GemStone®

GemBuilder for C

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GemStone/S 64™

GemStone Systems, Inc.
1260 NW Waterhouse Avenue, Suite 200
Beaverton, OR 97006

Preface

About This Manual

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

Assumptions

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 programming language, as described in Kernighan and Ritchie's *The C Programming Language* (Prentice Hall, 1978). Finally, you should be familiar with your C compiler, as described in its user documentation.

This manual assumes that the GemStone / S 64 Bit system has been correctly installed on your host computer as described in the *System Administration Guide for GemStone/S 64 Bit*, and that your system meets the requirements listed in the *GemStone/S 64 Bit Installation Guide*.

How This Manual Is Organized

Chapter 1, “Introduction,” describes the GemBuilder functions in general, and how they are used in application development with GemStone.

Chapter 2, “Building Applications with GemBuilder for C,” introduces the two versions of GemBuilder and explains how to build applications that bind to GemBuilder at run time.

Chapter 3, “Writing C Functions To Be Called from GemStone,” describes how to implement “user action” routines that can be called from GemStone Smalltalk methods.

Chapter 4, “Compiling and Linking,” describes how to compile and link your C applications and user actions, and how to install them in a GemStone environment prior to execution.

Chapter 5, “GemBuilder C Functions — A Reference Guide,” provides a detailed description of each GemBuilder function, including: synopsis (syntax), parameters, return value, a general description of what the function does, one or more examples of its use, and a list of related GemBuilder functions.

Terminology Conventions

This document uses the following terminology:

- The term “GemStone” is used to refer both to the product, GemStone / S 64 Bit, or previous GemStone / S server products; and to the company, GemStone Systems, Inc.

Typographical Conventions

In examples, system output is shown in `monospace` typeface, while commands you type are shown in **bold** typeface. Place holders that are meant to be replaced with real values are shown in *italic* typeface. For example:

```
% startstone myStone
startstone[Info]:
  GEMSTONE_SYS_CONF=/user1/gemstone/data/system.conf
  GEMSTONE_EXE_CONF=/user1/gemstone/data/system.conf
...
```

Other Useful Documents

For more information about the GemStone data management system and its development tools, see the *Programming Guide for GemStone/S 64 Bit*. The *Programming Guide for GemStone/S 64 Bit* offers a tutorial approach to GemStone Smalltalk, GemStone's object-oriented language.

Technical Support

GemStone provides several sources for product information and support. The product-specific manuals and online help provide extensive documentation, and should always be your first source of information. GemStone Technical Support engineers will refer you to these documents when applicable.

GemStone Web Site: http://support.gemstone.com

GemStone's Technical Support website provides a variety of resources to help you use GemStone products. Use of this site requires an account, but registration is free of charge. To get an account, just complete the Registration Form, found in the same location. You'll be able to access the site as soon as you submit the web form.

The following types of information are provided at this web site:

Help Request allows designated support contacts to submit new requests for technical assistance and to review or update previous requests.

Documentation for GemStone / S 64 Bit is provided in PDF format. This is the same documentation that is included with your GemStone / S 64 Bit product.

Release Notes and **Install Guides** for your product software are provided in PDF format in the Documentation section.

Downloads and **Patches** provide code fixes and enhancements that have been developed after product release. Most code fixes and enhancements listed on the GemStone Web site are available for direct downloading.

Bugnotes, in the Learning Center section, identify performance issues or error conditions that you may encounter when using a GemStone product. A bugnote describes the cause of the condition, and, when possible, provides an alternative means of accomplishing the task. In addition, bugnotes identify whether or not a fix is available, either by upgrading to another version of the product, or by applying a patch. Bugnotes are updated regularly.

TechTips, also in the Learning Center section, provide information and instructions for topics that usually relate to more effective or efficient use of

GemStone products. Some Tips may contain code that can be downloaded for use at your site.

Community Links provide customer forums for discussion of GemStone product issues.

Technical information on the GemStone Web site is reviewed and updated regularly. We recommend that you check this site on a regular basis to obtain the latest technical information for GemStone products. We also welcome suggestions and ideas for improving and expanding our site to better serve you.

You may need to contact Technical Support directly for the following reasons:

- Your technical question is not answered in the documentation.
- You receive an error message that directs you to contact GemStone Technical Support.
- You want to report a bug.
- You want to submit a feature request.

Questions concerning product availability, pricing, keyfiles, or future features should be directed to your GemStone account manager.

When contacting GemStone Technical Support, please be prepared to provide the following information:

- Your name, company name, and GemStone license number
- The GemStone product and version you are using
- The hardware platform and operating system you are using
- A description of the problem or request
- Exact error message(s) received, if any

Your GemStone support agreement may identify specific individuals who are responsible for submitting all support requests to GemStone. If so, please submit your information through those individuals. All responses will be sent to authorized contacts only.

For non-emergency requests, the support website is the preferred way to contact Technical Support. Only designated support contacts may submit help requests via the support website. If you are a designated support contact for your company, or the designated contacts have changed, please contact us to update the appropriate user accounts.

Email: support@gemstone.com
Telephone: (800) 243-4772 or (503) 533-3503

Requests for technical assistance may also be submitted by email or by telephone. We recommend you use telephone contact only for more serious requests that require immediate evaluation, such as a production system that is non-operational. In these cases, please also submit your request via the web or email, including pertinent details such error messages and relevant log files.

If you are reporting an emergency by telephone, select the option to transfer your call to the technical support administrator, who will take down your customer information and immediately contact an engineer.

Non-emergency requests received by telephone will be placed in the normal support queue for evaluation and response.

24x7 Emergency Technical Support

GemStone offers, at an additional charge, 24x7 emergency technical support. This support entitles customers to contact us 24 hours a day, 7 days a week, 365 days a year, if they encounter problems that cause their production application to go down, or that have the potential to bring their production application down. For more details, contact your GemStone account manager.

Training and Consulting

Consulting and training for all GemStone products is available through GemStone's Professional Services organization.

- Customized consulting services can help you make the best use of GemStone products in your business environment.

Contact your GemStone account representative for more details or to obtain consulting services.

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Chapter 1 Introduction

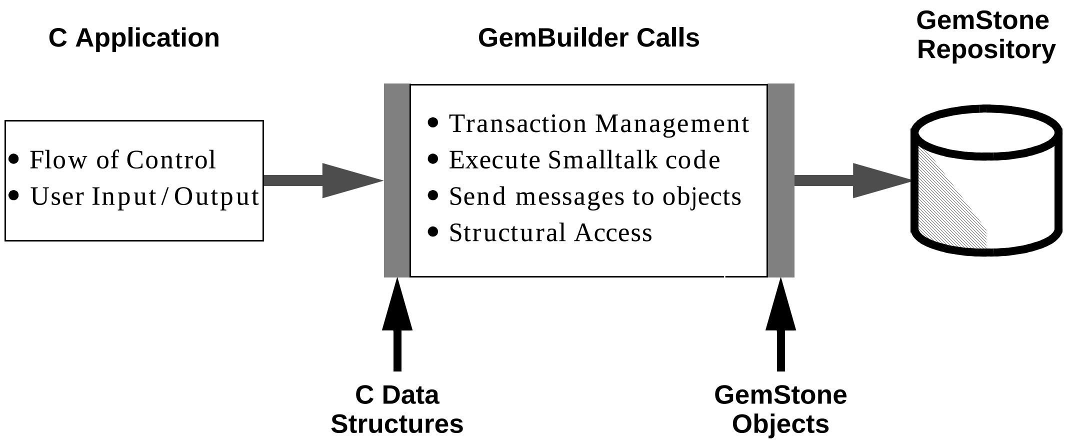
GemBuilder for C is a set of C functions that provide your C application with complete access to a GemStone repository and its programming language, Smalltalk[1]. The GemStone object server contains your schema (class definitions) and objects (instances of those classes), while your C program provides the user interface for your GemStone application. The GemBuilder functions allow your C program to access the GemStone repository either through structural access (the C model) or by sending messages (the Smalltalk model). Both of these approaches are discussed in detail later in this chapter.

1.1 GemBuilder Application Overview

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

1. GemStone embeds a variety of the Smalltalk language within the repository. It is separate from but similar to other varieties of Smalltalk that are sold commercially. Smalltalk serves as the data definition and data manipulation language for GemStone, and provides the repository with its ability to identify, access, and manipulate objects internally. When this manual mentions Smalltalk, it generally is referring to GemStone's internal language.

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.

Any GemBuilder application must manage its user interface through custom modules written in C.

Step 2. Decide where to perform the work.

Applications that are a hybrid of C functions and 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 your C program and perform the work there, or to send a message which invokes a Smalltalk method? In the next section, we'll examine this question in more detail.

Step 3. Implement and debug the application.

After you've developed a satisfactory design, you can implement and test the C-based functions using familiar techniques and tools (editor, C compiler, link editor, debugger). For information about implementing applications, see Chapter 2, "Building Applications with GemBuilder for C."

Step 4. Compile and link the application.

For instructions about compiling and linking your application, please see Chapter 4, "Compiling and Linking." For full details, see your C compiler user documentation.

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 and how much in Smalltalk methods. 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 “Manipulating Objects Through Structural Access” on page 1-17 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 “Manipulating Objects in GemStone” on page 1-13 defines the GemBuilder functions that allow C applications to send Smalltalk messages to objects and execute Smalltalk code.

Calling C Functions from Smalltalk Methods

Even though you may choose to perform your GemStone work in Smalltalk, you may find that you need to access some functions written in C. GemBuilder allows you to link your user-written C functions to a GemStone session process, and subsequently call those functions from Smalltalk. For example, operations that are computationally intensive or are external to GemStone can be written as C functions and called from within a Smalltalk method (whose high-level structure and control is written in Smalltalk). This is similar to the concept of “user-defined primitives” offered by other object-oriented systems. Here are some advantages of calling C functions from Smalltalk:

- For computationally intensive portions of a GemStone operation, C functions may execute faster than the same functions written in Smalltalk.
- Operating system services, or services of other software systems, can be accessed without the overhead of spawning a subprocess. In addition, using C functions to access such services provides greater flexibility for passing arguments and returning results.

Chapter 3, “Writing C Functions To Be Called from GemStone,” describes how to implement “user action” routines that can be called from Smalltalk methods, and how to link those routines into a GemBuilder application or a Gem (GemStone session) process.

The GemBuilder Functions

The remainder of this chapter introduces you to many of the GemBuilder C functions.

- First, we'll look at functions used in managing GemStone sessions: logging into (and out of) GemStone, switching between multiple sessions, and committing and aborting transactions.
- Next, we'll look at functions that allow your C program to manipulate objects by sending Smalltalk messages or executing Smalltalk code fragments.
- Finally, we'll examine those functions that perform "structural access" upon the representation of objects within your C program.

1.2 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.

Starting and Stopping GemBuilder

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 other GemBuilder functions until it calls **GciInit**.

The function **GciShutdown** logs out all sessions that are connected to the Gem and deactivates GemBuilder. Your C application should call **GciShutdown** before exiting, in order to guarantee that the process deallocates its resources.

Remote Login Setup

There are two ways to prepare for remote login to a GemStone repository:

1. First, you use a netldi that is running in guest mode, attached to the Stone process. Guest mode provides easy access in situations where it is not

considered necessary to authenticate users in the network environment before permitting them to log in.

2. Otherwise, you need to have a `.netrc` file in your `$HOME` directory. This file contains remote login data: the name of your host machine, your login name, and your host machine password, in the following format:

   `machine` *host_machine_name* `username` *name* `password` *passwd*

   If you will be using more than one host machine, you will need a separate entry in this file for each machine, with each entry on its own line.

You may also wish to set the GEM_RPCGCI_TIMEOUT configuration parameter in the GemStone configuration file you use when starting a remote Gem. This parameter sets a timeout limit for the remote Gem; if the Gem remains inactive too long, GemStone logs out the session and terminates the Gem process. See the *System Administration Guide for GemStone/S 64 Bit* for more details.

Logging In and Out

Before your C application can perform any useful repository work, it must create a session with the GemStone system by calling **GciLogin**. That function uses the network parameters initialized by **GciSetNet**.

> **GciInit** *must be called before the first* **GciLogin** *in the lifetime of a process.*

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, 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. 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 continuously committing 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. Your application can call **GciAlteredObjs** to determine which objects must be reread from the repository in order to make its view current. Then, to reread those objects, use whatever kind of GemBuilder fetch or traversal functions best suits your needs.

If an attempt to commit fails, your application must call **GciAbort** to discard the transaction. If it does not do so, subsequent calls to **GciCommit** will not succeed.

As mentioned earlier, if your C 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, 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 manual:

```
GciExecuteStr(
   "System transactionMode: #manualBegin", OOP_NIL);
```

The transaction mode can also be returned to the automatic default:

```
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 first set the mode to manual, and then either abort or commit the transaction.

1.3 Representing Objects in C

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 32-bit object-oriented pointer, or OOP. Whenever your C program 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 an application's C address space.

Within your C program, object identity is represented in variables of type **OopType** (object-oriented pointer). The GemBuilder include file `gci.ht` defines type **OopType**, along with other types used by GemBuilder functions. For more information, see "GemBuilder Include Files" on page 5-12.

GemStone-Defined Object Mnemonics

The GemBuilder include file `gcioop.ht` defines C mnemonics for all of the kernel classes in the GemStone repository, as well as the GemStone objects *nil*, *true*, and *false*, and the GemStone error dictionary.

In addition to the predefined objects mentioned above, the GemBuilder include file `gcioop.ht` also defines the C mnemonic *OOP_ILLEGAL*. That mnemonic 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.

NOTE
Bear in mind that 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.

Converting Between Special Objects and C Values

Some Smalltalk classes encode their objects' states directly in their OOPs:

- SmallInteger objects (for example, the number 5)
- AbstractCharacter and its subclasses, JISCharacter and Character (for example, the letter 'b')
- Boolean values (true and false)
- Instances of class UndefinedObject (such as *nil*)

The following GemBuilder functions and macros allow conversion between Character, Integer, or Boolean objects and the equivalent C values:

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

GciByteArrayToPointer — Given a result from GciPointerToByteArray, return a C pointer.

GCI_CHR_TO_OOP — (MACRO) Convert a C character value to a GemStone Character object.

GciI64ToOop — Convert a C 64-bit integer value to a GemStone object.

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.

GciOopToChr — Convert a Character object to a C character value.

GCI_OOP_TO_CHR — (MACRO) Convert a Character object to a C character value.

GciOopToI32, GciOopToI32_ — Convert a GemStone object to a C 32-bit integer value.

GciOopToI64, 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.

GciStringToInteger — Convert a C string to a GemStone SmallInteger, LargePositiveInteger or LargeNegativeInteger object.

In addition, the following functions allow conversion between Float objects and their equivalent C values. Although a Float's OOP does not encode its state, these functions are listed here for your convenience.

GciFltToOop — Convert a C double value to a SmallDouble or Float object.

GciOopToFlt — Convert a SmallDouble, Float, or SmallFloat object to a C double.

The following macros are for testing OOPs:

GCI_OOP_IS_BOOL — (MACRO) Determine whether or not a GemStone object represents a Boolean value.

GCI_OOP_IS_SMALL_INT — (MACRO) Determine whether or not a GemStone object represents a SmallInteger.

GCI_OOP_IS_SPECIAL — (MACRO) Determine whether or not a GemStone object has a special representation.

The GemBuilder include file `gcioop.ht` uses the C mnemonics OOP_TRUE, OOP_FALSE, and OOP_NIL to represent the GemStone objects *true*, *false*, and *nil*, respectively.

In Example 1.1, 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*. Finally, 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 1.1 imports the value of the zip code object to the C variable *zip*.

This example assumes that you already have a valid session (obtained from the successful execution of **GciLogin***).*

Example 1.1

```
int64 example1_1(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;
}
```

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.

In GemStone, a binary float is an instance of class Float (eight bytes) or SmallFloat (four bytes), or an instance of SmallDouble (a special object identifier that has no body). Instances of Float and SmallFloat have byte-format bodies whose size is fixed by GemStone and cannot be changed. The programmer must supply all the bytes, or provide a C double, for a binary floating object when creating or storing it.

The following GemBuilder functions provide automatic byte swizzling for instances of Float and SmallFloat:

GciClampedTraverseObjs — Traverse an array of objects, subject to clamps.

GciCreateByteObj — Create a new byte-format object.

GciFetchObjInfo — Fetch information and values from an object.

GciMoreTraversal — Continue object traversal, reusing a given buffer.

GciNbClampedTraverseObjs — Traverse an array of objects, subject to clamps (nonblocking).

GciNbMoreTraversal — Continue object traversal, reusing a given buffer (nonblocking).

GciNbStoreTrav — Store multiple traversal buffer values in objects (nonblocking).

GciNbStoreTravDo — Store multiple traversal buffer values in objects, execute the specified code, and return the resulting object (non-blocking).

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).

GciNbStoreTravDoTravRefs — Combine in a single function modifications to session sets, calls to GciNbStoreTravDo and GciNbClampedTrav, to store multiple traversal buffer values in objects, execute the specified code, and traverse the result object (non blocking)

GciNbTraverseObjs — Traverse an array of GemStone objects (nonblocking).

GciNewOopUsingObjRep — Create a new GemStone object from an existing object report.

GciPerformTraverse — First send a message to a GemStone object, then traverse the result of the message.

GciStoreBytesInstanceOf — Store multiple bytes in a byte object.

GciStoreTrav — Store multiple traversal buffer values in objects.

GciStoreTravDo — Store multiple traversal buffer values in objects, execute the specified code, and return the resulting object.

GciStoreTravDoTrav — Combine in a single function the calls to GciStoreTravDo and GciClampedTrav, to store multiple traversal buffer values in objects, execute the specified code, and traverse the result object.

GciStoreTravDoTravRefs — Combine in a single function modifications to session sets, calls to GciStoreTravDo and GciClampedTrav, to store multiple traversal buffer values in objects, execute the specified code, and traverse the result object.

GciTraverseObjs — Traverse an array of GemStone objects.

The following GemBuilder functions raise an error if you pass a Float or SmallFloat object to them:

GciAppendBytes — Append bytes to a byte object.

GciStoreByte — Store one byte in a byte object.

GciStoreBytes — (MACRO) Store multiple bytes in a byte object.

GciStoreChars — Store multiple ASCII characters in a byte object.

The **GciFetchBytes_** function does not raise an error if you pass an instance of Float or SmallFloat to it, but it also does not provide automatic byte swizzling. It is intended primarily for use with other kinds of byte objects, such as strings. If you wish to use it with Floats or SmallFloats, you must perform your own byte swizzling as needed.

1.4 Manipulating Objects in GemStone

GemBuilder provides functions that allow C applications to execute Smalltalk code in the repository and to send messages directly to GemStone objects. This section describes these functions in more detail.

Sending Messages to GemStone Objects

GemBuilder provides the function **GciPerform**, which sends a message to a GemStone object. When GemStone receives a message, it invokes and executes the method associated with that message. Thus, the code execution occurs in the repository, not in the application. Example 1.2 illustrates this function.

This example assumes that you already have a valid session (obtained from the successful execution of **GciLogin***).*

Example 1.2

```
void example_1_2(void)
{
  OopType userGlobals = GciResolveSymbol("UserGlobals", OOP_NIL);
  OopType aKey = GciNewSymbol("myNumber");
  OopType aValue = GciI32ToOop(55);

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

  /* Two statements that have the same effect when executed */
  OopType result = GciSendMsg(userGlobals, 4, "at:", aKey, "put:",
aValue);

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

Executing Code in GemStone

Your C application can execute Smalltalk code by calling any of the following GemBuilder functions:

GciExecute — Execute a Smalltalk expression contained in a String object.

GciExecuteFromContext — Execute a Smalltalk expression contained in a String object as if it were a message sent to another object.

GciExecuteStr — Execute a Smalltalk expression contained in a C string.

GciExecuteStrFromContext — Execute a Smalltalk expression contained in a C string as if it were a message sent to an object.

The GemBuilder function **GciExecuteStr** allows your application to send a C string containing Smalltalk code to GemStone for compilation and execution. The Smalltalk code may be a message expression, a statement, or a series of statements; in sum, any self-contained unit of code that you could execute within a Topaz **PrintIt** command.

GemStone uses the specified symbol list argument 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 1.3 demonstrates the use of this GemBuilder function.

This example assumes that you already have a valid session (obtained from the successful execution of **GciLogin***).*

Example 1.3

```
OopType example_1_3(void)
{
  // Pass the String to GemStone for compilation and execution.
  // If it succeeds, return the result of the expression shown
  // otherwise OOP_NIL will be returned.

  OopType objSize = GciExecuteStr(" ^ myObject size ",
                    OOP_NIL/*use default symbolList*/ );
  return objSize;
}
```

Your Smalltalk code has the same format as a method, and may include temporaries. In addition, although the circumflex (^) character is used in the above example to return a value after GemStone has executed Smalltalk code (`myObject size`), the circumflex is not required. GemStone returns the result of the last Smalltalk statement executed.

The other functions work similarly, with variations. Before you call **GciExecute** or **GciExecuteFromContext**, you must create or modify a GemStone String object to contain the Smalltalk text to be executed. The **GciExecuteFromContext** and **GciExecuteStrFromContext** functions execute the Smalltalk code within the context (scope) of a specified GemStone object, which implies that the code can access the object's instance variables.

Interrupting GemStone Execution

GemBuilder provides two ways for your application to handle repository interrupts:

- A *soft break* interrupts the Smalltalk virtual machine only. The only GemBuilder functions that can recognize a soft break are **GciPerform**, **GciContinue**, **GciExecute**, **GciExecuteFromContext**, **GciExecuteStr**, and **GciExecuteStrFromContext**.
- A *hard break* interrupts the Gem process itself, and is not trappable through Smalltalk exceptions.

Issuing a soft break may be desirable if, for example, your application sends a message to an object (via **GciPerform**), and for some reason the invoked Smalltalk method 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.

Modification of Classes

Some class definitions are more flexible than others. With respect to modification, classes fall into three categories:

kernel classes — Predefined kernel classes cannot be modified. You can, however, create a subclass of a kernel class and redefine your subclass's behavior.

invariant classes — Once a class has been fully developed, it is normally invariant. Class invariance does not imply that it is impervious to all change. You can add or remove methods, method categories, class variables, or pool variables to any class except a predefined kernel class. You can also create instances of an invariant class.

modifiable classes — You can also create specially modifiable classes, a feature that can be useful (for example) while you are defining schema or implementing the classes. You can modify these classes in the same ways as invariant classes, but you can also add or remove named instance variables or change constraints on instance variables. However, you cannot create an instance of a modifiable class. To create an instance, you must first change the class to invariant.

The GemStone Behavior class provides several methods for changing the characteristics of modifiable classes. Use only these predefined methods — *do not use structural access to modify classes*.

1.5 Manipulating Objects Through Structural Access

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 the same reason, do not use structural access to change the characteristics of modifiable classes. Use **GciPerform** to invoke the Smalltalk methods defined under class Behavior for this specific purpose.

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-sequenceable collection), or special. (These implementations are described in greater detail in the following section.) 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 in an object. **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 (such as *nil*, or instances of SmallInteger, Character, and Boolean), 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 — Append bytes to a byte object.

GciAppendChars — Append a C string to a byte object.

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.

GciStoreByte — Store one byte in a byte object.

GciStoreBytes — (MACRO) Store multiple bytes in a byte object.

GciStoreChars — Store multiple ASCII characters in a byte object.

Although instances of Float are implemented within GemStone as byte objects, use the functions GciOopToFlt and GciFltToOop to convert between Float objects and their equivalent C values.

Assume that the C variable *suppId* contains an OOP representing an object of class String. Example 1.4 imports that String into the C variable *suppName*.

This example assumes that you already have a valid session (obtained from the successful execution of **GciLogin***).*

Example 1.4

```
void example_1_4(OopType suppId)
{
  char suppName[1025];
  int64 size = GciFetchBytes_(suppId, 1L, (ByteType*)suppName,
                         sizeof(suppName) - 1);
  suppName[size] = ’\0’;

  // suppName now contains the bytes of the GemStone object
referenced
  //  by suppId , or the first 1024 bytes whichever is less
}
```

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 determine the positional mapping of instance variables to indexes within the OOP array by calling the GemBuilder function **GciIvNameToIdx**. The following GemBuilder functions allow your C program to store into, or fetch from, GemStone pointer objects with named instance variables:

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.

GciStoreNamedOop — Store one OOP into an object's named instance variable.

GciStoreNamedOops — Store one or more OOPs into an object's named instance variables.

Indexable Objects

Any indexable object not implemented as a byte object is represented as an array of OOPs. The following GemBuilder functions allow your C program to store into, or fetch from, indexable pointer objects:

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.

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.

In each of the following functions, if the indexable object contains named instance variables, pointers to the named instance variables precede pointers to the indexable instance variables.

GciFetchOop — Fetch the OOP of one instance variable of an object.

GciFetchOops — Fetch the OOPs of one or more instance variables of an object.

GciStoreOop — Store one OOP into an object's instance variable.

GciStoreOops — Store one or more OOPs into an object's instance variables.

Assume that the C variable *currSup* contains an OOP representing an object of class Supplier (which defines seven named instance variables). Example 1.5 imports the state of the Supplier object (that is, the OOPs of its component instance variables) into the C variable *instVar*.

This example assumes that you already have a valid session (obtained from the successful execution of **GciLogin***).*

Example 1.5

```
void example_1_5(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)

In addition to byte objects and pointer objects, GemStone exports objects implemented as nonsequenceable collections (NSCs). 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.

The following GemBuilder functions allow your C program to store into, or fetch from, GemStone NSC objects:

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

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

GciFetchOop — Fetch the OOP of one instance variable of an object.

GciFetchOops — Fetch the OOPs of one or more instance variables of an object.

GciRemoveOopFromNsc — Remove an OOP from an NSC.

GciRemoveOopsFromNsc — Remove one or more OOPs from an NSC.

GciReplaceVaryingOops — Replace all unnamed instance variables in an NSC object.

Note that GemStone preserves the position of objects in an NSC only until the NSC is modified, or until the session is terminated (whichever comes first). Although you may use the functions **GciFetchOops** or **GciFetchOop** (defined for pointer objects) to retrieve the OOPs of an NSC's elements, you must use one of the **GciAddOopToNsc** functions to modify the unnamed instance variables of an NSC. (You can use the **GciStoreOop**, **GciStoreOops**, **GciStoreNamedOop**, and **GciStoreNamedOops** functions to modify user-defined named instance variables of an NSC. You cannot, however, use these functions to modify the named instance variables defined in class IdentityBag.)

Assume that the C variable *mySuppSet* contains an OOP representing an object of class SupplierSet (a large set of Supplier objects). Example 1.6 exports the contents of the C variable *newSupp* (a Supplier object) into that SupplierSet.

This example assumes that you already have a valid session (obtained from the successful execution of **GciLogin***).*

Example 1.6

```
void example_1_6(OopType mySuppSet, OopType newSupp)
{
  GciAddOopToNsc(mySuppSet, newSupp);

  GciErrSType errInfo;
  if (GciErr(&errInfo)) {
    // an error occurred
  } else {
    // The instance of SupplierSet referenced by mySuppSet now
contains
    //  the OOP of the object newSupp.
  }
}
```

1.6 Creating Objects

The following GemBuilder functions allow your C program to create instances of Smalltalk classes:

GciNewOop — Create a new GemStone object.

GciNewOops — Create multiple new GemStone objects.

GciNewOopUsingObjRep — Create a new GemStone object from an existing object report.

Your C application may also create a new object by executing some Smalltalk code that creates new objects as a side-effect.

Once your application has created a new object, it can export the object to the repository by performing the following steps:

Step 1. Modify a previously committed object in the repository so that it references the new object. This may be accomplished with a call to one of the **GciStore...** functions, or by sending a Smalltalk message with the new object as an argument, where the invoked method changes a committed object to reference the new object.

Step 2. Give the new object some meaningful state.

Step 3. Commit a transaction. (As mentioned earlier in this chapter, your C program must first export the object to the GemStone repository before attempting to commit the transaction.)

1.7 Fetching and Storing Objects

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.

NOTE:
If you are using GciLnk (the "linkable" GemBuilder*), object traversal will be of little benefit to you. For details, see "GciRpc and GciLnk" on page 2-1.*

Suppose, for example, that you had created a GemStone Employee class like the one in Example 1.7.

This example assumes that you already have a valid session (obtained from the successful execution of **GciLogin***).*

Example 1.7

```
Object subclass: ’Employee’
  instVarNames: #( ’name’ ’empNum’ ’jobTitle’
                   ’department’ ’address’ ’favoriteTune’)
  classVars: #()
  poolDictionaries: #()
  inDictionary: UserGlobals
  constraints: #[ ]
  isInvariant: false.
```

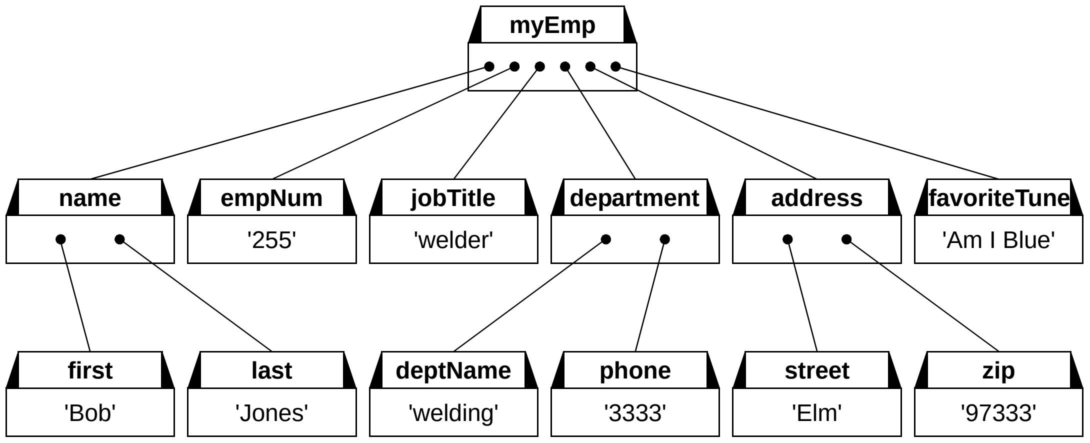
Imagine that you needed to write C code to make a two-column display of job titles and favorite tunes. By using GemBuilder's "object traversal" functions, you can minimize the number of network fetches and avoid running the Smalltalk virtual machine.

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

Figure 1.2 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 `$GEMSTONE/include/gcicmn.ht`. (For details about GciTravBufType, see page 5-25.)
- *Object reports* within the traversal buffer are described by the C++ classes GciObjRepSType and GciObjRepHdrSType, which are defined in `$GEMSTONE/include/gci.ht`. (For details about these classes, see page 5-19.)

Each object report provides information about an object's identity (its OOP), class, size (the number of instance variables, named plus unnamed), segment, 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.

The function **GciStoreTravDo** is 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. That function takes a structure as its 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 1.2. 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.

1.8 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.

1.9 Operating System Considerations

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.

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.

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 **GciPerform** or any of the **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 the version of GemBuilder that you are running. 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 for GemStone/S 64 Bit.*

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/gcicmn.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.

- 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.

1.10 Error Handling and Recovery

Your C program is responsible for processing any errors generated by GemBuilder function calls. GemStone errors and message creation information are handled by a GemStone language dictionary known as its *error category*. The OOP of this dictionary is available as a mnemonic, `OOP_GEMSTONE_ERROR_CAT`, that is defined in GemBuilder include file `gcioop.ht`.

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**.

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 **GciLongJmp** 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 **GciLongJmp** 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.

1.11 Garbage Collection

GemStone performs automatic garbage collection via several mechanisms, which are discussed more fully in the chapter "GemStone Garbage Collection" in the *System Administration Guide for GemStone/S 64 Bit*.

In-memory garbage collection of non-persistent temporary objects occurs regularly, to avoid low and out of memory issues. 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. To avoid this problem GemStone uses several internal sets: the *PureExportSet*, the *GciTrackedObjs* set, and the user action's export set.

Before removing any objects, the GemStone in-memory garbage collector checks the *PureExportSet* and the *GciTrackedObjs* set in the user session's workspace, and if in a user action, the user action's export set. Any object in these sets is considered to be referenced. The garbage collector does not remove objects that are in these sets, or objects that are referenced by a persistent object. It also does not remove any additional objects that they refer to, or more objects that those additional objects refer to, and so on.

Some functions will automatically add the objects which they return to the export sets. Objects may also be added and removed explicitly. 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 applicable export set - either the PureExportSet, or if the function is called from within a user action, to the user action's 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 PureExportSet or the user action's export set.
- When the function

  GciErr(GciErrSType *errorReport);

  returns TRUE, values of type OopType in the *errorReport are added to the applicable export set.

All of these functions return their results to the C application in the form of one or more OOPs (objects), through either return values or output parameters. To protect these result objects from premature garbage collection, GemBuilder *automatically* adds all of them to the applicable export set. GemBuilder does not automatically add other objects to the export sets; the application should be careful to explicitly call the **GciSaveObjs** or **GciSaveGlobalObjs** function when it needs to be sure to retain an object that is not already in an 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 sets. These are already referenced from the object whose instance variable references them. Note however that 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.

Persistent objects may be added to any of the three sets, in which case they are protected from garbage collection on persistent objects, such as markForCollection.

In a user action, some of these functions behave differently. When these functions are called from within a user action, the objects are added to the user action's export set to prevent them from being garbage collected, rather than to the PureExportSet. 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 consuming excess memory, for example if the user action exits with an unexpected error. In order to prevent objects saved from within a user action from being released prematurely, the user action can explicitly call GciSaveGlobalObjs, which will save them to the PureExportSet regardless of the user action context.

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

1.12 Preparing to Execute GemStone Applications

The following information includes the requirements and recommendations for preparing your environment to execute C applications for GemStone. Your application may have additional requirements, such as environment variables that it uses.

GemStone Environment Variables

Anyone who runs a GemStone application or process is responsible for setting the following environment variables:

GEMSTONE — A full pathname to your GemStone installation directory.

PATH — Add the GemStone `bin` directory to your path.

The following environment variables influence the behavior of GemStone and GemBuilder. You may wish to supply values or defaults for them when you or your users run your application or a Gem.

GEMSTONE_EXE_CONF — (not for RPC applications) A full path to a special GemStone configuration file for an executable, if any. See the *System Administration Guide for GemStone/S 64 Bit* for details.

GEMSTONE_SYS_CONF — (not for RPC applications) a full path to a special GemStone configuration file for your system, if any. See the *System Administration Guide for GemStone/S 64 Bit* for details.

GEMSTONE_NRS_ALL — A network resource string — a means for identifying certain GemStone file and process information. It can identify the name of the script to run to start an RPC Gem. See the *System Administration Guide for GemStone/S 64 Bit* for details.

GEMSTONE_LANG — A means of identifying the language to use for messages. Under Unix, it is a full pathname to a file containing message text. See the *System Administration Guide for GemStone/S 64 Bit* for more details.

Chapter 2

Building Applications with GemBuilder for C

This chapter explains how to use GemBuilder to build your C application. Two versions of GemBuilder for C are available to you: GciLnk (the linked version) and GciRpc (the RPC version).

2.1 GciRpc and GciLnk

With GciRpc, your application exists in a process separate from the Gem. The two processes communicate through remote procedure calls. With GciLnk, your application and default Gem (the GemStone session) exist as a single process. Your application is expected to provide the main entry point. You can also run RPC Gems when you use GciLnk.

With GciRpc, because networking software is used for the remote procedure call to the Gem process, there's a fixed overhead (many milliseconds) associated with each GemBuilder call, independent of whatever object access is performed or Smalltalk code is executed.

The function **GciIsRemote** reports whether your application was linked with GciRpc — the "remote procedure call" version of GemBuilder — or GciLnk. The following paragraphs explain some of the differences between these two versions of GemBuilder.

Use GciRpc for Debugging

When debugging a new application, you must use GciRpc. You should use GciLnk *only* after your application has been properly debugged.

When using an RPC Gem, you usually achieve the best performance by using functions such as **GciTraverseObjs**, **GciStoreTrav**, and **GciFetchPaths**. Those functions are designed to reduce the number of network round-trips through remote procedure calls.

Use GciLnk for Performance

You can use the linked, single-Gem configuration to enhance performance significantly. With GciLnk, a GemBuilder function call is a machine-instruction procedure call (with overhead measured in microseconds) 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 4-6.*

With GciLnk, you usually achieve the best performance by using the simple **GciFetch**... and **GciStore**... functions instead of the complex object traversal functions. This makes the application easier to write.

However, you can also run RPC Gems under GciLnk, when you login to GemStone multiple times. The complex traversal functions should perform better in those sessions.

Multiple GemStone Sessions

If your application will be running multiple GemStone sessions simultaneously, or if you will need to run your application and the GemStone session on separate machines, then you will need to use either the GciRpc (remote procedure call) version of GemBuilder, or a non-default login session from GciLnk.

2.2 The GemBuilder 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.*` reside in `$GEMSTONE/lib`.

2.3 Binding to GemBuilder at Run Time

Shared libraries are generally bound to their application 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 run-time-binds to GemBuilder:

1. Include `gcirtl.hf` (not `gci.hf`) in the C source code.

   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(useRpc, ...)` to load the RPC GemBuilder (if `useRpc`) or the linked GemBuilder (if not `useRpc`).

   Call `GciRtlLoad` before any other GemBuilder calls. Call `GciRtlUnload` to unload the current version of GemBuilder.

3. Link with `gcirtlobj.o`, not one of the GemBuilder libraries (`libgcirpc.*` and `libgcilnk.*`).

   Chapter 4, "Compiling and Linking," tells how to compile and link your application.

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 with **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 an environment variable:

LD_LIBRARY_PATH	Solaris or AIX
LD_LIBRARY_PATH or SHLIB_PATH	HP-UX

2. Any path recorded in the executable when it was built.
3. The global directory `/usr/lib`.

Chapter

3

Writing C Functions To Be Called from GemStone

For certain operations, you may choose to write a C function rather than to perform the work in GemStone. For example, operations that are computationally intensive or are external to GemStone 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” offered by some other object-oriented systems.

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.

3.1 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 at the same time. See Chapter 2, “Building Applications with GemBuilder for C,” for more information.

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 session process. The operation that is used to load the library determines which type it is, not any quality of the library itself. Application and Gem executables can load any library.

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.

3.2 How User Actions Work

Here's a quick overview of the sequence of events when a user action function is executed:

1. The Gem or your C application program initiates GemStone Smalltalk execution by calling one of the following functions: **GciExecute**, **GciExecuteStr**, **GciExecuteStrFromContext**, **GciPerform**, or **GciContinue**.
2. Your 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*. (You must have already initialized that function before logging in to GemStone. See "Loading User Actions" on page 3-7.)
3. 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).

   Specifically, the C user action function can call GemBuilder's structural access functions (**GciFetch**... and **GciStore**..., etc.) to read or modify, respectively, any objects that were passed as arguments to the user action.

   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 **GciExecute** (or whichever GemBuilder function executed the GemStone Smalltalk code in step 1).

4. 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.

3.3 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. Then 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.

Write the User Action Functions

Writing a C function to install as a user action called from Smalltalk is little different from writing other C functions. However, one important difference exists: user actions cannot reliably retain references to objects they create. 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. Therefore, make sure your C application treats all argument and result objects of a user action as temporary objects. Don't save the OOPs in static C variables for use by a subsequent invocation of the user action or by another C function.

Don't rely on **GciSaveObjs** to make the objects persistent. The application that called the user action can still call **GciReleaseOops** on the object that the user action needs to retain (or **GciReleaseAllOops** to release all objects at once).

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 collection created by the calling application (for example, a collection created in Smalltalk and committed to the repository).
- 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.

If you are working in GemBuilder for Smalltalk, you can also explicitly save these user action objects by populating a collection in the user-definable portion of `System sessionState` using `System > sessionStateAt:put:`. Your user action can retain references to objects that you add to this collection in this way.

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 shared library switches.
4. Link with `gciualib.o` and shared library switches.
5. Install the library in the `$GEMSTONE/ualib` 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 3.1 shows how the initialization function **GciUserActionInit** is defined, using the macro **GCIUSER_ACTION_INIT_DEF**. This macro must call the **GCI_DECLARE_ACTION** macro once for each function in the set of user actions.

Example 3.1

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

GCIUSER_ACTION_INIT_DEF()
{
  GCI_DECLARE_ACTION("doParse", doParse, 1);
  GCI_DECLARE_ACTION("doFetch", doFetch, 1);
  // ...
}
```

The **GCI_DECLARE_ACTION** macro 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 or arguments that the function takes. A call to the macro looks similar to this:

`GCI_DECLARE_ACTION("`*userActionName*`", `*userActionFunction*`, 1)`

The macro expands to a block of C statements that install 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 last argument to the **GCI_DECLARE_ACTION** macro 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**.

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

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 3.2 shows a shutdown definition that does nothing but report that it has been called.

Example 3.2

```
#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 4, “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.

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
- Smalltalk applications using GemBuilder for Smalltalk:

  `GBSM loadUserActionLibrary:` *ualib*

- 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. Always use the base name when you need portability. 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:

- Solaris (Sun): `lib`*ua*`.so`
- HP-UX (HP): `lib`*ua*`.sl`
- AIX (RS / 6000): `lib`*ua*`.so`
- Linux (x86_64): `lib`*ua*`.so`

and searches for the file in the following places in the specified order:

1. The current directory of the application or Gem.
2. The directory the executable is in, if it can be determined.
3. The `$GEMSTONE/ualib` directory.
4. The normal operating system search, as described in “Searching for the Library” on page 2-4.

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 the **GCI_DECLARE_ACTION** macro 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 **GCI_DECLARE_ACTION**. 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
```

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.
```

NOTE
You can also call a user action function directly from your C code, as you would any other C function.

Remote User Actions

The user action code that is called can be remote (on a different machine) from the Gem that invokes this method.

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 in that no more than 47 user actions may be active at any one time on the current Smalltalk stack. If the limit is exceeded, GemStone raises an error.

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 4-6.

Use the instructions for user actions in Chapter 4, “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.

3.4 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.

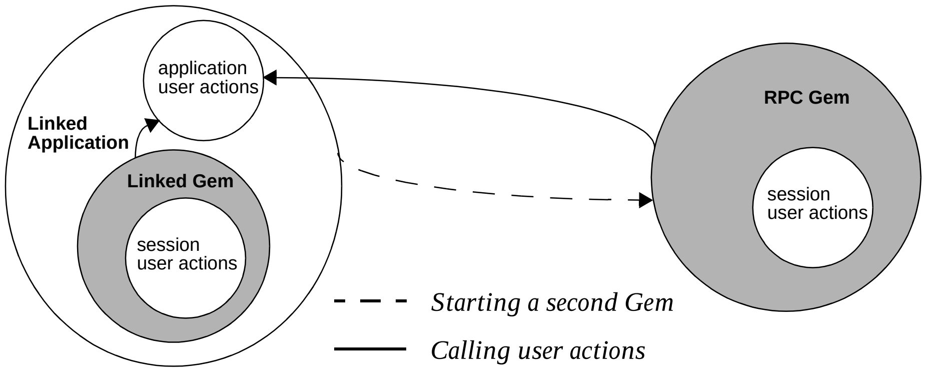
Applications With Multiple Gems

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 3.1. 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 3.1 Access to Application and Session User Actions



The following sections discuss the various possible configurations in detail.

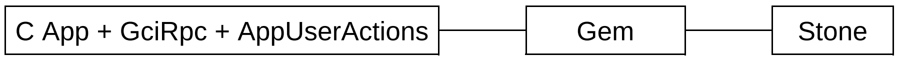
Running User Actions with Applications

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

Figure 3.2 illustrates how various architectural components are distributed among three GemStone processes when a set of user actions executes with an RPC application.

Figure 3.2 Application User Actions and RPC Applications in GemStone Processes



In this 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:

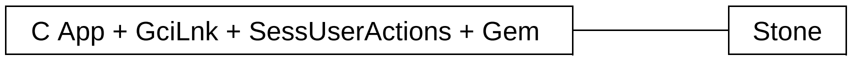
- The application and / or the user action needs to be debugged or tested.
- The user action depends on facilities or implement capabilities for the application environment. Screen management, GUI operations, and control of specialized hardware are possibilities.
- The application acquires data from 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

Figure 3.3 illustrates how various architectural components are distributed between two GemStone processes when a set of user actions executes with a linked application.

Figure 3.3 Session User Actions and Linked Applications in GemStone Processes



In this 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. (These sessions would be additions to the configuration of Figure 3.3.) 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.

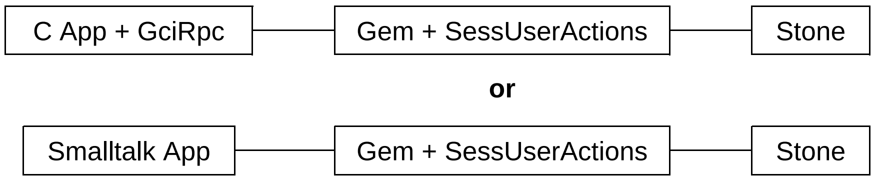
CAUTION
Debug your user actions in a process that does not include a Gem. For more information, see "Risk of Database Corruption" on page 4-6.

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.

Figure 3.4 illustrates how various architectural components are distributed among three GemStone processes when a set of user actions executes with an RPC Gem.

Figure 3.4 Session User Actions and RPC Gems in GemStone Processes



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 4-6.

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

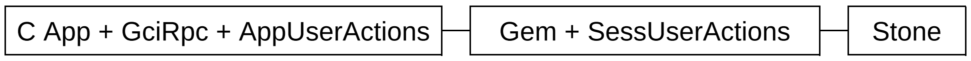
- You wish to execute the user action from a Smalltalk application using GemBuilder for Smalltalk. This configuration is required for that purpose.
- You wish the user action to be available to all or many other C applications.
- The user action is called frequently from GemStone. This configuration 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.

For example, the user action might retrieve a data matrix and a filter from GemStone, perform a Fast Fourier Transform, and send the result to the application.

Running User Actions with Applications and Gems

Figure 3.5 illustrates how various architectural components are distributed among three GemStone processes when one set of user actions executes with an RPC application and another set of user actions executes with an RPC Gem.

Figure 3.5 RPC Applications and Gems with User Actions in GemStone Processes

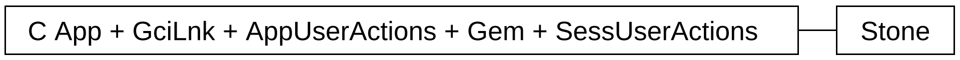


This configuration is a combination of previous configurations. The application and the Gem run in separate processes. User actions in the first set execute in the application process, and user actions in the second set execute in the Gem process.

When user actions are installed in a process, they are given a name by which GemBuilder refers to them. If a user action in the application has the same name as a user action in the Gem, then the one in the Gem is always used, and the one in the application is ignored.

The two types of user actions could also exist in one linked process, as shown in Figure 3.6.

Figure 3.6 Application and Session User Actions in GemStone Processes



In this configuration, the user actions can be loaded as either application or session user actions; it would be the same from the point of view of the linked Gem. Application user actions would be just as efficient as session user actions, because they are part of the Gem process. If a linked application user logs in to GemStone more than once, GemStone creates a new RPC Gem process for each new session, additions to the configuration of Figure 3.6. The RPC Gems do not have access to the linked Gem's session user actions. So it is generally better to load them as application user actions, just in case.

Chapter
4
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 server 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 and vendor publications for possible updates.

4.1 Development Environment and Standard Libraries

For simplicity, 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.[1] The order in which these libraries are specified can be significant; be sure to retain the ordering given in the command lines to follow in this section.

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.

4.2 Compiling 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.

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.

The example compiler and linker command lines in this chapter assume that a compatible compiler has been installed and is in your path.

The following C++ compilers were used to produce the GemStone product, and have been tested for producing C/C++ applications and user action libraries.

- Solaris (Sun) — Workshop 6 Update 2 C++ 5.3 Patch 111685-15 2003/05/14
- HP-UX — ANSI C++ compiler (aCC) B3910B A.03.63
- AIX — IBM XL C/C++ Enterprise Edition V8.0

1. The *socket* library in particular contains operating system calls that support TCP/IP sockets. The functions for this purpose sometimes also require functions that are found in yet other system libraries.

- Linux — gcc / g++ 4.1.0

  linker version 2.15.90.0.1.1

Other compilers, such as ANSI C++ compilers, are assumed to work, but have not been tested.

Listing the Version of Your Compiler

To list the version of your compiler, execute the appropriate command line.

Solaris (Sun):

```
% CC -V
CC: Sun WorkShop 6 update 2 C++ 5.3 Patch 111685-15
2003/05/14
```

HP-UX (HP):

```
% aCC -V
aCC: HP ANSI C++ B3910B A.03.63
```

AIX (IBM):

```
% /usr/vacpp/bin/xlC_r
```

This brings up the compiler man page, which includes the version number.

Linux:

```
% gcc --version
gcc (GCC) 4.1.0 (SuSE Linux)
```

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 should specify the GemStone `include` directory.

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

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

Compilation Command Lines

This section presents simple example command lines for compiling C source code on each platform.

The first command line for each platform illustrates how to compile a simple application program named *appl*, whose source contains one code file, *appl*`.c`. Its result is one object file, *appl*`.o`.

The second command line for each platform illustrates how to compile the user action file *useract*`.c`. For simplicity, 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. Its result is one object file, *useract*`.o`. Some platforms require the object files that are put in a user action library to be compiled with special flags.

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

Solaris (Sun):

```
$ CC -xcode=pic32 -xarch=v9 -mt -xchip=ultra2
      -I$GEMSTONE/include -c appl.c
$ CC -xcode=pic32 -xarch=v9 -mt -xchip=ultra2
      -I$GEMSTONE/include -c useract.c
```

To allow debugging of the resulting library, include the optional `-g` flag.

HP-UX (HP):

```
$ /opt/aCC/bin/aCC +Onolimit +Z -Aa +DD64 -D_PSTAT64
      -D_LARGEFILE64_SOURCE -mt +W212 +W749 +W740 +W863
      -D_POSIX_C_SOURCE=199506L -I$GEMSTONE/include
      -c appl.c -o appl.o
$ /opt/aCC/bin/aCC +Onolimit +Z -Aa +DD64 -D_PSTAT64
      -D_LARGEFILE64_SOURCE -mt +W212 +W749 +W740 +W863
      -D_POSIX_C_SOURCE=199506L -I$GEMSTONE/include
      -c useract.c -o useract.o
```

The `-Aa` switch is required; it designates the ANSI C mode. The `+Z` switch is required for user action library code. To allow debugging of the resulting library, also include the optional `-g` flag.

AIX (IBM):

```
$ /usr/vacpp/bin/xlC_r -O3 -qstrict -+ -q64 -qthreaded
      -qarch=pwr5 -qtune=pwr5 -I$GEMSTONE/include -c appl.c
      -o appl.o
$ /usr/vacpp/bin/xlC_r -O3 -qstrict -+ -q64 -qthreaded
      -qarch=pwr5 -qtune=pwr5 -I$GEMSTONE/include -c
      useract.c -o useract.o
```

To allow debugging of the resulting library, also include the optional `-g`, `-qdbxextra` and `-qfullpath` flags. Please consult the `xlC_r` documentation for more information.

Linux:

```
$ /usr/bin/g++ -D_REENTRANT -D_GNU_SOURCE -pthread -fPIC -m64
      -fno-strict-aliasing -fmessage-length=0 -fcheck-new
      -I$GEMSTONE/include -x c++ -c appl.c -o appl.o
$ /usr/bin/g++ -D_REENTRANT -D_GNU_SOURCE -pthread -fPIC -m64
      -fno-strict-aliasing  -fmessage-length=0 -fcheck-new
      -I$GEMSTONE/include -x c++ -c ua.c -o ua.o
```

The following warn flags are recommended for compilation:

```
-Wformat -Wtrigraphs -Wcomment -Wsystem-headers
-Wtrigraphs -Wno-aggregate-return -Wswitch -Wshadow
-Wunused-value -Wunused-variable -Wunused-label
-Wno-unused-function -Wchar-subscripts -Wconversion
-Wimplicit-function-dec -Wmissing-braces -Wmultichar
-Wparentheses -Wsign-compare -Wsign-promo
-Wwrite-strings -Wreturn-type
```

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

4.3 Linking C/C++ Object Code with GemStone

The following information includes the requirements and recommendations for linking C/C++ applications or user actions with GemStone. Your code may have additional requirements, such as link options or libraries.

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.

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.

Link Options

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 (compiler) documentation.

Command Line Assumptions

This section presents simple example command lines for linking object code on each platform. Each command line illustrates how to link a simple application program named *appl* with one application object file, *appl*`.o`. Its result is one executable file, *appl* or *appl*`.exe`, depending on your platform.

In addition, this section illustrates how to link a user action object file named *useract*`.o` with GemStone libraries to produce a user action library.

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

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

Linking Applications That Bind to GemBuilder at Run Time

Solaris (Sun):

```
$ CC -xildoff -xarch=v9 -i appl.o $GEMSTONE/lib/gcirtlobj.o
      -B dynamic -lc -lpthread -ldl -lrt -lsocket -lnsl
      -lm -o appl -z nodefs
```

HP-UX (HP):

```
$ /opt/aCC/bin/aCC -v +DD64 -Wl,+allowdups,+k,+allowunsats
      -Wl,+pd4M,+pi64K -z appl.o $GEMSTONE/lib/gcirtlobj.o
      -lrt -lsec -ldld -lm -l:libcres.a -lcl -lpthread
      -l:libc.sl -o appl
```

To enable debugging of your application, issue the `pxdb` command on the application that loads the DLL:

```
$ /opt/langtools/bin/pxdb -s enable appl
```

AIX (IBM):

```
$ /usr/vacpp/bin/xlC_r -q64 -Wl,-bbigtoc -Wl,-berok -o appl
      appl.o $GEMSTONE/lib/gcitrlobj.o -L/usr/vacpp/lib
      -lC_r -lm -lpthreads -ldl
```

Linux:

```
$ /usr/bin/g++ appl.o $GEMSTONE/lib/gcirtlobj.o -m64
      -lpthread -lcrypt -ldl -lc -lm -lrt -Wl,--no-undefined
      -Wl,-z,muldefs -o appl -Wl,--warn-unresolved-symbols
```

Linking User Actions into Shared Libraries

Solaris (Sun):

```
$ ld -G -B symbolic -h libua.so -i useract.o
      $GEMSTONE/lib/gciualib.o -o libua.so -B dynamic -lc
      -lpthread -ldl -lrt -lsocket -lnsl -lm
```

HP-UX (HP):

```
$ /opt/aCC/bin/aCC -v +DD64 -Wl,+allowdups,+k,+allowunsats
      -Wl,+pd4M,+pi64K -v -b -Wl,-B,symbolic -z ua.o
      $GEMSTONE/lib/gciualib.o -o libua.sl
      -Wl,+e,GciUserActionLibraryMain -lrt -lsec -ldld -lm
      -l:libcres.a
```

To enable debugging of your user action code, issue the pxdb command with whichever application will load the user action, Gem or Topaz:

```
$ /opt/langtools/bin/pxdb -s enable $GEMSTONE/sys/gem
```

or

```
$ /opt/langtools/bin/pxdb -s enable $GEMSTONE/bin/topaz
```

AIX (IBM):

```
$ /usr/vacpp/bin/xlC_r -q64 -G -Wl,-bbigtoc
      -e GciUserActionLibraryMain useract.o
      $GEMSTONE/lib/gciualib.o -olibua.so -L/usr/vacpp/lib
      -lC_r -lm -lpthreads -ldl
```

Linux:

```
$ /usr/bin/g++ -shared -Wl,-Bdynamic,-hlibua.so  ua.so
      $GEMSTONE/lib/gciualib.o -o libua.so -m64 -lpthread
      -lcrypt -ldl -lc -lm -lrt -Wl,--no-undefined
      -Wl,-z,muldefs
```

Chapter 5 GemBuilder C Functions — A Reference Guide

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

5.1 Function Summary Tables

Tables 5.1 through 5.9 summarize the GemBuilder C functions and the services that they provide to your application.

Table 5.1 Functions for Controlling Sessions and Transactions

GciAbort	Abort the current transaction.
GciAlteredObjs	Find all exported or dirty objects that have changed and are therefore in the ExportedDirtyObjs or TrackedDirtyObjs sets.
GciBegin	Begin a new transaction.
GciCommit	Write the current transaction to the database.
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.

Table 5.1 Functions for Controlling Sessions and Transactions (Continued)

GciDirtyTrackedObjs	Find all tracked objects that have changed and are therefore in the TrackedDirtyObjs set.
GciGetSessionId	Find the ID number of the current user session.
GciHardBreak	Interrupt GemStone and abort the current transaction.
GciInit	Initialize GemBuilder.
GciInitAppName	Override the default application configuration file name.
GciInitAppName_	Override the default application configuration file name and the size of temporary object memory.
GciInstallUserAction	Associate a C function with a Smalltalk user action.
GciIsRemote	Determine whether the application is running linked or remotely.
GciLogin	Load an application user action library.
GciLogin	Start a user session.
GciLogout	End the current user session.
GciNbAbort	Abort the current transaction (nonblocking).
GciNbBegin	Begin a new transaction (nonblocking).
GciNbCommit	Write the current transaction to the database (nonblocking).
GciNbEnd	Test the status of nonblocking call in progress for completion.
GciProcessDeferredUpdates_	Process deferred updates to objects that do not allow direct structural update.
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.
GciReleaseAllTrackedOops	Clear the GciTrackedObjs set, making all tracked OOPs eligible for garbage collection.
GciReleaseGlobalOops	Remove an array of GemStone OOPs from the PureExportSet, making them eligible for garbage collection.
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.
GciReleaseTrackedOops	Remove an array of OOPs from the GciTrackedObjs set, making them eligible for garbage collection.
GciRtlIsLoaded	Report whether a GemBuilder library is loaded.
GciRtlLoad	Load a GemBuilder library.

Table 5.1 Functions for Controlling Sessions and Transactions (Continued)

GciRtlUnload	Unload a GemBuilder library.
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.
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	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.
GciStep	Continue code execution in GemStone with specified single-step semantics.
GciTrackedObjsFetchAllDirty	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.
GciUserActionInit	Declare user actions for GemStone.
GciUserActionShutdown	Enable user-defined clean-up for user actions.

Table 5.2 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	Continue code execution in GemStone after an error.
GciContinueWith	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.

Table 5.2 Functions for Handling Errors and Interrupts and for Debugging (Continued)

GciEnableSignaledErrors	Establish or remove GemBuilder visibility to signaled errors from GemStone.
GciErr	Prepare a report describing the most recent GemBuilder error.
GciInUserAction	Determine whether or not the current process is executing a user action.
GciLongJmp	Provides equivalent functionality to the corresponding longjmp() or _longjmp() function.
GciNbContinue	Continue code execution in GemStone after an error (nonblocking).
GciNbContinueWith	Continue code execution in GemStone after an error (nonblocking).
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.

Table 5.3 Functions for Compiling and Executing Smalltalk Code in the Database

GciClassMethodForClass	Compile a class method for a class.
GciExecute	Execute a Smalltalk expression contained in a String object.
GciExecuteFromContext	Execute a Smalltalk expression contained in a String object as if it were a message sent to another object.
GciExecuteStr	Execute a Smalltalk expression contained in a C string.
GciExecuteStrFromContext	Execute a Smalltalk expression contained in a C string as if it were a message sent to an object.
GciInstMethodForClass	Compile an instance method for a class.
GciNbExecute	Execute a Smalltalk expression contained in a String object (nonblocking).
GciNbExecuteStr	Execute a Smalltalk expression contained in a C string (nonblocking).
GciNbExecuteStrFromContext	Execute a Smalltalk expression contained in a C string as if it were a message sent to an object (nonblocking).

Table 5.3 Functions for Compiling and Executing Smalltalk Code in the Database

GciNbPerform	Send a message to a GemStone object (nonblocking).
GciNbPerformNoDebug	Send a message to a GemStone object, and temporarily disable debugging (nonblocking).
GciPerform	Send a message to a GemStone object.
GciPerformNoDebug	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 5.4 Functions for Accessing Symbol Dictionaries

GciResolveSymbol	Find the OOP of the object to which a symbol name refers, in the context of the current session's user profile.
GciResolveSymbolObj	Find the OOP of the object to which a symbol object 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.
GciStrKeyValueDictAtObj	Find the value in a symbol KeyValue dictionary at the corresponding object key.
GciStrKeyValueDictAtObj Put	Store a value into a symbol KeyValue dictionary at the corresponding object key.
GciStrKeyValueDictAtPut	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 at the corresponding object key.
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 5.5 Functions for Creating and Initializing Objects

GciCreateByteObj	Create a new byte-format object.
GciCreateOopObj	Create a new pointer-format object.
GciGetFreeOop	Allocate an OOP.

Table 5.5 Functions for Creating and Initializing Objects (Continued)

GciGetFreeOops	Allocate multiple OOPs.
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 date-time object.
GciNewOop	Create a new GemStone object.
GciNewOops	Create multiple new GemStone objects.
GciNewOopUsingObjRep	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.

Table 5.6 Functions and Macros for Converting Objects and Values

GCI_BOOL_TO_OOP	(MACRO) Convert a C Boolean value to a GemStone Boolean object.
GciByteArrayToPointer	Given a result from GciPointerToByteArray, return a C pointer.
GCI_CHR_TO_OOP	(MACRO) Convert a 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.
GciFetchDateTime	Convert the contents of a DateTime object and place the results in a C structure.
GciFloatKind	Obtain the float kind corresponding to a C double value.
GciFltToOop	Convert a C double value to a SmallDouble or Float object.
GCI_I64_IS_SMALL_INT	Determine whether or not a C 64-bit integer value can be translated into a SmallInteger 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 Boolean value.
GCI_OOP_IS_SMALL_INT	(MACRO) Determine whether or not a GemStone object represents a SmallInteger.
GCI_OOP_IS_SPECIAL	(MACRO) Determine whether or not a GemStone object has a special representation.

Table 5.6 Functions and Macros for Converting Objects and Values (Continued)

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.
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.
GciOopToI32_	Convert a GemStone object to a C 32-bit integer value, with error handling.
GciOopToI64	Convert a GemStone object to a C 64-bit integer value.
GciOopToI64_	Convert a GemStone object to a C 64-bit integer value, with error handling.
GciPointerToByteArray	Given a C pointer, return a SmallInteger or ByteArray containing the value of the pointer.
GciStringToInteger	Convert a C string to a GemStone SmallInteger, LargePositiveInteger or LargeNegativeInteger object.

Table 5.7 Object Traversal and Path Functions and Macros

GCI_ALIGN	(MACRO) Align an address to a word boundary.
GciClampedTrav	Traverse an array of objects, subject to clamps.
GciClampedTraverseObjs	Traverse an array of objects, subject to clamps.
GciClampedTravRefs	Traverse an array of objects, subject to clamps, while modifying the PureExportSet and ReferencedSet.
GciExecuteStrTrav	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	Continue object traversal, reusing a given buffer.
GciNbClampedTrav	Traverse an array of objects, subject to clamps (nonblocking).
GciNbClampedTraverseObjs	Traverse an array of objects, subject to clamps (nonblocking).
GciNbClampedTravRefs	Traverse an array of objects, subject to clamps, while modifying the PureExportSet and ReferencedSet (nonblocking)
GciNbExecuteStrTrav	Execute a string and traverse the result of the execution (nonblocking).

Table 5.7 Object Traversal and Path Functions and Macros (Continued)

GciNbMoreTraversal	Continue object traversal, reusing a given buffer (nonblocking).
GciNbPerformTrav	First send a message to a GemStone object, then traverse the result of the message (nonblocking).
GciNbStoreTrav	Store multiple traversal buffer values in objects (nonblocking).
GciNbStoreTravDo	Store multiple traversal buffer values in objects, execute the specified code, and return the resulting object (non-blocking).
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).
GciNbStoreTravDoTravRefs	Combine in a single function modifications to session sets, calls to GciNbStoreTravDo and GciNbClampedTrav, to store multiple traversal buffer values in objects, execute the specified code, and traverse the result object (non blocking)
GciNbTraverseObjs	Traverse an array of GemStone objects (nonblocking).
GciObjRepSize_	Find the number of bytes in an object report.
GciPathToStr	Convert a path representation from numeric to string.
GciPerformTrav	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.
GciSetTraversalBufSwizzling	Control swizzling of the traversal buffers.
GciStorePaths	Store selected multiple OOPs into an object tree.
GciStoreTrav	Store multiple traversal buffer values in objects.
GciStoreTravDo	Store multiple traversal buffer values in objects, execute the specified code, and return the resulting object.
GciStoreTravDoTrav	Combine in a single function the calls to GciStoreTravDo and GciClampedTrav, to store multiple traversal buffer values in objects, execute the specified code, and traverse the result object.
GciStoreTravDoTravRefs	Combine in a single function modifications to session sets, calls to GciStoreTravDo and GciClampedTrav, to store multiple traversal buffer values in objects, execute the specified code, and traverse the result object.
GciStrToPath	Convert a path representation from string to numeric.
GciTraverseObjs	Traverse an array of GemStone objects.

Table 5.8 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.
GciFetchObjectInfo	Fetch information and values from an object.
GciFetchObjImpl	Fetch the implementation of an object.
GciFetchObjInfo	Fetch information and values from 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.
GciHiddenSetIncludesOop	Determines whether the given OOP is present in the specified hidden set.
GciIsKindOf	Determine whether or not an object is some kind of a given class or class history.

Table 5.8 Structural Access Functions and Macros (Continued)

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.
GciIvNameToIdx	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 5.9 Utility Functions

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.

Table 5.9 Utility Functions (Continued)

GciEnableFreeOopEncoding	Enable run-length encoding of free OOPs.
GciEnableFullCompression	Enable full compression between the client and the RPC version of GemBuilder.
GciEncodeOopArray	Encode an array of OOPs, using run-length encoding.
GciFetchNumEncodedOops	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.

5.2 GemBuilder Include Files

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

Your C source code should include *exactly* one of these three include files:

`gcirtl.hf`	Forward references to the GemBuilder functions, to be included in code that will bind to GemBuilder at run time. For a discussion of how to load a library that was compiled against `gcirtl.hf`, see “Binding to GemBuilder at Run Time” on page 2-3. For modules that define user actions, use `gciua.hf` instead of this file.
`gciua.hf`	Used instead of `gcirtl.hf` in modules that define user actions.
`gci.hf`	Forward references to the GemBuilder functions; indirectly included by `gcirtl.hf` and `gciua.hf`. Used for a C application that will call GciInit and GciLogin, on platforms that allow shared libraries to be built containing references to unresolved symbols (which are defined in `gci.hf` and resolved at run time).

In addition, your code can include these files:

`gcifloat.hf`	Macros, constants and functions for accessing the bodies of instances of GemStone classes Float and SmallFloat. Optional for code that includes `gci.hf` and `gciua.hf`, not used with `gcirtl.hf`.
`gcisend.hf`	Inline implementations of deprecated GciSendMsg, which no longer uses variable arguments. New code should use GciPerform. For convenience, if you are using GciSendMsg in your GemBuilder application, include this file after the include of `gcirtl.hf`.

You do not include the following files explicitly; they are listed here for your information.

`flag.ht`	Contains host-specific C definitions for compilation.
`gci.ht`	Defines C types for use by GemBuilder functions. See “GemBuilder Data Types” on page 5-13.
`gcicmn.ht`	Defines common C types and macros used by `gcirtl.hf`, `gci.hf`, and `gciua.hf`.

`gcierr.ht`	Defines mnemonics for all GemStone errors.
`gcioc.ht`	Defines C mnemonics for sizes and offsets into objects.
`gcioop.ht`	Defines C mnemonics for predefined GemStone objects. See Appendix A, “Reserved OOPs,” for a list of constants defined in this file.
`gcirtl.ht`	Defines C types specific to shared libraries for use by GemBuilder functions. Used by `gcirtl.hf`.
`gcirtlm.hf`	Macros used by `gcirtl.hf`.
`gciuser.hf`	Defines a macro to be used to install user actions. Include `gciua.hf` instead of this file.
`version.ht`	Defines C mnemonics for version-dependent strings.

5.3 GemBuilder Data Types

The following C types are used by GemBuilder functions. The file `gci.ht` defines each of the GemBuilder types (shown in capital letters below). That file is in the `$GEMSTONE/include` directory.

BoolType	An int.
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 dates and times.
GciDbgFuncType	The type of C function called by **GciDbgEstablish.**
GciErrSType	A GemStone error report (see “The Error Report Structure” on page 5-15).
GciJumpBufSType	Jump buffer, defined in the `setjmp.h` file.

GciObjInfoSType
A C++ class for a GemStone object information report (see “The Object Information Structure” on page 5-16).

GciObjRepHdrSType
A C++ class for an object report header (see “The Object Report Header Class” on page 5-20).

GciObjRepSType
A C++ class for an object report (see “The Object Report Structure” on page 5-19).

GciSessionIdType
A signed 32-bit integer.

GciStoreTravDoArgsSType
A C++ class for store traversal arguments.

GciTravBufType
A traversal buffer. See page 5-25.

GciUserActionSType
A structure for describing a user action (see “The User Action Information Structure” on page 5-24.

The Structure for Representing the Date and Time

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 structured type **GciDateTimeSType**, which provides a C representation of an instance of class DateTime, contains the following fields:

```
#if !defined(GCICMN_HT)

typedef struct {
   int year;
   int dayOfYear;
   int milliseconds;
   OopType timeZone;
} GciDateTimeSType;

#endif
```

The `year` value must be less than 1,000,000.

In addition, a C mnemonic supports representation of DateTime objects.

```
#define GCI_SECONDS_PER_DAY        86400
/* conversion constant */
```

NOTE:
The OOP of the Smalltalk DateTime class is OOP_CLASS_DATE_TIME.

The Error Report Structure

An error report is a C structured type named **GciErrSType**. This structure contains the following fields:

OopType	*category* The OOP of the GemStone error dictionary (OOP_GEMSTONE_ERROR_CAT).
OopType	*context* 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 GciContinue or GciClearStack. If the virtual machine was not running, then *context* is OOP_NIL. If you are not interested in debugging or in continuing from an error, or if the error is not in the runtime error category, your program can ignore this value.
OopType	*args*[GCI_MAX_ERR_ARGS] An optional array of error arguments. In this release, GCI_MAX_ERR_ARGS is defined to be 10.
int	*number* The GemStone error number (a positive integer).
int	*argCount* The number of arguments in the args array.
unsigned char	*fatal* Nonzero if this error is fatal.
char	*message*[GCI_ERR_STR_SIZE + 1] The null-terminated string which contains the text of the error message. In this release, GCI_ERR_STR_SIZE is defined to be 300.

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

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.

The Object Information Structure

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 the **GciFetchObjInfo** function on page 5-135.

OopType	*objId* OOP of the object.
OopType	*objClass* Class of the object (see the **GciFetchClass** function on page 5-119).
int64	*objSize* Object's total size in bytes or OOPs (see the **GciFetchSize_** function on page 5-152).
int	*namedSize* Number of named instance variables in the object.
unsigned short	*segmentId* The segment ID of the object’s segment.

Functions

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

```
enum {          implem_mask = 0x03,
                indexable_mask = 0x04,
                invariant_mask = 0x08,
                partial_mask   = 0x10,
                overlay_mask   = 0x20
                };
```

Defines bits to use in evaluating whether this instance is invariable, indexable, partial, or overlayed.

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 isOverlayed( );

Returns non-zero if overlay semantics were used on this operation. Returns zero otherwise.

When the traversal is overlayed, 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. See the description on page 5-18.

void clearBits( );

Sets the invariant, indexable, partial, and overlayed bits to FALSE.

void setBits(unsigned char *bits*);

Sets the invariant, indexable, partial, and overlayed bits.

void setObjImpl(unsigned char *impl*);

Defines the object's implementation format. The argument must be an integer in the range 0..3 corresponding to the implementation format. See the description on page 5-18.

void setInvariant(unsigned char *val*);

If *val* is non-zero, make this object invariant.

void setIndexable(unsigned char *val*);

If *val* is non-zero, make this object indexable.

void setPartial(unsigned char *val*);

This function has no practical effect.

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

Description

The `gcioc.ht` include file defines four mnemonics that can be of assistance when you are handling the object implementation field: 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 the *objImpl* field, or to test its contents.

The Object Report Structure

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):

```
#if !defined(GCI_HT)
class GciObjRepSType { /* object report struct */
 public:
  GciObjRepHdrSType hdr;                /* object report header */
  union {
    ByteType        bytes[1];           /* Byte obj impl. obj's 
value buff   */
    OopType         oops[1];           /* Pointer obj impl. obj's 
value buff*/
  } u;

  inline int64 usedBytes() const {
    return this->hdr.usedBytes();
  }

  inline GciObjRepSType* nextReport() const {
    return (GciObjRepSType*) this->hdr.nextReport();
  }

  inline ByteType* valueBufferBytes() const {
    return (ByteType*)this->u.bytes;
  }

  inline OopType* valueBufferOops() const {
    return (OopType*)this->u.oops;
  }
};
#endif
```

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.

The Object Report Header Class

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	*valueBuffSize* Size (in bytes) of the object's value buffer.
short	*namedSize* Number of named instance variables in the object.
unsigned short	*segmentId* The segment ID of the object’s segment.
OopType	*objId* OOP of the object.
OopType	*oclass* Class of the object (see the **GciFetchClass** function on page 5-119).
int64	*firstOffset* Offset of first value to fetch or store.

Functions

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

```
enum {       implem_mask = 0x03,
             indexable_mask = 0x04,
             invariant_mask = 0x08,
             partial_mask   = 0x10,
             overlay_mask   = 0x20,
             no_read_auth_mask   = 0x40,
             clamped_mask   = 0x80,
             unused_mask    = 0xFF00
```

all_bits_mask = 0xFFFF
};
Defines bits to use in evaluating this instance's implementation format, and whether this instance is indexable, invariable, partial, overlayed, readable, or clamped.

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 5-23.

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. See the description on page 5-23.

int64 objSize( );
Returns the total number of instance variables in the object (both indexable and named). See the **GciFetchSize_** function on page 5-152.

void clearBits( );
Sets indexable, invariable, partial, overlayed, 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 isOverlayed( );
: Returns non-zero if overlay semantics were used on this store traversal operation. Returns zero otherwise.

  When the traversal is overlayed, 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 setPartial(unsigned char *val*);
: This function has no practical effect.

void clearPartial(unsigned char *val*);
: This function has no practical effect.

void setOverlayed(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 `gcioc.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 `gcioc.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.

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.

Table 5.10 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 "Manipulating Objects Through Structural Access" on page 1-17.

The User Action Information Structure

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

char	*userActionName*[GCI_MAX_ACTION_NAME+1] The user action name (a case-insensitive, null-terminated string). In this release, GCI_MAX_ACTION_NAME is defined to be 31.
int	*userActionNumArgs* The number of arguments in the C function.
GciUserActionFType	*userAction* A pointer to the C user action function.

unsigned int	*userActionFlags* Mainly for internal use. If you use it, set it to 0 before passing a pointer to it.

The Traversal Buffer Type

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

int64	*allocatedBytes* The allocated size of the body.
int64	*usedBytes* The used bytes of the body.
ByteType	*body*[8] The actual body size is variable, with a minimum of GCI_MIN_TRAV_BUFF_SIZE.

Functions

The following function call is used to create an instance of **GciTravBufType**:

static GciTravBufType* malloc(size_t allocationSize);

Returns an instance obtained from ::malloc initialized with *allocatedBytes* equal to allocationSize and *usedBytes*== 0. (If allocationSize is not a multiple of 8 bytes, *allocatedBytes* is rounded up to the next 8-byte multiple.) Returns NULL if malloc fails.

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.

5.4 Structural Access Functions

The following caution applies to GemBuilder's structural access functions listed in Table 5.8 on page 5-9:

CAUTION

Exercise caution when using 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 constraint violations, authorization violations, or concurrency conflicts.

5.5 UNIX Signal Handling

Both versions of GemBuilder (GciLnk and GciRpc) use the SIGIO signal handler. GciLnk also uses the signals SIGSEGV and SIGVTALRM. SIGVTALRM is used by the ProfMonitor class.

If you must install your own signal handler (using signal or sigvec) for any of these signals, be sure that your application signal handler chains to the previous handler when done. Similar chaining is required for SIGVTALRM, if you intend to use ProfMonitor.

SIGSEGV occurs normally when a Smalltalk stack overflow occurs, and is translated to a Smalltalk stack overflow error by the GemStone SIGSEGV handler. If you use GciLnk and install handlers for this signal after calling GciLogin, your own SIGSEGV handler must determine whether the SIGSEGV was produced by your own C code, and if not, chain to the GemStone handler.

CAUTION
Do not, under any circumstances, turn off SIGIO.

5.6 GemBuilder Function and Macro Reference

This section provides a complete description of each GemBuilder C function that your application can call.

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)`. For more information, see “Interrupting GemStone Execution” on page 1-16.

See Also

GCI_CHR_TO_OOP, page 5-47
GciCommit, page 5-62
GciNbAbort, page 5-202
GciNbCommit, page 5-209

GciAddOopToNsc

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

Syntax

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

Input Arguments

theNsc	The OOP of the NSC.
theOop	The OOP 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, page 5-31
GciNscIncludesOop, page 5-251
GciRemoveOopFromNsc, page 5-311
GciRemoveOopsFromNsc, page 5-313

GciAddOopsToNsc

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

Syntax

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

Input Arguments

theNsc	The OOP of the NSC.
theOops	An array of OOPs to be added.
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, page 5-29
GciNscIncludesOop, page 5-251
GciRemoveOopFromNsc, page 5-311
GciRemoveOopsFromNsc, page 5-313

GCI_ALIGN

(MACRO) Align an address to a word boundary.

Syntax

uintptr_t * GCI_ALIGN(*argument*)

Input Arguments

argument	The pointer or integer to be aligned.

Result 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 page 5-20).

See Also

GciMoreTraversal, page 5-199
GciNewOopUsingObjRep, page 5-246
GciTraverseObjs, page 5-408

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 );
```

Input Arguments

theOops	An array that will contain 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*.

Result Arguments

theOops	The resulting array of OOPs of objects that are in either the ExportedDirtyObjs or TrackedDirtyObjs sets.
* *numOops*	The number of actual OOPs in the result array *theOops*.

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**). It may also track them by storing them in the GciTrackedObjs set (see **GciSaveAndTrackObjs**). 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

GciAbort, page 5-28
GciCommit, page 5-62
GciDirtyObjsInit, page 5-87
GciReleaseAllOops, page 5-304
GciReleaseOops, page 5-307
GciSaveAndTrackObjs, page 5-324

GciSaveGlobalObjs, page 5-326
GciSaveObjs, page 5-327

GciAppendBytes

Append bytes to a byte object.

Syntax

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

Input Arguments

theObject	A byte object to which bytes are to be appended.
numBytes	The number of bytes to be appended.
theBytes	A pointer to the bytes to be appended.

Result Arguments

theObject	The resulting byte object, with the appended bytes.

Description

The **GciAppendBytes** 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, page 5-38

GciAppendChars

Append a C string to a byte object.

Syntax

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

Input Arguments

theObject	A byte object to which the string is to be appended.
aString	A pointer to the string to be appended.

Result Arguments

theObject	The resulting byte object, with the appended string.

Description

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

See Also

GciAppendBytes, page 5-37

GciAppendOops

Append OOPs to the unnamed variables of a collection.

Syntax

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

Input Arguments

theObject	A collection to which additional OOPs are to be added.
numOops	The number of OOPs to be added.
theOops	A pointer to the OOPs to be added.

Result Arguments

theObject	The resulting collection, with the added OOPs.

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.

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, page 5-28
GciExecuteStr, page 5-105
GciNbAbort, page 5-202
GciNbBegin, page 5-203
GciNbExecuteStr, page 5-216

GCI_BOOL_TO_OOP

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

Syntax

OopType GCI_BOOL_TO_OOP(*aBoolean*)

Input Arguments

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

Result 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* (represented in your C program as OOP_FALSE). Any other C value translates to the GemStone Boolean object *true* (represented as OOP_TRUE). For more information, see Appendix A, “Reserved OOPs.”

Example

```
int GCI_BOOL_TO_OOP_example(void)
{
  int z = 0;
  int nonZ = 99;

  OopType Fa = GCI_BOOL_TO_OOP(z);

  // any non-zero argument will produce a result of OOP_TRUE
  OopType Tr = GCI_BOOL_TO_OOP(nonZ);

  // the following will always be true
  return  Fa == OOP_FALSE && Tr == OOP_TRUE;
}
```

See Also

GciOopToBool, page 5-262

GciByteArrayToPointer

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

Syntax

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

Input 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, page 5-289

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, page 5-185

GciCheckAuth

Gather the current authorizations for an array of database objects.

Syntax

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

Input 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*.

Result Arguments

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 segment using the **GciPerform** function.

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

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

Syntax

OopType GCI_CHR_TO_OOP(*aChar*)

Input Arguments

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

Result Value

The OOP of the GemStone Character object that is equivalent to *aChar*.

Description

This macro translates a C character value into the equivalent GemStone Character object. For more information, see Appendix A, “Reserved OOPs.”

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, page 5-266

GciClampedTrav

Traverse an array of objects, subject to clamps.

Syntax

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

Input 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** containing the following input argument fields:

OopType	*clampSpec* The OOP of the Smalltalk ClampSpecification to be used, or OOP_NIL, if the traversal is to operate without clamping.
int	*level* 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 *	*travBuff* A pointer to the traversal buffer.
int	*retrievalFlags* If (*retrievalFlags* & GCI_RETRIEVE_EXPORT != 0) then OOPs of non-special objects for which an object report header is returned in the traversal buffer are automatically added to the PureExportSet or the user action's export set (see **GciSaveObjs**). The value of *retrievalFlags* should

be given by using the following GemBuilder mnemonics:
GCI_RETRIEVE_DEFAULT
GCI_RETRIEVE_EXPORT
GCI_CLEAR_EXPORT causes the traversal to clear the PureExportSet or the user action's export set before it adds any OOPs to the traverse buffer.

Result Arguments

travArgs Pointer to an instance of **GciClampedTravArgsSType** containing the following result argument field:

GciTravBufType * *travBuff*
The buffer for the results of the traversal. 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

The **GciClampedTrav** function 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 5-408 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, page 5-199
GciSaveObjs, page 5-327

GciClampedTraverseObjs

Traverse an array of objects, subject to clamps.

This function is provided for compatibility with prior releases. New code should use **GciClampedTrav**.

Syntax

```
BoolType GciClampedTraverseObjs(
      OopType                  clampSpec,
      const OopType            theOops[ ],
      int                      numOops,
      GciTravBufType *         travBuff,
      int                      level );
```

Input Arguments

clampSpec	The OOP of the Smalltalk ClampSpecification to be used.
theOops	An array of OOPs representing the objects to traverse.
numOops	The number of elements in *theOops*.
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.

Result Arguments

travBuff	The buffer for the results of the traversal. 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**. If a given object report represents a clamped object, the *valueBuffSize* of the report is zero. The *idxSize* of the report is filled in with the *varyingSize* for simple objects such as Array, String, IdentityBag, IdentitySet, and some kinds of ObjectDictionary. For details about the object information and object report structures, see the discussion beginning on page 5-16. If the report array would otherwise be empty, a single object report is created for the object nil.

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

The **GciClampedTraverseObjs** function initiates a traversal of the specified objects, subject to the clamps in the specified ClampSpecification. If you specify OOP_NIL as the *clampSpec* parameter, the function behaves identically to **GciTraverseObjs**. 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 the **GciTraverseObjs** function for a detailed discussion of object traversal.

GciClampedTraverseObjs provides automatic byte swizzling for Float and SmallFloat objects. (For more about byte swizzling, see page 1-11.)

GemBuilder clamped traversal functions are intended primarily for GemStone internal use.

See Also

GciTraverseObjs, page 5-408
GciNbClampedTraverseObjs, page 5-205
GciNbTraverseObjs, page 5-236

GciClampedTravRefs

Traverse an array of objects, subject to clamps, while modifying the PureExportSet and ReferencedSet.

Syntax

BoolType GciClampedTravRefs(
    GciClampedTravArgsSType **args*);

Input Arguments

args	Pointer to an instance of **GciClampedTravArgsSType**, which if called to complete a call to **GciStoreTravDoTravRefs**, must be the same instance used in that call. For details, refer the discussion of GciClampedTrav on page 5-48.

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

The **GciClampedTravRefs** function initiates a traversal of the specified objects, subject to the clamps in the specified ClampSpecification. It is similar to GciClampedTrav, but also modifies the PureExportSet and ReferencedSet, and does not return objects already in the PureExportSet; see the comments `gci.hf` for details. This function is primarily intended to be used following a call to **GciStoreTravDoTravRefs**.

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

GciClampedTrav, page 5-48
GciMoreTraversal, page 5-199
GciStoreTravDoTravRefs, page 5-389

GciClassMethodForClass

Compile a class method for a class.

Syntax

```
OopType GciClassMethodForClass(
    OopType             source,
    OopType             oclass,
    OopType             category,
    OopType             symbolList );
```

Input Arguments

source	The OOP of a Smalltalk string to be compiled as a class method.
oclass	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 (that is, an Array of instances of SymbolListDictionary). 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

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 *GemStone/S 64 Bit Programming Guide* for a list of the optimized selectors.

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

Example

```
void GciClassMethodForClass_example(void)
{
  // Assumes the topaz code for GciFetchVaryingOop example
  // has been executed.

  OopType theClass = GciResolveSymbol("Component", OOP_NIL);
  OopType oCateg = GciNewString("instance creation");
  // method to create a new instance with a specified part number
  OopType oMethodSrc = GciNewString(
"newWithNumber: aNum . | o | o := self new . o partNumber: aNum. ^
o");

  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

GciInstMethodForClass, page 5-183

GciClassNamedSize

Find the number of named instance variables in a class.

Syntax

```
int GciClassNamedSize(
      OopType                    oclass );
```

Input Arguments

oclass	The OOP of the class from which to obtain information about instance variables. Appendix A, “Reserved OOPs,” lists the OOP of each Smalltalk kernel class.

Return Value

Returns the number of named instance variables in the class. In case of error, this function returns zero.

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, page 5-191

GciClearStack

Clear the Smalltalk call stack.

Syntax

```
void GciClearStack(
    OopType                    process );
```

Input Arguments

process	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.category == OOP_GEMSTONE_ERROR_CAT &&
      errInfo.number == RT_ERR_GENERIC_ERROR) {
    // 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, page 5-67
GciSoftBreak, page 5-345

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, page 5-28
GCI_CHR_TO_OOP, page 5-47
GciNbAbort, page 5-202
GciNbCommit, page 5-209

GciCompress

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

Syntax

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

Input Arguments

dest	Pointer to the buffer intended to 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.

Result Arguments

dest	The resulting compressed 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, page 5-413

GciContinue

Continue code execution in GemStone after an error.

Syntax

```
OopType GciContinue(
    OopType                    process );
```

Input Arguments

process	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 1-16.

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 the **GciClearStack** function on page 5-60.

See Also

GciClearStack, page 5-60
GciErr, page 5-99
GciExecute, page 5-101
GciNbContinue, page 5-210
GciNbExecute, page 5-214

GciContinueWith

Continue code execution in GemStone after an error.

Syntax

```
OopType GciContinueWith (
    OopType           process,
    OopType           replaceTopOfStack,
    int               flags,
    GciErrSType *     error );
```

Input Arguments

process	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 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**.
error	If not NULL, continue with an 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

GciContinue, page 5-67
GciErr, page 5-99
GciExecute, page 5-101
GciNbContinueWith, page 5-211
GciNbExecute, page 5-214
GciPerformNoDebug, page 5-280

GciCreateByteObj

Create a new byte-format object.

Syntax

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

Input Arguments

oclass	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 <= 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 (*objId*) previously obtained from **GciGetFreeOop** or **GciGetFreeOops**. For more about the semantics of such object identifiers, see the **GciGetFreeOop** function on page 5-166.

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, LargePositiveInteger, and LargeNegativeInteger, 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, page 5-73
GciGetFreeOop, page 5-166
GciGetFreeOops, page 5-168

GciCreateOopObj

Create a new pointer-format object.

Syntax

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

Input Arguments

oclass	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 <= 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 the **GciGetFreeOop** function on page 5-166.

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, page 5-71
GciGetFreeOop, page 5-166
GciGetFreeOops, page 5-168

GciCTimeToDateTime

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

Syntax

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

Input Arguments

arg	The C time value to be converted.

Result Arguments

result	A pointer to the C struct in which to place 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.

GciDateTimeToCTime

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

Syntax

```
time_t GciDateTimeToCTime(
    const GciDateTimeSType *arg );
```

Input 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.

GciDbgEstablish

Specify the debugging function for GemBuilder to execute before most calls to GemBuilder functions.

Syntax

```
GciDbgFuncType * GciDbgEstablish(
    GciDbgFuncType *        newDebugFunc );
```

Input 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 **GciDbgEstablish** itself.

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.

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*.

To disable previous debugging routines, your program can use the following statement:

```
GciDbgEstablish(NULL);
```

Example

```
void traceGciFunct(const char* gciFname)
{
  printf("trace gci call %s \n", gciFname);
}

void debugEstablishExample(void)
{
  GciDbgEstablish(traceGciFunct); // enable tracing

  GciFetchSize_(OOP_CLASS_STRING);  // this call will be traced

  GciDbgEstablish(NULL);  // shut off tracing
}
```

See Also

GciDbgEstablishToFile, page 5-79
GciErr, page 5-99

GciDbgEstablishToFile

Write trace information for most GemBuilder functions to a file.

Syntax

```
BoolType GciDbgEstablishToFile(
    const char *                fileName );
```

Input 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, your program can use the following statement:

```
GciDbgEstablishToFile(NULL);
```

Alternatively, your program can call**GciShutdown**.

For details about the trace information generated, see **GciDbgEstablish**.

See Also

GciDbgEstablish, page 5-77
GciErr, page 5-99

GciDbgLogString

Pass a message to a trace function.

Syntax

```
void GciDbgLogString(
    const char *            message);
```

Input 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, page 5-77
GciDbgEstablishToFile, page 5-79

GciDecodeOopArray

Decode an OOP array that was previously run-length encoded.

Syntax

```
int GciDecodeOopArray(
      OopType *              encodedOopArray,
      const int              numEncodedOops,
      OopType *              decodedOopArray,
      const int              decodedOopArraySize);
```

Input Arguments

encodedOopArray	An OOP array that was encoded by a call to **GciEncodeOopArray**.
numEncodedOops	The number of OOPs in *encodedOopArray*.
decodedOopArraySize	The maximum number of OOPs in *decodedOopArray*.

Result Arguments

decodedOopArray	The decoded OOP array that had been run-length encoded.

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, page 5-130
GciEnableFreeOopEncoding, page 5-93
GciEncodeOopArray, page 5-97
GciGetFreeOopsEncoded, page 5-170

GciDecSharedCounter

Decrement the value of a shared counter.

Syntax

```
BoolType GciDecSharedCounter(
      int64_t          counterIdx,
      int64_t *        value,
      int64_t *        floor);
```

Input 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.
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.

Result Arguments

value	Pointer to a value that indicates the new value of the shared counter, after the decrement.

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, page 5-131
GciIncSharedCounter, page 5-177
GciSetSharedCounter, page 5-341
GciReadSharedCounter, page 5-300
GciReadSharedCounterNoLock, page 5-301
GciFetchSharedCounterValuesNoLock, page 5-150

GciDirtyExportedObjs

Find all objects in the ExportedDirtyObjs set.

Syntax

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

Input Arguments

numOops	The maximum number of objects that can be put into *theOops* buffer.

Result Arguments

theOops	An array of the dirty exported objects found.
numOops	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 **GciDirtyAlteredObjs**, **GciDirtyExportedObjs**, **GciDirtyObjsInit**, **GciDirtySaveObjs**, or **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 1-32
GciDirtyObjsInit, page 5-87
GciDirtySaveObjs, page 5-89
GciDirtyTrackedObjs, page 5-91
GciTrackedObjsFetchAllDirty, page 5-405
GciHiddenSetIncludesOop, page 5-174
GciReleaseAllGlobalOops, page 5-303
GciSaveGlobalObjs, page 5-326
GciSaveObjs, page 5-327

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, page 5-85
GciDirtySaveObjs, page 5-89

GciTrackedObjsFetchAllDirty, page 5-405
GciHiddenSetIncludesOop, page 5-174

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 );
```

Input Arguments

numOops	The number of objects that can be put into *theOops* buffer.

Result Arguments

theOops	An array of the dirty cached objects found.
numOops	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

GciDirtySaveObjs 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**; it is cleared by calls to **GciDirtyAlteredObjs**, **GciDirtyExportedObjs**, **GciDirtySaveObjs** (this function), or **GciTrackedObjsFetchAllDirty**. The TrackedDirtyObjs set is initialized by

GciTrackedObjsInit and 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 1-32
GciDirtyExportedObjs, page 5-85
GciDirtyObjsInit, page 5-87
GciDirtyTrackedObjs, page 5-91
GciTrackedObjsFetchAllDirty, page 5-405
GciSaveObjs, page 5-327

GciDirtyTrackedObjs

Find all tracked objects that have changed and are therefore in the TrackedDirtyObjs set.

Syntax

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

Input Arguments

numOops	The maximum number of objects that can be put into *theOops* buffer.

Result Arguments

theOops	An array of the dirty tracked objects found.
numOops	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 1-32
GciDirtySaveObjs, page 5-89
GciHiddenSetIncludesOop, page 5-174
GciReleaseAllTrackedOops, page 5-305
GciSaveAndTrackObjs, page 5-324
GciTrackedObjsFetchAllDirty, page 5-405
GciTrackedObjsInit, page 5-407

GciEnableFreeOopEncoding

Enable run-length encoding of free OOPs.

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.

See Also

GciDecodeOopArray, page 5-81
GciEncodeOopArray, page 5-97
GciFetchNumEncodedOops, page 5-130
GciGetFreeOopsEncoded, page 5-170

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.

See Also

GciIsRemote, page 5-188

GciEnableSignaledErrors

Establish or remove GemBuilder visibility to signaled errors from GemStone.

Syntax

```
BoolType GciEnableSignaledErrors(
    BoolType                newState );
```

Input 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 **GciLongJmp** 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, page 5-99
GciPollForSignal, page 5-290

GciEncodeOopArray

Encode an array of OOPs, using run-length encoding.

Syntax

```
int GciEncodeOopArray(
      OopType *            oopArray,
      const int            numOops,
      OopType *            encodedOopArray,
      BoolType             needsSorting );
```

Input Arguments

oopArray	An OOP array to be encoded.
numOops	The number of OOPs in *oopArray*.
needsSorting	If *oopArray* is known to be in ascending order, set this to FALSE; otherwise set it to TRUE.

Result Arguments

encodedOopArray	The encoded OOP array.

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, page 5-81
GciEnableFreeOopEncoding, page 5-93
GciFetchNumEncodedOops, page 5-130
GciGetFreeOopsEncoded, page 5-170

GciErr

Prepare a report describing the most recent GemBuilder error.

Syntax

```
BoolType GciErr(
    GciErrSType *          errorReport );
```

Result 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 **StoreTravDoTravRefs** or traversal with GCI_TRAV_WITH_REF_SET, 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 GCI_INVALID_SESSION_ID.

The **GciErr** function is especially useful when error traps are disabled or are not present. See “GciPopErrJump” on page 5-292 for information about using general-purpose error traps in GemBuilder. The section “The Error Report Structure” on page 5-15 describes the C structure for error reports.

See Also

GciClearStack, page 5-60
GciContinue, page 5-67
GciExecute, page 5-101
GciPopErrJump, page 5-292

GciExecute

Execute a Smalltalk expression contained in a String object.

Syntax

```
OopType GciExecute(
    OopType          source,
    OopType          symbolList );
```

Input Arguments

source	The OOP of a String containing a sequence of one or more statements to be executed.
symbolList	The OOP of a GemStone symbol list (that is, an Array of instances of SymbolListDictionary). The compiler uses the *symbolList* to resolve symbolic references in the code in *source*. 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 object (see the following example.) If the source is already a String 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 1-16.

Example

```
void executeExample(void)
{
  OopType oString = GciNewString(" ^ 3 + 4 ");

  OopType result = GciExecute(oString, OOP_NIL);
  if (result == OOP_NIL) {
    printf("error from execution\n");
  } else {
    BoolType conversionErr = FALSE;
    int val = GciOopToI32_(result, &conversionErr);
    if (conversionErr) {
      printf("Error converting result to C int\n");
    } else {
      printf("result = %d\n", val);
    }
  }
}
```

See Also

GciContinue, page 5-67
GciErr, page 5-99
GciExecuteFromContext, page 5-103
GciExecuteStr, page 5-105
GciExecuteStrFromContext, page 5-107
GciNbContinue, page 5-210
GciNbExecute, page 5-214
GciNbExecuteStr, page 5-216
GciNbExecuteStrFromContext, page 5-218

GciExecuteFromContext

Execute a Smalltalk expression contained in a String object as if it were a message sent to another object.

Syntax

```
OopType GciExecuteFromContext(
    OopType            source,
    OopType            contextObject,
    OopType            symbolList );
```

Input Arguments

source	The OOP of a String containing a sequence of one or more statements to be executed.
contextObject	The OOP of any GemStone object.
symbolList	The OOP of a GemStone symbol list (that is, an Array of instances of SymbolListDictionary). The compiler uses the *symbolList* to resolve symbolic references in the code in *source*. 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 object (see the following example.) If the source is already a String 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 1-16.

See Also

GciContinue, page 5-67
GciErr, page 5-99
GciExecute, page 5-101
GciExecuteStr, page 5-105
GciExecuteStrFromContext, page 5-107
GciNbContinue, page 5-210
GciNbExecute, page 5-214
GciNbExecuteStr, page 5-216
GciNbExecuteStrFromContext, page 5-218

GciExecuteStr

Execute a Smalltalk expression contained in a C string.

Syntax

```
OopType GciExecuteStr(
    const char          source[ ],
    OopType             symbolList );
```

Input Arguments

source	A null-terminated string containing a sequence of one or more statements to be executed.
symbolList	The OOP of a GemStone symbol list (that is, an Array of instances of SymbolListDictionary). The compiler uses the *symbolList* to resolve symbolic references in the code in *source*. 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 1-16.

Example

```
void executeStrExample(void)
{
  // get the symbolList for UserProfile named ’romeo’
  OopType symbolList = GciExecuteStr(
"(AllUsers userWithId: ’romeo’) symbolList", OOP_NIL);

  // get the value associated with key "nativeLanguage" in that
  // symbolList ; values expected to be a kind of String
  OopType lang = GciExecuteStr("nativeLanguage", symbolList);

 // fetch characters of the String
  char buf[1024];
  GciFetchChars_(lang, 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("nativeLanuage is %s \n", buf);
  }
}
```

See Also

GciContinue, page 5-67
GciErr, page 5-99
GciExecute, page 5-101
GciExecuteFromContext, page 5-103
GciExecuteStrFromContext, page 5-107
GciNbContinue, page 5-210
GciNbExecute, page 5-214
GciNbExecuteStr, page 5-216
GciNbExecuteStrFromContext, page 5-218

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 );
```

Input Arguments

source	A null-terminated string containing a sequence of one or more statements to be executed.
contextObject	The OOP of any GemStone object.
symbolList	The OOP of a GemStone symbol list (that is, an Array of instances of SymbolListDictionary). The compiler uses the *symbolList* to resolve symbolic references in the code in *source*. 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 1-16.

Example

```
void executeFromContextExample(void)
{
  // get the Assocation 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

GciContinue, page 5-67
GciErr, page 5-99
GciExecute, page 5-101
GciExecuteFromContext, page 5-103
GciExecuteStr, page 5-105
GciNbContinue, page 5-210
GciNbExecute, page 5-214
GciNbExecuteStr, page 5-216
GciNbExecuteStrFromContext, page 5-218

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                source[ ],
    OopType                   contextObject,
    OopType                   symbolList,
    GciClampedTravArgsSType *travArgs );
```

Input Arguments

source	A null-terminated string containing a sequence of one or more statements to be executed.
contextObject	The OOP of any GemStone object. A value of OOP_ILLEGAL means no context.
symbolList	The OOP of a GemStone symbol list (that is, an Array of instances of SymbolDictionary). The compiler uses the *symbolList* to resolve symbolic references in the code in *source*. 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** containing the following input argument fields:

OopType	*clampSpec* The OOP of the Smalltalk ClampSpecification to be used, or OOP_NIL, if the traversal is to operate without clamping.
int	*level* Maximum traversal depth. When the level is 1, an object report is written to the traversal buffer for each element in the array of OOPs representing the objects to traverse. 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.

int	*retrievalFlags* Flags to control object retrieval. The value of *retrievalFlags* should be given by using the following GemBuilder mnemonics: GCI_RETRIEVE_DEFAULT GCI_RETRIEVE_EXPORT GCI_CLEAR_EXPORT causes the traversal to clear the PureExportSet or the user action's export set before it adds any OOPs to the traverse buffer.

Result Arguments

travArgs Pointer to an instance of **GciClampedTravArgsSType** containing the following result argument field:

ByteType *	*travBuff* The buffer for the results of the traversal. 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

GciExecuteStr, page 5-105
GciMoreTraversal, page 5-199
GciPerformTrav, page 5-284

GciFetchByte

Fetch one byte from an indexed byte object.

Syntax

```
ByteType GciFetchByte(
      OopType              theObject,
      int64                atIndex );
```

Input 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_, page 5-114
GciStoreByte, page 5-349
GciStoreBytes, page 5-351

GciFetchBytes_

Fetch multiple bytes from an indexed byte object.

Syntax

```
int64 GciFetchBytes_(
      OopType          theObject,
      int64            startIndex,
      ByteType         theBytes[ ],
      int64            numBytes );
```

Input 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.
numBytes	The maximum number of bytes to return.

Result Arguments

theBytes	The array of fetched bytes

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

NOTE

In previous GemStone/S 64 Bit releases, this function was named **GciFetchBytes** *(without the underscore). Customers must ensure that the variables that receive this function's result are large enough to accommodate an int64 value.*

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 Float or SmallFloat, but it does not provide automatic byte swizzling. In that case, you must provide your own byte swizzling as needed. Alternatively, you can call **GciFetchObjInfo** instead, and that function will provide any necessary byte swizzling. (For more about byte swizzling, see page 1-11.)

Example

This example illustrates a C function that incrementally processes a GemStone String of arbitrary size, while using a limited amount of C memory space.

```
void displayByteObject(OopType oObject)
{
  enum { BUF_SIZE =  5000 };
  char displayBuff[BUF_SIZE];

  BoolType done = FALSE;
  int idx = 1;
  while (! done) {
    int64 numRet = GciFetchBytes_(oObject, idx,
(ByteType*)displayBuff,
            BUF_SIZE - 1);
    if (numRet == 0) {
      done = TRUE;  // hit end of object or error
      GciErrSType errInfo;
      if (GciErr(&errInfo)) {
        printf("unexpected error category "FMT_OID" number %d,
%s\n",
    errInfo.category, errInfo.number, errInfo.message);
      }
    } else {
      displayBuff[numRet] = ’\0’;
      printf("%s\n", displayBuff);
      idx += numRet;
    }
  }
}
```

See Also

GciFetchByte, page 5-112
GciFetchObjInfo, page 5-135
GciStoreByte, page 5-349
GciStoreBytes, page 5-351

GciFetchChars_

Fetch multiple ASCII characters from an indexed byte object.

Syntax

```
int64 GciFetchChars_(
      OopType               theObject,
      int64                 startIndex,
      char *                cString,
      int64                 maxSize );
```

Input Arguments

theObject	The OOP of a text object.
startIndex	The index of the first character to retrieve.
maxSize	Maximum number of characters to fetch.

Result Arguments

cString	Pointer to the location in which to store the returned string.

Return Value

Returns the number of characters fetched.

Description

NOTE
In previous GemStone/S 64 Bit releases, this function was named **GciFetchChars** *(without the underscore). Customers must ensure that the variables that receive this function's result are large enough to accommodate an int64 value.*

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

GciFetchBytes_, page 5-114

GciFetchClass

Fetch the class of an object.

Syntax

```
OopType GciFetchClass(
    OopType                theObject );
```

Input Arguments

theObject	The OOP of the specified object.

Return Value

Returns the OOP of the object's class. In case of error, this function returns OOP_NIL.

The GemBuilder include file `gcioop.ht` defines a C constant for each of the Smalltalk kernel classes. Those C constants are listed in Appendix A, "Reserved OOPs."

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
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

GciFetchNamedSize, page 5-128
GciFetchObjImpl, page 5-134
GciFetchSize_, page 5-152
GciFetchVaryingSize_, page 5-159

GciFetchDateTime

Convert the contents of a DateTime object and place the results in a C structure.

Syntax

```
void GciFetchDateTime(
    OopType             datetimeObj,
    GciDateTimeSType *  result );
```

Input Arguments

datetimeObj	OOP of the object to fetch.

Result Arguments

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.

GciFetchNamedOop

Fetch the OOP of one of an object's named instance variables.

Syntax

```
OopType GciFetchNamedOop(
    OopType                 theObject,
    int                     atIndex );
```

Input Arguments

theObject	The OOP of the GemStone 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

In the following example, assume that you've defined the class Component and populated the set AllComponents, as shown in the example for the **GciFetchVaryingOop** function on page 5-154.

```
void fetchNamedOopExample(void)
{
  // C constants to match Smalltalk class definition
  enum { COMPONENT_OFF_PARTNUMBER = 1,
         COMPONENT_OFF_NAME       = 2,
         COMPONENT_OFF_COST       = 3 };

  // retrieve a random instance of class Component
  OopType aComponent = GciExecuteStr(
"AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);
  if (aComponent == OOP_NIL) {
    // error during execution or detect found nothing
    return;
  }

  // fetch the name instance variable of aComponent
  OopType oName = GciFetchNamedOop(aComponent,
COMPONENT_OFF_NAME);

  // fetch nameinstance variable without fixing its offset at C
compile time
  int ivOffset = GciIvNameToIdx(GciFetchClass(aComponent),
"name");
  oName = GciFetchNamedOop(aComponent, ivOffset);
}
```

See Also

GciFetchNamedOops, page 5-125
GciFetchVaryingOop, page 5-154
GciFetchVaryingOops, page 5-157
GciIvNameToIdx, page 5-191
GciStoreIdxOop, page 5-357
GciStoreIdxOops, page 5-359

GciStoreNamedOop, page 5-362
GciStoreNamedOops, page 5-365

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 );
```

Input Arguments

theObject	The OOP of the source GemStone 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 number of the object's named instance variables, this function returns an array of size 0, but no error is generated.
numOops	The maximum number of elements to return.

Result Arguments

theOops	The array of fetched OOPs.

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

In the following example, assume that you've defined the class Component and populated the set AllComponents, as shown in the example for the **GciFetchVaryingOop** function on page 5-154.

```
void fetchNamedOops_example(void)
{
  // retrieve a random instance of class Component
  OopType aComponent = GciExecuteStr(
"AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);
  if (aComponent == OOP_NIL) {
    // execution error, or detect: found nothing
    return;
  }

  // fetch name instance variables without knowing offset at C
compile time
  int namedSize = GciFetchNamedSize(aComponent);
  if (namedSize == 0) {
    // error during fetch
    return;
  }
  OopType *oBuffer = (OopType*) malloc( sizeof(OopType) *
namedSize );
  if (oBuffer != NULL) {
    int numRet = GciFetchNamedOops(aComponent, 1, oBuffer,
namedSize);
    if (numRet != namedSize) {
      // error during fetch
    } else {
      // do something with contents of oBuffer
    }
    free(oBuffer);
  } else {
    // malloc failure
  }
}
```

See Also

GciFetchNamedOop, page 5-122
GciFetchVaryingOop, page 5-154
GciIvNameToIdx, page 5-191
GciStoreIdxOop, page 5-357
GciStoreNamedOop, page 5-362

GciFetchNamedSize

Fetch the number of named instance variables in an object.

Syntax

```
int GciFetchNamedSize(
      OopType                    theObject );
```

Input Arguments

theObject	The OOP of the specified 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 the **GciFetchNamedOops** function on page 5-125.

GciFetchNameOfClass

Fetch the class name object for a given class.

Syntax

```
OopType GciFetchNameOfClass(
    OopType                    aClass );
```

Input 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 );
```

Input Arguments

encodedOopArray	An OOP array that was encoded by a call to **GciEncodeOopArray**.

Result Arguments

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, page 5-81
GciEnableFreeOopEncoding, page 5-93
GciEncodeOopArray, page 5-97
GciGetFreeOopsEncoded, page 5-170

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, page 5-83
GciIncSharedCounter, page 5-177
GciSetSharedCounter, page 5-341
GciReadSharedCounter, page 5-300
GciReadSharedCounterNoLock, page 5-301
GciFetchSharedCounterValuesNoLock, page 5-150

GciFetchObjectInfo

Fetch information and values from an object.

Syntax

```
BoolType GciFetchObjInfo(
     OopType                        theObject,
     GciFetchObjInfoArgsSType *args );
```

Input Arguments

theObject	OOP of any object with byte, pointer, or NSC format.
args	Pointer to an instance of **GciFetchObjInfoArgsSType** with the following input argument fields:

int64	*startIndex* The offset in the object at which to start fetching, using **GciFetchOops** or **GciFetchBytes_** semantics. *startIndex* is 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 greater than zero, and if a Float or BinaryFloat is being fetched, it must be large enough to fetch the complete object.
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 the **GciSaveObjs** function).

Result Arguments

args	Pointer to an instance of **GciFetchObjInfoArgsSType** with the following result argument fields:

GciObjInfoSType	**info* Pointer to an instance of **GciObjInfoSType**; may be NULL.
ByteType *	*buffer* Pointer to an area where byte or OOP values will be returned; may be NULL.
int64	*numReturned* Number of logical elements (bytes or OOPs) returned in buffer. Remember that the size of (**OopType**) is 8 bytes.

If either *info* or *buffer* is NULL, that portion of the result is not filled in.

Return Value

TRUE if successful, FALSE if an error occurs.

Description

This function 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.

See Also

GciFetchOops, page 5-140
GciFetchBytes_, page 5-114
GciFetchObjInfo, page 5-135
GciSaveObjs, page 5-327

GciFetchObjImpl

Fetch the implementation of an object.

Syntax

```
int GciFetchObjImpl(
    OopType              theObject );
```

Input Arguments

theObject	The OOP of the specified 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 undefined.

Description

This function obtains the implementation of an object (pointer, byte, NSC, special) from GemStone. For more information about implementation types, see “Direct Access to Metadata” on page 1-18.

See Also

GciFetchClass, page 5-119
GciFetchNamedSize, page 5-128
GciFetchSize_, page 5-152
GciFetchVaryingSize_, page 5-159

GciFetchObjInfo

Fetch information and values from an object.

Syntax

```
BoolType GciFetchObjInfo(
    OopType              theObject,
    int64                startIndex,
    int64                bufSize,
    GciObjInfoSType *    info,
    ByteType *           buffer,
    int64 *              numReturned );
```

Input Arguments

theObject	OOP of any object with byte, pointer, or NSC format.
startIndex	The index into *theObject* at which to begin fetching elements. (The index of the first element is 1.) If the start index is 1 greater than the size of the object, this function returns an array of size 0, but no error is generated.
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* / 4.

Result Arguments

info	Pointer to an instance of **GciObjInfoSType**; may be NULL.
buffer	Pointer to an area where byte or OOP values will be returned; may be NULL.
numReturned	Number of logical elements (bytes or OOPs) returned in buffer. Remember that the sizeof(**OopType**) is 4 bytes.

Return Value

TRUE if successful, FALSE if an error occurs. If an error occurs, *info*, *buffer*, and *numReturned* are undefined.

Description

This function 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.

GciFetchObjInfo provides automatic byte swizzling for Float and SmallFloat objects. (For more about byte swizzling, see page 1-11.) If *theObject* is a Float or SmallFloat, then *startIndex* must be one and *bufSize* must be the actual size for the class of *theObject*. If either of these conditions are not met, then **GciFetchObjInfo** raises an error as a safety check.

GciFetchOop

Fetch the OOP of one instance variable of an object.

Syntax

```
OopType GciFetchOop(
      OopType                    theObject,
       int64                     atIndex );
```

Input 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

In the following example, assume that you've defined the class Component and populated the set AllComponents, as shown in the example for the **GciFetchVaryingOop** function on page 5-154.

```
void fetchOop_example(void)
{
  // C constant to match Smalltalk class definition
  enum {  COMPONENT_OFF_NAME = 2 };

  // retrieve a random instance of class Component
  OopType aComponent = GciExecuteStr(
"AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);
  if (aComponent == OOP_NIL) {
    // error during execution, select: found nothing
    return ;
  }

  // Two ways to fetch the name instance variable of aComponent */
  OopType oName = GciFetchOop(aComponent, COMPONENT_OFF_NAME);
  oName = GciFetchNamedOop(aComponent, COMPONENT_OFF_NAME);

  // Fetch the 3rd element of aComponent's partsList,
  // without knowing exactly how many named instance variables
exist.
  int namedSize = GciFetchNamedSize(aComponent);
  if (namedSize == 0) {
    // error during fetch
    return ;
  }
  OopType aSubComponent = GciFetchOop(aComponent, namedSize + 3);

  // alternate way to Fetch the 3rd element of aComponent's
partsList
  aSubComponent = GciFetchVaryingOop(aComponent, 3);
}
```

See Also

GciFetchOops, page 5-140
GciStoreOop, page 5-368
GciStoreOops, page 5-371

GciFetchOops

Fetch the OOPs of one or more instance variables of an object.

Syntax

```
int GciFetchOops(
      OopType        theObject,
      int64          startIndex,
      OopType        theOops[ ],
      int            numOops );
```

Input Arguments

theObject	The OOP of the source object.
startIndex	The index into *theObject* at which to begin fetching OOPs. The index of the first OOP is 1. If *startIndex* is 1 greater than the size of the object, this function returns an array of size 0, but no error is generated.
numOops	The maximum number of OOPs to return.

Result Arguments

theOops	The array of fetched OOPs.

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

In the following example, assume that you've defined the class Component and populated the set AllComponents, as shown in the example for the **GciFetchVaryingOop** function on page 5-154.

```
void fetchOops_example(void)
{
  // retrieve a random instance of class Component
  OopType aComponent = GciExecuteStr(
"AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);
  if (aComponent == OOP_NIL) {
    // error during execution, or detect: found nothing
    return ;
  }

  enum { BUF_SIZE = 60 };
  OopType oBuf[BUF_SIZE];

  int namedSize = GciFetchNamedSize(aComponent);
  if (namedSize == 0 || namedSize > 50) {
    // error during fetch, or too many named instVars for buffer
    return;
  }

  // Two ways to fetch first 5 elements of aComponent’s partsList
  GciFetchOops(aComponent, namedSize + 1, oBuf, 5);
  GciFetchVaryingOops(aComponent, 1, oBuf, 5);

  // Fetch the named instance variables PLUS
  //  the first 5 elements of partsList
  GciFetchOops(aComponent, 1, oBuf, namedSize + 5);
  // oBuf[0..namedSize-1] are named instVar values,
  // oBuf[namedSize] is first varying instVar value
}
```

See Also

GciFetchOop, page 5-137
GciFetchVaryingOop, page 5-154

GciStoreOop, page 5-368
GciStoreOops, page 5-371

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[ ] );
```

Input 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.

Result Arguments

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.

> *This function is most useful with applications that are linked with GciRpc (the "remote procedure call" version of* GemBuilder*). If your application will be linked with GciLnk (the "linkable"* GemBuilder*), you'll usually achieve best performance by using the simple* **GciFetch***... and* **GciStore***... functions instead. For more information, see "GciRpc and GciLnk" on page 2-1.*

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.

Examples

Example 1: Calling sequence for a single object and a single path

```
void fetchPath1(void)
{
  enum { path_size = 5 };
  int    aPath[path_size]; /* the path itself */
  int    aSize = path_size;    /* the size of the path */

  for (int j = 0; j < path_size; j++) {
    aPath[j] = j + 1;  // arbitrary offsets
  }
  OopType anOop; // the OOP to use as the root of the path
  anOop = GciExecuteStr("AllComponents detect:[:i|i partNumber =
1234]", OOP_NIL);
  if (anOop == OOP_NIL) {
    return; // error during resolve
  }

  OopType result;
  GciFetchPaths(&anOop, 1, aPath, &aSize, 1, &result);
}
```

Example 2: Calling sequence for multiple objects with a single path

```
void fetchPath2(void)
{
  OopType coll = GciResolveSymbol("AllComponents", OOP_NIL);
  if (coll == OOP_NIL) {
    return ; // error during resolve
  }
  enum { num_roots = 3 ,
         path_size = 5 };
  OopType oops[num_roots];
  int numRet = GciFetchVaryingOops(coll, 1, oops, num_roots);
  if (numRet != num_roots) {
    return; // error during fetch or collection too small
  }

  int  aPath[path_size];
  int  aSize = path_size;
  for (int j = 0; j < path_size; j++) {
    aPath[j] = 1;  // arbitrary offsets
  }
  OopType results[num_roots];
  GciFetchPaths(oops, num_roots, aPath, &aSize, 1, results);
}
```

Example 3: Calling sequence for a single object with multiple paths

```
void fetchPath3(void)
{
  OopType anOop; // the OOP to use as the root of the path
  anOop = GciExecuteStr("AllComponents detect:[:i|i partNumber = 
1234]", OOP_NIL);
  if (anOop == OOP_NIL) {
    return; // error during execution
  }

  enum { num_paths = 10,
 path_size = 5 };

  int pathSizes[num_paths];
  int paths[path_size * num_paths ];
  int idx = 0;
  for (int j = 0; j < num_paths; j++) {
    for (int k = 0; k < path_size; k++) {
      paths[idx++] = k + 1;  // arbitrary offset
    }
  }
  OopType results[num_paths];
  GciFetchPaths (&anOop, 1, paths, pathSizes, num_paths, results);
}
```

Example 4: Calling sequence for multiple objects with multiple paths

```
void fetchPath4(void)
{
  OopType coll = GciResolveSymbol("AllComponents", OOP_NIL);
  if (coll == OOP_NIL) {
    return ; // error during resolve
  }

  enum { num_roots = 10,
         num_paths = 3,
         path_size = 5 };

  OopType oops[num_roots];
  int numRet = GciFetchVaryingOops(coll, 1, oops, num_roots);
  if (numRet != num_roots) {
    return; // error during fetch or collection too small
  }

  int pathSizes[num_paths];
  int paths[path_size * num_paths ];
  int idx = 0;
  for (int j = 0; j < num_paths; j++) {
    for (int k = 0; k < path_size; k++) {
      paths[idx++] = k + 1;  // arbitrary offset
    }
  }

  OopType results[num_roots * num_paths];
  GciFetchPaths(oops, num_roots, paths, pathSizes, num_paths,
results);
}
```

Example 5: Integrated Code

In the following example, assume that you've defined the class Component and populated the set AllComponents, as shown in the example for the **GciFetchVaryingOop** function on page 5-154.

```
void fetchPath5(void)
{
  // retrieve a random instance of class Component */
  OopType aComponent = GciExecuteStr(
"AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);
  if (aComponent == OOP_NIL) {
    return; // error in execute, or detect: found nothing
  }

  // fetch name instVar of 5th element of aComponent's partsList
*/
  enum { path_size = 2 };
  int path[path_size];
  path[0] = -5;  // 5th varying instVar
  path[1] = GciIvNameToIdx(GciFetchClass(aComponent), "name");
  int pathSizes = path_size;

  OopType oName;
  GciFetchPaths(&aComponent, 1, path, &pathSizes, 1, &oName);
};
```

See Also

GciStorePaths, page 5-374

GciFetchSharedCounterValuesNoLock

Fetch the value of multiple shared counters without locking them.

Syntax

```
int GciFetchSharedCounterValuesNoLock(
      int                 startIndex,
      int64_t             buffer[ ],
      size_t *            maxReturn);
```

Input Arguments

startIndex	The offset into the shared counters array of the first shared counter value to fetch.
maxReturn	Pointer to a value that indicates the maximum number of shared counters to fetch.

Result Arguments

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.

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

GciFetchNumSharedCounters, page 5-131
GciDecSharedCounter, page 5-83
GciIncSharedCounter, page 5-177
GciSetSharedCounter, page 5-341
GciReadSharedCounter, page 5-300
GciReadSharedCounterNoLock, page 5-301

GciFetchSize_

Fetch the size of an object.

Syntax

```
int64 GciFetchSize_(
    OopType              theObject );
```

Input Arguments

theObject	The OOP of the specified 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.

NOTE
In previous GemStone/S 64 Bit releases, this function was named **GciFetchSize** *(without the underscore). Customers must ensure that the variables that receive this function's result are large enough to accommodate an int64 value.*

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 5.11:

Table 5.11 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, page 5-119
GciFetchNamedSize, page 5-128
GciFetchObjImpl, page 5-134
GciFetchVaryingOop, page 5-154

GciFetchVaryingOop

Fetch the OOP of one unnamed instance variable from an indexable pointer object or NSC.

Syntax

```
OopType GciFetchVaryingOop(
    OopType            theObject,
    int64              atIndex );
```

Input Arguments

theObject	The OOP of the pointer object or NSC.
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

In the following example, assume that you've executed the following Smalltalk code to define the class Component and to populate the set AllComponents:

```
run
" define the class Component and compile accessor methods"
| cls |
cls := Array subclass: #Component
   instVarNames: #(#partNumber #name #cost
               "varying instVars form the partsList")
   classVars: #()
   poolDictionaries: #()
   inDictionary: UserGlobals
   constraints: #[#[#partNumber, SmallInteger],
                  #[#name, String], #[#cost, Number]]
    isInvariant: false .
cls compileAccessingMethodsFor: cls instVarNames .
^ cls
%
run
"create and populate the set of all Components"
| allC |
allC := IdentitySet new .
UserGlobals at: #AllComponents put: allC .
1 to: 100 do:[:j || aComp |
  aComp := Component new .
  aComp partNumber: 1200 + j .
  aComp name: 'part' + j asString .
  aComp cost: j asFloat .
  allC add: aComp .
] .
^ allC size
%
run
"build a parts list for each part."
| allC idx |
allC := Array withAll: AllComponents .
idx := 1 .
AllComponents do:[ :aComp | | list |
  list := Array new: (idx \\ 10 ) .  "list size varies from 0 to
9"
```

```
  idx > 75 ifTrue:[ idx := 1 ].
  1 to: list size do:[:k |
    list at: k put: (allC at: idx + (k * 2)).
  ].
  aComp addAll: list .
  idx := idx + 1.
].
%
```

Now execute this C code:

```
OopType fetchVaryingOopExample(void)
{
  // retrieve a random instance of class Component */
  OopType aComponent = GciExecuteStr(
        "AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);
  if (aComponent == OOP_NIL) {
    return OOP_NIL; // error in execute, or detect: found nothing
  }

  /* fetch 3rd element of aComponent’s parts list */
  OopType aSubComponent = GciFetchVaryingOop(aComponent, 3);
  return aSubComponent;
}
```

See Also

GciFetchNamedOop, page 5-122
GciFetchNamedOops, page 5-125
GciFetchVaryingOops, page 5-157
GciStoreIdxOop, page 5-357
GciStoreIdxOops, page 5-359
GciStoreNamedOop, page 5-362
GciStoreNamedOops, page 5-365

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 );
```

Input Arguments

theObject	The OOP of the pointer object or NSC.
startIndex	The index of the first OOP to be fetched. The index of the first unnamed instance variable's OOP is 1. Note that if *startIndex* is 1 greater than the number of *theObject*'s unnamed instance variables, this function returns an array of size 0, but no error is generated.
numOops	Maximum number of elements to return.

Result Arguments

theOops	The array of fetched OOPs.

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

In the following example, assume that you've defined the class Component and populated the set AllComponents, as shown in the example for the **GciFetchVaryingOop** function on page 5-154.

```
int fetchVaryingOopsExample(void)
{
  // retrieve a random instance of class Component */
  OopType aComponent = GciExecuteStr(
        "AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);
  if (aComponent == OOP_NIL) {
    return -1; // error in execute, or detect: found nothing
  }

  /* fetch the up to the first 5 elements of aComponent's parts
list */
  enum { num_oops = 5 };
  OopType oBuf[num_oops];

  int numRet = GciFetchVaryingOops(aComponent, 1, oBuf, num_oops);
  // at this point we have   0 <= numRet <= 5
  return numRet;
}
```

See Also

GciFetchNamedOop, page 5-122
GciFetchNamedOops, page 5-125
GciFetchVaryingOop, page 5-154
GciStoreIdxOop, page 5-357
GciStoreIdxOops, page 5-359
GciStoreNamedOop, page 5-362
GciStoreNamedOops, page 5-365

GciFetchVaryingSize_

Fetch the number of unnamed instance variables in a pointer object or NSC.

Syntax

```
int64 GciFetchVaryingSize_(
    OopType                    theObject );
```

Input Arguments

theObject	The OOP of the specified object.

Return Value

Returns the number of unnamed instance variables in *theObject*. In case of error, this function returns zero.

Description

NOTE

In previous GemStone/S 64 Bit releases, this function was named **GciFetchVaryingSize** *(without the underscore). Customers must ensure that the variables that receive this function's result are large enough to accommodate an int64 value.*

The **GciFetchVaryingSize_** function obtains from GemStone the number of indexed variables in an indexable object or the number of unordered variables in an NSC.

Example

In the following example, assume that you've defined the class Component and populated the set AllComponents, as shown in the example for the **GciFetchVaryingOop** function on page 5-154.

```
int64 fetchVaryingSizeExample(void)
{

  // retrieve a random instance of class Component */
  OopType aComponent = GciExecuteStr(
        "AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);
  if (aComponent == OOP_NIL) {
    return -1; // error in execute, or detect: found nothing
  }

  /* fetch the size of aComponent's partsList */
  int64 theSize = GciFetchVaryingSize_(aComponent);
  return theSize;
}
```

See Also

GciFetchClass, page 5-119
GciFetchNamedSize, page 5-128
GciFetchObjImpl, page 5-134
GciFetchSize_, page 5-152
GciSetVaryingSize, page 5-343

GciFindObjRep

Fetch an object report in a traversal buffer.

Syntax

GciObjRepHdrSType * GciFindObjRep(
    GciTravBufType * *travBuff*,
    OopType *theObject*);

Input 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 GCI_ERR_TRAV_OBJ_NOT_FOUND.

NOTE
This function is most useful with applications that are linked with GciRpc (the "remote procedure call" version of GemBuilder*). If your application will be linked with GciLnk (the "linkable"* GemBuilder*), you'll usually achieve best performance by using the simple* **GciFetch**... *and* **GciStore**... *functions rather than object traversal. For more information, see "GciRpc and GciLnk" on page 2-1.*

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

GciMoreTraversal, page 5-199
GciObjRepSize_, page 5-256
GciTraverseObjs, page 5-408

GciFloatKind

Obtain the float kind corresponding to a C double value.

Syntax

```
GciFloatKindEType GciFloatKind(
    double                    aReal );
```

Input 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, page 5-164
GciOopToFlt, page 5-269

GciFltToOop

Convert a C double value to a SmallDouble or Float object.

Syntax

```
OopType GciFltToOop(
    double                    aReal );
```

Input Arguments

aReal	The floating point value to be translated into an object.

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, page 5-269
GciGetFreeOopsEncoded, page 5-170

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. 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 **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, page 5-71
GciCreateOopObj, page 5-73
GciGetFreeOops, page 5-168
GciGetFreeOopsEncoded, page 5-170

GciGetFreeOops

Allocate multiple OOPs.

Syntax

```
void GciGetFreeOops(
    int             count,
    OopType *       resultOops );
```

Input Arguments

count	The number of OOPs to allocate.

Result Arguments

resultOops	An array to hold the returned 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 *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. 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, page 5-71
GciCreateOopObj, page 5-73
GciGetFreeOop, page 5-166
GciGetFreeOopsEncoded, page 5-170

GciGetFreeOopsEncoded

Allocate multiple OOPs.

Syntax

```
void GciGetFreeOopsEncoded(
    int *                       count,
    OopType *                   encodedOops );
```

Input Arguments

count	The number of OOPs to allocate.
encodedOops	A pointer to memory for holding encoded oops. Must be large enough to hold at least the input value of *count*.

Result Arguments

count	The number of OOPs returned in the encoded OOP array.
encodedOops	An array to hold the returned encoded oops. Must be large enough to hold at least the input value of *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

GciGetFreeOop, page 5-166
GciGetFreeOops, page 5-168
GciFetchNumEncodedOops, page 5-130
GciEnableFreeOopEncoding, page 5-93
GciEncodeOopArray, page 5-97
GciDecodeOopArray, page 5-81

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

GciLogin, page 5-195
GciSetSessionId, page 5-339

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.

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, page 5-345

GciHiddenSetIncludesOop

Determines whether the given OOP is present in the specified hidden set.

Syntax

```
BoolType GciHiddenSetIncludesOop(
      OopType              theOop,
      int                  hiddenSetId );
```

Input 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. **GciHiddenSetIncludesOop** allows you to pass in an index to a specified hidden set to determine if the set includes an specific object. For indexes of available hidden sets, see the GemStone Smalltalk method System Class >> hideenSetSpecifiers.

Example

```
OopType TrackedSetContainsOop(OopType anOop)
{
   if (GciHiddenSetIncludesOop(anOop, 40/* GciTrackedObjs */))
     return OOP_TRUE;
   else
     return OOP_FALSE;
}
```

GCI_I64_IS_SMALL_INT

Determine whether or not a C 64-bit integer value can be translated into a SmallInteger object.

Syntax

static inline BoolType GCI_I64_IS_SMALL_INT(*anInt*)

Input Arguments

anInt	A C 64-bit signed integer.

Result Value

A C Boolean value. Returns TRUE if *anInt* is within SmallInteger range, FALSE otherwise. A SmallInteger has a 61-bit two's-complement integer and three tag bits.

For a positive argument to be within the range of the GemStone SmallInteger class, its top four bits must be 2r0000. For a negative argument, the top four bits must be 2r1111.

Description

This macro tests to see if *anInt* can be represented as a SmallInteger.

See Also

GCI_OOP_IS_SMALL_INT, page 5-260

GciI64ToOop

Convert a C 64-bit integer value to a GemStone object.

Syntax

```
OopType GciI64ToOop(
    int64                          anInt );
```

Input 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 by a GciSaveObjs() call.

See Also

GciOopToI64, page 5-273
GciOopToI64_, page 5-274
GciSaveObjs, page 5-327

GciIncSharedCounter

Increment the value of a shared counter.

Syntax

```
BoolType GciIncSharedCounter(
    int64_t          counterIdx,
    int64_t *        value);
```

Input 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. Shared counters cannot be incremented to a value greater than INT_MAX (2147483647). Attempt to do so will not cause an error, but will set the counter to a value of INT_MAX.

Result Arguments

value	Pointer to a value that indicates the new value of 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.

This function is not supported for remote GCI interfaces, and will always return FALSE.

See Also

GciFetchNumSharedCounters, page 5-131
GciDecSharedCounter, page 5-83
GciSetSharedCounter, page 5-341
GciReadSharedCounter, page 5-300
GciReadSharedCounterNoLock, page 5-301
GciFetchSharedCounterValuesNoLock, page 5-150

GciInit

Initialize GemBuilder.

Syntax

BoolType GciInit( )

Return Value

The function **GciInit** returns TRUE or FALSE to indicate successful or unsuccessful initialization of GemBuilder.

Description

The **GciInit** 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 the **GciInitAppName** function, 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 2-3.)

When GemBuilder is initialized on UNIX platforms, it establishes its own handler for SIGIO interrupts. See “Signal Handling in Your GemBuilder Application” on page 1-29 for information on **GciInit**’s handling of interrupts and pointers on making GemBuilder, application, and third-party handlers work together.

See Also

GciInitAppName, page 5-180

GciInitAppName

Override the default application configuration file name.

Syntax

```
void GciInitAppName(
     const char *          applicationName,
     BoolType              logWarnings );
```

Input Arguments

applicationName	The application’s name, as a character string.
logWarnings	If TRUE, causes the configuration file parser to print any warnings to standard output at executable startup.

Description

The **GciInitAppName** 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.

GciInitAppName_

Override the default application configuration file name and the size of temporary object memory.

Syntax

```
void GciInitAppName_(
      const char *          applicationName,
      BoolType              logWarnings,
      unsigned int          gemTempObjCacheOverrideKB );
```

Input Arguments

applicationName	The application's name, as a character string.
logWarnings	If TRUE, causes the configuration file parser to print any warnings to standard output at executable startup.
gemTempObjCacheOverrideKB	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 **GciInit**.

Description

This function is similar to the **GciInitAppName** function (page 5-180), but with one exception: you can override any GEM_TEMPOBJ_CACHE_SIZE settings in configuration files read by **GciInit**.

If your application calls this function, it must not call **GciInitAppName**.

GciInstallUserAction

Associate a C function with a Smalltalk user action.

Syntax

```
void GciInstallUserAction(
    GciUserActionSType *    userAction );
```

Input Arguments

userAction	A pointer to a C structure that describes the user-written C function.

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 3, “Writing C Functions To Be Called from GemStone.”

See Also

“The User Action Information Structure” on page 5-24
GciUserActionShutdown, page 5-416

GciInstMethodForClass

Compile an instance method for a class.

Syntax

```
OopType GciInstMethodForClass(
    OopType            source,
    OopType            oclass,
    OopType            category,
    OopType            symbolList );
```

Input Arguments

source	The OOP of a Smalltalk string to be compiled as an instance method.
oclass	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 will add this method to the category “as yet unclassified”.
symbolList	The OOP of a GemStone symbol list (that is, an Array of instances of SymbolListDictionary). Smalltalk resolves symbolic references in source code 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

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.

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 *GemStone/S 64 Bit Programming Guide* for a list of the optimized selectors.

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

Example

```
void instanceMethodExample(void)
{
  // Assumes the topaz code for GciFetchVaryingOop example
  // has been executed.

  OopType theClass = GciResolveSymbol("Component", OOP_NIL);
  OopType oCateg = GciNewString("printing");
  // method to return the part number as a String
  OopType oMethodSrc = GciNewString("partNumString   ^ partNumber 
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

GciClassMethodForClass, page 5-56

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, page 5-44

GciIsKindOf

Determine whether or not an object is some kind of a given class or class history.

Syntax

```
BoolType GciIsKindOf(
      OopType             anObj,
      OopType             givenClass );
```

Input Arguments

anObj	The object whose kind is to be checked.
givenClass	A class or class history to compare with the object's kind.

Return Value

GciIsKindOf returns TRUE when the class of *anObj* or any of its superclasses is in the class history of *givenClass*. 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 *givenClass* is simply a class (which is typical), **GciIsKindOf** uses *givenClass*'s class history. When *givenClass* is itself a class history, **GciIsKindOf** uses *givenClass* 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, page 5-187
GciIsSubclassOf, page 5-189
GciIsSubclassOfClass, page 5-190

GciIsKindOfClass

Determine whether or not an object is some kind of a given class.

Syntax

```
BoolType GciIsKindOfClass(
      OopType                    anObj,
      OopType                    givenClass );
```

Input Arguments

anObj	The object whose kind is to be checked.
givenClass	A class to compare with the object's kind.

Return Value

GciIsKindOfClass returns TRUE when the class of *anObj* or any of its superclasses is *givenClass*. It returns FALSE otherwise.

Description

GciIsKindOfClass 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 the *givenClass*.

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, page 5-186
GciIsSubclassOf, page 5-189
GciIsSubclassOfClass, page 5-190

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              aClass,
    OopType              givenClass );
```

Input Arguments

aClass	The class that is to be checked.
givenClass	A class or class history to compare with the first class.

Return Value

GciIsSubclassOf returns TRUE when *aClass* or any of its superclasses is in the class history of *givenClass*. It returns FALSE otherwise.

Description

GciIsSubclassOf performs structural access that is equivalent to the `isSubclassOf:` method of the Smalltalk class Behavior. It compares *aClass* and *aClass*'s superclasses to see if any of them are in a given class history. When *givenClass* is simply a class (which is typical), **GciIsSubclassOf** uses *givenClass*'s class history. When *givenClass* is itself a class history, **GciIsSubclassOf** uses *givenClass* 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, page 5-186
GciIsKindOfClass, page 5-187
GciIsSubclassOfClass, page 5-190

GciIsSubclassOfClass

Determine whether or not a class is a subclass of a given class.

Syntax

```
BoolType GciIsSubclassOf(
    OopType             aClass,
    OopType             givenClass );
```

Input Arguments

aClass	The class that is to be checked.
givenClass	A class to compare with the first class.

Return Value

GciIsSubclassOf returns TRUE when *aClass* or any of its superclasses is *givenClass*. It returns FALSE otherwise.

Description

GciIsSubclassOfClass performs structural access that is equivalent to the `isSubclassOf:` method of the Smalltalk class Behavior. It compares *aClass* and *aClass*'s superclasses to see if any of them are the *givenClass*.

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, page 5-186
GciIsKindOfClass, page 5-187
GciIsSubclassOf, page 5-189

GciIvNameToIdx

Fetch the index of an instance variable name.

Syntax

```
int GciIvNameToIdx(
      OopType             oclass,
      const char          instVarName[ ] );
```

Input Arguments

oclass	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 the **GciFetchNamedOop** or **GciStoreNamedOop** function call.

Example

```
int nameToIdx_example(void)
{
  // Assumes topaz code for GciFetchVaryingOop example has run

  OopType theClass = GciResolveSymbol("Component", OOP_NIL);
  int idx = GciIvNameToIdx(theClass, "cost");
  if (idx < 1) {
    printf("error during GciIvNameToIdx\n");
  }
  return idx;
}
```

See Also

GciClassNamedSize, page 5-58
GciFetchNamedOop, page 5-122
GciFetchNamedOops, page 5-125
GciStoreNamedOop, page 5-362
GciStoreNamedOops, page 5-365

GciLoadUserActionLibrary

Load an application user action library.

Syntax

```
BoolType GciLoadUserActionLibrary(
    const char *         uaLibraryName[ ],
    BoolType             mustExist,
    void **              libHandlePtr,
    char                 infoBuf[ ],
    int64                infoBufSize );
```

Input 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 3, “Writing C Functions To Be Called from GemStone.”

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, page 5-182
GciInUserAction, page 5-185
GciUserActionShutdown, page 5-416

GciLogin

Start a user session.

Syntax

```
BoolType GciLogin(
      const char               gemstoneUsername[ ],
      const char               gemstonePassword[ ] );
```

Input Arguments

gemstoneUsername	The user's GemStone user name (a null-terminated string).
gemstonePassword	The user's GemStone password (a null-terminated string).

Description

The GemStone system is much like a time-shared computer system in that the user 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    = "!tcp@lichen!gs64stone";
  const char* HostUserId   = "";
  const char* HostPassword = "";
  const char* GemService   = "!tcp@lichen!gemnetobject";
  const char* gsUserName   = "isaacNewton";
  const char* gsPassword   = "pomme";

  // 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

GciGetSessionId, page 5-171
GciLogout, page 5-197
GciSetNet, page 5-336
GciSetSessionId, page 5-339

GciLogout

End the current user session.

Syntax

```
void GciLogout( )
```

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 5-171 for more information.)

See Also

GciGetSessionId, page 5-171
GciLogin, page 5-195
GciSetSessionId, page 5-339

GciLongJmp

Provides equivalent functionality to the corresponding longjmp() or _longjmp() function.

Syntax

```
void GciLongJmp(
    GciJmpBufSType *      jumpBuffer,
    int                   val );
```

Input 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, page 5-99
GciPopErrJump, page 5-292
GciPushErrJump, page 5-297
GciSetErrJump, page 5-331
Gci_SETJMP, page 5-335

GciMoreTraversal

Continue object traversal, reusing a given buffer.

Syntax

```
BoolType GciMoreTraversal(
    GciTravBufType *        travBuff);
```

Result Arguments

travBuff	A buffer in which the results of the traversal will be placed.

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.

NOTE
This function is most useful with applications that are linked with GciRpc (the “remote procedure call” version of GemBuilder*). If your application will be linked with GciLnk (the “linkable”* GemBuilder*), you’ll usually achieve best performance by using the simple* **GciFetch**... *and* **GciStore**... *functions rather than object traversal. For more information, see “GciRpc and GciLnk” on page 2-1.*

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 5-409 describes the organization of traversal buffers in detail.

GciMoreTraversal provides automatic byte swizzling for Float and SmallFloat objects. (For more about byte swizzling, see page 1-11.)

Example

```
void moreTraversalExample(void)
{
  // Assumes topaz code for GciFetchVaryingOops example has run

  OopType rootObj = GciResolveSymbol("AllComponents", OOP_NIL);
  GciTravBufType *buf = GciTravBufType::malloc(8000);

  int totalCount = 0;
  // traverse the AllComponents collection to 10 levels deep
  BoolType done = GciTraverseObjs(&rootObj, 1, buf, 10);
  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, page 5-33
GciFindObjRep, page 5-161
GciNbMoreTraversal, page 5-222
GciNbTraverseObjs, page 5-236
GciObjRepSize_, page 5-256
GciTraverseObjs, page 5-408

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, page 5-28
GCI_CHR_TO_OOP, page 5-47
GciCommit, page 5-62
GciNbCommit, page 5-209

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

GciAbort, page 5-28
GciBegin, page 5-40
GciExecuteStr, page 5-105
GciNbAbort, page 5-202
GciNbExecuteStr, page 5-216

GciNbClampedTrav

Traverse an array of objects, subject to clamps (nonblocking).

Syntax

```
void GciNbClampedTrav(
    const OopType *           theOops,
    int                       numOops,
    GciClampedTravArgsSType *travArgs );
```

Input 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 **GciClampedTrav** (**page 5-48**) for documentation on the fields in *travArgs***.**

Result Arguments

travArgs	Pointer to an instance of **GciClampedTravArgsSType** containing the result argument field *travBuff*.

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

The **GciNbClampedTrav** 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, page 5-48

GciNbClampedTraverseObjs

Traverse an array of objects, subject to clamps (nonblocking).

Syntax

```
void GciNbClampedTraverseObjs(
      OopType              clampSpec,
      const OopType        theOops[ ],
      int                  numOops,
      GciTravBufType *     travBuff,
      int                  level );
```

Input Arguments

clampSpec	The OOP of the Smalltalk ClampSpecification to be used.
theOops	An array of OOPs representing the objects to traverse.
numOops	The number of elements in *theOops*.
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.

Result Arguments

travBuff	The buffer for the results of the traversal. 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

The **GciNbClampedTraverseObjs** function, unlike **GciClampedTraverseObjs**, 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 **GciClampedTraverseObjs** by using the argument to **GciNbEnd**.

Description

The **GciNbClampedTraverseObjs** function is equivalent in effect to **GciClampedTraverseObjs**. However, **GciNbClampedTraverseObjs** permits the application to proceed with non-GemStone tasks while the traversal is completed, and **GciClampedTraverseObjs** does not.

GciNbClampedTraverseObjs provides automatic byte swizzling for Float and SmallFloat objects. (For more about byte swizzling, see page 1-11.)

GemBuilder clamped traversal functions are intended primarily for GemStone internal use.

See Also

GciClampedTraverseObjs, page 5-51
GciNbTraverseObjs, page 5-236
GciTraverseObjs, page 5-408

GciNbClampedTravRefs

Traverse an array of objects, subject to clamps, while modifying the PureExportSet and ReferencedSet (nonblocking)

Syntax

void GciNbClampedTravRefs(
    GciClampedTravArgsSType **args*);

Input Arguments

args	Pointer to an instance of **GciClampedTravArgsSType**, which if called to complete a call to **GciNbStoreTravDoTravRefs**, must be the same instance used in that call. For details, refer the discussion of GciClampedTrav on page 5-48.

Return Value

The **GciNbClampedTravRefs** function, unlike **GciClampedTravRefs**, 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 **GciClampedTravRefs** by using the argument to **GciNbEnd**.

Description

The **GciNbClampedTravRefs** function initiates a traversal of the specified objects, subject to the clamps in the specified ClampSpecification. It is similar to GciNbClampedTrav, but also modifies the PureExportSet and ReferencedSet; see the comments in `gci.hf` for details. This function is primarily intended to be used following a call to **GciNbStoreTravDoTravRefs**.

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

GciNbClampedTrav, page 5-204
GciMoreTraversal, page 5-199
GciNbStoreTravDoTravRefs, page 5-234

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

The **GciNbCommit** 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

GciAbort, page 5-28
GCI_CHR_TO_OOP, page 5-47
GciCommit, page 5-62
GciNbAbort, page 5-202

GciNbContinue

Continue code execution in GemStone after an error (nonblocking).

Syntax

```
void GciNbContinue(
    OopType                    process );
```

Input Arguments

process	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

GciClearStack, page 5-60
GciContinue, page 5-67
GciErr, page 5-99
GciExecute, page 5-101
GciNbExecute, page 5-214

GciNbContinueWith

Continue code execution in GemStone after an error (nonblocking).

Syntax

```
void GciNbContinueWith (
    OopType          process,
    OopType          replaceTopOfStack,
    int              flags,
    GciErrSType *    error );
```

Input Arguments

process	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 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**.
error	If not NULL, continue with an 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

GciContinue, page 5-67
GciContinueWith, page 5-69
GciErr, page 5-99
GciExecute, page 5-101
GciNbExecute, page 5-214
GciPerformNoDebug, page 5-280

GciNbEnd

Test the status of nonblocking call in progress for completion.

Syntax

```
GciNbProgressEType GciNbEnd(
    void **                     result );
```

Input Arguments

result	The address at which **GciNbEnd** should place a pointer to the result of the nonblocking call when it is complete.

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** 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 **GciNbEnd** too often or not often enough.

Once an operation is complete, you are permitted to call **GciNbEnd** 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** 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

GciCallInProgress, page 5-44

GciNbExecute

Execute a Smalltalk expression contained in a String object (nonblocking).

Syntax

```
void GciNbExecute(
    OopType             source,
    OopType             symbolList );
```

Input Arguments

source	The OOP of a String containing a sequence of one or more statements to be executed.
symbolList	The OOP of a GemStone symbol list (that is, an Array of instances of SymbolListDictionary). The compiler uses the *symbolList* to resolve symbolic references in the code in *source*. 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

GciContinue, page 5-67
GciErr, page 5-99
GciExecute, page 5-101

GciExecuteFromContext, page 5-103
GciExecuteStr, page 5-105
GciExecuteStrFromContext, page 5-107
GciNbContinue, page 5-210
GciNbExecuteStr, page 5-216
GciNbExecuteStrFromContext, page 5-218

GciNbExecuteStr

Execute a Smalltalk expression contained in a C string (nonblocking).

Syntax

```
void GciNbExecuteStr(
    const char          source[ ],
    OopType             symbolList );
```

Input Arguments

source	A null-terminated string containing a sequence of one or more statements to be executed.
symbolList	The OOP of a GemStone symbol list (that is, an Array of instances of SymbolListDictionary). The compiler uses the *symbolList* to resolve symbolic references in the code in *source*. 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

GciContinue, page 5-67
GciErr, page 5-99
GciExecute, page 5-101

GciExecuteFromContext, page 5-103
GciExecuteStr, page 5-105
GciExecuteStrFromContext, page 5-107
GciNbContinue, page 5-210
GciNbExecute, page 5-214
GciNbExecuteStrFromContext, page 5-218

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              source[ ],
      OopType                 contextObject,
      OopType                 symbolList );
```

Input Arguments

source	A null-terminated string containing a sequence of one or more statements to be executed.
contextObject	The OOP of any GemStone object.
symbolList	The OOP of a GemStone symbol list (that is, an Array of instances of SymbolListDictionary). The compiler uses the *symbolList* to resolve symbolic references in the code in *source*. 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

GciContinue, page 5-67
GciErr, page 5-99
GciExecute, page 5-101
GciExecuteFromContext, page 5-103
GciExecuteStr, page 5-105
GciExecuteStrFromContext, page 5-107
GciNbContinue, page 5-210
GciNbExecute, page 5-214
GciNbExecuteStr, page 5-216

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                    source[ ],
      OopType                       contextObject,
      OopType                       symbolList,
      GciClampedTravArgsSType *travArgs );
```

Input Arguments

source	A null-terminated string containing a sequence of one or more statements to be executed.
contextObject	The OOP of any GemStone object. A value of OOP_ILLEGAL means no context.
symbolList	The OOP of a GemStone symbol list (that is, an Array of instances of SymbolDictionary). The compiler uses the *symbolList* to resolve symbolic references in the code in *source*. 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 the **GciExecuteStrTrav** function (page 5-109) 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, page 5-109
GciExecuteStr, page 5-105
GciMoreTraversal, page 5-199
GciPerformTraverse, page 5-286

GciNbMoreTraversal

Continue object traversal, reusing a given buffer (nonblocking).

Syntax

```
void GciNbMoreTraversal(
    GciTravBufType *        travBuff);
```

Result Arguments

travBuff	A buffer in which the results of the traversal will be placed.

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 for Float and SmallFloat objects. (For more about byte swizzling, see page 1-11.)

See Also

GCI_ALIGN, page 5-33
GciFindObjRep, page 5-161
GciMoreTraversal, page 5-199
GciNbTraverseObjs, page 5-236
GciObjRepSize_, page 5-256
GciTraverseObjs, page 5-408

GciNbPerform

Send a message to a GemStone object (nonblocking).

Syntax

```
void GciNbPerform(
      OopType                receiver,
      const char             selector[ ],
      const OopType          args[ ],
      int                    numArgs );
```

Input 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

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

GciContinue, page 5-67
GciErr, page 5-99
GciExecute, page 5-101
GciNbContinue, page 5-210
GciNbExecute, page 5-214
GciNbPerformNoDebug, page 5-225
GciPerform, page 5-278
GciPerformNoDebug, page 5-280
GciPerformSymDbg, page 5-282

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 );
```

Input 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.

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

GciContinue, page 5-67
GciErr, page 5-99
GciExecute, page 5-101
GciNbContinue, page 5-210
GciNbExecute, page 5-214
GciNbPerform, page 5-223
GciPerform, page 5-278
GciPerformNoDebug, page 5-280
GciPerformSymDbg, page 5-282

GciNbPerformTrav

First send a message to a GemStone object, then traverse the result of the message (nonblocking).

Syntax

```
BoolType GciNbPerformTrav(
    OopType                      receiver,
    const char *                 selector,
    const OopType *              args,
    int                          numArgs,
    GciClampedTravArgsSType *travArgs );
```

Input 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.
travArgs	Pointer to an instance of **GciClampedTravArgsSType**. See the **GciClampedTrav** function (page 5-48) for documentation of the fields in *travArgs*.

Result Arguments

The result of the **GciNbPerformTrav** is the first object in the resulting *travBuffs* field in *travArgs*.

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, page 5-284
GciPerform, page 5-278
GciClampedTrav, page 5-48

GciNbStoreTrav

Store multiple traversal buffer values in objects (nonblocking).

Syntax

```
void GciNbStoreTrav(
    GciTravBufType *        travBuff,
    int                     behaviorFlag );
```

Input 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, predefined in the `gci.ht` 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 for Float and SmallFloat objects. (For more about byte swizzling, see page 1-11.)

See Also

GciMoreTraversal, page 5-199
GciNbMoreTraversal, page 5-222
GciNbTraverseObjs, page 5-236
GciNewOopUsingObjRep, page 5-246

GciStoreTrav, page 5-381
GciTraverseObjs, page 5-408

GciNbStoreTravDo

Store multiple traversal buffer values in objects, execute the specified code, and return the resulting object (non-blocking).

Syntax

void GciNbStoreTravDo(
    GciStoreTravDoArgsSType **stdArgs*);

Input Arguments

stdArgs	An instance of **GciStoreTravDoArgsSType**. For details, refer to the discussion of **GciStoreTravDo** on page 5-385.

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

GciNbClampedTrav, page 5-204
GciNbEnd, page 5-212
GciNbStoreTrav, page 5-229
GciNbStoreTravDoTrav, page 5-232
GciStoreTravDo, page 5-385

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 *stdArgs,
    GciClampedTravArgsSType *ctArgs );
```

Input Arguments

stdArgs	An instance of GciStoreTravDoArgsSType. For details, refer to the discussion of GciStoreTravDo on page 5-385.
ctArgs	An instance of GciClampedTravArgsSType. For details, see the discussion of GciClampedTrav on page 5-48.

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

GciNbClampedTrav, page 5-204
GciNbEnd, page 5-212
GciNbStoreTrav, page 5-229

GciNbStoreTravDoTravRefs

Combine in a single function modifications to session sets, 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 GciNbStoreTravDoTravRefs(
      const OopType *          oopsNoLongerReplicated,
      int                      numNotReplicated,
      const OopType *          oopsGcedOnClient,
      int                      numGced,
      GciStoreTravDoArgsSType *stdArgs,
      GciClampedTravArgsSType *ctArgs );
```

Input 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*.
stdArgs	An instance of GciStoreTravDoArgsSType. For details, refer to the discussion of GciStoreTravDo on page 5-381.
ctArgs	An instance of GciClampedTravArgsSType. For details, see the discussion of GciClampedTrav on page 5-48.

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, execute behavior on the Gem, and return the traversal of the result object, all in a single network round-trip. For more details, see **GciClampedTravRefs** on page 5-54.

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

GciClampedTravRefs, page 5-54
GciStoreTravDoTrav, page 5-388
GciStoreTravDoTravRefs, page 5-389

GciNbTraverseObjs

Traverse an array of GemStone objects (nonblocking).

Syntax

```
void GciNbTraverseObjs(
      const OopType          theOops[ ],
      int                    numOops,
      GciTravBufType *       travBuff,
      int                    level );
```

Input Arguments

theOops	An array of OOPs representing the objects to traverse.
numOops	The number of elements in theOops.
travBuffSize	The number of bytes allocated to the traversal buffer.
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.

Result Arguments

travBuff	A buffer in which the results of the traversal will be placed.

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 for Float and SmallFloat objects. (For more about byte swizzling, see page 1-11.)

See Also

GciFindObjRep, page 5-161
GciMoreTraversal, page 5-199
GciNbMoreTraversal, page 5-222
GciNbStoreTrav, page 5-229
GciNewOopUsingObjRep, page 5-246
GciObjRepSize_, page 5-256
GciStoreTrav, page 5-381
GciTraverseObjs, page 5-408

GciNewByteObj

Create and initialize a new byte object.

Syntax

```
OopType GciNewByteObj(
      OopType                  aClass,
      const ByteType *         value,
      int64                    valueSize );
```

Input Arguments

aClass	The OOP of the class of which an instance is to be created.
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.

GciNewCharObj

Create and initialize a new character object.

Syntax

```
OopType GciNewCharObj(
    OopType             aClass,
    const char *        cString );
```

Input Arguments

aClass	The OOP of the class of which an instance is to be created. *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.

GciNewDateTime

Create and initialize a new date-time object.

Syntax

```
OopType GciNewDateTime(
    OopType                 theClass,
    const GciDateTimeSType *timeVal );
```

Input Arguments

theClass	The class of the object to be created. *theClass* must be OOP_CLASS_DATE_TIME or a subclass thereof.
timeVal	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.

GciNewOop

Create a new GemStone object.

Syntax

```
OopType GciNewOop(
    OopType                    oclass );
```

Input Arguments

oclass	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. Appendix A, “Reserved OOPs,” lists the C constants that are defined for each of the Smalltalk 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

GciNewOops, page 5-243
GciNewOopUsingObjRep, page 5-246
GciReleaseAllOops, page 5-304
GciReleaseGlobalOops, page 5-306

GciNewOops

Create multiple new GemStone objects.

Syntax

```
void GciNewOops(
    int                 numOops,
    const OopType       oclass[ ],
    const int64         idxSize[ ],
    OopType             result[ ] );
```

Input Arguments

numOops	The number of new objects to be created.
oclass	For each new object, the OOP of its class. This should not be the OOP of Symbol or DoubleByteSymbol.
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 Arguments

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 *oclass* 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 *oclass* contains the OOP of a class with special implementation (such as Boolean), then the corresponding element in *result* is OOP_NIL. Appendix A, “Reserved OOPs,” lists the C constants that are defined for each of the Smalltalk 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, page 5-241
GciNewOopUsingObjRep, page 5-246
GciReleaseAllOops, page 5-304
GciReleaseGlobalOops, page 5-306
GciStoreTrav, page 5-381

GciNewOopUsingObjRep

Create a new GemStone object from an existing object report.

Syntax

```
void GciNewOopUsingObjRep(
    GciObjRepSType *         anObjectReport );
```

Input Arguments

anObjectReport	A pointer to an object report.

Result Arguments

anObjectReport	A modified object report that contains the OOP of the new object (*hdr.objId*), the ID of the object's segment (*hdr.segmentId*), 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 "The Object Report Structure" on page 5-19.

NOTE:
This function is most useful with applications that are linked with GciRpc (the "remote procedure call" version of GemBuilder*). If your application will be linked with GciLnk (the "linkable"* GemBuilder*), you'll usually achieve best performance by using the simple* **GciFetch***... and* **GciStore***... functions rather than object traversal. For more information, see "GciRpc and GciLnk" on page 2-1.*

GciNewOopUsingObjRep provides automatic byte swizzling for Float and SmallFloat objects. (For more about byte swizzling, see page 1-11.)

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

GciNewOop, page 5-241
GciReleaseAllOops, page 5-304
GciReleaseGlobalOops, page 5-306
GciTraverseObjs, page 5-408

GciNewString

Create a new String object from a C character string.

Syntax

```
OopType GciNewString(
    const char *             cString );
```

Input 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 );
```

Input 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.

GciNscIncludesOop

Determines whether the given OOP is present in the specified unordered collection.

Syntax

BoolType GciNscIncludesOop(
OopType *theNsc*,
OopType *theOop*);

Input 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, page 5-29
GciAddOopsToNsc, page 5-31
GciRemoveOopFromNsc, page 5-311
GciRemoveOopsFromNsc, page 5-313

GciObjExists

Determine whether or not a GemStone object exists.

Syntax

```
BoolType GciObjExists(
    OopType                theObject );
```

Input 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 );
```

Input 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                oop );
```

Input Arguments

oop	The OOP of an object.

Return Value

GciObjIsCommitted returns TRUE if the object is committed, FALSE otherwise.

Description

The **GciObjIsCommitted** function determines if the given object is committed or not.

See Also

GciObjExists, page 5-253

GciObjRepSize_

Find the number of bytes in an object report.

Syntax

size_t GciObjRepSize_(*anObjectReport*)
    const GciObjRepHdrSType **anObjectReport*;

Input Arguments

anObjectReport	A pointer to an object report returned by **GciFindObjRep**.

Return Value

Returns the size of the specified object report.

Description

NOTE
In previous GemStone/S 64 Bit releases, this function was named **GciObjRepSize** *(without the underscore). Customers must ensure that the variables that receive this function's result are large enough to accommodate a 64-bit value.*

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.

NOTE
This function is most useful with applications that are linked with GciRpc (the "remote procedure call" version of GemBuilder*). If your application will be linked with GciLnk (the "linkable"* GemBuilder*), you'll usually achieve best performance by using the simple* **GciFetch***... and* **GciStore***... functions rather than object traversal. For more information, see "GciRpc and GciLnk" on page 2-1.*

Example

```
void objRepSize_example(void)
{

  // Assumes topaz code for GciFetchVaryingOops example has run

  OopType rootObj = GciResolveSymbol("AllComponents", OOP_NIL);
  GciTravBufType *buf = GciTravBufType::malloc(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, page 5-161
GciMoreTraversal, page 5-199
GciTraverseObjs, page 5-408

GciOldOopToNewOop

Return a GemStone / S 64 Bit v2.0 OopType corresponding to a GemStone / S 64 Bit v1.1 OOP.

Syntax

```
OopType GciOldOopToNewOop(
      unsigned int                oldOop );
```

Input Arguments

oldOop	The GemStone / S 64 Bit v1.1.1 OOP.

Return Value

Returns an OopType that corresponds to the GemStone / S 64 Bit v1.1 OOP. Returns OOP_ILLEGAL if the argument is not a valid GemStone / S 64 Bit v1.1 OopType.

Description

This function converts a v1.1 OOP into the equivalent v2.0 OopType. If the result is not a special OOP, this function does not check for the existence of the object.

This function returns OOP_ILLEGAL if the argument is not a legal special OOP or if the current session is not valid.

This function does not convert LargeIntegers to new SmallIntegers.

GCI_OOP_IS_BOOL

(MACRO) Determine whether or not a GemStone object represents a Boolean value.

Syntax

GCI_OOP_IS_BOOL(*theOop*)

Input Arguments

theOop	The OOP of the object to test.

Result 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 value.

See Also

GCI_OOP_IS_SMALL_INT, page 5-260
GCI_OOP_IS_SPECIAL, page 5-261

GCI_OOP_IS_SMALL_INT

(MACRO) Determine whether or not a GemStone object represents a SmallInteger.

Syntax

GCI_OOP_IS_SMALL_INT(*theOop*)

Input Arguments

theOop	The OOP of the object to test.

Result 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, page 5-259
GCI_OOP_IS_SPECIAL, page 5-261

GCI_OOP_IS_SPECIAL

(MACRO) Determine whether or not a GemStone object has a special representation.

Syntax

GCI_OOP_IS_SPECIAL(*theOop*)

Input Arguments

theOop	The OOP of the object to test.

Result 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.

See Also

GCI_OOP_IS_BOOL, page 5-259
GCI_OOP_IS_SMALL_INT, page 5-260

GciOopToBool

Convert a Boolean object to a C Boolean value.

Syntax

```
BoolType GciOopToBool(
    OopType                  theObject );
```

Input Arguments

theObject	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, page 5-41

GCI_OOP_TO_BOOL

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

Syntax

GCI_OOP_TO_BOOL(*theObject*)

Input Arguments

theObject	The OOP of the Boolean object to be translated into a C Boolean value.

Result 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** (see page 5-262). For the definition of GCI_OOP_TO_BOOL, see `$GEMSTONE/include/gcicmn.ht`

See Also

GCI_BOOL_TO_OOP, page 5-41

GciOopToChar16

Convert a Character object to a 16-bit C character value.

Syntax

```
unsigned int GciOopToChar16(
    OopType                theObject );
```

Input Arguments

theObject	The OOP of the JisCharacter 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

GciOopToChr, page 5-266

GciOopToChr

Convert a Character object to a C character value.

Syntax

```
char GciOopToChr(
      OopType                  theObject );
```

Input Arguments

theObject	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.

Description

This function translates a GemStone Character object into the equivalent C character value.

Example

```
char oopToChar_example(OopType arg)
{
  char aChar = GciOopToChr(arg);

  GciErrSType errInfo;
  if (GciErr(&errInfo)) {
    // argument was not a Character
    printf("error category "FMT_OID" number %d, %s\n",
       errInfo.category, errInfo.number, errInfo.message);
    return 0;
  }
  return aChar;
}
```

See Also

GCI_CHR_TO_OOP, page 5-47
GciOopToChar16, page 5-265

GCI_OOP_TO_CHR

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

Syntax

GCI_OOP_TO_CHR(*theObject*)

Input Arguments

theObject	The OOP of the Character object to be translated into a C character value.

Result 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, page 5-265
GciOopToChr, page 5-266

GciOopToFlt

Convert a SmallDouble, Float, or SmallFloat object to a C double.

Syntax

```
double GciOopToFlt(
      OopType                    theObject );
```

Input Arguments

theObject	The OOP of the SmallDouble, Float, or SmallFloat object to be translated into a C floating point value.

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, page 5-164
GciGetFreeOopsEncoded, page 5-170

GciOopToI32

Convert a GemStone object to a C 32-bit integer value.

Syntax

```
int GciOopToI32(
    OopType            theObject );
```

Input Arguments

theObject	The OOP of the object to be translated into a C 32-bit integer value.

Return Value

The **GciOopToI32** function returns the C 32-bit integer value that is equivalent to the value of *theObject*.

Description

The **GciOopToI32** function translates 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.

See Also

GciOopToI32_, page 5-272
GciOopToI64, page 5-273
GciOopToI64_, page 5-274

GciOopToI32_

Convert a GemStone object to a C 32-bit integer value, with error handling.

Syntax

```
int GciOopToI32_(
      OopType            theObject,
      BoolType *         error );
```

Input Arguments

theObject	The OOP of the object to be translated into a C 32-bit integer value.

Result Arguments

error	TRUE if *theObject* does not fit in the result type or is not an Integer. Otherwise unchanged.

Return Value

The **GciOopToI32_** function returns the C 32-bit integer value that is equivalent to the value of *theObject*.

Description

The **GciOopToI32_** function translates a GemStone object into the equivalent C 32-bit integer value. The GemStone object must be a SmallInteger within the range of C integers. **GciOopToI32_** provides for error handling if *theObject* does not fit in the result type or is not an Integer. Compare with **GciOopToI32**, which does not provide for error handling.

See Also

GciOopToI32, page 5-271
GciOopToI64, page 5-273
GciOopToI64_, page 5-274

GciOopToI64

Convert a GemStone object to a C 64-bit integer value.

Syntax

```
int64 GciOopToI64(
    OopType                 theObject );
```

Input Arguments

theObject	The OOP of the object to be translated into a C 64-bit integer value.

Return Value

The **GciOopToI64** function returns the C int64_t value that is equivalent to the value of *theObject*.

Description

NOTE
In previous GemStone/S 64 Bit releases, this function was named **GciOopToInt64***. Customers must ensure that the variables that receive this function's result are large enough to accommodate an int64 value.*

The **GciOopToI64** function translates a GemStone object into the equivalent C 64-bit integer value.

The object identified by *theObject* must be a SmallInteger, a LargePositiveInteger, or a LargeNegativeInteger. If the object is not one of these kinds, **GciOopToI64** generates an error.

See Also

GciOopToI32, page 5-271
GciOopToI32_, page 5-272
GciOopToI64_, page 5-274

GciOopToI64_

Convert a GemStone object to a C 64-bit integer value, with error handling.

Syntax

```
int64 GciOopToI64_(
      OopType                    theObject,
      BoolType *                 error );
```

Input Arguments

theObject	The OOP of the object to be translated into a C 64-bit integer value.

Result Arguments

error	TRUE if *theObject* does not fit in the result type or is not an Integer. Otherwise unchanged.

Return Value

The **GciOopToI64_** function returns the C int64_t value that is equivalent to the value of *theObject*.

Description

The **GciOopToI64_** function translates a GemStone object into the equivalent C 64-bit integer (int64_t) value. The GemStone object must be a SmallInteger, a LargePositiveInteger, or a LargeNegativeInteger. **GciOopToI64_** provides for error handling if *theObject* does not fit in the result type or is not an Integer. Compare with **GciOopToI64**, which does not provide for error handling.

See Also

GciOopToI32, page 5-271
GciOopToI32_, page 5-272
GciOopToI64, page 5-273

GciPathToStr

Convert a path representation from numeric to string.

This function is deprecated and may be removed from future releases.

Syntax

```
BoolType GciPathToStr(
      OopType              aClass,
      const int            path[ ],
      int                  pathSize,
      int64                maxResultSize,
      char                 result[ ] );
```

Input Arguments

aClass	The class of the object for which this path will apply. That is, for each instance of this class, store or fetch objects along the designated path.
path	The path array to be converted to string format.
pathSize	The number of integers in the path array.
maxResultSize	The maximum allowable length of the resulting path string, excluding the null terminator.

Result Arguments

result	The resulting path string, terminated with a null character. The resulting string is of the form `foo.bar.name`. Each element of the path string is the name of an instance variable (that is, bar is an instance variable of foo, and name is an instance variable of bar).

Return Value

Returns TRUE if the path array was successfully converted to a string. Returns FALSE otherwise.

Description

The **GciPathToStr** function converts the numeric representation of a path to its equivalent string representation.

The functions **GciFetchPaths** and **GciStorePaths** allow you to specify paths along which to fetch from, or store into, objects within an object tree.

A path may be represented as an array of integers, in which each step along the path is represented by an integral offset from the beginning of an object. For example, an array containing the integers 5 and 2 would represent the offsets of the fifth and second instance variables, respectively. Alternatively, a path may be represented as a string in which each element is the name of the corresponding instance variable. For example, *address.zip*, in which *zip* is an instance variable of *address*.

For more information about paths, see the discussion of the **GciFetchPaths** function on page 5-143.

NOTE
This function is most useful with applications that are linked with GciRpc (the "remote procedure call" version of GemBuilder*). If your application will be linked with GciLnk (the "linkable"* GemBuilder*), you'll usually achieve best performance by using the simple* **GciFetch**... *and* **GciStore**... *functions rather than object traversal. For more information, see "GciRpc and GciLnk" on page 2-1.*

Restrictions

Note that **GciPathToStr** can convert a numeric path only if:

- The instance variables of the specified Smalltalk class (*aClass*) are constrained in such a way that the path is guaranteed to be valid for all instances.
- The path touches only named instance variables. If a path leads through the indexed variables of some object, then no symbolic representation can be used.

If your application does not impose GemStone constraints on classes of all objects from which you to fetch, or if you want to fetch from indexable objects, then you need to maintain your paths as arrays of integers.

Error Conditions

The following errors may be generated by this function:

GCI_ERR_RESULT_PATH_TOO_LARGE
The *result* was larger than the specified *maxResultSize*.

RT_ERR_PATH_TO_STR_IVNAME
One of the instance variable offsets in the path array was invalid.

RT_ERR_STR_TO_PATH_CONSTRAINT
One of the instance variables in the path string was not sufficiently constrained.

Example

In the following example, assume that you've defined the class Component and populated the set AllComponents, as shown in the example for the **GciFetchVaryingOop** function on page 5-154.

```
void pathToString_example(void)
{
  // retrieve a random instance of class Component
  OopType aComponent = GciExecuteStr(
"AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);

  int ofs = 3;  // offset of cost instVar
  int pathSize = 1;
  char result[1024];
  GciPathToStr(GciFetchClass(aComponent), &ofs, pathSize,
               sizeof(result), result);

  printf("result = %s\n", result);
}
```

See Also

GciFetchPaths, page 5-143
GciStorePaths, page 5-374
GciStrToPath, page 5-396

GciPerform

Send a message to a GemStone object.

Syntax

```
OopType GciPerform(
     OopType              receiver,
     const char           selector[ ],
     const OopType        args[ ],
     int                  numArgs );
```

Input 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 1-16.

See Also

GciContinue, page 5-67
GciErr, page 5-99
GciExecute, page 5-101
GciNbContinue, page 5-210
GciNbExecute, page 5-214
GciNbPerform, page 5-223
GciNbPerformNoDebug, page 5-225
GciPerformNoDebug, page 5-280
GciPerformSymDbg, page 5-282

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 );
```

Input 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.

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.

The value of *flags* should be given by using one or more of these GemBuilder mnemonics:

- GCI_PERFORM_FLAG_ENABLE_DEBUG makes **GciPerformNoDebug** behave like **GciPerform** with respect to debugging.
- GCI_PERFORM_FLAG_DISABLE_ASYNC_EVENTS disables asynchronous events.
- GCI_PERFORM_FLAG_SINGLE_STEP places a single-step breakpoint at the start of the method to be performed, and then executes to hit that breakpoint.

These flags can either be used alone or logically “or”ed together.

See Also

GciContinue, page 5-67
GciErr, page 5-99
GciExecute, page 5-101
GciNbContinue, page 5-210
GciNbExecute, page 5-214
GciNbPerform, page 5-223
GciNbPerformNoDebug, page 5-225
GciPerform, page 5-278
GciPerformSymDbg, page 5-282

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
      );
```

Input 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

GciContinue, page 5-67
GciErr, page 5-99
GciExecute, page 5-101
GciPerform, page 5-278
GciPerformNoDebug, page 5-280

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 );
```

Input 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.
travArgs	Pointer to an instance of **GciClampedTravArgsSType**. See the **GciClampedTrav** function (page 5-48) for documentation of the fields in *travArgs*.

Result Arguments

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 is 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

GciPerform, page 5-278
GciClampedTrav, page 5-48

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;
```

Input 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.
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.

Result Arguments

travBuff	A buffer in which the results of the traversal are placed.

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

Consider the following function call:

```
BoolType performTrav_1(void)
{
  OopType receiver = GciResolveSymbol("AllComponents", OOP_NIL);
  OopType arg = GciI32ToOop(1);
  GciTravBufType *buf = GciTravBufType::malloc(8000);


  BoolType atEnd = GciPerformTraverse(receiver, "at:", &arg, 1,
buf, 10);
  return atEnd;
}
```

It is equivalent to the following code:

```
BoolType performTrav_2(void)
{
  OopType receiver = GciResolveSymbol("AllComponents", OOP_NIL);
  OopType arg = GciI32ToOop(1);
  OopType obj = GciPerform(receiver, "at:", &arg, 1);

  GciTravBufType *buf = GciTravBufType::malloc(8000);
  BoolType atEnd = GciTraverseObjs(&obj, 1, buf, 10);
  return atEnd;
}
```

GciPerformTraverse provides automatic byte swizzling for Float and SmallFloat objects. (For more about byte swizzling, see page 1-11.)

See Also

GciContinue, page 5-67
GciErr, page 5-99
GciExecute, page 5-101
GciFindObjRep, page 5-161
GciMoreTraversal, page 5-199
GciNewOopUsingObjRep, page 5-246
GciObjRepSize_, page 5-256
GciPerform, page 5-278
GciPerformNoDebug, page 5-280
GciPerformSymDbg, page 5-282
GciStoreTrav, page 5-381
GciTraverseObjs, page 5-408

GciPointerToByteArray

Given a C pointer, return a SmallInteger or ByteArray containing the value of the pointer.

Syntax

```
OopType GciPointerToByteArray(
    void *                    pointer );
```

Input 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, page 5-43

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, page 5-95
GciErr, page 5-99

GciPopErrJump

Discard a previously saved error jump buffer.

Syntax

```
void GciPopErrJump(
     GciJmpBufSType *        jumpBuffer );
```

Input 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, page 5-99
GciPushErrJump, page 5-297
GciSetErrJump, page 5-331
GciLongJmp, page 5-198

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

NOTE
In previous GemStone/S 64 Bit releases, this function was named **GciProcessDeferredUpdates** *(without the underscore). Customers must ensure that the variables that receive this function's result are large enough to accommodate an int64 value.*

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 once 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, page 5-381

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. Currently-defined integers are:

1 — GemStone / S

2 — GemStone / S 2G

3 — 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.

Although GciProduct can be used by any GemBuilder client, it is specifically provided for the use of GemBuilder for Smalltalk.

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, page 5-417

GciPushErrJump

Associate GemBuilder error handling with a jump buffer by pushing a jump buffer onto the stack.

Syntax

```
void GciPushErrJump(
     GciJmpBufSType *        jumpBuffer );
```

Result 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 **GciLongJmp**.

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 **GciLongJmp** 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 **GciLongJmp** mechanism (and to re-enable it afterwards).

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

Example

For an example of how **GciPushErrJump** is used, see the **GciPopErrJump** function on page 5-292.

See Also

GciErr, page 5-99
GciPopErrJump, page 5-292
GciSetErrJump, page 5-331

GciRaiseException

Signal an error, synchronously, within a user action.

Syntax

```
void GciRaiseException(
      const GciErrSType *       err );
```

Input Arguments

err	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.

This function has no effect when executed outside of a user action.

GciReadSharedCounter

Lock and fetch the value of a shared counter.

Syntax

```
BoolType GciReadSharedCounter(
      int                        counterIdx,
      int64_t *                  value);
```

Input Arguments

counterIdx	The offset into the shared counters array of the value to fetch.

Result Arguments

value	Pointer to a value that indicates the value at 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

GciFetchNumSharedCounters, page 5-131
GciDecSharedCounter, page 5-83
GciIncSharedCounter, page 5-177
GciSetSharedCounter, page 5-341
GciReadSharedCounterNoLock, page 5-301
GciFetchSharedCounterValuesNoLock, page 5-150

GciReadSharedCounterNoLock

Fetch the value of a shared counter without locking it.

Syntax

```
BoolType GciReadSharedCounterNoLock(
    int                     counterIdx,
    int64_t *               value);
```

Input Arguments

counterIdx	The offset into the shared counters array of the value to fetch.

Result Arguments

value	Pointer to a value at 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

GciFetchNumSharedCounters, page 5-131
GciDecSharedCounter, page 5-83
GciIncSharedCounter, page 5-177
GciSetSharedCounter, page 5-341

GciReadSharedCounter, page 5-300
GciFetchSharedCounterValuesNoLock, page 5-150

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 do not need to retain any of them for any reason.

See Also

"Garbage Collection" on page 1-32
GciReleaseAllOops, page 5-304
GciReleaseGlobalOops, page 5-306
GciSaveGlobalObjs, page 5-326
GciSaveObjs, page 5-327

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 do not need to retain any of them for any reason.

See Also

"Garbage Collection" on page 1-32
GciReleaseAllGlobalOops, page 5-303
GciReleaseGlobalOops, page 5-306
GciReleaseOops, page 5-307
GciSaveGlobalObjs, page 5-326
GciSaveObjs, page 5-327

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 do not need to retain them for any reason.

See Also

GciHiddenSetIncludesOop, page 5-174
GciReleaseAllGlobalOops, page 5-303
GciReleaseAllOops, page 5-304
GciReleaseTrackedOops, page 5-310
GciSaveAndTrackObjs, page 5-324

GciReleaseGlobalOops

Remove an array of GemStone OOPs from the PureExportSet, making them eligible for garbage collection.

Syntax

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

Input 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 do not need to retain them for any reason.

See Also

"Garbage Collection" on page 1-32
GciReleaseAllGlobalOops, page 5-303
GciReleaseOops, page 5-307
GciSaveGlobalObjs, page 5-326

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 );
```

Input 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 do not need to retain them for any reason.

Example

```
void releaseOops_example(void)
{
  // assumes topaz code for GciFetchVaryingOops example has run.

  OopType oClass = GciResolveSymbol("Component", OOP_NIL);

  OopType namedIvs[3];
  namedIvs[0] = GciI32ToOop(5699); // a SmallInteger , don’t need 
to release
  namedIvs[1] = GciNewString("cfm56-99");
  namedIvs[2] = GciFltToOop(9.0e6); // a Float or SmallDouble

  OopType newComp = GciNewOop(oClass);
  GciStoreOops(newComp, 1, namedIvs, 3);

  OopType oColl = GciResolveSymbol("AllComponents", OOP_NIL);
  GciAddOopToNsc(oColl, newComp);  // new objects now reachable 
from AllComponents

  // release newly created objects so that  if aComp is removed 
from
  // AllComponents by other application code, these new objects 
can
  // be garbage collected.
  OopType releaseBuf[3];
  releaseBuf[0] = namedIvs[1];  // a String
  releaseBuf[1] = namedIvs[1]; // might be a Float
  releaseBuf[2] = newComp;     // a Component
  GciReleaseOops(releaseBuf, 3);
}
```

See Also

“Garbage Collection” on page 1-32
GciReleaseAllGlobalOops, page 5-303
GciReleaseAllOops, page 5-304
GciReleaseGlobalOops, page 5-306

GciSaveGlobalObjs, page 5-326
GciSaveObjs, page 5-327

GciReleaseTrackedOops

Remove an array of OOPs from the GciTrackedObjs set, making them eligible for garbage collection.

Syntax

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

Input 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 do not need to retain them for any reason.

See Also

GciHiddenSetIncludesOop, page 5-174
GciReleaseAllTrackedOops, page 5-305
GciSaveAndTrackObjs, page 5-324
GciTrackedObjsInit, page 5-407

GciRemoveOopFromNsc

Remove an OOP from an NSC.

Syntax

```
BoolType GciRemoveOopFromNsc(
    OopType             theNsc,
    OopType             theOop );
```

Input Arguments

theNsc	The OOP of the NSC from which to remove an OOP.
theOop	The OOP of the object to be removed.

Result Arguments

theNsc	The OOP of the modified NSC.

Return Value

Returns FALSE if *theOop* was not present in the NSC. Returns TRUE if *theOop* was present in the NSC.

Description

This function removes an OOP from the unordered variables of an NSC, using structural access.

Example

```
BoolType removeOop_example(void)
{
  // assumes topaz code for GciFetchVaryingOop has run
  OopType aComponent = GciExecuteStr(
        "AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);

  OopType aColl = GciResolveSymbol("AllComponents", OOP_NIL);

  BoolType wasPresent = GciRemoveOopFromNsc(aColl, aComponent);

  GciReleaseOops(&aComponent, 1); // release because it was  a
result
           //   from an execute
  return wasPresent;
}
```

See Also

GciAddOopToNsc, page 5-29
GciAddOopsToNsc, page 5-31
GciNscIncludesOop, page 5-251
GciRemoveOopsFromNsc, page 5-313

GciRemoveOopsFromNsc

Remove one or more OOPs from an NSC.

Syntax

```
BoolType GciRemoveOopsFromNsc(
    OopType             theNsc,
    const OopType       theOops[ ],
    int                 numOops );
```

Input Arguments

theNsc	The OOP of the NSC from which to remove the OOPs.
theOops	The array of OOPs to be removed from the NSC.
numOops	The number of OOPs to remove.

Result Arguments

theNsc	The OOP of the modified NSC.

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

```
BoolType removeOops_example(void)
{
  // assumes topaz code for GciFetchVaryingOop has run
  OopType subColl = GciExecuteStr(
        "AllComponents select:[i|i partNumber > 1000 ]", OOP_NIL);

  OopType buf[10];
  int numRet = GciFetchVaryingOops(subColl, 1, buf, 10);
  // buf contains at most 10 components with partNumber > 1000 .

  OopType aColl = GciResolveSymbol("AllComponents", OOP_NIL);
  BoolType allPresent = GciRemoveOopsFromNsc(aColl, buf, numRet);

  GciReleaseOops(&subColl, 1);// release because it was result of
an execute
  return allPresent;
}
```

See Also

GciAddOopToNsc, page 5-29
GciAddOopsToNsc, page 5-31
GciNscIncludesOop, page 5-251
GciRemoveOopFromNsc, page 5-311

GciReplaceOops

Replace all instance variables in a GemStone object.

Syntax

```
void GciReplaceOops(
      OopType              theObj,
      const OopType        theOops[ ],
      int                  numOops );
```

Input Arguments

theOops	The array of OOPs used as the replacements.
numOops	The number of OOPs in *theOops*.

Result Arguments

theObj	The object whose instance variables are replaced.

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, page 5-317
GciStoreIdxOops, page 5-359
GciStoreNamedOops, page 5-365
GciStoreOops, page 5-371

GciReplaceVaryingOops

Replace all unnamed instance variables in an NSC object.

Syntax

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

Input Arguments

theOops	The array of objects used as the replacements.
numOops	The number of objects in *theOops*.

Result Arguments

theNsc	The NSC object whose unnamed instance variables are replaced.

Description

GciReplaceVaryingOops uses structural access to replace all unnamed instance variables in the NSC object.

See Also

GciReplaceOops, page 5-315
GciStoreIdxOops, page 5-359
GciStoreNamedOops, page 5-365
GciStoreOops, page 5-371

GciResolveSymbol

Find the OOP of the object to which a symbol name refers, in the context of the current session's user profile.

Syntax

```
OopType GciResolveSymbol(
      const char *            cString,
      OopType                 symbolList );
```

Input Arguments

cString	The name of a symbol as a character string.
symbolList	The OOP of an instance of OOP_CLASS_SYMBOL_LIST or OOP_NIL.

Return Value

The OOP of the object that corresponds to the specified symbol.

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, page 5-319

GciResolveSymbolObj

Find the OOP of the object to which a symbol object refers, in the context of the current session's user profile.

Syntax

```
OopType GciResolveSymbolObj(
    OopType             aSymbolObj,
    OopType             symbolList );
```

Input Arguments

aSymbolObj	The OOP of a kind of String. That is, this object's class must be OOP_CLASS_STRING or a subclass thereof.
symbolList	The OOP of an instance of OOP_CLASS_SYMBOL_LIST or OOP_NIL.

Return Value

The OOP of the object that corresponds to the specified symbol.

Description

Attempts to resolve *aSymbolObj* 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 instead of a C string.

See Also

GciResolveSymbol, page 5-318

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 Shared Libraries" on page 2-2 for more information.

See Also

GciRtlLoad, page 5-321
GciRtlUnload, page 5-323

GciRtlLoad

Load a GemBuilder library.

Syntax

```
BoolType GciRtlLoad(
    BoolType          useRpc,
    const char *      path,
    char              errBuf[ ],
    size_t            errBufSize );
```

Input 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 Shared Libraries” on page 2-2 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.

If a GemBuilder library is already loaded, the call fails.

See Also

GciRtlIsLoaded, page 5-320
GciRtlUnload, page 5-323

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 Shared Libraries” on page 2-2 for more information.

See Also

GciRtlLoad, page 5-321
GciRtlIsLoaded, page 5-320

GciSaveAndTrackObjs

Add objects to GemStone's internal GciTrackedObjs set to prevent them from being garbage collected.

Syntax

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

Input Arguments

theOops	An array of OOPs.
numOops	The number of elements in theOops.

Description

The **GciSaveAndTrackOops** 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 **GciSaveAndTrackOops** 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

GciHiddenSetIncludesOop, page 5-174
GciDirtySaveObjs, page 5-89
GciDirtyTrackedObjs, page 5-91
GciReleaseAllTrackedOops, page 5-305
GciReleaseTrackedOops, page 5-310
GciTrackedObjsInit, page 5-407
GciTrackedObjsFetchAllDirty, page 5-405

GciSaveGlobalObjs

Add an array of OOPs to the PureExportSet, making them ineligible for garbage collection.

Syntax

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

Input 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 1-32
GciReleaseAllGlobalOops, page 5-303
GciReleaseAllOops, page 5-304
GciReleaseGlobalOops, page 5-306
GciReleaseOops, page 5-307
GciSaveObjs, page 5-327

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 );
```

Input 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 1-32
GciReleaseGlobalOops, page 5-306
GciReleaseOops, page 5-307
GciSaveGlobalObjs, page 5-326

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

The **GciSessionIsRemote** function 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_(
      const char *                name );
```

Input 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 );
```

Input 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 the **GciErr** function on page 5-99 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)
{
   GciJmpBufSType 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, page 5-99
GciPopErrJump, page 5-292
GciPushErrJump, page 5-297

GciSetHaltOnError

Halt the current session when a specified error occurs.

Syntax

```
int GciSetHaltOnError(
    int                    errNum );
```

Input 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. When *errNum* is zero, halt on error is disabled.

See Also

GciErr, page 5-99

Gci_SETJMP

(MACRO) Save a jump buffer in GemBuilder's error jump stack.

Syntax

```
void Gci_SETJMP(
    GciJmpBufSType *        jumpBuffer );
```

Input 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.

Except for the difference in argument type, the semantics of this function are the same as for setjmp() on Solaris and _setjmp() on HP-UX.

See Also

GciErr, page 5-99
GciLongJmp, page 5-198
GciPopErrJump, page 5-292
GciPushErrJump, page 5-297
GciSetErrJump, page 5-331

GciSetNet

Set network parameters for connecting the user to the Gem and Stone processes.

Syntax

```
void GciSetNet(
    const char          StoneName[ ],
    const char          HostUserId[ ],
    const char          HostPassword[ ],
    const char          GemService[ ] );
```

Input Arguments

S*toneName*	Network resource string for the database monitor process.
HostUserId	Login name.
HostPassword	Password of the user.
GemService	Network resource string for the GemStone service.

Description

Your application, your GemStone session (Gem), and the database monitor (Stone) can all run in separate processes, on separate machines in your network. The **GciSetNet** function 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 Appendix B, “Network Resource String Syntax”). See the *System Administration Guide for GemStone/S 64 Bit* for complete information on the network environment.

StoneName 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. Every session must communicate with a Stone, in both linked and remote applications. Hence, *StoneName* is a required argument.

A Stone process called “gs64stone” on node “lichen” could be described in a network resource string as:

```
!tcp@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
```

GemService 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 no such Gem is present. Therefore, each time an application user logs in to GemStone (after the first time in linked applications), the GemStone service must create a new Gem. Hence, *GemService* is a required argument, except in the special case of a linked application that limits itself to one GemStone login per application process. In this special case, specify *GemService* as an empty string.

For most installations, the GemStone service name is *gemnetobject*. Specify, for example:

```
!tcp@lichen!gemnetobject
```

If you use the C shell (`/bin/csh`) under UNIX, the GemStone service name is *gemnetobjcsh*.

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. These arguments provide authentication for such tasks as creating a Gem and establishing communications with a Stone. 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. Remote applications must always create a Gem, but linked applications may also do so.

With TCP / IP, GemBuilder can also try to find a username and password for authentication on a host machine in your network initialization file. Because this file contains your password, you should ensure that other users do not have authorization to read it. Under UNIX, the file is named `.netrc` and it should contain lines of the form:

`machine` *machine_name* `login` *user_name* `password` *passwd*

For example:

```
machine alf login joebob password mypassword
```

To prevent GemBuilder from looking for authentication information in the network initialization file, supply a valid non-empty C string for the *HostUserId* argument. Also supply 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.

Alternatively, to direct GemBuilder to look in the network initialization file at need, supply an empty C string or a NULL pointer for the *HostUserId* argument. In this case, supply a NULL pointer for the *HostPassword* argument as well. Any valid string that you supply for a password is ignored in favor of the information that is present in the network initialization file.

Example

For an example of how **GciSetNet** is used, see the **GciLogin** function on page 5-195.

See Also

GciLogin, page 5-195
"Network Resource String Syntax" on page B-1

GciSetSessionId

Set an active session to be the current one.

Syntax

```
void GciSetSessionId(
    GciSessionIdType         sessionId );
```

Input 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.

Example

```
void setSession_example(void)
{
  // assume topaz code for GciFetchVaryingOop has run
  // see GciLogin for login_example()
  if (! login_example())
    return;
  GciSessionIdType sess1 = GciGetSessionId();

  if (! login_example())
    return;
  GciSessionIdType sess2 = GciGetSessionId();

  { OopType aColl = GciResolveSymbol("AllComponents", OOP_NIL);
    OopType aComponent = GciExecuteStr(
        "AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);
    GciRemoveOopFromNsc(aColl, aComponent);
    GciReleaseOops(&aComponent, 1);
    printf("session %d , size after removal "FMT_I64"\n",
   sess2, GciFetchVaryingSize_(aColl));
  }
  // other session will still see the original size before removal
  // because it has an independent transactional view of the
repository.
  GciSetSessionId(sess1);
  { OopType aColl = GciResolveSymbol("AllComponents", OOP_NIL);
    printf("session %d , current size "FMT_I64"\n",
                sess1, GciFetchVaryingSize_(aColl));
  }
}
```

See Also

GciGetSessionId, page 5-171
GciLogin, page 5-195

GciSetSharedCounter

Set the value of a shared counter.

Syntax

```
BoolType GciSetSharedCounter(
      int                       counterIdx,
      int64_t *                 value);
```

Input 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

GciFetchNumSharedCounters, page 5-131
GciDecSharedCounter, page 5-83
GciIncSharedCounter, page 5-177
GciReadSharedCounter, page 5-300
GciReadSharedCounterNoLock, page 5-301
GciFetchSharedCounterValuesNoLock, page 5-150

GciSetTraversalBufSwizzling

Control swizzling of the traversal buffers.

Syntax

```
BoolType GciSetTraversalBufSwizzling(
      BoolType                    enabled );
```

Input 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 (for example, GemBuilder for Smalltalk) 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**

GciSetVaryingSize

Set the size of a collection.

Syntax

```
void GciSetVaryingSize(
    OopType             collection,
    int64               size );
```

Input 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_, page 5-159

GciShutdown

Logout from all sessions and deactivate GemBuilder.

Syntax

void GciShutdown( )

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.

It is especially important to call this function explicitly on any computer whose operating system does not automatically deallocate resources when a process quits. This effect is found on certain small, single-user systems.

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. For example, if your application sends a message to an object (via **GciSendMessage** or **GciPerform**), and for some reason the invoked Smalltalk method enters an infinite loop, the user can interrupt the application.

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.

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.category == OOP_GEMSTONE_ERROR_CAT &&
          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, page 5-60
GciContinue, page 5-67
GciExecute, page 5-101
GciHardBreak, page 5-173
GciPerform, page 5-278

GciStep

Continue code execution in GemStone with specified single-step semantics.

Syntax

```
OopType GciStep(
    OopType          process,
    int              level );
```

Input Arguments

process	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

Return Value

Returns the OOP of the result of the Smalltalk execution. Returns OOP_ILLEGAL in case of error.

Description

The **GciStep** 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(*process*, "stackDepth", NULL, 0), **GciStep** generates an error.

See Also

GciPerform, page 5-278

GciStoreByte

Store one byte in a byte object.

Syntax

```
void GciStoreByte(
      OopType              theObject,
      int64                atIndex,
      ByteType             theByte );
```

Input Arguments

theObject	The OOP of the GemStone byte object.
atIndex	The index into theObject at which to store the byte.
theByte	The 8-bit value to be stored.

Result Arguments

theObject	The resulting GemStone byte object.

Description

The **GciStoreByte** 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, page 5-112
GciFetchBytes_, page 5-114
GciStoreBytes, page 5-351

GciStoreBytes

(MACRO) Store multiple bytes in a byte object.

Syntax

```
void GciStoreBytes(
      OopType              theObject,
      int64                startIndex,
      const ByteType       theBytes[ ],
      int64                numBytes );
```

Input Arguments

theObject	The OOP of the GemStone byte object.
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.

Result Arguments

theObject	The resulting GemStone byte object.

Description

The **GciStoreBytes** 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.

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, page 5-112
GciFetchBytes_, page 5-114
GciStoreByte, page 5-349
GciStoreBytesInstanceOf, page 5-353
GciStoreChars, page 5-355

GciStoreBytesInstanceOf

Store multiple bytes in a byte object.

Syntax

```
void GciStoreBytesInstanceOf(
      OopType              theClass,
      OopType              theObject,
      int64                startIndex,
      const ByteType       theBytes[ ],
      int64                numBytes );
```

Input Arguments

theClass	The OOP of the class of the GemStone byte object.
theObject	The OOP of the GemStone byte object.
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.

Result Arguments

theObject	The resulting GemStone byte object.

Description

The **GciStoreBytesInstanceOf** function uses structural access to store multiple elements from a C array in a byte object, beginning at a specified index. A common application of **GciStoreBytesInstanceOf** would be to store a Float or SmallFloat object.

GciStoreBytesInstanceOf provides automatic byte swizzling for Float and SmallFloat objects. (For more about byte swizzling, see page 1-11.) 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, page 5-112
GciFetchBytes_, page 5-114
GciStoreByte, page 5-349
GciStoreBytes, page 5-351
GciStoreChars, page 5-355

GciStoreChars

Store multiple ASCII characters in a byte object.

Syntax

void GciStoreChars(
OopType *theObject*,
int64 *startIndex*,
const char * *aString*);

Input Arguments

theObject	The OOP of the GemStone byte object.
startIndex	The index into theObject at which to begin storing the string.
aString	The string to be stored.

Result Arguments

theObject	The resulting GemStone byte object.

Description

The **GciStoreChars** 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

GciFetchByte, page 5-112
GciFetchBytes_, page 5-114
GciStoreByte, page 5-349
GciStoreBytes, page 5-351

GciStoreIdxOop

Store one OOP in an indexable pointer object's unnamed instance variable.

Syntax

```
void GciStoreIdxOop(
    OopType          theObject,
    int64            atIndex,
    OopType          theOop );
```

Input Arguments

theObject	The pointer object.
atIndex	The index into *theObject* at which to store the object.
theOop	The OOP to be stored.

Result Arguments

theObject	The resulting pointer object.

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 the **GciAddOopToNsc** function on page 5-29.)

Example

In the following example, assume that you've defined the class Component and populated the set AllComponents, as shown in the example for the **GciFetchVaryingOop** function on page 5-154.

```
void storeIdxOop_example(void)
{
  // retrieve a random instance of class Component
  OopType aComponent = GciExecuteStr(
"AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);

  OopType otherComp = GciExecuteStr(
        "AllComponents detect:[i|i partNumber = 1333]", OOP_NIL);

  // store new value into 3rd element of aComponent's parts list
  GciStoreIdxOop(aComponent, 3, otherComp);

  GciReleaseOops(&aComponent, 1);   // release results of 
execution
  GciReleaseOops(&otherComp, 1);
}
```

See Also

GciAddOopToNsc, page 5-29
GciFetchVaryingOop, page 5-154
GciFetchVaryingOops, page 5-157
GciStoreIdxOops, page 5-359

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 );
```

Input Arguments

theObject	The pointer object.
startIndex	The index into *theObject* at which to begin storing OOPs.
theOops	The array of OOPs to be stored.
numOops	The number of OOPs to store.

Result Arguments

theObject	The resulting pointer object.

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 the **GciAddOopsToNsc** function on page 5-31.)

Example

In the following example, assume that you've defined the class Component and populated the set AllComponents, as shown in the example for the **GciFetchVaryingOop** function on page 5-154.

```
void storeIdxOops_example(void)
{
  // retrieve a random instance of class Component
  OopType firstC = GciExecuteStr(
"AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);

  OopType secondC = GciExecuteStr(
        "AllComponents detect:[i|i partNumber = 1333]", OOP_NIL);

  // make first component's parts list be identical to second
component's list
  enum { buf_size = 100 };
  OopType buf[buf_size];
  int64 firstSize = GciFetchVaryingSize_(firstC);
  int64 idx = 1;
  while (idx <= firstSize) {
    int numRet = GciFetchVaryingOops(firstC, idx, buf, buf_size);
    GciStoreIdxOops(secondC, idx, buf, numRet);
    idx += numRet;
  }
  // truncate second component's parts list if it was larger than
first's
  GciSetVaryingSize(secondC, firstSize);

  GciReleaseOops(&firstC, 1);   // release results of executions
  GciReleaseOops(&secondC, 1);
}
```

See Also

GciAddOopsToNsc, page 5-31
GciFetchVaryingOop, page 5-154
GciFetchVaryingOops, page 5-157
GciReplaceOops, page 5-315

GciReplaceVaryingOops, page 5-317
GciStoreIdxOop, page 5-357
GciStoreIdxOops, page 5-359
GciStoreNamedOops, page 5-365
GciStoreOops, page 5-371

GciStoreNamedOop

Store one OOP into an object’s named instance variable.

Syntax

```
void GciStoreNamedOop(
    OopType          theObject,
    int64            atIndex,
    OopType          theOop );
```

Input Arguments

theObject	The object in which to store the OOP.
atIndex	The index into *theObject*’s named instance variables at which to store the OOP.
theOop	The OOP to be stored.

Result Arguments

theObject	The resulting object with the new OOP.

Description

This function stores a single OOP into an object’s named instance variable at the specified index, using structural access.

Example

In the following example, assume that you've defined the class Component and populated the set AllComponents, as shown in the example for the **GciFetchVaryingOop** function on page 5-154.

```
void storeNamedOop_example(void)
{
  // C constants to match Smalltalk class definition
  enum { COMPONENT_OFF_PARTNUMBER = 1,
         COMPONENT_OFF_NAME       = 2,
         COMPONENT_OFF_COST       = 3 };

  // retrieve a random instance of class Component
  OopType aComponent = GciExecuteStr(
        "AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);
  if (aComponent == OOP_NIL) {
    // error during execution or detect found nothing
    return;
  }

  //  assign a new value to the name instance variable of
aComponent
  OopType newName = GciNewString("compressor blade");
  GciStoreNamedOop(aComponent, COMPONENT_OFF_NAME, newName);

  // alternate approach: assign a new value to a named instance
  //variable without knowing its offset at compile time
  GciStoreNamedOop(aComponent,
GciIvNameToIdx(GciFetchClass(aComponent), "name"), newName);

  GciReleaseOops(&newName, 1);
  GciReleaseOops(&aComponent, 1);
}
```

See Also

GciFetchNamedOop, page 5-122
GciFetchNamedOops, page 5-125

GciStoreIdxOop, page 5-357
GciStoreNamedOops, page 5-365

GciStoreNamedOops

Store one or more OOPs into an object's named instance variables.

Syntax

```
void GciStoreNamedOops(
    OopType             theObject,
    int64               startIndex,
    const OopType       theOops[ ],
    int                 numOops );
```

Input Arguments

theObject	The object in which to store the OOPs.
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.

Result Arguments

theObject	The resulting object with the new OOPs.

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

In the following example, assume that you've defined the class Component and populated the set AllComponents, as shown in the example for the **GciFetchVaryingOop** function on page 5-154.

```
void storeNamedOops_example(void)
{
  // retrieve a random instance of class Component
  OopType aComponent = GciExecuteStr(
"AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);
  if (aComponent == OOP_NIL) {
    // execution error, or detect: found nothing
    return;
  }

  // fetch name instance variables without knowing offset at C
compile time
  int namedSize = GciFetchNamedSize(aComponent);
  if (namedSize == 0) {
    // error during fetch
    return;
  }
  OopType *oBuffer = (OopType*) malloc( sizeof(OopType) *
namedSize );
  if (oBuffer == NULL) {
    printf("malloc failure\n");
    return;
  }
  int numRet = GciFetchNamedOops(aComponent, 1, oBuffer,
namedSize);
  if (numRet != namedSize) {
    printf("error during fetch\n");
    return;
  }

  // alter one of the instVars and then store them all
  OopType newName = GciNewString("compressor blade");
  int ivOffset = GciIvNameToIdx(GciFetchClass(aComponent),
"name");
  if (ivOffset <= 0) {
    printf("error during GciIvNameToIdx\n");
```

```
      return;
    }
    oBuffer[ivOffset  - 1 ] = newName;
    GciStoreNamedOops(aComponent, 1, oBuffer, namedSize);

    GciReleaseOops(&newName, 1);
    GciReleaseOops(&aComponent, 1);
  }
```

See Also

GciFetchNamedOop, page 5-122
GciFetchNamedOops, page 5-125
GciReplaceOops, page 5-315
GciReplaceVaryingOops, page 5-317
GciStoreIdxOop, page 5-357
GciStoreIdxOops, page 5-359
GciStoreNamedOop, page 5-362
GciStoreNamedOops, page 5-365
GciStoreOops, page 5-371

GciStoreOop

Store one OOP into an object's instance variable.

Syntax

```
void GciStoreOop(
    OopType         theObject,
    int64           atIndex,
    OopType         theOop );
```

Input Arguments

theObject	The object in which to store the OOP.
atIndex	The index into *theObject* 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.
theOop	The OOP to be stored.

Result Arguments

theObject	The resulting object.

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 the **GciAddOopToNsc** function on page 5-29.

Example

In the following example, assume that you’ve defined the class Component and populated the set AllComponents, as shown in the example for the **GciFetchVaryingOop** function on page 5-154.

```
void storeOop_example(void)
{
  /* C constants to match Smalltalk class definition */
  enum { COMPONENT_OFF_NAME = 2 };

  /* retrieve a random instance of class Component */
  OopType aComponent = GciExecuteStr(
"AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);

  OopType newName = GciNewString("vane");

  /* Two ways to assign new value to name instance variable of
aComponent */
  GciStoreOop(aComponent, COMPONENT_OFF_NAME, newName);
  GciStoreNamedOop(aComponent, COMPONENT_OFF_NAME, newName);

  OopType subPart = GciExecuteStr(
"AllComponents detect:[i|i partNumber = 1333]", OOP_NIL);

  /* Two ways to assign a new value to the 3rd element of
   aComponent’s parts list without knowing exactly how many named
   instance variables exist  */

  GciStoreOop(aComponent, GciFetchNamedSize(aComponent) + 3,
subPart);
  GciStoreIdxOop(aComponent, 3, subPart);
}
```

See Also

GciAddOopToNsc, page 5-29
GciFetchVaryingOop, page 5-154
GciFetchVaryingOops, page 5-157

GciFetchOops, page 5-140
GciStoreOops, page 5-371

GciStoreOops

Store one or more OOPs into an object’s instance variables.

Syntax

```
void GciStoreOops(
    OopType           theObject,
    int64             startIndex,
    const OopType     theOops[ ],
    int               numOops );
```

Input Arguments

theObject	The object in which to store the OOPs.
startIndex	The index into *theObject* 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 array of OOPs to be stored.
numOops	The number of OOPs to store.

Result Arguments

theObject	The resulting object.

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 the **GciAddOopsToNsc** function on page 5-31.

Example

In the following example, assume that you've defined the class Component and populated the set AllComponents, as shown in the example for the **GciFetchVaryingOop** function on page 5-154.

```
void storeOops_example(void)
{
  /* retrieve a random instance of class Component */
  OopType aComponent = GciExecuteStr(
"AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);

  int namedSize = GciFetchNamedSize(aComponent);
  int64 instSize = GciFetchSize_(aComponent);
  // allow space in buffer for storing into first varying instVar
plus
  // appending a new varying instVar
  int64 bufVaryingSize = instSize - namedSize + 1;
  if (bufVaryingSize < 2)
    bufVaryingSize = 2;

  int64 bufSize = namedSize + bufVaryingSize;
  OopType *buf = (OopType*) malloc(sizeof(OopType) * bufSize);
  if (buf == NULL) {
    printf("malloc failure");
    return;
  }
  GciFetchOops(aComponent, 1, buf, instSize);

  OopType newName = GciNewString("strut");
  int nameOfs = GciIvNameToIdx(GciFetchClass(aComponent), "name");
  buf[nameOfs - 1] = newName;

  OopType firstSubPart = GciExecuteStr(
"AllComponents detect:[i|i partNumber = 1333]", OOP_NIL);

  OopType lastSubPart = GciExecuteStr(
"AllComponents detect:[i|i partNumber = 1555]", OOP_NIL);

  // assign first element of parts list
  buf[namedSize] = firstSubPart;
```

```
    // append lastSubPart to aComponent’s parts list
    int64 newSize = instSize + 1;
    buf[newSize - 1] = lastSubPart;

    // now store all the instVars back to the repository
    GciStoreOops(aComponent, 1, buf, newSize);
  }
```

See Also

GciAddOopsToNsc, page 5-31
GciFetchNamedOops, page 5-125
GciFetchOop, page 5-137
GciFetchOops, page 5-140
GciFetchVaryingOop, page 5-154
GciReplaceOops, page 5-315
GciReplaceVaryingOops, page 5-317
GciStoreIdxOops, page 5-359
GciStoreNamedOops, page 5-365
GciStoreOop, page 5-368
GciStoreOops, page 5-371

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 );
```

Input 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*.

Result Arguments

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.

NOTE
This function is most useful with applications that are linked with GciRpc (the "remote procedure call" version of GemBuilder*). If your application will be linked with GciLnk (the "linkable"* GemBuilder*), you'll usually achieve best performance by using the simple* **GciFetch***... and* **GciStore***... functions rather than object traversal. For more information, see "GciRpc and GciLnk" on page 2-1.*

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 (*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]
```

The first element of this newValues array is stored along the first path into the first element of *theOops*. New values are then stored into the first element of *theOops* along each remaining element of the paths array. Similarly, new values are stored into each subsequent element of *theOops*, 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.

Examples

Example 1: Calling sequence for a single object and a single path

```
void storePath1(void)
{
  enum { path_size = 5 };
  int    aPath[path_size]; /* the path itself */
  int    aSize = path_size;    /* the size of the path */

  OopType anOop; // the OOP to use as the root of the path
  anOop = GciExecuteStr("AllComponents detect:[:i|i partNumber =
1234]", OOP_NIL);
  if (anOop == OOP_NIL) {
    return; // error during resolve
  }

  OopType newValue = GciNewString("a new value");
  int    failCount;

  GciStorePaths(&anOop, 1, aPath, &aSize, 1, &newValue,
&failCount);
}
```

Example 2: Calling sequence for multiple objects with a single path

```
void storePath2(void)
{
  OopType coll = GciResolveSymbol("AllComponents", OOP_NIL);
  if (coll == OOP_NIL) {
    return ; // error during resolve
  }
  enum { num_roots = 3 ,
         path_size = 5 };
  OopType oops[num_roots];
  int numRet = GciFetchVaryingOops(coll, 1, oops, num_roots);
  if (numRet != num_roots) {
    return; // error during fetch or collection too small
  }

  int  aPath[path_size];
  int  aSize = path_size;
  for (int j = 0; j < path_size; j++) {
    aPath[j] = 1;  // arbitrary offsets
  }

  OopType newValues[num_roots];
  for (int j = 0; j < num_roots; j++) {
    newValues[j] = GciI32ToOop(1345600 + j);
  }
  int    failCount;
  GciStorePaths(oops, num_roots, aPath, &aSize, 1, newValues,
&failCount);
}
```

Example 3: Calling sequence for a single object with multiple paths

```
void storePath3(void)
{
  OopType anOop; // the OOP to use as the root of the path
  anOop = GciExecuteStr("AllComponents detect:[:i|i partNumber = 
1234]", OOP_NIL);
  if (anOop == OOP_NIL) {
    return; // error during execution
  }

  enum { num_paths = 10,
         path_size = 5 };

  int pathSizes[num_paths];
  int paths[path_size * num_paths ];
  int idx = 0;
  for (int j = 0; j < num_paths; j++) {
    for (int k = 0; k < path_size; k++) {
      paths[idx++] = k + 1;  // arbitrary offset
    }
  }
  OopType newValues[num_paths];
  for (int j = 0; j < num_paths; j++) {
    newValues[j] = GciI32ToOop(1345600 + j);
  }
  int    failCount;

  GciStorePaths(&anOop, 1, paths, pathSizes, num_paths, newValues, 
&failCount);
}
```

Example 4: Calling sequence for multiple objects with multiple paths

```
void storePaths4(void)
{
  OopType coll = GciResolveSymbol("AllComponents", OOP_NIL);
  if (coll == OOP_NIL) {
    return ; // error during resolve
  }

  enum { num_roots = 10,
         num_paths = 3,
         path_size = 5 ,
         num_new_values = num_roots * num_paths
        };
  OopType oops[num_roots];
  int numRet = GciFetchVaryingOops(coll, 1, oops, num_roots);
  if (numRet != num_roots) {
    return; // error during fetch or collection too small
  }

  int pathSizes[num_paths];
  int paths[path_size * num_paths ];
  int idx = 0;
  for (int j = 0; j < num_paths; j++) {
    for (int k = 0; k < path_size; k++) {
      paths[idx++] = k + 1;  // arbitrary offset
    }
  }

  OopType newValues[num_new_values];
  for (int j = 0; j < num_new_values; j++) {
    newValues[j] = GciI32ToOop(1345600 + j);
  }
  int    failCount;
  GciStorePaths(oops, num_roots, paths, pathSizes, num_paths,
newValues,
   &failCount);
}
```

Example 5: Integrated Code

In the following example, assume that you've defined the class Component and populated the set AllComponents, as shown in the example for the **GciFetchVaryingOop** function on page 5-154.

```
void storePaths5(void)
{
  // retrieve a random instance of class Component */
  OopType aComponent = GciExecuteStr(
        "AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);
  if (aComponent == OOP_NIL) {
    return; // error in execute, or detect: found nothing
  }


  // assign a new value to the name instVar of 5th element of
  //   aComponent's parts list
  enum { path_size = 2 };
  int path[path_size];
  path[0] = -5;  // 5th varying instVar
  path[1] = GciIvNameToIdx(GciFetchClass(aComponent), "name");
  int pathSizes = path_size;

  OopType newValue = GciNewString("pump");
  int failCount;
  GciStorePaths(&aComponent, 1, path, &pathSizes, 1, &newValue,
&failCount);
}
```

See Also

GciFetchPaths, page 5-143

GciStoreTrav

Store multiple traversal buffer values in objects.

Syntax

```
void GciStoreTrav(
     GciTravBufType *        travBuff,
     int                     behaviorFlag );
```

Input Arguments

travBuff	A traversal buffer, which contains object data to be stored.
behaviorFlag	A flag that determines how the objects should be handled.

Description

The **GciStoreTrav** function stores data from the traversal buffer *travBuff* (a C-language structural description) into multiple GemStone objects. 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**, which includes a variable-length data area. **GciStoreTrav** stores data object by object, using one object report at a time. **GciStoreTrav** raises an error if the traversal buffer contains a report for any object of special implementation format.

GciStoreTrav allows you to reduce the number of GemBuilder calls that are required for your application program to store complex objects in the database.

NOTE
This function is most useful with applications that are linked with GciRpc (the "remote procedure call" version of GemBuilder*). If your application will be linked with GciLnk (the "linkable"* GemBuilder*), you'll usually achieve best performance by using the simple* **GciFetch***... and* **GciStore***... functions rather than object traversal. For more information, see "GciRpc and GciLnk" on page 2-1.*

The value of *behaviorFlag* should be given by using one or more of the following GemBuilder mnemonics: GCI_STORE_TRAV_DEFAULT, GCI_STORE_TRAV_NSC_REP, GCI_STORE_TRAV_CREATE, and GCI_STORE_TRAV_FINISH_UPDATES. The first of these must be used alone. The others can either be used alone or can be logically "or"ed together. The effect of the mnemonics depends somewhat upon the implementation format of the objects that are stored.

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 can only modify 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. Naturally, any new object is initialized with the data in its object report.

When GCI_STORE_TRAV_FINISH_UPDATES is used, **GciStoreTrav** automatically executes **GciProcessDeferredUpdates_** after processing the last object report in the traversal buffer.

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.

Contrast byte and pointer object handling with the default when **GciStoreTrav** modifies an existing NSC. 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* indicates 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 for Float and SmallFloat objects. (For more about byte swizzling, see page 1-11.)

Use of Object Reports

The **GciStoreTrav** function 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 on page 5-19). **GciStoreTrav** uses the fields in each object report as follows:

rpt->hdr.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.

rpt->hdr.namedSize
Ignored by this function.

rpt->hdr.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.

rpt->hdr.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.

rpt->hdr.objId
: The OOP of the object to be stored.

rpt->hdr.oclass
: Used only when creating a new object, to identify its intended class.

rpt->hdr.segmentId
: The segment ID of the object's segment.

rpt->hdr.clearBits()
: Must be called before any of the following:

  rpt->hdr.setObjImpl()
  You must call *rpt->hdr.setObjImpl* to set this field to be consistent with the object's implementation.

  rpt->hdr.setInvariant()
  Boolean value. Call *rpt->hdr.setInvariant(TRUE)* if you want this object to be made invariant after the store specified by *rpt** is completed.

  rpt->hdr.setIndexable()
  Ignored by this function.

rpt->valueBufferBytes()
: The value buffer of an object of byte format.

rpt->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, page 5-199
GciNbMoreTraversal, page 5-222
GciNbStoreTrav, page 5-229
GciNbTraverseObjs, page 5-236
GciNewOopUsingObjRep, page 5-246
GciProcessDeferredUpdates_, page 5-294
GciStoreTravDo, page 5-385
GciTraverseObjs, page 5-408

GciStoreTravDo

Store multiple traversal buffer values in objects, execute the specified code, and return the resulting object.

Syntax

```
OopType GciStoreTravDo(
    GciStoreTravDoArgsSType *args );
```

Input Arguments

args An instance of GciStoreTravDoArgsSType (as described in `$GEMSTONE/include/gcicmn.ht`) containing the following fields:

GciTravBufType*	*storeTravBuff* The traversal buffer. For details, see “GciStoreTrav” on page 5-381.
int	*storeTravFlags* A flag that determines how the objects should be handled. For details, see “GciStoreTrav” on page 5-381.
int	*doPerform* If this field is 1, the function executes a perform using *args->u.perform*, with the sematics of “GciPerformNoDebug” on page 5-280. If 2, then executes a string, with the sematics of “GciExecuteStrFromContext” on page 5-107. If 3, then executes a block.
int	*doFlags* Flags to disable or permit asynchronous events and debugging in Smalltalk, as described in “GciPerformNoDebug” on page 5-280. These flags apply whatever the value of *doPerform*.
union	*u* A union of two nested structures; the first containing the input fields for the perform, the

	second containing the input fields for executing a String or Block. For more information on these structs and how to use them, see `gcicmn.ht`.
OopType*	*alteredTheOops* An array allocating memory for OOPs of objects that will be modified as a consequence of executing the specified code. For more information, see “GciAlteredObjs” on page 5-34.
int	*alteredNumOops* The number of OOPs in the previous array. On input, the sender must set this to the anticipated size of *alteredTheOops*. Upon completion, this field indicates the number of OOPs actually written to *alteredTheOops*.
BoolType	*alteredCompleted* Upon output, TRUE if the previous arrays contain the complete set of objects modified as a result of executing the specified code; false otherwise. If FALSE, call GciAlteredObjs for the rest of the modified objects.
const OopType*	*execBlock_args* The arguments to the block to be executed. Only applies if *doPerform* is 3, ignored otherwise.
int	*execBlock_numArgs* The number of arguments to the block to be executed. Only applies if *doPerform* is 3, ignored otherwise.

Return Value

Returns the OOP of the result of executing the specified code. In case of error, this function returns OOP_NIL.

Description

The **GciStoreTravDo** function works exactly as “GciStoreTrav” on page 5-381, and also executes the supplied code in the same network round-trip.

The description of “GciStoreTrav” on page 5-381 explains the first two arguments. If the value of the third argument is 1, see “GciPerformNoDebug” on page 5-280 for details of the next five arguments—flags to enable or disable asynchronous events, and the first nested structure.

If the value of the third argument is 2, see “GciExecuteStrFromContext” on page 5-107 for details on next set of arguments—flags to enable or disable asynchronous events, and the second nested structure of five arguments.

If the value of the third argument is 3, the arguments are similar to those for GciExecuteStrFromContext, but *source* must be a String that when compiled will return a Block. In this case, the last two arguments also are used, which provide the arguments, and the count of arguments, to be used to execute the compiled block.

The next five input arguments supply needed output after the function has completed. Read *alteredTheOops* to get the OOPs of the objects that were modified; read *alteredSymbolBuf* to get the pairs of symbols and symbol dictionaries for symbol canonicalization; finally, 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.

Handling Error Conditions

If you get a run time error while executing **GciStoreTravDo**, we recommend that you abort the current transaction.

See Also

GciAlteredObjs, page 5-34
GciExecuteStrFromContext, page 5-107
GciMoreTraversal, page 5-199
GciNbMoreTraversal, page 5-222
GciNbStoreTrav, page 5-229
GciNbTraverseObjs, page 5-236
GciNewOopUsingObjRep, page 5-246
GciPerformNoDebug, page 5-280
GciProcessDeferredUpdates_, page 5-294
GciStoreTrav, page 5-381
GciTraverseObjs, page 5-408

GciStoreTravDoTrav

Combine in a single function the calls to GciStoreTravDo and GciClampedTrav, to store multiple traversal buffer values in objects, execute the specified code, and traverse the result object.

Syntax

BoolType GciStoreTravDoTrav(
    GciStoreTravDoArgsSType **stdArgs*,
    GciClampedTravArgsSType **ctArgs*);

Input Arguments

stdArgs	An instance of GciStoreTravDoArgsSType. For details, refer to the discussion of GciStoreTravDo on page 5-385.
ctArgs	An instance of GciClampedTravArgsSType. For details, see the discussion of GciClampedTrav on page 5-48.

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 Also

GciClampedTrav, page 5-48
GciStoreTrav, page 5-381
GciStoreTravDo, page 5-385

GciStoreTravDoTravRefs

Combine in a single function modifications to session sets, calls to GciStoreTravDo and GciClampedTrav, to store multiple traversal buffer values in objects, execute the specified code, and traverse the result object.

Syntax

```
int GciStoreTravDoTravRefs(
    const OopType *        oopsNoLongerReplicated,
    int                    numNotReplicated,
    const OopType *        oopsGcedOnClient,
    int                    numGced,
    GciStoreTravDoArgsSType *stdArgs,
    GciClampedTravArgsSType *ctArgs );
```

Input 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*.
stdArgs	An instance of GciStoreTravDoArgsSType. For details, refer to the discussion of GciStoreTravDo on page 5-385.
ctArgs	An instance of GciClampedTravArgsSType. For details, see the discussion of GciClampedTrav on page 5-48.

Return Value

Returns an int with the following meaning:

0 —traversal of both altered objects and execution result completed.

1 —traversal buffer became full during the altered objects. You must call **GciMoreTraversal** to finish traversal of the altered objects, then use **GciClampedTravRefs** to traverse the execution result, with *ctArgs* pointer being exactly the same C pointer as was used to start **GciStoreTravDoTravRefs**.

2 —The traversal buffer became full during traversal of the execution result, must use **GciMoreTraversal** to finish traversal of execution result.

Description

This function allows the client to modify the PureExportSet and ReferencedSet, execute behavior on the Gem, and return the traversal of 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.

Elements 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 performs a **GciPerformNoDebug**, **GciExecuteStrFromContext**, or executes the code as a block. See **GciStoreTravDo** on page page 5-385 for details on how this is handled using GciStoreTravDoArgsSType.

Finally, this function does **GciClampedTravRefs** starting with altered objects. Altered objects are those that would be returned from a **GciAlteredObjs** after the code exection step.

For more details on this function, including the structure of the traversal result and the conditions under which objects are added to the PureExportSet and ReferencedSet, see the comments in `gci.hf`.

GciStoreTravDoTravRefs is not intended for use within a user action.

See Also

GciClampedTrav, page 5-48
GciClampedTravRefs, page 5-54
GciStoreTrav, page 5-381
GciStoreTravDo, page 5-385
GciStoreTravDoTravRefs, page 5-389

GciStringToInteger

Convert a C string to a GemStone SmallInteger, LargePositiveInteger or LargeNegativeInteger object.

Syntax

```
OopType GciStringToInteger(
    const char*            string,
    int64                  stringSize );
```

Input Arguments

string	The C string to be translated into a GemStone SmallInteger, LargePositiveInteger or LargeNegativeInteger object.
stringSize	The length of *string*.

Return Value

Returns the OOP of the GemStone SmallInteger, LargePositiveInteger or LargeNegativeInteger 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, LargePositiveInteger or LargeNegativeInteger object that has the same value.

Leading blanks are ignored. Trailing non-digits are ignored.

See Also

GciStrKeyValueDictAt

Find the value in a symbol KeyValue dictionary at the corresponding string key.

Syntax

```
void GciStrKeyValueDictAt(
    OopType              theDict,
    const char *         keyString,
    OopType *            value );
```

Input Arguments

theDict	The OOP of a SymbolKeyValueDictionary.
keyString	The OOP of a key in the SymbolKeyValueDictionary.

Result Arguments

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, page 5-393
GciStrKeyValueDictAtObjPut, page 5-394
GciStrKeyValueDictAtPut, page 5-395

GciStrKeyValueDictAtObj

Find the value in a symbol KeyValue dictionary at the corresponding object key.

Syntax

```
void GciStrKeyValueDictAtObj(
    OopType          theDict,
    OopType          keyObj,
    OopType *        value );
```

Input Arguments

theDict	The OOP of a SymbolKeyValueDictionary.
keyObj	The OOP of a key in the SymbolKeyValueDictionary.

Result Arguments

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, page 5-392
GciStrKeyValueDictAtObjPut, page 5-394
GciStrKeyValueDictAtPut, page 5-395

GciStrKeyValueDictAtObjPut

Store a value into a symbol KeyValue dictionary at the corresponding object key.

Syntax

```
void GciStrKeyValueDictAtObjPut(
    OopType             theDict,
    OopType             keyObj,
    OopType             theValue );
```

Input Arguments

theDict	The OOP of the SymbolKeyValueDictionary into which the object is to be stored.
keyObj	The OOP of the key under which the object 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

GciStrKeyValueDictAt, page 5-392
GciStrKeyValueDictAtObj, page 5-393
GciStrKeyValueDictAtPut, page 5-395

GciStrKeyValueDictAtPut

Store a value into a symbol KeyValue dictionary at the corresponding string key.

Syntax

```
void GciStrKeyValueDictAtPut(
      OopType                  theDict,
      const char *             keyString,
      OopType                  theValue );
```

Input Arguments

theDict	The OOP of the SymbolKeyValueDictionary into which the object is to be stored.
keyString	The string key under which the object 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, page 5-392
GciStrKeyValueDictAtObj, page 5-393
GciStrKeyValueDictAtObjPut, page 5-394

GciStrToPath

Convert a path representation from string to numeric.

This function is deprecated and may be removed from future releases.

Syntax

```
BoolType GciStrToPath(
    OopType             aClass,
    const char          pathString[ ],
    int64               maxPathSize,
    int *               resultPathSize,
    int                 resultPath[ ] );
```

Input Arguments

aClass	The class of the object for which this path will apply. That is, for each instance of this class, store or fetch objects along the designated path.
pathString	The (null-terminated) path string to be converted to the equivalent numeric array.
maxPathSize	The maximum allowable size of the resulting path array (the number of elements). This is the size of the buffer that will be allocated for the resulting path array.

Result Arguments

resultPathSize	A pointer to the actual size of *resultPath*.
resultPath	The resulting array of integers. Those integers are offsets that specify a path from which to fetch objects. A positive integer x refers to an object’s xth named instance variable. When a path goes through an indexed instance variable (an Array element, for example), the position of that object must be represented by a negative integer. The third element of an Array, for example, would be denoted in a path by -3.

Return Value

Returns TRUE if the path string was successfully translated to an array of integer offsets. Returns FALSE otherwise.

Description

The functions **GciFetchPaths** and **GciStorePaths** allow you to specify paths along which to fetch from, or store into, objects within an object tree.

NOTE:
This function is most useful with applications that are linked with GciRpc (the "remote procedure call" version of GemBuilder*). If your application will be linked with GciLnk (the "linkable"* GemBuilder*), you'll usually achieve best performance by using the simple* **GciFetch**... *and* **GciStore**... *functions rather than object traversal. For more information, see "GciRpc and GciLnk" on page 2-1.*

A path may be represented as a string, in which each element is the name of an instance variable (for example, '`address.zip`', in which *zip* is an instance variable of *address*.) Alternatively, a path may be represented as an array of integers, in which each step along the path is represented by the corresponding integral offset from the beginning of an object (for example, an array containing the integers 5 and 2 would represent the offsets of the fifth and second instance variables, respectively).

This function (**GciStrToPath**) converts the string representation of a path to its equivalent numeric representation, for use with **GciFetchPaths** or **GciStorePaths**.

For more information about paths, see the description of the **GciFetchPaths** function on page 5-143.

Restrictions

Note that **GciStrToPath** can convert a numeric path only if the instance variables of the specified Smalltalk class (*aClass*) are constrained in such a way that the path is guaranteed to be valid for all instances.

If your application doesn't impose GemStone constraints on classes of all objects from which you to fetch, then you'll need to maintain your paths as arrays of integers.

Error Conditions

The following errors may be generated by this function:

GCI_ERR_RESULT_PATH_TOO_LARGE
: The *resultPath* was larger than the specified *maxPathSize*

RT_ERR_STR_TO_PATH_IVNAME
: One of the instance variable names in the path string was invalid

RT_ERR_STR_TO_PATH_CONSTRAINT
: One of the instance variables in the path string was not sufficiently constrained

Example

In the following example, assume that you've defined the class Component and populated the set AllComponents, as shown in the example for the **GciFetchVaryingOop** function on page 5-154.

```
void strToPath_example(void)
{
  // retrieve a random instance of class Component */
  OopType aComponent = GciExecuteStr(
"AllComponents detect:[i|i partNumber = 1234]", OOP_NIL);

  // fetch name instVar of the first 10 elements of aComponent's
part list */

  OopType oClass = GciFetchClass(aComponent);
  enum { buf_size = 10 };
  OopType subParts[buf_size];
  int64 numSubParts = GciFetchVaryingOops(aComponent, 1, subParts,
buf_size);

  enum { path_array_size = 3 };
  int path[path_array_size];
  int pathSize;  // actual number of terms in path , expect 1
  GciStrToPath(oClass, "name", path_array_size, &pathSize, path);

  int numPaths = 1;
  OopType nameIvs[buf_size];
  GciFetchPaths(subParts, numSubParts, path, &pathSize, numPaths,
nameIvs);
}
```

GciFetchPaths, page 5-143
GciPathToStr, page 5-275
GciStorePaths, page 5-374

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 );
```

Input Arguments

theDict	The OOP of a SymbolDictionary.
keyString	The OOP of a key in the SymbolDictionary.

Result Arguments

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

GciSymDictAtObj, page 5-402
GciSymDictAtObjPut, page 5-403
GciSymDictAtPut, page 5-404

GciSymDictAtObj

Find the value in a symbol dictionary at the corresponding object key.

Syntax

```
void GciSymDictAtObj(
    OopType          theDict,
    OopType          keyObj,
    OopType *        value,
    OopType *        association );
```

Input Arguments

theDict	The OOP of a SymbolDictionary.
keyObj	The OOP of a key in the SymbolDictionary.

Result Arguments

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 *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

GciSymDictAt, page 5-400
GciSymDictAtObjPut, page 5-403
GciSymDictAtPut, page 5-404

GciSymDictAtObjPut

Store a value into a symbol dictionary at the corresponding object key.

Syntax

```
void GciSymDictAtObjPut(
      OopType              theDict,
      OopType              keyObj,
      OopType              theValue );
```

Input Arguments

theDict	The OOP of the SymbolDictionary into which the value is to be stored.
keyObj	The OOP of the 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

GciSymDictAt, page 5-400
GciSymDictAtObj, page 5-402
GciSymDictAtPut, page 5-404

GciSymDictAtPut

Store a value into a symbol dictionary at the corresponding string key.

Syntax

```
void GciSymDictAtPut(
      OopType                theDict,
      const char *           keyString,
      OopType                theValue );
```

Input Arguments

theDict	The OOP of the SymbolDictionary into which the object is to be stored.
keyString	The string key under which the object 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

GciSymDictAt, page 5-400
GciSymDictAtObj, page 5-402
GciSymDictAtObjPut, page 5-403

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 );
```

Input Arguments

exportedDirty	OOP of the collection (an instance of either IdentitySet or IdentityBag) that will contain the objects in the ExportedDirtyObjs set.
trackedDirty	OOP of the collection (an instance of either IdentitySet or IdentityBag) that will contain the objects in the TrackedDirtyObjs set.

Result Arguments

numExportedDirty	Pointer to an integer that returns the number of objects in the *exportedDirty* collection.
numTrackedDirty	Pointer to an integer that returns the number of objects in the *trackedDirty* 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 1-32
GciDirtyExportedObjs, page 5-85
GciDirtyObjsInit, page 5-87
GciDirtySaveObjs, page 5-89
GciDirtyTrackedObjs, page 5-91
GciTrackedObjsInit, page 5-407

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, page 5-89
GciDirtyTrackedObjs, page 5-91
GciHiddenSetIncludesOop, page 5-174
GciTrackedObjsFetchAllDirty, page 5-405

GciTraverseObjs

Traverse an array of GemStone objects.

Syntax

```
BoolType GciTraverseObjs(
      const OopType         theOops[ ],
      int                   numOops,
      GciTravBufType *      travBuff,
      int                   level );
```

Input Arguments

theOops	An array of OOPs representing the objects to traverse.
numOops	The number of elements in *theOops*.
travBuffSize	The number of bytes in *travBuff*.
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.

Result Arguments

travBuff	A buffer in which the results of the traversal will be placed.

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.

NOTE
This function is most useful with applications that are linked with GciRpc (the "remote procedure call" version of GemBuilder*). If your application will be linked with GciLnk (the "linkable"* GemBuilder*), you'll usually achieve best performance by using the simple* **GciFetch**... *and* **GciStore**... *functions rather than object traversal. For more information, see "GciRpc and GciLnk" on page 2-1.*

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 for Float and SmallFloat objects. (For more about byte swizzling, see page 1-11.)

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 on page 5-382.

In order for the traversal buffer to accommodate *m* objects, each of which is of size *n* bytes, your application should allocate at least enough memory so that the traversal buffer's size can be assigned according to the following formula:

```
GciTravBufType* travBufAllocation_example(void)
{
  int numObjs = 100;
  int bodyBytesPerObj = 1000;
  size_t allocationSize =
numObjs * GCI_ALIGN(sizeof(GciObjRepHdrSType) + bodyBytesPerObj);

  GciTravBufType *buf = GciTravBufType::malloc(allocationSize);
  return buf;
}
```

The macro GCI_ALIGN ensures that the value buffer portion of each object report begins at a word boundary.

This function ensures that each object report header and value buffer begins on a word boundary. To provide proper alignment, 0 to 7 bytes may be inserted between each header and value buffer.

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 0, 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 a nonzero value 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:

hdr.valueBuffSize	`0`
hdr.namedSize	`0`
hdr.idxSize	`0`
hdr.firstOffset	`1`
hdr.objId	`theOop`
hdr.oclass	`OOP_NIL`
hdr.segmentId	`0`
hdr.objImpl	`GC_FORMAT_SPECIAL`
hdr.isInvariant	`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 (as specified with *travBuffSize*), 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 the **GciMoreTraversal** function on page 5-199.

See Also

GciFindObjRep, page 5-161
GciMoreTraversal, page 5-199
GciNbMoreTraversal, page 5-222
GciNbStoreTrav, page 5-229
GciNbTraverseObjs, page 5-236
GciNewOopUsingObjRep, page 5-246
GciObjRepSize_, page 5-256
GciStoreTrav, page 5-381

GciUncompress

Uncompress the supplied data, assumed to have been compressed with **GciCompress**.

Syntax

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

Input Arguments

dest	Pointer to the buffer intended 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.

Result Arguments

dest	The resulting uncompressed 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 1.2.3, and returns the result exactly as the GNU `uncompress` function returns it.

See Also

GciCompress, page 5-64

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.

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.

GciVersion

Return a string that describes the GemBuilder version.

Syntax

```
const char* GciVersion( )
```

Description

GciVersion returns a string terminated by 0, containing fields that describe the specific release of GemBuilder. Fields in the string are delimited by a period (.).

For more version information, use the methods in class System in the Version Management category.

See Also

GciProduct, page 5-296

Appendix A Reserved OOPs

The GemBuilder for C include file `gcioop.ht` defines C mnemonics for the OOPs of certain GemStone objects that are already defined in your GemStone software package. Your C application can compare all these mnemonics with any value of type `OopType`. However, the value of any mnemonic is subject to change without notice in future software releases. Your C application should refer to the OOPs of predefined GemStone objects *by mnemonic name only*.

The following mnemonic names for predefined GemStone objects are available to C programs:

- 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 mnemonic to test whether or not an OOP is valid, that is, whether or not it actually points to any GemStone object.
  - OOP_ILLEGAL
- Special objects
  - OOP_NIL (*nil*)
  - OOP_FALSE (*FALSE*)
  - OOP_TRUE (*true*)

- Instances of SmallInteger
    - OOP_MinusOne
    - OOP_Zero
    - OOP_One
    - OOP_Two
- Instances of Character
    - OOP_ASCII_NUL represents the first ASCII character OOP
    - 255 other OOPs represent the remaining ASCII characters, but they have no mnemonics
- Instances of JISCharacter
    - OOP_FIRST_JIS_CHAR
- The GemStone Smalltalk kernel classes
    - OOP_CLASS_*className* (in this case, the class name is in capital letters, with words separated by underscore characters)
    - OOP_LAST_KERNEL_OOP (which has the same value as the last class)
    - OOP_CLASS_EXCEPTION
- The GemStone error dictionary
    - OOP_GEMSTONE_ERROR_CAT
- The cluster bucket category
    - OOP_ALL_CLUSTER_BUCKETS

Appendix B Network Resource String Syntax

This appendix describes the syntax for network resource strings. A network resource string (NRS) provides a means for uniquely identifying a GemStone file or process by specifying its location on the network, its type, and authorization information. GemStone utilities use network resource strings to request services from a NetLDI.

B.1 Overview

One common application of NRS strings is the specification of login parameters for a remote process (RPC) GemStone application. An RPC login typically requires you to specify a GemStone repository monitor and a Gem service on a remote server, using NRS strings that include the remote server's hostname. For example, to log in from Topaz to a Stone process called "gs64stone" running on node "handel", you would specify two NRS strings:

```
topaz> set gemstone !@handel!gs64stone
topaz> set gemnetid !@handel!gemnetobject
```

Many GemStone processes use network resource strings, so the strings show up in places where command arguments are recorded, such as the GemStone log file. Looking at log messages will show you the way an NRS works. For example:

```
Opening transaction log file for read,
filename = !tcp@oboe#dbf!/user1/gemstone/data/tranlog0.dbf
```

An NRS can contain spaces and special characters. On heterogeneous network systems, you need to keep in mind that the various UNIX shells have their own rules for interpreting these characters. If you have a problem getting a command to work with an NRS as part of the command line, check the syntax of the NRS recorded in the log file. It may be that the shell didn't expand the string as you expected.

NOTE
Before you begin using network resource strings, make sure you understand the behavior of the software that will process the command.

See each operating system's documentation for a full discussion of its own rules. For example, under the UNIX C shell, you must escape an exclamation point (!) with a preceding backslash (\) character:

```
% waitstone \!tcp@oboe\!gs64stone -1
```

If there is a space in the NRS, you can replace the space with a colon (:), or you can enclose the string in quotes (" "). For example, the following network resource strings are equivalent:

```
% waitstone !tcp@oboe#auth:user@password!gs64stone
% waitstone "!tcp@oboe#auth user@password!gs64stone"
```

B.2 Defaults

The following items uniquely identify a network resource:

- communications protocol— TCP/IP
- destination node—the host that has the resource
- authentication of the user—such as a system authorization code
- resource type—such as server, database extent, or task
- environment—such as a NetLDI, a directory, or the name of a log file
- resource name—the name of the specific resource being requested.

A network resource string can include some or all of this information. In most cases, you need not fill in all of the fields in a network resource string. The information required depends upon the nature of the utility being executed and the task to be accomplished. Most GemStone utilities provide some context-sensitive defaults. For example, the Topaz interface prefixes the name of a Stone process with the **#server** resource identifier.

When a utility needs a value for which it does not have a built-in default, it relies on the system-wide defaults described in the syntax productions in “Syntax” on page B-4. You can supply your own default values for NRS modifiers by defining an environment variable named GEMSTONE_NRS_ALL in the form of the *nrs-header* production described in the Syntax section. If GEMSTONE_NRS_ALL defines a value for the desired field, that value is used in place of the system default. (There can be no meaningful default value for “resource name.”)

A GemStone utility picks up the value of GEMSTONE_NRS_ALL as it is defined when the utility is started. Subsequent changes to the environment variable are not reflected in the behavior of an already-running utility.

When a client utility submits a request to a NetLDI, the utility uses its own defaults and those gleaned from its environment to build the NRS. After the NRS is submitted to it, the NetLDI then applies additional defaults if needed. Values submitted by the client utility take precedence over those provided by the NetLDI.

B.3 Notation

Terminal symbols are printed in boldface. They appear in a network resource string as written:

#server

Nonterminal symbols are printed in italics. They are defined in terms of terminal symbols and other nonterminal symbols:

username ::= *nrs-identifier*

Items enclosed in square brackets are optional. When they appear, they can appear only one time:

address-modifier ::= [*protocol*] [**@** *node*]

Items enclosed in curly braces are also optional. When they appear, they can appear more than once:

nrs-header ::= **!** [*address-modifier*] {*keyword-modifier*} **!**

Parentheses and vertical bars denote multiple options. Any single item on the list can be chosen:

keyword-modifier ::= (*authorization-modifier* | *environment-modifier*)

B.4 Syntax

nrs ::= [*nrs-header*] *nrs-body*

where:

nrs-header ::= **!** [*address-modifier*] {*keyword-modifier*} [*resource-modifier*]**!**
All modifiers are optional, and defaults apply if a modifier is omitted. The value of an environment variable can be placed in an NRS by preceding the name of the variable with “$”. If the name needs to be followed by alphanumeric text, then it can be bracketed by “{” and “}”. If an environment variable named `foo` exists, then either of the following will cause it to be expanded: `$foo` or `${foo}`. Environment variables are only expanded in the *nrs-header*. The *nrs-body* is never parsed.

address-modifier ::= [*protocol*] [**@** *node*]
Specifies where the network resource is.

protocol ::= (**tcp**)
Supports heterogeneous connections by predicating address on a network type. If no protocol is specified, GCI_NET_DEFAULT_PROTOCOL is used. On UNIX hosts, this default is **tcp**.

node ::= *nrs-identifier*
If no node is specified, the current machine’s network node name is used. The identifier may also be an Internet-style numeric address. For example:

```
!tcp@120.0.0.4#server!cornerstone
```

nrs-identifier ::= *identifier*
Identifiers are runs of characters; the special characters !, #, $, @, ^ and white space (blank, tab, newline) must be preceded by a “^”. Identifiers are words in the UNIX sense.

keyword-modifier ::= (*authorization-modifier* | *environment-modifier*)
Keyword modifiers may be given in any order. If a keyword modifier is specified more than once, the latter replaces the former. If a keyword modifier takes an argument, then the keyword may be separated from the argument by a space or a colon.

authorization-modifier ::= ((**#auth** | **#encrypted**) [**:**] *username* [**@** *password*])

#auth specifies a valid user on the target network. A valid password is needed only if the resource type requires authentication. **#encrypted** is used by GemStone utilities. If no authentication information is specified, the system will try to get it from the `.netrc` file. This type of authorization is the default.

username ::= *nrs-identifier*

If no user name is specified, the default is the current user.
(See the earlier discussion of *nrs-identifier*.)

password ::= *nrs-identifier*

If no password is specified, the system will try to obtain it from the user's `.netrc` file. (See the earlier discussion of *nrs-identifier*.)

environment-modifier ::= (**#netldi** | **#dir** | **#log**) [**:**] *nrs-identifier*

#netldi causes the named NetLDI to be used to service the request. If no NetLDI is specified, the default is `gs64ldi`. When you specify the **#netldi** option, the *nrs-identifier* (page B-4) is either the name of a NetLDI service or the port number at which a NetLDI is running.

#dir sets the default directory of the network resource. It has no effect if the resource already exists. If a directory is not set, the pattern "`%H`" (home directory) is used. (See the definition of *nrs-identifier* on page B-4.)

#log sets the name of the log file of the network resource. It has no effect if the resource already exists. If the log name is a relative path, it is relative to the working directory. If a log name is not set, the pattern "`%N%P%M.log`" (defined below) is used. (See the definition of *nrs-identifier* on page B-4.)

The argument to **#dir** or **#log** can contain patterns that are expanded in the context of the created resource. The following patterns are supported:

%H	home directory
%M	machine's network node name
%N	executable's base name
%P	process pid
%U	user name
%%	%

resource-modifier ::= (**#server** | **#spawn** **|** **#task** | **#dbf** | **#monitor** | **#file**)

Identifies the intended purpose of the string in the *nrs-body*. An NRS can contain only one resource modifier. The default resource modifier is context sensitive. For instance, if the system expects an NRS for a database file, then the default is **#dbf**.

#server directs the NetLDI to search for the network address of a server, such as a Stone or another NetLDI. If successful, it returns the address. The *nrs-body* is a network server name. A successful lookup means only that the service has been defined; it does not indicate whether the service is currently running. A new process will not be started. (Authorization is needed only if the NetLDI is on a remote node and is running in secure mode.)

#task starts a new Gem. The *nrs-body* is a NetLDI service name (such as "gemnetobject"), followed by arguments to the command line. The NetLDI creates the named service by looking first for an entry in `$GEMSTONE/bin/services.dat`, and then in the user's home directory for an executable having that name. The NetLDI returns the network address of the service. (Authorization is needed to create a new process unless the NetLDI is in guest mode.) The **#task** resource modifier is also used internally to create page servers.

#dbf is used to access a database file. The *nrs-body* is the file spec of a GemStone database file. The NetLDI creates a page server on the given node to access the database and returns the network address of the page server. (Authorization is needed unless the NetLDI is in guest mode).

#spawn is used internally to start the garbage-collection Gem process.

#monitor is used internally to start up a shared page cache monitor.

#file means the *nrs-body* is the file spec of a file on the given host (not currently implemented).

nrs-body ::= unformatted text, to end of string

The *nrs-body* is interpreted according to the context established by the *resource-modifier*. No extended identifier expansion is done in the *nrs-body*, and no special escapes are needed.

Appendix

C Linking to Static User Action Code

Shared libraries on Unix platforms cannot link to non-shared code, which creates a problem if a user action needs to call code in a static library and no equivalent shared library is available. For this reason, GemBuilder provides a way to link non-shared code into a custom Gem. Static linking requires that all entry points be resolved at link time. You must have a C++ development environment, and if you create an RPC product, you must ship the libraries with it.

C.1 Creating the Custom Gem

A Gem is customized if you have defined user actions that it can execute in its own process. To produce a custom Gem with static user action functions, complete the following steps:

Step 1. Modify the user action code.

The static user action code must define **StaticUserActionInit**, which will be called by the Gem the static code is linked into, and the code must include the files `staticua.hf` and `gci.hf`. Define **StaticUserActionInit** in exactly the same way as GCIUSER_ACTION_INIT_DEF (see Example 3.1 on page 3-5). Include `gciuser.hf` also, if you wish to use the GCI_DECLARE_ACTION macro.

Step 2. Test the static user action code.

You can implement your own Topaz to test the code. Use the **GciLoadUserActionLibrary** function to implement your version of the Topaz **loadua** command. To use a custom Topaz, just execute it.

Step 3. Link the static code into a custom Gem.

Once the code is compiled, you can create a custom Gem by linking your user action code with `gemrpcobj.a`, which contains the object code for an RPC Gem.

Each command line illustrates how to link a set of user actions for a Gem. The link step produces a custom Gem executable named *usrgem*.

Solaris (Sun):

```
$ CC -xildoff -xarch=v9  -i useract.o
   $GEMSTONE/lib/gemrpcobj.a -B dynamic -lc -lpthread
   -ldl -lrt -lsocket -lnsl -lm  -lCrun -lpthread
   -o usrgem
```

HP-UX (HP):

```
$ /opt/aCC/bin/aCC -v +DD64
   -Wl,+allowdups,+k,+allowunsats -Wl,+pd4M,+pi64K
   -z useract.o $GEMSTONE/lib/gemrpcobj.a  -lrt -lsec
   -ldld -lm -l:libcres.a -lcl -lpthread -l:libc.sl
   -o usrgem
```

The `-z` switch is highly recommended.

AIX (IBM):

```
$ /usr/vacpp/bin/xlC_r -Wl,-bbigtoc -q64 useract.o
   $GEMSTONE/lib/gciualib.o $GEMSTONE/lib/gemrpcobj.a
   -L/usr/vacpp/lib -lpthreads -lC_r -lm -ldl
   -Wl,-bbigtoc -q64 -o usrgem
```

Linux:

```
$ /usr/bin/g++ useract.o $GEMSTONE/lib/gciualib.o
   $GEMSTONE/lib/gemrpcobj.a -m64 -lpthread -lcrypt -ldl
   -lc -lm -lrt -Wl,--no-undefined -Wl,-z,muldefs
   -o usrgem
```

C.2 Deploying Static User Actions for Custom Gems

This section describes how to make static user actions available to custom RPC Gem processes at run time. A linked Gem has the same user actions available as does the application with which it is linked.

How GemStone Starts Gem Processes

When an application logs in to GemStone, an RPC Gem process must be started for the GemStone session, unless it is the first GemStone login from a linked application. (One Gem is already running in the application process in that case.) The application calls the **GciLogin** function. GemBuilder then sends a network resource string (NRS) to the NetLDI process on the machine where the RPC Gem process is to be created. The NRS tells the NetLDI everything it needs to know in order to start the Gem process.

An RPC Gem is a GemStone service. The NRS specifies at least the service name of the RPC Gem. It can also supply more information to govern the operation of the process. Consult Appendix B, “Network Resource String Syntax,” for details.

To make the custom Gem available to any application user, it is generally necessary to define a new service name in the GemStone services file in a shared GemStone installation. Then either the application or application user must specify that service name as the default for starting Gems.

On Unix platforms, a custom Gem requires a specially-linked executable file. The new GemStone service generally runs the executable file from a special script that sets the execution environment.

By default, GemBuilder starts RPC Gems by sending an NRS with just the default service name, `gemnetobject`. If the GEMSTONE_NRS_ALL environment variable is set in the application process, its value overrides the GemStone default. The application programmer can override these values by calling **GciSetNet**. Such means can be used to specify different settings for the `gemnetobject` service, or to specify a different service altogether. They can also supply a different (non-GemStone) default for the application. **GciSetNet** can also be used to specify the NRS for RPC Gems directly based upon user input.[1]

When GemBuilder asks the NetLDI to start an RPC Gem process, the NetLDI reads the GemStone services file. This file, named `services.dat`, is found in the

1. Topaz sets its RPC Gem NRS from user input with the **set gemnetid** command. GemBuilder for Smalltalk sets the RPC Gem NRS when you add or edit the Gem service of a session entry from the GemStone Session Browser.

GemStone `bin` directory. The file associates a service name with an executable file to be run when the service is requested. Each service name in the file must be unique, but more than one service name can be associated with a single executable file. The NetLDI executes the file associated with the service name to start the new process.

For more details on placing custom Gems into your GemStone installation, please see your *System Administration Guide for GemStone/S 64 Bit*.

Starting a Private Custom Gem Under UNIX

Assume that you have built (linked) a custom Gem, *usrgem*, and have placed it in the directory *usrgemdir*. Assume also that the user actions that it contains have already been debugged. You should not run this configuration with user actions that have not been debugged (see “Risk of Database Corruption” on page 4-6 for details). To use *usrgem* yourself, but without allowing others to use it for now, perform the following steps:

Step 1. Select a name for a script that will execute the custom Gem while it remains private. Be sure that the name does not match any entry in the GemStone services file, `$GEMSTONE/bin/services.dat`. We will call this script *run_usrgem* for the purposes of this procedure.

Step 2. Copy the GemStone default script to your home directory:

```
$ cp $GEMSTONE/sys/gemnetobject $HOME/run_usrgem
```

Step 3. Modify *run_usrgem*.

❒ Modify the line that defines the script’s **gemname** variable. Set its value to *usrgem*.

❒ Modify the line that defines the script’s **gemdir** variable. Set its value to *usrgemdir*.

❒ Find the lines that define the script’s **systemConfig** and **exeConfig** variables. If you wish to specify custom GemStone configuration files for the custom Gem, modify the appropriate line(s) accordingly.

The Gem service name associated with the private *usrgem* is now *run_usrgem*, because the script of that name is in your home directory. To run the custom Gem, supply its service name (NRS) as the application requires. From Topaz, you can use the **set gemnetid** command. If you are using GemBuilder for Smalltalk, add or edit the Gem service of a session entry from the GemStone Session Browser.

C.3 Name Conflicts with Dynamic User Actions

When user actions are installed in a process, they are given a name by which GemBuilder refers to them. These names must be unique. In case of a name conflict, a static user action in a custom Gem always takes precedence. If the custom Gem attempts to dynamically load a user action library containing a user action with the same name as one the Gem’s static user actions, the load operation fails. If an application attempts to load a user action library with a user action by the same name as one of the Gem’s static user actions, the load operation succeeds, but the application user action with the conflicting name is ignored. The static Gem user action is always used.

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