000, GciI32ToOop(5678));  
}
```

### See Also

[GciFetchVaryingSize\\_](#) on page 202

# GciShutdown

## GciShutdown\_

Logout from all sessions and deactivate GemBuilder.

### Syntax

```
void GciShutdown();  
void GciShutdown_(  
    BoolByte          doLogouts );
```

### Arguments

*doLogouts* If FALSE, does not performs an orderly logout of the all sessions. GciShutdown() is equivalent to GciShutdown(TRUE), which does perform a logout on all sessions.

### Description

This function is intended to be called by image exit routines, such as the **on\_exit** system call. In the linkable GemBuilder, **GciShutdown** calls **GciLogout**. In the RPC version, it logs out all sessions connected to the Gem process and shuts down the networking layer, thus releasing all memory allocated by GemBuilder.

# GciSoftBreak

Interrupt the execution of Smalltalk code, but permit it to be restarted.

## Syntax

```
void GciSoftBreak()
```

## Description

This function sends a soft break to the current user session (set by the last **GciLogin** or **GciSetSessionId**).

GemBuilder allows users of your application to terminate Smalltalk execution. This is useful, for example, if the a Smalltalk method is invoked that enters an infinite loop.

**GciSoftBreak** interrupts only the Smalltalk virtual machine (if it is running), and does so in such a way that the it can be restarted. The only GemBuilder functions that can recognize a soft break include **GciSendMessage**, **GciPerform**, and **GciContinue**, and the **GciExecute...** functions.

**GciHardBreak** has no effect if called from within a User Action.

In order for GemBuilder functions in your program to recognize interrupts, your program will need a signal handler that can call the functions **GciSoftBreak** and **GciHardBreak**. Since GemBuilder does not relinquish control to an application until it has finished its processing, soft and hard breaks must be initiated from another thread.

If GemStone is executing when it receives the break, it replies with the error message `RT_ERR_SOFT_BREAK`. Otherwise, it ignores the break.

## Example

```
#include "signal.h"

extern "C" {
    static void doSoftBreak(int sigNum, siginfo_t* info, void* ucArg)
    {
        GciSoftBreak();
    }
}

void softBreakExample(void)
{
    // save previous SIGINT handler and install ours
    struct sigaction oldHandler;
    struct sigaction newHandler;
    newHandler.sa_handler = SIG_DFL;
    newHandler.sa_sigaction = doSoftBreak;
    newHandler.sa_flags = SA_SIGINFO | SA_RESTART ;
    sigaction(SIGINT, &newHandler, &oldHandler);

    // execute a loop that will take 120 seconds to execute and
    // return the SmallInteger with value 11 .
}
```

```

OopType result = GciExecuteStr(
    "| a | a := 1 . 10 timesRepeat:[ System sleep:10. a := a + 1]. ^
    a",
    OOP_NIL/*use default symbolList for execution*/);

BoolType done = FALSE;
int breakCount = 0;
do {
    // assume the user may type ctl-C or issue kill -INT from
    // another shell process during the 120 seconds .
    GciErrSType errInfo;
    if ( GciErr(&errInfo)) {
        if (errInfo.number == RT_ERR_SOFT_BREAK) {
            // GciExecuteStr was interrupted by a GciSoftBreak .
            breakCount++;
            // now continue the execution to finish the computation
            result = GciContinue(errInfo.context);
        } else {
            // FMT_OID format string is defined in gci.ht
            printf("unexpected error category "FMT_OID" number %d, %s\n",
                errInfo.category, errInfo.number, errInfo.message);
            // terminate the execution
            GciClearStack(errInfo.context);
            done = TRUE;
        }
    } else {
        // GciExecuteStr or GciContinue completed without error
        done = TRUE;
        BoolType conversionErr = FALSE;
        int val = GciOopToI32_(result, &conversionErr);
        if (conversionErr) {
            printf("Error converting result to C int\n");
        } else {
            printf("Got %d interrupts, result = %d\n", breakCount, val);
        }
    }
} while (! done);

// restore previous SIGINT handler
sigaction(SIGINT, &oldHandler, NULL);
}

```

## See Also

[GciClearStack](#) on page 115  
[GciContinue](#) on page 122  
[GciHardBreak](#) on page 212

# GciStep

## GciStep\_

Continue code execution in GemStone with specified single-step semantics.

### Syntax

```

OopType GciStep(
  OopType
  int
  gsProcess,
  level );

OopType GciStep_(
  OopType
  int
  BoolType
  gsProcess,
  level
  through);

```

### Arguments

*gsProcess* The OOP of a GsProcess object (obtained as the value of the context field of an error report returned by **GciErr**).

*level* One of the following values:  
 0 – step-into semantics starting from top of stack  
 1 – step-over semantics starting from top of stack  
 > 1 – step-over semantics from specified level on stack

*through* When *level* =1 and this argument is TRUE, provides step through semantics, stopping in blocks for which the top of the stack frame is the home method.

### Return Value

Returns the OOP of the result of the Smalltalk execution. Returns OOP\_ILLEGAL in case of error.

### Description

This function continues code execution in GemStone using the specified single-step semantics. This function is intended for use by debuggers.

If you specify a *level* that is either less than zero or greater than the value represented by **GciPerform**(*gsProcess*, "stackDepth", NULL, 0), this function generates an error.

# GciStoreByte

Store one byte in a byte object.

## Syntax

```
void GciStoreByte(  
    OopType          theObject,  
    int64            atIndex,  
    ByteType         theByte );
```

## Arguments

*theObject* The OOP of the GemStone byte object into which the store will be done.

*startIndex* The index into theObject at which to begin storing bytes.

*theByte* The 8-bit value to be stored.

## Description

This function stores a single element in a byte object at a specified index, using structural access.

**GciStoreByte** raises an error if *theObject* is a Float or SmallFloat. You must store all the bytes of a Float or SmallFloat if you store any.

## Example

```
void storeByte_example(void)  
{  
    OopType oString = GciNewOop(OOP_CLASS_STRING);  
  
    for (int j = 0; j < 200; j++) {  
        ByteType val = j;  
        GciStoreByte(oString, j + 1 , val );  
    }  
}
```

## See Also

**GciFetchByte** on page 165

**GciStoreBytes** on page 368

# GciStoreBytes

(MACRO) Store multiple bytes in a byte object.

## Syntax

```
void GciStoreBytes(  
    OopType          theObject,  
    int64            startIndex,  
    const ByteType   theBytes[],  
    int64            numBytes );
```

## Arguments

*theObject* The OOP of the GemStone byte object, into which the bytes will be stored.

*startIndex* The index into theObject at which to begin storing bytes.

*theBytes* The array of bytes to be stored.

*numBytes* The number of elements to store.

## Description

This macro uses structural access to store multiple elements from a C array in a byte object, beginning at a specified index. A common application of **GciStoreBytes** would be to store a text string. For an object with multiple bytes per character or digit, *theBytes* is expected to be in client native byte order, and will be swizzled if needed by the server.

## Error Conditions

**GciStoreBytes** raises an error if *theObject* is a Float or SmallFloat. Use **GciStoreBytesInstanceOf** instead for Float or SmallFloat objects.

## Example

```
void storeBytes_example(void)  
{  
    OopType oString = GciNewOop(OOP_CLASS_STRING);  
  
    enum { buf_size = 2000 };  
    ByteType buf[buf_size];  
    for (int j = 0; j < buf_size; j++) {  
        buf[j] = (ByteType)j;  
    }  
    GciStoreBytes(oString, 1, buf, buf_size);  
}
```



## See Also

- GciFetchByte** on page 165
- GciFetchBytes\_** on page 166
- GciStoreByte** on page 367
- GciStoreBytesInstanceOf** on page 370
- GciStoreChars** on page 372

## GciStoreBytesInstanceOf

Store multiple bytes in a byte object.

### Syntax

```
void GciStoreBytesInstanceOf(
    OopType          theClass,
    OopType          theObject,
    int64            startIndex,
    const ByteType   theBytes[ ],
    int64            numBytes );
```

### Arguments

- theClass* The OOP of the class of the GemStone byte object.
- theObject* The OOP of the GemStone byte object into which the bytes will be stored.
- startIndex* The index into *theObject* at which to begin storing bytes.
- theBytes* The array of bytes to be stored.
- numBytes* The number of elements to store

### Description

This function uses structural access to store multiple elements from a C array into a byte object, beginning at a specified index. A common application of **GciStoreBytesInstanceOf** would be to store a Float or LargeInteger object.

**GciStoreBytesInstanceOf** provides automatic byte swizzling for objects such as Float, LargeInteger, and DoubleByteString that use multiple bytes per digit or character. For more about byte swizzling, see “Byte-Swizzling of Binary Floating-Point Values” on page 26. For these objects, *theBytes* is assumed to be in client native byte order. For DoubleByteStrings, *startIndex* must be aligned on character boundaries and *numBytes* must be a multiple of the number of bytes per character; for numeric objects *startIndex* must be one and the *numBytes* the size of the numeric class.

The presence of the argument *theClass* enables the swizzling to be implemented more efficiently. If *theObject* is a Float or SmallFloat, then *theClass* must match the actual class of *theObject*, *startIndex* must be one, and *numBytes* must be the actual size for *theClass*. If any of these conditions are not met, then **GciStoreBytesInstanceOf** raises an error as a safety check.

If *theObject* is not a Float or SmallFloat, then *theClass* is ignored. Hence, you must supply the correct class for *theClass* if *theObject* is a Float or SmallFloat, but you can use OOP\_NIL otherwise.

### Example

```
void storeBytesInstof_example(void)
{
    double pi = 3.1415926;
    OopType oFloat = GciNewOop(OOP_CLASS_FLOAT);
    GciStoreBytesInstanceOf(OOP_CLASS_FLOAT, oFloat, 1,
```

```
        (ByteType *)&pi, sizeof(pi));  
    }
```

## See Also

[GciFetchByte](#) on page 165  
[GciFetchBytes\\_](#) on page 166  
[GciStoreByte](#) on page 367  
[GciStoreBytes](#) on page 368  
[GciStoreChars](#) on page 372

## GciStoreChars

Store multiple ASCII characters in a byte object.

### Syntax

```
void GciStoreChars(  
    OopType          theObject,  
    int64            startIndex,  
    const char *     aString );
```

### Arguments

- theObject* The OOP of the GemStone byte object, into which the chars will be stored.
- startIndex* The index into *theObject* at which to begin storing bytes.
- aString* The string to be stored.

### Description

This function uses structural access to store a C string in a byte object, beginning at a specified index.

**GciStoreChars** raises an error if *theObject* is a Float or SmallFloat. ASCII characters have no meaning as bytes in a Float or SmallFloat object.

### Example

```
void storeChars_example(void)  
{  
    OopType oString = GciNewOop(OOP_CLASS_STRING);  
  
    GciStoreChars(oString, 1, "some string data");  
}
```

### See Also

[GciFetchBytes\\_](#) on page 166

[GciStoreBytes](#) on page 368

# GciStoreDynamicIv

Create or change the value of an object's dynamic instance variable.

## Syntax

```
void GciStoreDynamicIv(  
    OopType          theObject,  
    OopType          aSymbol,  
    OopType          value);
```

## Arguments

*theObject* The OOP of the object.

*aSymbol* Specifies the name of the dynamic instance variable.

*value* The value to store in the dynamic instance variable.

## Return Value

Creates or changes the value of the dynamic instance variable specified by *aSymbol* within *theObject*.

## Description

This function stores a value into the dynamic instance variable specified by *aSymbol*.

Dynamic instance variables are not allowed in instances of ExecBlock, Behavior, GsNMethod, or special objects.

To delete a dynamic instance variable, pass OOP\_REMOTE\_NIL as the value.

## See Also

[GciFetchDynamicIv](#) on page 174

[GciFetchDynamicIvs](#) on page 175

## GciStoreIdxOop

Store one OOP in an indexable pointer object's unnamed instance variable.

### Syntax

```
void GciStoreIdxOop(  
    OopType          theObject,  
    int64            atIndex,  
    OopType          theOop );
```

### Arguments

*theObject* The OOP of a pointer object, into which the *theOop* will be stored

*atIndex* The index into *theObject* at which to store *theOop*.

*theOop* The OOP to be stored.

### Description

This function stores a single OOP into an indexed variable of a pointer object at the specified index, using structural access. Note that this function cannot be used for NSCs. (To add an OOP to an NSC, use **GciAddOopToNsc** on page 94.)

### Example

```
void storeIdxOop_example(void)  
{  
    GciErrSType err;  
    OopType oArray = GciExecuteStr("Array new: 5", OOP_NIL);  
    OopType oSet = GciExecuteStr("Set with: 'GBS/VA' with: 'GBS/VW'",  
                                OOP_NIL);  
  
    // store the Set into the 3rd slot of the Array  
    GciStoreIdxOop(oArray, 3, oSet);  
  
    // release results of execution  
    GciReleaseOops(&oArray, 1);  
    GciReleaseOops(&oSet, 1);  
}
```

### See Also

**GciAddOopToNsc** on page 94

**GciFetchVaryingOop** on page 198

**GciFetchVaryingOops** on page 200

**GciStoreIdxOops** on page 375

## GciStoreIdxOops

Store one or more OOPs in an indexable pointer object's unnamed instance variables.

### Syntax

```
void GciStoreIdxOops(
    OopType          theObject,
    int64            startIndex,
    const OopType    theOops[],
    int              numOops);
```

### Arguments

*theObject* The OOP of a pointer object into which *theOops* will be stored.

*startIndex* The index into *theObject* at which to begin storing OOPs.

*theOops* The array of OOPs to be stored.

*numOops* The number of elements to store

### Description

This function uses structural access to store multiple OOPs from a C array into the indexed variables of a pointer object, beginning at the specified index. Note that this call cannot be used with NSCs. (To add multiple OOPs to an NSC, use **GciAddOopsToNsc** on page 95.)

### Example

This example creates a new Array containing the first 10 elements of Globals.

```
BoolType storeIdxOops_example(void)
{
    GciErrSType err;
    OopType oArray = GciExecuteStr("Array new: 10", OOP_NIL);
    OopType oGlobals = GciExecuteStr("Globals", OOP_NIL);
    int buf_size = 10;
    OopType oBuffer[buf_size];

    // Fetch first 10 elements in Globals
    int numRet = GciFetchVaryingOops(oGlobals, 1, oBuffer, buf_size);

    // and put these in oArray
    GciStoreIdxOops(oArray, 1, oBuffer, numRet);
    if (GciErr(&err)) {
        printf("Error %d, %s\n", err.number, err.message);
        return false;    }

    // release results of execution
    GciReleaseOops(&oArray, 1);
    return true;
}
```

```
}
```

## See Also

- GciAddOopToNsc** on page 94
- GciFetchVaryingOops** on page 200
- GciReplaceOops** on page 337
- GciReplaceVaryingOops** on page 338
- GciStoreIdxOops** on page 375
- GciStoreNamedOops** on page 378
- GciStoreOops** on page 382



# GciStoreNamedOop

Store one OOP into an object's named instance variable.

## Syntax

```
void GciStoreNamedOop(  
    OopType          theObject,  
    int64            atIndex,  
    OopType          theOop );
```

## Arguments

*theObject* The Object into which to store the OOP.

*startIndex* The index into *theObject*'s named instance variables at which to begin storing OOPs.

*theOops* The array of OOPs to be stored.

## Description

This function stores a single OOP into an object's named instance variable at the specified index, using structural access.

## Example

See "Executing the examples" on page 91 for the Smalltalk code that defines the classes and objects that support the examples.

```
void storeNamedOop_example(OopType anAccount)  
{  
    OopType newName = GciNewString("Josiah Chang");  
  
    // assign new value to instvar at a hardcoded offset  
    int indexOfSalesRep = 3;  
    GciStoreNamedOop(anAccount, indexOfSalesRep, newName);  
  
    // assign new value to instvar without knowing offset  
    GciStoreNamedOop(anAccount,  
        GciIvNameToIdx(GciFetchClass(anAccount), "salesRep"),  
        newName);  
}
```

## See Also

[GciFetchNamedOop](#) on page 176  
[GciFetchVaryingOop](#) on page 198  
[GciStoreIdxOop](#) on page 374  
[GciStoreNamedOops](#) on page 378

## GciStoreNamedOops

Store one or more OOPs into an object's named instance variables.

### Syntax

```
void GciStoreNamedOops(
    OopsType          theObject,
    int64             startIndex,
    const OopsType    theOops[ ],
    int               numOops );
```

### Arguments

- theObject* The Object in which to store the OOP.
- startIndex* The index into *theObject*'s named instance variables at which to begin storing OOPs.
- theOops* The array of OOPs to be stored.
- numOops* The number of OOPs to store. If (numOops+startIndex) exceeds the number of named instance variables in *theObject*, an error is generated.

### Description

This function uses structural access to store multiple OOPs from a C array into an object's named instance variables, beginning at the specified index.

### Example

See "Executing the examples" on page 91 for the Smalltalk code that defines the classes and objects that support the examples.

```
void storeNamedOops_example(OopsType anAddress)
{
    // allocation buffer for unknown number of instvars
    int namedSize = GciFetchNamedSize(anAddress);
    if (namedSize == 0) { return ; }
    OopsType *oBuffer = (OopsType*) malloc( sizeof(OopsType) * namedSize );
    if (oBuffer == NULL) { return; }

    // fetch existing values
    int numRet = GciFetchNamedOops(anAddress, 1, oBuffer, namedSize);
    if (numRet != namedSize) {
        printf("error during fetch\n");
        return;
    }

    // update street and city, but not state
    OopsType newValue = GciNewString("4545 45th Str");
    int ivOffset = GciIvNameToIdx(GciFetchClass(anAddress), "street");
```

```
oBuffer[ivOffset - 1 ] = newValue;
newValue = GciNewString("Tualatin");
ivOffset = GciIvNameToIdx(GciFetchClass(anAddress), "city");
oBuffer[ivOffset - 1 ] = newValue;

// store changes
GciStoreNamedOops(anAddress, 1, oBuffer, namedSize);
}
```

## See Also

**GciAddOopToNsc** on page 94  
**GciFetchNamedOops** on page 177  
**GciFetchVaryingOops** on page 200  
**GciReplaceOops** on page 337  
**GciReplaceVaryingOops** on page 338  
**GciStoreIdxOops** on page 375  
**GciStoreNamedOop** on page 377  
**GciStoreOops** on page 382

## GciStoreOop

Store one OOP into an object's instance variable.

### Syntax

```
void GciStoreOop(
    OopType          theObject,
    int64            atIndex,
    OopType          theOop );
```

### Arguments

- theObject* The Object in which to store the OOP.
- startIndex* The index into *theObject*'s named or unnamed instance variables at which to store the OOP. This function does not distinguish between named and unnamed instance variables. Indices are based at the beginning of an object's array of instance variables. In that array, the object's named instance variables are followed by its unnamed instance variables
- theOops* The OOP to be stored.

### Description

This function stores a single OOP into an object at the specified index, using structural access. Note that this function cannot be used for NSCs. To add an object to an NSC, use **GciAddOopToNsc** on page 94.

### Example

See "Executing the examples" on page 91 for the Smalltalk code that defines the classes and objects that support the examples.

```
void storeOop_example(OopType anAccount)
{
    // Two ways to assign new value to a named instance variable of
    // anAccount
    OopType newName = GciNewString("Jeni Johnson-Klien");
    int indexOfSalesRep = 3;
    GciStoreOop(anAccount, indexOfSalesRep, newName);
    GciStoreNamedOop(anAccount, indexOfSalesRep, newName);

    // Two ways to assign a product string to the first indexed instance
    // variable
    OopType newProduct = GciNewString("GemConnect");
    GciStoreOop(anAccount, GciFetchNamedSize(anAccount) + 1, newProduct);
    GciStoreIdxOop(anAccount, 1, newProduct);
}
```

## See Also

**GciAddOopToNsc** on page 94

**GciFetchNamedOop** on page 176

**GciFetchVaryingOop** on page 198

**GciFetchOops** on page 188

**GciStoreOops** on page 382

## GciStoreOops

Store one or more OOPs into an object's instance variables.

### Syntax

```
void GciStoreOops(
    OopType          theObject,
    int64            startIndex,
    const OopType    theOops[],
    int              numOops);
```

### Arguments

- theObject* The Object in which to store the OOPs.
- startIndex* The index into *theObject*'s named or unnamed instance variables at which to begin storing OOPs. This function does not distinguish between named and unnamed instance variables. Indices are based at the beginning of an object's array of instance variables. In that array, the object's named instance variables are followed by its unnamed instance variables
- theOops* The OOP to be stored.
- numOops* The number of OOPs to store

### Description

This function uses structural access to store multiple OOPs from a C array into a pointer object, beginning at the specified index. Note that this call cannot be used with NSCs. To add multiple OOPs to an NSC, use **GciAddOopsToNsc** on page 95.

### Example

See "Executing the examples" on page 91 for the Smalltalk code that defines the classes and objects that support the examples.

```
void storeOops_example(OopType anAccount)
{
    int namedSize = GciFetchNamedSize(anAccount);
    int64 instSize = GciFetchSize_(anAccount);

    // allow space in buffer for storing into first varying instVar plus
    // appending a new varying instVar
    int64 bufVaryingSize = instSize - namedSize + 1;

    int64 bufSize = namedSize + bufVaryingSize;
    OopType *buf = (OopType*) malloc(sizeof(OopType) * bufSize);
    if (buf == NULL) {
        printf("malloc failure");
        return;
    }
}
```

```
GciFetchOops(anAccount, 1, buf, instSize);

OopType newName = GciNewString("Josiah Chang");
int indexOfSalesRep = GciIvNameToIdx(GciFetchClass(anAccount),
    "salesRep");
buf[indexOfSalesRep - 1] = newName;

OopType firstProduct = GciNewString("GS64");
OopType newProduct = GciNewString("GemConnect");

// assign first element
buf[namedSize] = firstProduct;

// append new product
int64 newSize = instSize + 1;
buf[newSize - 1] = newProduct;

// now store all the instVars back to the repository
GciStoreOops(anAccount, 1, buf, newSize);
}
```

## See Also

**GciAddOopsToNsc** on page 95  
**GciFetchNamedOops** on page 177  
**GciFetchVaryingOop** on page 198  
**GciFetchOops** on page 188  
**GciRemoveOopsFromNsc** on page 335  
**GciReplaceOops** on page 337  
**GciReplaceVaryingOops** on page 338  
**GciStoreIdxOops** on page 375  
**GciStoreNamedOops** on page 378  
**GciStoreOops** on page 382

## GciStorePaths

Store selected multiple OOPs into an object tree.

### Syntax

```
BoolType GciStorePaths(
    const OopType      theOops[ ],
    int                numOops,
    const int          paths[ ],
    const int          pathSizes[ ],
    int                numPaths,
    const OopType      newValues[ ],
    int *              failCount );
```

### Arguments

- theOops* A collection of OOPs into which you want to store new values.
- numOops* The size of *theOops*.
- paths* An array of integers. This one-dimensional array contains the elements of all constituent paths, laid end to end.
- pathSizes* An array of integers. Each element of this array is the length of the corresponding path in the *paths* array (that is, the number of elements in each constituent path).
- numPaths* The number of paths in the *paths* array. This should be the same as the number of integers in the *pathSizes* array.
- newValues* An array containing the new values to be stored into *theOops*.
- failCount* A pointer to an integer that indicates which element of the *newValues* array could not be successfully stored. If all values were successfully stored, *failCount* is 0. If the *i*th store failed, *failCount* is *i*. If any of the objects in *newValues* does not exist, or is not an OOP allocated to GemBuilder, *failCount* is 1.

### Return Value

Returns TRUE if all values were successfully stored. Returns FALSE if the store on any path fails for any reason.

### Description

This function allows you to store multiple objects at selected positions in an object tree with a single GemBuilder call, exporting only the desired information to the database.

Each path in the *paths* array is itself an array of longs. Those longs are offsets that specify a path along which to store objects. In each path, a positive integer *x* refers to an offset within an object's named instance variables, while a negative integer *-x* refers to an offset within an object's indexed instance variables.



The *newValues* array contains (*numOps* \* *numPaths*) elements, stored in the following order:

```
[0,0]..[0,numPaths-1]..[1,0]..[1,numPaths-1]..
[numOps-1,0]..[numOps-1,numPaths-1]
```

The first element of this *newValues* array is stored along the first path into the first element of *theOps*. New values are then stored into the first element of *theOps* along each remaining element of the paths array. Similarly, new values are stored into each subsequent element of *theOps*, until all paths have been applied to all its elements.

The new value to be stored into object *i* along path *j* is thus represented as:

```
newValues[ ((i-1) * numPaths) + (j-1) ]
```

The expressions *i-1* and *j-1* are used because C has zero-based arrays.

If the store on any path fails for any reason, this function stops and generates a GemBuilder error. Any objects that were successfully stored before the error occurred will remain stored.

## Example of a single object and a single path

See "Executing the examples" on page 91 for the Smalltalk code that defines the classes and objects that support the examples.

This example updates the street address along one path for a single account.

```
BoolType storePaths_example1(OopType anAccount)
{
    GciErrSType errInfo;
    int path_size = 3;
    int aPath[path_size];
    aPath[0] = 2; //customer
    aPath[1] = 2; //address
    aPath[2] = 1; //street

    // update anAccount.customer.address.street with the newValue
    OopType newValue = GciNewString("312 North Rd");
    int failCount;
    GciStorePaths(&anAccount, 1, aPath, &path_size, 1, &newValue,
                 &failCount);
    if (failCount != 0) {
        printf("GciStorePaths fail count is %d\n", failCount);
        return false;
    }
    if (GciErr(&errInfo)) {
        printf("GciStorePaths error %d, %s\n", errInfo.number,
              errInfo.message);
        return false;
    }
    return true;
}
```

## Example with multiple objects and multiple paths

This example updates several values along two paths for two Accounts.

```
BoolType storePaths_example2(int numofAccounts, OopType* resultAccounts)
{
    GciErrSType errInfo;
    OopType myAccts;
    myAccts = GciExecuteStr("AllAccounts", OOP_NIL);
    if (myAccts == OOP_NIL) { return false; }

    int numRet = GciFetchVaryingOops(myAccts, 1, resultAccounts,
                                     numofAccounts);
    if (numRet != numofAccounts) { return false; }

    int path_segments[2];
    path_segments[0] = 2;
    path_segments[1] = 3;
    int serialPath[6]; // size is sum of path_segments
    serialPath[0] = 2; //customer
    serialPath[1] = 1; //name
    serialPath[2] = 2; //customer
    serialPath[3] = 2; //address
    serialPath[4] = 2; //city

    OopType newValues[2 * numofAccounts];
    // size of path_segments * number of accounts
    newValues[0] = GciNewString("Samual B. Houston");
    newValues[1] = GciNewString("Paisley");
    newValues[2] = GciNewString("Maya J. Johnson");
    newValues[3] = GciNewString("Bend");

    int failCount;
    GciStorePaths(resultAccounts, numofAccounts, serialPath,
                 path_segments, 2, newValues, &failCount);

    if (failCount != 0) {
        printf("GciStorePaths fail count is %d\n", failCount);
        return false;
    }
    if (GciErr(&errInfo)) {
        printf("GciStorePaths error %d, %s\n", errInfo.number,
              errInfo.message);
        return false;
    }
    return true;
}
```

## See Also

[GciFetchPaths](#) on page 190

## GciStoreTrav

Store multiple traversal buffer values in objects.

### Syntax

```
void GciStoreTrav(
    GciTravBufType *    travBuff,
    int                 behaviorFlag );
```

### Arguments

- travBuff* A traversal buffer, which contains object data to be stored.
- behaviorFlag* Flag bits that determines how the objects should be handled. Either use `GCI_STORE_TRAV_DEFAULT`, or any combination of the other flags.
- `GCI_STORE_TRAV_DEFAULT = 0`  
 Default behavior: use "add" semantics for varying instvars of NSC; if the object to be stored into does not exist, give error.
- `GCI_STORE_TRAV_NSC_REP = 0x1`,  
 Use REPLACE semantics for varying instvars of NSC
- `GCI_STORE_TRAV_CREATE = 0x2`  
 If an object to be stored into does not exist, create the new object and add it to the PureExportSet .

### Description

This function stores data from the traversal buffer *travBuff* into multiple GemStone objects. A traversal buffer is a specialized C structure that optimizes transfer of data. **GciStoreTrav**, by providing a way to modify and create a number of new object in one command, allows you to reduce the number of GemBuilder calls that are required for your application program to store complex objects in the database.

The first element in the traversal buffer is an integer that indicates how many bytes are stored in the buffer. The remainder of the traversal buffer consists of a series of object reports. Each object report is a C structure of type **GciObjRepSType**. A **GciObjRepSType** includes a header with the OOP and class of the object, and a variable-length data area. **GciStoreTrav** stores data object by object, using one object report at a time.

**GciStoreTrav** can create new objects and store data into them, or it can modify existing objects with the data in their object reports, or a combination of the two. By default (`GCI_STORE_TRAV_DEFAULT`), it only modifies existing objects, and it raises an error if an object does not already exist. When `GCI_STORE_TRAV_CREATE` is used, it modifies any object that already exists and creates a new object when an object does not exist. The new object is initialized with the data in its object report.

To create a new object based on an object report, you need to provide the OOP of the object, using **GciGetFreeOops**.

When **GciStoreTrav** modifies an existing object of byte or pointer format, it replaces that object's data with the data in its object report, regardless of *behaviorFlag*. All instance variables, named (if any) or indexed (if any), receive new values. Named instance variables for which values are not

given in the object report are initialized to nil or to zero. Indexable objects may change in size; the object report determines the new number of indexed variables.

When an existing NSC is modified, it replaces all named instance variables of the NSC (if any), but adds further data in its object report to the unordered variables, increasing its size. If *behaviorFlag* includes `GCI_STORE_TRAV_NSC_REP`, then it removes all existing unordered variables and adds new unordered variables with values from the object report.

**GciStoreTrav** provides automatic byte swizzling. See “Byte-Swizzling of Binary Floating-Point Values” on page 26.

This function raises an error if the traversal buffer contains a report for any object of special implementation format; special objects cannot be modified.

## Use of Object Reports

**GciStoreTrav** stores values in GemStone objects according to the object reports contained in *travBuff*. Each object report is an instance of the C++ class **GciObjRepSType** (described in “Object Report Header - GciObjRepHdrSType” on page 71). **GciStoreTrav** uses the fields in each object report as follows:

*report->header.valueBuffSize*

The size (in bytes) of the value buffer, where object data is stored. If *objId* is a Float or SmallFloat and *valueBuffSize* differs from the actual size for objects of *objId*'s class, then **GciStoreTrav** raises an error.

*report->header.setIdxSize()*

Only needs to be called if the object is indexable. The number of indexed variables in the object stored by **GciStoreTrav** is never less than this quantity. It may be more if the value buffer contains enough data. **GciStoreTrav** stores all the indexed variables that it finds in the value buffer. If an existing object has more indexed variables, then it also retains the extras, up to a total of *idxSize*, and removes any beyond *idxSize*. If *idxSize* is larger than the number of indexed variables in both the current object and the value buffer, then **GciStoreTrav** creates slots for elements in the stored object up to index *idxSize* and initializes any added elements to nil.

*report->header.firstOffset*

Ignored for NSC objects. The absolute offset into the target object at which to begin storing values from the value buffer. The absolute offset of the object's first named instance variable (if any) is one; the offset of its first indexed variable (if any) is one more than the number of its named instance variables. Values are stored into the object in the order that they appear in the value buffer, ignoring the boundary between named and indexed variables. Variables whose offset is less than *firstOffset* (if any) are initialized to nil or zero. For nonindexable objects, **GciStoreTrav** raises an error if *valueBuffSize* and *firstOffset* imply a size that exceeds the actual size of the object. If *objId* is a Float or SmallFloat and *firstOffset* is not one, then **GciStoreTrav** raises an error.

*report->header.objId*

The OOP of the object to be stored.

*report->header.oclass*

Used only when creating a new object, to identify its intended class.

*report->header.objectSecurityPolicyId*

The ID of the object's security policy.

*report->header.clearBits()*

Must be called before any of the following:

*report->header.setObjImpl()*

You must call *rpt->hdr.setObjImpl* to set this field to be consistent with the object's implementation. Formats usable here are GC\_FORMAT\_OOP, GC\_FORMAT\_BYTE, and GC\_FORMAT\_NSC.

*report->header.setInvariant()*

Boolean value. Call *rpt->hdr.setInvariant(TRUE)* if you want this object to be made invariant after the store specified by *report\** is completed.

*report->valueBufferBytes()*

The value buffer of an object of byte format.

*report->valueBufferOops()*

The value buffer of an object of pointer or NSC format.

## Handling Error Conditions

If you get a runtime error while executing **GciStoreTrav**, the recommended course of action is to abort the current transaction.

## See Also

**GciMoreTraversal** on page 238

**GciNbStoreTrav** on page 263

**GciNewOopUsingObjRep** on page 277

**GciProcessDeferredUpdates\_** on page 321

**GciStoreTravDo\_** on page 390

**GciTraverseObjs** on page 407

## GciStoreTravDo\_

Store multiple traversal buffer values in objects, execute the specified code, and return the resulting object.

### Syntax

```
OopType GciStoreTravDo_(  
    GciStoreTravDoArgsSType * storeTravArgs );
```

### Arguments

*storeTravArgs* An instance of **GciStoreTravDoArgsSType**.

### Return Value

Returns the OOP of the result of executing the specified code. In case of error, this function returns OOP\_NIL.

### Description

**GciStoreTravDo\_**, like **GciStoreTrav**, stores data from a traversal buffer into multiple GemStone objects, and also executes supplied code, all in the same network round-trip.

For details of the fields in the instance of **GciStoreTravDoArgsSType**, see “Store Traversal Arguments - GciStoreTravDoArgsSType” on page 75. The fields of this structure include the traversal buffer and flags as described under “GciStoreTrav” on page 387.

**GciStoreTravDoArgsSType** includes the *doPerform* field to indicate different perform options.

- If *doPerform* is 0, this function executes a string using *args->u.executestr*, with the semantics of “GciExecuteFromContext” on page 155.
- If *doPerform* is any other value, then executes a perform using *args->u.perform*, with the semantics of “GciPerformNoDebug” on page 311.

The remaining fields supply needed output after the function has completed. Read *alteredTheOops* to get the OOPs of the objects that were modified and read *alteredCompleted* to determine if the array as originally allocated was large enough to hold all the modified objects. If the value is false, the array was too small and holds only some of the modified objects; in this case, call **GciAlteredObjs** for the rest.

Similarly to **GciStoreTrav**, **GciStoreTravDo\_** provides automatic byte swizzling, unless **GciSetTraversalBufSwizzling** is used to disable swizzling. For more about byte swizzling, see “Byte-Swizzling of Binary Floating-Point Values” on page 26.

### Handling Error Conditions

If you get a run time error while executing **GciStoreTravDo\_**, we recommend that you abort the current transaction.

## See Also

- [GciAlteredObjs](#) on page 99
- [GciExecuteStrFromContext](#) on page 161
- [GciMoreTraversal](#) on page 238
- [GciNbStoreTravDo\\_](#) on page 264
- [GciNewOopUsingObjRep](#) on page 277
- [GciPerformNoDebug](#) on page 311
- [GciProcessDeferredUpdates\\_](#) on page 321
- [GciStoreTrav](#) on page 387
- [GciTraverseObjs](#) on page 407

## GciStoreTravDoTrav\_

Combine in a single function the calls to **GciStoreTravDo\_** and **GciClampedTrav**, to store multiple traversal buffer values in objects, execute specified code, and traverse the result object.

### Syntax

```
BoolType GciStoreTravDoTrav_(  
    GciStoreTravDoArgsSType * storeTravArgs,  
    GciClampedTravArgsSType *clampedTravArgs );
```

### Arguments

- storeTravArgs* An instance of **GciStoreTravDoArgsSType**. For details, refer to the discussion of **GciStoreTravDo\_** on page 390.
- clampedTravArgs* An instance of **GciClampedTravArgsSType**. For details, refer to the discussion of **GciClampedTrav** on page 110.

### Return Value

Returns FALSE if the traversal is not yet completed. Returns TRUE if there are no more objects to be returned by subsequent calls to **GciMoreTraversal** (that is, an object report was constructed for each object, minus the special objects).

### Description

This function allows the client to execute behavior on the Gem and return the traversal of the result object in a single network round-trip. See the descriptions for **GciStoreTravDo\_** on page 390 and **GciClampedTrav** on page 110 for details.

### See Also

- GciClampedTrav** on page 110
- GciStoreTrav** on page 387
- GciStoreTravDo\_** on page 390



## GciStoreTravDoTravRefs\_

Combine in a single function modifications to session sets, traversal of objects to the server, optional Smalltalk execution, and traversal to the client of changed objects and (optionally) the result object.

### Syntax

```
int GciStoreTravDoTravRefs_(
    const OopType *      oopsNoLongerReplicated,
    int                  numNotReplicated,
    const OopType *      oopsGcedOnClient,
    int                  numGced,
    GciStoreTravDoArgsSType * storeTravArgs,
    GciClampedTravArgsSType *clampedTravArgs );
```

### Arguments

|                               |                                                                                                                                                                                                                                                                                                                        |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>oopsNoLongerReplicated</i> | An Array of objects to be removed from the PureExportSet and added to the ReferencedSet.                                                                                                                                                                                                                               |
| <i>numNotReplicated</i>       | The number of elements in <i>oopsNoLongerReplicated</i> .                                                                                                                                                                                                                                                              |
| <i>oopsGcedOnClient</i>       | An Array of objects to be removed from both the PureExportSet and ReferencedSet.                                                                                                                                                                                                                                       |
| <i>numGced</i>                | The number of elements in <i>oopsGcedOnClient</i> .                                                                                                                                                                                                                                                                    |
| <i>storeTravArgs</i>          | An instance of <b>GciStoreTravDoArgsSType</b> , as described under “Store Traversal Arguments - GciStoreTravDoArgsSType” on page 75.                                                                                                                                                                                   |
| <i>clampedTravArgs</i>        | An instance of <b>GciClampedTravArgsSType</b> . For details, see <b>Clamped Traversal Arguments - GciClampedTravArgsSType</b> on page 77, and the discussion of <b>GciStoreTrav</b> on page 387. There is one exception: in this function, <i>retrievalFlags</i> GCI_RETRIEVE_EXPORT and GCI_CLEAR_EXPORT are ignored. |

### Return Value

Returns an int with the following meaning:

- 0 – traversal of both altered objects and execution result completed.
- 1 – traversal buffer became full. You must call **GciMoreTraversal** to finish traversal of the altered and result objects.

### Description

This function allows the client to modify the PureExportSet and ReferencedSet, modify or create any number of objects on the server, execute behavior on the Gem, and return the traversal of the changed objects and the result object, all in a single network round-trip.

The elements in *oopsGcedOnClient* are removed from both PureExportSet and ReferencedSet, and the elements in *oopsNoLongerReplicated* are removed from the PureExportSet and added to the ReferencedSet.

**GciStoreTravDoArgsSType** includes the *doPerform* field to indicate different perform options. The *doPerform*, which also determines which nested structure is used in the union field.

- If *doPerform* is 0, this function executes a string using *args->u.executestr*, with the semantics of “GciExecute” on page 153.
- If *doPerform* is 1, then executes a perform using *args->u.perform*, with the semantics of “GciPerform” on page 307.
- If *doPerform* is 2, execute a string that is the source code for a Smalltalk block using *stdArgs->u.executestr*, passing the block arguments in *execBlock\_args*.
- If *doPerform* is 3, perform no server Smalltalk execution, but traverse the object specified in *stdArgs->u.perform.receiver* as if it was the results of execution.
- If *doPerform* is 4, resume execution of a suspended Smalltalk Process using *stdArgs->u.continueArgs*, with the semantics of “GciContinueWith” on page 123.

Objects in the ReferencedSet are protected from garbage collection, but may be faulted out of memory. Dirty tracking is not done on objects in the ReferencedSet.

Then per the *stdArgs*, a **GciStoreTrav** is done, which may modify or create any number of objects on the server. Newly created objects are added to the PureExportSet.

Then, if specified, Smalltalk execution is performed as in **GciPerformNoDebug**, **GciExecuteStrFromContext**, or executing the block code with the given arguments.

Finally, this function does a special **GciClampedTrav** starting with altered objects, followed by the execution result from the previous step. If no execution was specified, the specified object is traversed as if it was an execution result. Altered objects are those that would be returned from a **GciAlteredObjs** after the code execution step. This traversal both relies on the contents of the PureExportSet and ReferencedSet does not, and also modifies those sets in ways that **GciClampedTrav** does not. For details, see the comments in `gci.hf`.

**GciStoreTravDoTravRefs\_** is not intended for use within a user action.

## See Also

- GciAlteredObjs** on page 99
- GciClampedTrav** on page 110
- GciExecuteStrFromContext** on page 161
- GciMoreTraversal** on page 238
- GciNbStoreTravDoTravRefs\_** on page 266
- GciPerformNoDebug** on page 311
- GciStoreTrav** on page 387
- GciStoreTravDo\_** on page 390
- GciStoreTravDoTrav\_** on page 392
- GciTraverseObjs** on page 407

# GciStringToInteger

Convert a C string to a GemStone SmallInteger or LargeInteger object.

## Syntax

```
OopsType GciStringToInteger(  
    const char*      string,  
    int64            stringSize );
```

## Arguments

*string* The C string to be translated into a GemStone SmallInteger or LargeInteger object.  
*stringSize* The length of *string*.

## Return Value

Returns the OOP of the GemStone SmallInteger or LargeInteger object. If *string* has an invalid format, this function returns OOP\_NIL without an error.

## Description

The **GciStringToInteger** function translates a C string to a GemStone SmallInteger or LargeInteger object that has the same value.

Leading blanks are ignored. Trailing non-digits are ignored.

## GciStrKeyValueDictAt

Find the value in a symbol KeyValue dictionary at the corresponding string key.

### Syntax

```
void GciStrKeyValueDictAt(  
    OopType          theDict,  
    const char *     keyString,  
    OopType *        value );
```

### Arguments

*theDict* The OOP of a SymbolKeyValueDictionary.

*keyString* A string that matches a key in *theDict*.

*value* A pointer to the variable that is to receive the OOP of the returned value.

### Description

Returns the value in symbol KeyValue dictionary *theDict* that corresponds to key *keyString*. If an error occurs or *keyString* is not found, *value* is OOP\_ILLEGAL. KeyValue dictionaries do not have associations, so no association is returned. **GciStrKeyValueDictAt** is equivalent to **GciStrKeyValueDictAtObj** except that the key is a character string, not an object.

### See Also

**GciStrKeyValueDictAtObj** on page 397

**GciStrKeyValueDictAtPut** on page 399

# GciStrKeyValueDictAtObj

Find the value in a symbol KeyValue dictionary at the corresponding object key.

## Syntax

```
void GciStrKeyValueDictAtObj(  
    OopType          theDict,  
    OopType          keyObj,  
    OopType *        value );
```

## Arguments

*theDict* The OOP of a SymbolKeyValueDictionary.

*keyObj* The OOP of a key in *theDict*.

*value* A pointer to the variable that is to receive the OOP of the returned value.

## Description

Returns the value in symbol KeyValue dictionary *theDict* that corresponds to key *keyObj*. If an error occurs or *keyObj* is not found, *value* is OOP\_ILLEGAL. KeyValue dictionaries do not have associations, so no association is returned. Equivalent to the GemStone Smalltalk expression:

```
^ { theDict at:keyObj }
```

## See Also

[GciStrKeyValueDictAt](#) on page 396

[GciStrKeyValueDictAtObjPut](#) on page 398

## GciStrKeyValueDictAtObjPut

Store a value into a symbol KeyValue dictionary at the corresponding object key.

### Syntax

```
void GciStrKeyValueDictAtObjPut(  
    OopType          theDict,  
    OopType          keyObj,  
    OopType          theValue );
```

### Arguments

*theDict* The OOP of a SymbolKeyValueDictionary into which the object is to be stored.

*keyObj* The OOP of a key under which the value is to be stored.

*theValue* The OOP of the object to be stored in the SymbolKeyValueDictionary.

### Description

Adds object *theValue* to symbol KeyValue dictionary *theDict* with key *keyObj*. Equivalent to the Smalltalk expression:

```
theDict at: keyObj put: theValue
```

### See Also

[GciStrKeyValueDictAtObj](#) on page 397

[GciStrKeyValueDictAtPut](#) on page 399

## GciStrKeyValueDictAtPut

Store a value into a symbol KeyValue dictionary at the corresponding string key.

### Syntax

```
void GciStrKeyValueDictAtPut(  
    OopType          theDict,  
    const char *     keyString,  
    OopType          theValue );
```

### Arguments

*theDict* The OOP of a SymbolKeyValueDictionary into which the object is to be stored.

*keyObj* The string key under which the value is to be stored.

*theValue* The OOP of the object to be stored in the SymbolKeyValueDictionary.

### Description

Adds object *theValue* to symbol KeyValue dictionary *theDict* with key *keyString*.

**GciStrKeyValueDictAtPut** is equivalent to **GciStrKeyValueDictAtObjPut**, except the key is a character string, not an object.

### See Also

**GciStrKeyValueDictAt** on page 396

**GciStrKeyValueDictAtObjPut** on page 398

## GciSymDictAt

Find the value in a symbol dictionary at the corresponding string key.

### Syntax

```
void GciSymDictAt(  
    OopType          theDict,  
    const char *    keyString,  
    OopType *       value,  
    OopType *       association );
```

### Arguments

*theDict* The OOP of a SymbolDictionary.

*keyObj* The OOP of a key in *theDict*.

*value* A pointer to the variable that is to receive the OOP of the returned value.

*association* A pointer to the variable that is to receive the OOP of the association.

### Description

Returns the value in symbol dictionary *theDict* that corresponds to key *keyString*. If an error occurs or *keyString* is not found, *value* is OOP\_ILLEGAL. If *association* is not NULL and an error does not occur, stores the OOP of the association for *keyString* at *\*association*, or stores OOP\_ILLEGAL if *keyString* was not found. Equivalent to **GciSymDictAtObj** except that the key is a character string, not an object.

To operate on kinds of Dictionary other than SymbolDictionary, such as KeyValueDictionary, use **GciPerform**, since the KeyValueDictionary class is implemented in Smalltalk. If your dictionary will be large (greater than 20 elements) a KeyValueDictionary is more efficient than a SymbolDictionary.

### See Also

**GciStrKeyValueDictAt** on page 396

**GciSymDictAtObj** on page 401

**GciSymDictAtPut** on page 403



# GciSymDictAtObj

Find the value in a symbol dictionary corresponding to the key object.

## Syntax

```
void GciSymDictAtObj(  
    OopType          theDict,  
    OopType          keyObj,  
    OopType *        value,  
    OopType *        association );
```

## Arguments

*theDict* The OOP of a SymbolDictionary.

*keyObj* The OOP of a key in *theDict*.

*value* A pointer to the variable that is to receive the OOP of the returned value.

*association* A pointer to the variable that is to receive the OOP of the association.

## Description

Fetches the value in symbol dictionary *theDict* that corresponds to key *keyObj*. If an error occurs or *keyObj* is not found, *value* is OOP\_ILLEGAL. If *association* is not NULL and an error does not occur, stores the OOP of the association for *keyObj* at *\*association*, or stores OOP\_ILLEGAL if *keyObj* was not found. Similar to the GemStone Smalltalk expression:

```
^ { theDict at: keyObj . theDict associationAt: keyObj }
```

## See Also

[GciStrKeyValueDictAtObj](#) on page 397

[GciSymDictAt](#) on page 400

[GciSymDictAtObjPut](#) on page 402

## GciSymDictAtObjPut

Store a value into a symbol dictionary at the corresponding object key.

### Syntax

```
void GciSymDictAtObjPut(  
    OopType      theDict,  
    OopType      keyObj,  
    OopType      theValue );
```

### Arguments

*theDict* The OOP of a SymbolDictionary into which the object is to be stored.

*keyObj* The OOP of a key under which the value is to be stored.

*theValue* The OOP of the object to be stored in the SymbolDictionary.

### Description

Adds object *theValue* to symbol dictionary *theDict* with key *keyObj*. Equivalent to the Smalltalk expression:

```
theDict at: keyObj put: theValue
```

### See Also

[GciStrKeyValueDictAtObjPut](#) on page 398

[GciSymDictAtObj](#) on page 401

[GciSymDictAtPut](#) on page 403

# GciSymDictAtPut

Store a value into a symbol dictionary at the corresponding string key.

## Syntax

```
void GciSymDictAtPut(  
    OopType          theDict,  
    const char *     keyString,  
    OopType          theValue );
```

## Arguments

- theDict* The OOP of a SymbolDictionary into which the object is to be stored.
- keyString* The string key under which the value is to be stored.
- theValue* The OOP of the object to be stored in the SymbolDictionary.

## Description

Adds object *theValue* to symbol dictionary *theDict* with key *keyString*. Equivalent to **GciSymDictAtObjPut**, except the key is a character string, not an object.

## See Also

- GciStrKeyValueDictAtPut** on page 399
- GciSymDictAt** on page 400
- GciSymDictAtObjPut** on page 402

## GciTrackedObjsFetchAllDirty

Find all exported or tracked objects that have changed and are therefore in the ExportedDirtyObjs or TrackedDirtyObjs sets.

### Syntax

```
void GciTrackedObjsFetchAllDirty(  
    OopType          exportedDirty,  
    int64 *          numExportedDirty,  
    OopType          trackedDirty,  
    int64 *          numTrackedDirty );
```

### Arguments

|                         |                                                                                                                                      |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| <i>exportedDirty</i>    | OOB of the collection (an instance of either IdentitySet or IdentityBag) that will contain the objects in the ExportedDirtyObjs set. |
| <i>numExportedDirty</i> | Pointer to an integer that returns the number of objects in the <i>exportedDirty</i> collection.                                     |
| <i>trackedDirty</i>     | OOB of the collection (an instance of either IdentitySet or IdentityBag) that will contain the objects in the TrackedDirtyObjs set.  |
| <i>numTrackedDirty</i>  | Pointer to an integer that returns the number of objects in the <i>trackedDirty</i> collection.                                      |

### Description

**GciTrackedObjsFetchAllDirty** fetches all dirty objects and sorts them into two categories:

- Objects in the ExportedDirtyObjs set - objects in the PureExportSet that have been changed since the ExportedDirtyObjs set was initialized or cleared.
- Objects in the TrackedDirtyObjs set - objects in the GciTrackedObjs set that have been changed since the TrackedDirtyObjs set was initialized or cleared.

The ExportedDirtyObjs set is initialized by **GciDirtyObjsInit**; it is cleared by calls to **GciDirtyAlteredObjs**, **GciDirtyExportedObjs**, **GciDirtySaveObjs**, or **GciTrackedObjsFetchAllDirty** (this function).

The TrackedDirtyObjs set is initialized by **GciTrackedObjsInit** and cleared by calls to **GciDirtyAlteredObjs**, **GciDirtySaveObjs**, **GciDirtyTrackedObjs**, or **GciTrackedObjsFetchAllDirty** (this function).

An object is considered dirty (changed) under one or more of the following conditions:

- The object was changed by Smalltalk execution.
- The object was changed by a call to any GemBuilder function from within a user action.
- The object was changed by a call to one or more of the following functions: **GciStorePaths**, **GciSymDictAtObjPut**, **GciSymDictAtPut**, **GciStrKeyValueDictAtObjPut**, or **GciStrKeyValueDictAtPut**.
- A change to the object was committed by another transaction since it was read by this one.
- The object is persistent, but was modified in the current session before the session aborted the transaction. (When the transaction is aborted, the modifications are destroyed, thus changing the state of the object in memory).

You must call both **GciDirtyObjsInit** and **GciTrackedObjsInit** once after **GciLogin** before calling **GciTrackedObjsFetchAllDirty**.

Note that the `ExportedDirtyObjs` and `TrackedDirtyObjs` sets are cleared when this function is executed.

## See Also

“Garbage Collection” on page 18

**GciDirtyExportedObjs** on page 138

**GciDirtyObjsInit** on page 140

**GciDirtySaveObjs** on page 141

**GciDirtyTrackedObjs** on page 143

**GciSaveAndTrackObjs** on page 345

**GciTrackedObjsInit** on page 406

## GciTrackedObjsInit

Reinitialize the set of tracked objects maintained by GemStone.

### Syntax

```
void GciTrackedObjsInit();
```

### Description

The **GciTrackedObjsInit** function permits an application to request GemStone to maintain a set of tracked objects. **GciTrackedObjsInit** must be called once after **GciLogin** before other tracked objects functions in order for those functions to operate properly, because they depend upon GemStone's set of tracked objects.

### See Also

**GciDirtySaveObjs** on page 141  
**GciDirtyTrackedObjs** on page 143  
**GciSaveAndTrackObjs** on page 345  
**GciTrackedObjsFetchAllDirty** on page 404

## GciTraverseObjs

Traverse an array of GemStone objects.

### Syntax

```
BoolType GciTraverseObjs(
    const OopType      theOops [ ],
    int                numOops,
    GciTravBufType *   travBuff,
    int                level );
```

### Arguments

- theOops* An array of OOPs representing the objects to be traversed.
- numOops* The number of elements in *theOops*.
- travBuff* A buffer in which the results of the traversal will be placed. For details, see “Traversal Buffer - GciTravBufType” on page 78.
- level* Maximum traversal depth. When the level is 1, an object report is written to the traversal buffer for each element in theOops. When level is 2, an object report is also obtained for the instance variables of each level-1 object. When level is 0, the number of levels in the traversal is not restricted.

### Return Value

Returns FALSE if the traversal is not yet completed. Returns TRUE if there are no more objects to be returned by subsequent calls to **GciMoreTraversal**.

### Description

This function allows you to reduce the number of GemBuilder calls that are required for your application program to obtain information about complex objects in the database.

There are no built-in limits on how much information can be obtained in the traversal. You can use the *level* argument to restrict the size of the traversal.

**GciTraverseObjs** provides automatic byte swizzling, unless **GciSetTraversalBufSwizzling** is used to disable swizzling. For more about byte swizzling, see “Byte-Swizzling of Binary Floating-Point Values” on page 26.

### Organization of the Traversal Buffer

The first element placed in a traversal buffer is an integer that indicates how many bytes were actually stored in the buffer by this function. The remainder of the traversal buffer consists of a series of object reports, each of which is of type **GciObjRepSType**, as described under “Use of Object Reports” on page 388.

To create a traversal buffer, use **GciAllocTravBuf**. This function takes an argument of the size of traversal buffer to allocate. Multiple the number of object *m* by the object size to determine the size

buffer you require. If the traversal buffer is not large enough, you will need to perform **GciMoreTraversal**.

## The Value Buffer

The object report's *value buffer* begins at the first byte following the object report header. For byte objects, the value buffer *rpt->valueBufferBytes()* is an array of type **ByteType**; for pointer objects and NSCs, the buffer *rpt->valueBufferOops()* is an array of type **OopType**. The size of the report's value buffer (*rpt->hdr.valueBuffSize*) is the number of bytes of the object's value returned by this traversal. That number is no greater than the size of the object.

## How This Function Works

This section explains how **GciTraverseObjs** stores object reports in the traversal buffer and values in the value buffer.

1. First, **GciTraverseObjs** verifies that the traversal buffer is large enough to accommodate at least one object report header (**GciObjRepHdrSType**). If the buffer is too small, GemBuilder returns an error.
2. For each object in the traversal, **GciTraverseObjs** discovers if there is enough space left in the traversal buffer to store both the object report header and the object's values. If there isn't enough space remaining, the function returns FALSE, and your program can call **GciMoreTraversal** to continue the traversal. Otherwise (if there is enough space), the object's values are stored in the traversal buffer.
3. When there are no more objects left to traverse, **GciTraverseObjs** returns TRUE to indicate that the traversal is complete.

## Special Objects

For each occurrence of an object with a special implementation (that is, an instance of SmallInteger, Character, Boolean, or UndefinedObject) contained in *theOops*, this function will return an accurate object report. For any special object encountered at some deeper point in the traversal, no object report will be generated.

## Authorization Violations

If the user is not authorized to read some object encountered during the traversal, the traversal will continue. No value will be placed in the object report's value buffer, but the report for the forbidden object will contain the following values:

|                                   |                   |
|-----------------------------------|-------------------|
| <i>hdr.valueBuffSize</i>          | 0                 |
| <i>hdr.namedSize</i>              | 0                 |
| <i>hdr.idxSize</i>                | 0                 |
| <i>hdr.firstOffset</i>            | 1                 |
| <i>hdr.objId</i>                  | theOop            |
| <i>hdr.oclass</i>                 | OOP_NIL           |
| <i>hdr.objectSecurityPolicyId</i> | 0                 |
| <i>hdr.objImpl</i>                | GC_FORMAT_SPECIAL |
| <i>hdr.isInvariant</i>            | 0                 |



## Incomplete Object Reports

It is possible for an object report to not contain all the instance variables of an object, due to traversal specifications or buffer size limitations. The value buffer is incomplete when *hdr.isPartial()* returns non-zero.

## Continuing the Traversal

When the amount of information obtained in a traversal exceeds the amount of available memory, your application can break the traversal into manageable amounts of information by issuing repeated calls to **GciMoreTraversal**. Generally speaking, an application can continue to call **GciMoreTraversal** until it has obtained all requested information.

During the entire sequence of **GciTraverseObjs** and **GciMoreTraversal** calls that constitute a traversal, any single object report will be returned exactly once. Regardless of the connectivity of objects in the GemStone database, only one report will be generated for any non-special object.

## When Traversal Can't Be Continued

Naturally, GemStone will not continue an incomplete traversal if there is any chance that changes to the database in the intervening period might have invalidated the previous report or changed the connectivity of the objects in the path of the traversal. Specifically, GemStone will refuse to continue a traversal if, in the interval before attempting to continue, you:

- Modify the objects in the database directly, by calling any of the **GciStore...** or **GciAdd...** functions;
- Call one of the Smalltalk message-sending functions **GciPerform**, **GciContinue**, or any of the **GciExecute...** functions;
- Abort your transaction, thus invalidating any subsequent information from that traversal.

Any attempt to call **GciMoreTraversal** after one of these actions will generate an error.

Note that this holds true across multiple GemBuilder applications sharing the same GemStone session. Suppose, for example, that you were holding on to an incomplete traversal buffer and the user moved from the current application to another, did some work that required executing Smalltalk code, and then returned to the original application. You would be unable to continue the interrupted traversal.

## Example

For an example of how **GciTraverseObjs** is used, see **GciMoreTraversal** on page 238.

## See Also

**GciFindObjRep** on page 203  
**GciMoreTraversal** on page 238  
**GciNbTraverseObjs** on page 268  
**GciNewOopUsingObjRep** on page 277  
**GciObjRepSize\_** on page 286  
**GciStoreTrav** on page 387

## GciUncompress

Uncompress the supplied data, assumed to have been compressed with **GciCompress**.

### Syntax

```
int GciUncompress(  
    char *                dest,  
    uint *                destLen,  
    const char *          source,  
    uint                  sourceLen );
```

### Arguments

- dest* Pointer to the buffer to hold the resulting uncompressed data.
- destLen* Length, in bytes, of the buffer intended to hold the uncompressed data.
- source* Pointer to the source data to uncompress.
- sourceLen* Length, in bytes, of the source data.

### Return Value

**GciUncompress** returns `Z_OK` (equal to 0) if the decompression succeeded, or various error values if it failed; see the documentation for the `uncompress` function in the GNU `zlib` library at <http://www.gzip.org>.

### Description

**GciUncompress** passes the supplied inputs unchanged to the `uncompress` function in the GNU `zlib` library Version, and returns the result exactly as the GNU `uncompress` function returns it.

### See Also

**GciCompress** on page 120

# GciUserActionInit

Declare user actions for GemStone.

## Syntax

```
void GciUserActionInit()
```

## Description

**GciUserActionInit** is implemented by the application developer, but it is called by **GciInit**. It enables Smalltalk to find the entry points for the application's user actions, so that they can be executed from the database.

## See Also

Chapter 4, "Writing User Actions", starting on page 45

**GciDeclareAction** on page 135

**GciInstallUserAction** on page 221

**GciInUserAction** on page 224

**GciUserActionShutdown** on page 412

# GciUserActionShutdown

Enable user-defined clean-up for user actions.

## Syntax

```
void GciUserActionShutdown()
```

## Description

**GciUserActionShutdown** is implemented by the application developer, and is called when a session user action library is unloaded. It enables user-defined clean-up for the application's user actions.

## See Also

Chapter 4, "Writing User Actions", starting on page 45

**GciDeclareAction** on page 135

**GciInstallUserAction** on page 221

**GciInUserAction** on page 224

**GciUserActionInit** on page 411

## GciUtf8To8Bit

Convert UTF-8 input to 8 bit data.

### Syntax

```
BoolType GciUtf8To8bit(  
int GciUncompress(  
    const char *      src,  
    char *            dest,  
    ssize_t *         destSize );
```

### Description

**GciUtf8To8bit** converts Utf8 input in *\*src* to 8 bit data in *\*dest*. If all code points in *\*src* are in the range 0..255, and the result fits in *destSize*-1, returns TRUE and *\*dest* is null terminated, otherwise returns FALSE.

## GciVersion

Return a string that describes the GemBuilder version.

### Syntax

```
const char* GciVersion()
```

### Return Value

A null-terminated string, containing period-separated fields that describe the specific release of GemBuilder.

### Description

**GciVersion** gets version information from the shared libraries. The string returned describes the GCI version (that is, the version of the shared libraries, not the version of a GemStone repository).

The version number is provided as a series of period-delimited fields within the string, with the first field being the major version number, the second field the minor version number, and so on. There may be any number of additional fields for a particular version of the GCI. Following this is the build information.

More detailed version information, including Stone version information, can be retrieved using System class methods such as `System class >> stoneVersionReport` and `System class >> gemVersionReport`.

### Example

```
BoolType version_example(void)
{
    const char* buf;
    buf = GciVersion();
    printf("Version is %s\n", buf);
    return ( buf[0] == '3' );
}
```

An example of the string that is returned is:

```
Version is 3.4.0 build 64bit-42647
```

### See Also

**GciProduct** on page 322

## GciX509Login

Start an X.509-authenticated user session.

### Syntax

```
BoolType GciX509Login(  
    GciX509LoginArg      loginParameters);
```

### Arguments

*loginParameters* Instance of the C++ class GciX509LoginArg. This is defined as:

```
class CLS_EXPORT GciX509LoginArg  
public:  
    const char *netldiHostOrIp;  
    const char *netldiNameOrPort;  
    const char *privateKey;  
    const char *cert;  
    const char *caCert;  
    const char *extraGemArgs;  
    const char *dirArg;  
    const char *logArg;  
    unsigned int loginFlags;  
    BoolType argsArePemStrings;  
    BoolType executedSessionInit; // output
```

If *argsArePemStrings* is true, the *privateKey*, *cert*, and *caCert* are strings in PEM format. If false, these are strings containing the name of a file that is in PEM format.

### Return Value

Returns true if login succeeded, false otherwise

### Description

This function creates a user session and its corresponding transaction workspace, using authentication using X.509 certificates. This login requires that the NetLDIs be setup to use X509 authentication, as described in the GemStone/S 64 Bit X509-Secured GemStone Administration Guide. Specifically, note that the Stone name and User name and password are not included; these are obtained from the certificates.

### See Also

[GciEncrypt](#) on page 150

[GciLogin](#) on page 232

[GciSetNet](#) (page 355)

[GciSetNetEx](#) (page 357)





# GemStone C Statistics Interface

This chapter describes the GemStone C Statistics Interface (GCSI), a library of functions that allow your C application to collect GemStone statistics directly from the shared page cache without starting a database session.

## 8.1 Developing a GCSI Application

The command lines in this chapter assume that you have set the `$GEMSTONE` environment variable to your GemStone installation directory.

### Required Header Files

Your GCSI program must include the following header files:

- ▶ `$GEMSTONE/include/shrpcstats.ht` – Defines all cache statistics. (For a list of cache statistics, refer to the “Monitoring GemStone” chapter of the *System Administration Guide for GemStone/S 64 Bit*.)
- ▶ `$GEMSTONE/include/gcsi.hf` – Prototypes for all GCSI functions.
- ▶ `$GEMSTONE/include/gcsierr.ht` – GCSI error numbers.

Your program must define a `main()` function somewhere.

### The GCSI Shared Library

GemStone provides a shared library, `$GEMSTONE/lib/libgcsi-3.6.0-64.so`, that your program will load at runtime.

- ▶ Make sure that `$GEMSTONE/lib` is included in your `LD_LIBRARY_PATH` environment variable, so that the runtime loader can find the GCSI library. For example:

```
export LD_LIBRARY_PATH=$GEMSTONE/lib:$LD_LIBRARY_PATH
```

- ▶ `$GEMSTONE/lib/libgcsi-3.6.0-64.so` is a multi-threaded library, so your program must also be compiled and linked as a multi-threaded program.

## Compiling and Linking

The `$GEMSTONE/examples` directory includes the sample GCSI program `gsstat.cc`, along with a set of sample makefiles that show how to compile the sample GCSI program, using the compilers that are used to build the GemStone product.

### NOTE

*It may still be possible to build your program with another compiler, as long as you specify the appropriate flags to enable multi-threading.*

Whenever you upgrade to a new GemStone version, you must re-compile and re-link all your GCSI programs. This is because the internal structure of the shared cache may change from version to version. Assuming you've created a makefile, all you should need to do is change `$GEMSTONE` and rebuild.

## Connecting to the Shared Page Cache

The GCSI library allows your program to connect to a single GemStone shared page cache. Once the connection is made, a thread is started to monitor the cache and disconnect from it if the cache monitor process dies. This thread is needed to prevent your program from "holding on" to the shared cache after all other processes have detached from it. In this way, your program can safely sleep for a long time without preventing the operating system from freeing and recycling shared memory should the Stone be unexpectedly shut down.

## The Sample Program

The sample program `gsstat.cc` (in `$GEMSTONE/examples`) monitors a running GemStone repository by printing out a set of statistics at a regular interval that you specify. The program prints the following statistics:

- ▶ `Sess` – `TotalSessionsCount`; the total number of sessions currently logged in to the system.
- ▶ `CR` – `CommitRecordCount`; the number of outstanding commit records that are currently being maintained by the system.
- ▶ `PNR` – `PagesNeedReclaimSize`; the amount of reclamation work that is pending, that is, the backlog waiting for the `GcGem` reclaim task.
- ▶ `PD` – `PossibleDeadSize`; the number of objects previously marked as dereferenced in the repository, but for which sessions currently in a transaction might have created a reference in their object space.
- ▶ `DNR` – `DeadNotReclaimedSize`; the number of objects that have been determined to be dead (current sessions have indicated they do not have a reference to these objects) but have not yet been reclaimed.
- ▶ `FP` – The number of free pages in the Stone.
- ▶ `OCS` – `OldestCrSession`; the session ID of the session referencing the oldest commit record. Prints 0 if the oldest commit record is not referenced by any session, or if there is only one commit record.
- ▶ `FF` – `FreeFrameCount`; the number of unused page frames in the shared page cache.

To invoke `gsstat`, supply the name of a running Stone (or shared page cache, if running on a Gem server) and a time interval in seconds. For example:

```
% gsstat myStone 2
```

To stop the `gsstat` program and detach from the cache, issue a CTRL-C.

## 8.2 GCSI Data Types

The following C types are used by GCSI functions. The file `shrpcstats.ht` defines each of the GCSI types (shown in capital letters below). That file is in the `$GEMSTONE/include` directory.

|                             |                                                                                                            |
|-----------------------------|------------------------------------------------------------------------------------------------------------|
| <b>ShrPcMonStatSType</b>    | Shared page cache monitor statistics.                                                                      |
| <b>ShrPcStnStatSType</b>    | Stone statistics.                                                                                          |
| <b>ShrPcPgsvrStatSType</b>  | Page server statistics.                                                                                    |
| <b>ShrPcGemStatSType</b>    | Gem session statistics.                                                                                    |
| <b>ShrPcStatUnion</b>       | The union of all four statistics structured types: shared page cache monitor, page server, Stone, and Gem. |
| <b>ShrPcCommonStatSType</b> | Common statistics collected for all processes attached to the shared cache.                                |

### The Structure for Representing the GCSI Function Result

The structured type `GcsiResultSType` provides a C representation of the result of executing a GCSI function. This structure contains the following fields:

```
typedef struct {
    signed int processId;
    signed int sessionId;
    ShrPcCommonStatSType cmn;
    union ShrPcStatUnion u;
} ShrPcStatsSType;

class GcsiResultSType {
public:
    char vsdName[SHRPC_PROC_NAME_SIZE + 1];
    unsigned int statType;
    ShrPcStatsSType stats;
};
```

In addition, a set of C mnemonics support representation of the count of each process-specific structured type:

```
#define COMMON_STAT_COUNT
    (sizeof(ShrPcCommonStatSType)/sizeof(int))

#define SHRPC_STAT_COUNT
    (sizeof(ShrPcMonStatSType)/sizeof(int) + COMMON_STAT_COUNT)

#define GEM_STAT_COUNT
    (sizeof(ShrPcGemStatSType)/sizeof(int) + COMMON_STAT_COUNT)

#define PGSVR_STAT_COUNT
    (sizeof(ShrPcPgsvrStatSType)/sizeof(int) + COMMON_STAT_COUNT)

#define STN_STAT_COUNT
    (sizeof(ShrPcStnStatSType)/sizeof(int) + COMMON_STAT_COUNT)
```

# GcsiAllStatsForMask

Get all cache statistics for a specified set of processes.

## Syntax

```
int GcsiAllStatsForMask(  
    unsigned int          mask;  
    GcsiResultSType *    result;  
    int *                 resultSize);
```

## Arguments

- mask* Indicates what types of processes to collect statistics for.
- result* Address of an array of kind GcsiResultSType where statistics will be stored.
- resultSize* Pointer to an integer that indicates the size of the result in elements (not bytes). On return, indicates the number of that were stored into *result*. Indicates the maximum number of processes for which statistics can be returned.

## Return Value

Returns 0 if successful; otherwise returns an error code, as defined in `gcsierr.ht`; see “GCSI Errors” on page 433.

## Example

Mask bits should be set by a bitwise OR of the desired process types. For example, to get statistics for the stone and Shared Page Cache Monitor:

```
unsigned int mask = SHRPC_MONITOR | SHRPC_STONE;
```

# GcsiAttachSharedCache

Attach to the specified shared page cache.

## Syntax

```
int GcsiAttachSharedCache(  
    const char *      fullCacheName;  
    char *           errBuf;  
    size_t           errBufSize);
```

## Arguments

*fullCacheName* Full name of the shared page cache, in the format *stoneName@stoneHostIpAddress*. To determine the full name of the shared cache, use the `gslis -x` utility.

*errBuf* A buffer that will contain a string describing an error.

*errBufSize* Size (in bytes) of *errBuf*.

## Return Value

Returns 0 if successful; otherwise returns an error code, as defined in `gcsierr.ht`; see “GCSI Errors” on page 433.

## See Also

**GcsiAttachSharedCacheForStone** on page 423

**GcsiDetachSharedCache** on page 424

# GcsiAttachSharedCacheForStone

Attaches this process to the specified shared page cache.

## Syntax

```
int GcsiAttachSharedCacheForStone(  
    const char *      stoneName,  
    char *            errBuf,  
    size_t            errBufSize);
```

## Arguments

*stoneName* Name of the Stone process.

*errBuf* A buffer that will contain a string describing an error.

*errBufSize* Size (in bytes) of *errBuf*.

## Return Value

Returns 0 if successful; otherwise returns an error code, as defined in `gcsierr.ht`; see “GCSI Errors” on page 433.

## Description

This function assumes that the cache name is `<stoneName>@<thisIpAddress>` where `thisIpAddress` is the IP address of the local machine. This function may fail if the host is multi-homed (has more than one network interface). In that case, use **GcsiAttachSharedCache** (page 422) to specify the full name of the shared cache.

## See Also

**GcsiAttachSharedCache** on page 422

**GcsiDetachSharedCache** on page 424

## GcsiDetachSharedCache

Detach from the shared page cache.

### Syntax

```
int GcsiDetachSharedCache (void);
```

### Return Value

Returns 0 if successful; otherwise returns an error code, as defined in `gcsierr.ht`; see “GCSI Errors” on page 433.

### See Also

[GcsiAttachSharedCache](#) on page 422

[GcsiAttachSharedCacheForStone](#) on page 423



## GcsiFetchMaxProcessesInCache

Return the maximum number of processes that can be attached to this shared cache at any instant. The result may be used to allocate memory for a calls to the **GcsiFetchStatsForAll\*** family of functions.

### Syntax

```
int GcsiFetchMaxProcessesInCache(  
    int *                               maxProcesses);
```

### Arguments

*maxProcesses* The maximum number of processes that can be attached to this shared cache at any instant.

### Return Value

Returns 0 if successful; otherwise returns an error code, as defined in `gcsierr.ht`; see "GCSI Errors" on page 433.

## Gcsilnit

Initialize the library. This function must be called before all other GCSI functions.

### Syntax

```
void GcsiInit(void);
```

## GcsiStatsForGemSessionId

Get the cache statistics for the given Gem session id.

### Syntax

```
int GcsiStatsForGemSessionId(  
    int          sessionId;  
    GcsiResultSType * result);
```

### Arguments

*sessionId* Session ID of the Gem for which statistics are requested.

*result* Pointer to a GcsiResultSType structure.

### Return Value

Returns 0 if successful; otherwise returns an error code, as defined in `gcsierr.ht`; see “GCSI Errors” on page 433.

### See Also

[GcsiStatsForGemSessionWithName](#) on page 428

[GcsiStatsForPgsvrSessionId](#) on page 429

[GcsiStatsForProcessId](#) on page 430

[GcsiStatsForShrPcMon](#) on page 431

[GcsiStatsForStone](#) on page 432

## GcsiStatsForGemSessionWithName

Get the cache statistics for the first Gem in the cache with the given cache name.

### Syntax

```
int GcsiStatsForGemSessionWithName(  
    char *                gemName;  
    GcsiResultSType *    result);
```

### Arguments

*gemName* The case-sensitive name of the Gem for which statistics are requested.

*result* Pointer to a GcsiResultSType structure.

### Return Value

Returns 0 if successful; otherwise returns an error code, as defined in `gcsierr.ht`; see “GCSI Errors” on page 433.

### See Also

[GcsiStatsForGemSessionId](#) on page 427

[GcsiStatsForPgsvrSessionId](#) on page 429

[GcsiStatsForProcessId](#) on page 430

[GcsiStatsForShrPcMon](#) on page 431

[GcsiStatsForStone](#) on page 432

## GcsiStatsForPgsvrSessionId

Get the cache statistics for the given page server with the given session id. Remote Gems have page servers on the Stone's cache that assume the same session ID as the remote Gem.

### Syntax

```
int GcsiStatsForPgsvrSessionId(  
    int          sessionId;  
    GcsiResultSType * result);
```

### Arguments

*sessionId* Session ID of the page server for which statistics are requested.

*result* Pointer to a GcsiResultSType structure.

### Return Value

Returns 0 if successful; otherwise returns an error code, as defined in `gcsierr.ht`; see "GCSI Errors" on page 433.

### See Also

[GcsiStatsForGemSessionId](#) on page 427

[GcsiStatsForGemSessionWithName](#) on page 428

[GcsiStatsForProcessId](#) on page 430

[GcsiStatsForShrPcMon](#) on page 431

[GcsiStatsForStone](#) on page 432

## GcsiStatsForProcessId

Get the cache statistics for the given process ID.

### Syntax

```
int GcsiStatsForProcessId(  
    int pid;  
    GcsiResultSType * result;
```

### Arguments

*pid* Process ID for which statistics are requested.  
*result* Pointer to a GcsiResultSType structure.

### Return Value

Returns 0 if successful; otherwise returns an error code, as defined in `gcsierr.ht`; see “GCSI Errors” on page 433.

### See Also

[GcsiStatsForGemSessionId](#) on page 427  
[GcsiStatsForGemSessionWithName](#) on page 428  
[GcsiStatsForPgsvrSessionId](#) on page 429  
[GcsiStatsForShrPcMon](#) on page 431  
[GcsiStatsForStone](#) on page 432

## GcsiStatsForShrPcMon

Get the cache statistics for the shared page cache monitor process for this shared page cache.

### Syntax

```
int GcsiStatsForShrPcMon(  
    GcsiResultSType *    result);
```

### Arguments

*result* Pointer to a GcsiResultSType structure.

### Return Value

Returns 0 if successful; otherwise returns an error code, as defined in `gcsierr.ht`; see “GCSI Errors” on page 433.

### See Also

**GcsiStatsForGemSessionId** on page 427  
**GcsiStatsForGemSessionWithName** on page 428  
**GcsiStatsForPgsvrSessionId** on page 429  
**GcsiStatsForProcessId** on page 430  
**GcsiStatsForStone** on page 432

## GcsiStatsForStone

Get the cache statistics for the Stone if there is a Stone attached to this shared page cache.

### Syntax

```
int GcsiStatsForStone(  
    GcsiResultSType *    result);
```

### Arguments

*result* Pointer to a GcsiResultSType structure.

### Return Value

Returns 0 if successful; otherwise returns an error code, as defined in `gcsierr.ht`; see “GCSI Errors” on page 433.

### See Also

[GcsiStatsForGemSessionId](#) on page 427  
[GcsiStatsForGemSessionWithName](#) on page 428  
[GcsiStatsForPgsvrSessionId](#) on page 429  
[GcsiStatsForProcessId](#) on page 430  
[GcsiStatsForShrPcMon](#) on page 431



## GCSI Errors

The following errors are defined for the GemStone C Statistics Interface.

**Table 1** GCSI Errors

| Error Name                        | Definition                                                                |
|-----------------------------------|---------------------------------------------------------------------------|
| GCSI_SUCCESS                      | The requested operation was successful.                                   |
| GCSI_ERR_NO_INIT                  | GcsiInit() must be called before any other Gcsi functions.                |
| GCSI_ERR_CACHE_ALREADY_ATTACHED   | The requested shared cache is already attached.                           |
| GCSI_ERR_NOT_FOUND                | The requested session or process was not found.                           |
| GCSI_ERR_BAD_ARG                  | An invalid argument was passed to a Gcsi function.                        |
| GCSI_ERR_CACHE_CONNECTION_SEVERED | The connection to the shared cache was lost.                              |
| GCSI_ERR_NO_STONE                 | Stone statistics were requested on a cache with no stone process.         |
| GCSI_ERR_CACHE_NOT_ATTACHED       | No shared page cache is currently attached.                               |
| GCSI_ERR_NO_MORE_HANDLES          | The maximum number of shared caches are attached.                         |
| GCSI_ERR_CACHE_ATTACH_FAILED      | The attempt to attach the shared cache has failed.                        |
| GCSI_ERR_WATCHER_THREAD_FAILED    | The cache watcher thread could not be started.                            |
| GCSI_ERR_CACHE_WRONG_VERSION      | The shared cache version does not match that of the libgcsixx.so library. |

