Objective-C Runtime Reference

Tools & Languages: Objective-C

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Apple Inc.
1 Infinite Loop
Cupertino, CA 95014
408-996-1010

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Overview

This document describes the Mac OS X Objective-C 2.0 runtime library support functions and data structures. The functions are implemented in the shared library found at `/usr/lib/libobjc.A.dylib`. This shared library provides support for the dynamic properties of the Objective-C language, and as such is linked to by all Objective-C applications.

This reference is useful primarily for developing bridge layers between Objective-C and other languages, or for low-level debugging. You typically do not need to use the Objective-C runtime library directly when programming in Objective-C.

The Mac OS X implementation of the Objective-C runtime library is unique to the Mac OS X platform. For other platforms, the GNU Compiler Collection provides a different implementation with a similar API. This document covers only the Mac OS X implementation.

The low-level Objective-C runtime API is significantly updated in Mac OS X version 10.5. Many functions and all existing data structures are replaced with new functions. The old functions and structures are deprecated in 32-bit and absent in 64-bit mode. The API constrains several values to 32-bit ints even in 64-bit mode—class count, protocol count, methods per class, ivars per class, arguments per method, sizeof(all arguments) per method, and class version number. In addition, the new Objective-C ABI (not described here) further constrains `sizeof(anInstance)` to 32 bits, and three other values to 24 bits—methods per class, ivars per class, and sizeof(a single ivar). Finally, the obsolete `NXHashTable` and `NXMapTable` are limited to 4 billion items.

"Deprecated" below means "deprecated in Mac OS X version 10.5 for 32-bit code, and disallowed for 64-bit code."

Who Should Read This Document

The document is intended for readers who might be interested in learning about the Objective-C runtime.

Because this isn't a document about C, it assumes some prior acquaintance with that language. However, it doesn't have to be an extensive acquaintance.

Functions by Task

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Sending Messages

When it encounters a method invocation, the compiler might generate a call to any of several functions to perform the actual message dispatch, depending on the receiver, the return value, and the arguments. You can use these functions to dynamically invoke methods from your own plain C code, or to use argument forms not permitted by NSObject's `perform...` methods. These functions are declared in `/usr/include/objc/objc-runtime.h`.

- `objc_msgSend` (page 35) sends a message with a simple return value to an instance of a class.
- `objc_msgSend_stret` (page 37) sends a message with a data-structure return value to an instance of a class.
- `objc_msgSendSuper` (page 35) sends a message with a simple return value to the superclass of an instance of a class.
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Working with Methods

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Working with Properties

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`property_getAttributes` (page 43)
Returns the attribute string of an property.

Functions

class_addIvar

Adds a new instance variable to a class.

```
BOOL class_addIvar(Class cls, const char *name, size_t size, uint8_t alignment,
const char *types)
```

Return Value
`YES` if the instance variable was added successfully, otherwise `NO` (for example, the class already contains an instance variable with that name).

Discussion
This function may only be called after `objc_allocateClassPair` (page 30) and before `objc_registerClassPair` (page 37). Adding an instance variable to an existing class is not supported.

The class must not be a metaclass. Adding an instance variable to a metaclass is not supported.

The instance variable's minimum alignment in bytes is `1<<align`. The minimum alignment of an instance variable depends on the ivar's type and the machine architecture. For variables of any pointer type, pass `log2(sizeof(pointer_type))`.

Declared In
`runtime.h`

class_addMethod

Adds a new method to a class with a given name and implementation.

```
BOOL class_addMethod(Class cls, SEL name, IMP imp, const char *types)
```

Parameters

cls

The class to which to add a method.

name

A selector that specifies the name of the method being added.

imp

A function which is the implementation of the new method. The function must take at least two arguments—`self` and `_cmd`.

types

An array of characters that describe the types of the arguments to the method. For possible values, see *Objective-C Runtime Programming Guide* > Type Encodings. Since the function must take at least two arguments—`self` and `_cmd`, the second and third characters must be "`@:`" (the first character is the return type).

Return Value

`YES` if the method was added successfully, otherwise `NO` (for example, the class already contains a method implementation with that name).

Discussion

`class_addMethod` will add an override of a superclass's implementation, but will not replace an existing implementation in this class. To change an existing implementation, use `method_setImplementation` (page 30).

An Objective-C method is simply a C function that take at least two arguments—`self` and `_cmd`. For example, given the following function:

```
void myMethodIMP(id self, SEL _cmd)
{
    // implementation ....
}
```

you can dynamically add it to a class as a method (called `resolveThisMethodDynamically`) like this:

```
class_addMethod([self class], @selector(resolveThisMethodDynamically), (IMP)
myMethodIMP, "v@:");
```

Declared In

`runtime.h`

class_addProtocol

Adds a protocol to a class.

```
BOOL class_addProtocol(Class cls, Protocol *protocol)
```

Parameters

cls

The class to modify.

outCount

The protocol to add to *cls*.

Return Value
`YES` if the method was added successfully, otherwise `NO` (for example, the class already conforms to that protocol).

Declared In
`runtime.h`

class_conformsToProtocol

Returns a Boolean value that indicates whether a class conforms to a given protocol.

```
BOOL class_conformsToProtocol(Class cls, Protocol *protocol)
```

Parameters

cls
The class you want to inspect.

protocol
A protocol.

Return Value
`YES` if *cls* conforms to *protocol*, otherwise `NO`.

Discussion
You should usually use `NSObject`'s `conformsToProtocol:` method instead of this function.

Declared In
`runtime.h`

class_copyIvarList

Describes the instance variables declared by a class.

```
Ivar * class_copyIvarList(Class cls, unsigned int *outCount)
```

Parameters

cls
The class to inspect.

outCount
On return, contains the length of the returned array. If *outCount* is `NULL`, the length is not returned.

Return Value
An array of pointers of type Ivar describing the instance variables declared by the class. Any instance variables declared by superclasses are not included. The array contains `*outCount` pointers followed by a `NULL` terminator. You must free the array with `free()`.

If the class declares no instance variables, or `cls` is `Nil`, `NULL` is returned and `*outCount` is `0`.

Declared In
`runtime.h`

class_copyMethodList

Describes the instance methods implemented by a class.

```
Method * class_copyMethodList(Class cls, unsigned int *outCount)
```

Parameters

cls

The class you want to inspect.

outCount

On return, contains the length of the returned array. If *outCount* is NULL, the length is not returned.

Return Value

An array of pointers of type Method describing the instance methods implemented by the class—any instance methods implemented by superclasses are not included. The array contains *outCount pointers followed by a NULL terminator. You must free the array with free().

If *cls* implements no instance methods, or *cls* is Nil, returns NULL and *outCount is 0.

Discussion

To get the class methods of a class, use class_copyMethodList(object_getClass(cls), &count).

To get the implementations of methods that may be implemented by superclasses, use class_getInstanceMethod (page 20) or class_getClassMethod (page 19).

Declared In

runtime.h

class_copyPropertyList

Describes the properties declared by a class.

```
objc_property_t * class_copyPropertyList(Class cls, unsigned int *outCount)
```

Parameters

cls

The class you want to inspect.

outCount

On return, contains the length of the returned array. If *outCount* is NULL, the length is not returned.

Return Value

An array of pointers of type objc_property_t describing the properties declared by the class. Any properties declared by superclasses are not included. The array contains *outCount pointers followed by a NULL terminator. You must free the array with free().

If *cls* declares no properties, or *cls* is Nil, returns NULL and *outCount is 0.

Declared In

runtime.h

class_copyProtocolList

Describes the protocols adopted by a class.

```
Protocol ** class_copyProtocolList(Class cls, unsigned int *outCount)
```

Parameters

cls

The class you want to inspect.

outCount

On return, contains the length of the returned array. If *outCount* is NULL, the length is not returned.

Return Value

An array of pointers of type Protocol* describing the protocols adopted by the class. Any protocols adopted by superclasses or other protocols are not included. The array contains *outCount pointers followed by a NULL terminator. You must free the array with free().

If *cls* adopts no protocols, or *cls* is Nil, returns NULL and *outCount is 0.

Declared In

runtime.h

class_createInstance

Creates an instance of a class, allocating memory for the class in the default malloc memory zone.

```
id class_createInstance(Class cls, size_t extraBytes)
```

Parameters

cls

The class that you wish to allocate an instance of.

extraBytes

An integer indicating the number of extra bytes to allocate. The additional bytes can be used to store additional instance variables beyond those defined in the class definition.

Return Value

An instance of the class *cls*.

Declared In

runtime.h

class_getClassMethod

Returns a pointer to the data structure describing a given class method for a given class.

```
Method class_getClassMethod(Class aClass, SEL aSelector)
```

Parameters

aClass

A pointer to a class definition. Pass the class that contains the method you want to retrieve.

aSelector

A pointer of type SEL (page 50). Pass the selector of the method you want to retrieve.

Return Value

A pointer to the Method (page 49) data structure that corresponds to the implementation of the selector specified by *aSelector* for the class specified by *aClass*, or NULL if the specified class or its superclasses do not contain an instance method with the specified selector.

Discussion
Note that this function searches superclasses for implementations, whereas `class_copyMethodList` (page 18) does not.

Declared In
`runtime.h`

class_getClassVariable

Returns the `Ivar` for a specified class variable of a given class.

```
Ivar class_getClassVariable(Class cls, const char* name)
```

Parameters

`cls`
The class definition whose class variable you wish to obtain.

`name`
The name of the class variable definition to obtain.

Return Value
A pointer to an `Ivar` (page 49) data structure containing information about the class variable specified by `name`.

Declared In
`runtime.h`

class_getInstanceMethod

Returns a specified instance method for a given class.

```
Method class_getInstanceMethod(Class aClass, SEL aSelector)
```

Parameters

`aClass`
The class you want to inspect.

`aSelector`
The selector of the method you want to retrieve.

Return Value
The method that corresponds to the implementation of the selector specified by *`aSelector`* for the class specified by *`aClass`*, or `NULL` if the specified class or its superclasses do not contain an instance method with the specified selector.

Discussion
Note that this function searches superclasses for implementations, whereas `class_copyMethodList` (page 18) does not.

Declared In
`runtime.h`

class_getInstanceSize

Returns the size of instances of a class.

```
size_t class_getInstanceSize(Class cls)
```

Parameters

cls

A class object.

Return Value

The size in bytes of instances of the class *cls*, or 0 if *cls* is Nil.

Declared In

runtime.h

class_getInstanceVariable

Returns the Ivar for a specified instance variable of a given class.

```
Ivar class_getInstanceVariable(Class cls, const char* name)
```

Parameters

cls

The class whose instance variable you wish to obtain.

name

The name of the instance variable definition to obtain.

Return Value

A pointer to an Ivar (page 49) data structure containing information about the instance variable specified by name.

Declared In

runtime.h

class_getIvarLayout

Returns a description of the Ivar layout for a given class.

```
const char *class_getIvarLayout(Class cls)
```

Parameters

cls

The class to inspect.

Return Value

A description of the Ivar layout for *cls*.

Declared In

runtime.h

class_getMethodImplementation

Returns the function pointer that would be called if a particular message were sent to an instance of a class.

```
IMP class_getMethodImplementation(Class cls, SEL name)
```

Parameters

cls

The class you want to inspect.

name

A selector.

Return Value

The function pointer that would be called if `[object name]` were called with an instance of the class, or `NULL` if *cls* is `Nil`.

Discussion

`class_getMethodImplementation` may be faster than `method_getImplementation(class_getInstanceMethod(cls, name))`.

The function pointer returned may be a function internal to the runtime instead of an actual method implementation. For example, if instances of the class do not respond to the selector, the function pointer returned will be part of the runtime's message forwarding machinery.

Declared In

`runtime.h`

class_getMethodImplementation_stret

Returns the function pointer that would be called if a particular message were sent to an instance of a class.

```
IMP class_getMethodImplementation_stret(Class cls, SEL name)
```

Parameters

cls

The class you want to inspect.

name

A selector.

Return Value

The function pointer that would be called if `[object name]` were called with an instance of the class, or `NULL` if *cls* is `Nil`.

Declared In

`runtime.h`

class_getName

Returns the name of a class.

```
const char * class_getName(Class cls)
```

Parameters

cls

A class object.

Return Value

The name of the class, or the empty string if *cls* is `Nil`.

Declared In
runtime.h

class_getProperty

Returns a property with a given name of a given class.

```
objc_property_t class_getProperty(Class cls, const char *name)
```

Return Value
A pointer of type objc_property_t describing the property, or NULL if the class does not declare a property with that name, or NULL if *cls* is Nil.

Declared In
runtime.h

class_getSuperclass

Returns the superclass of a class.

```
Class class_getSuperclass(Class cls)
```

Parameters
cls
A class object.

Return Value
The superclass of the class, or Nil if *cls* is a root class, or Nil if *cls* is Nil.

Discussion
You should usually use NSObject's superclass method instead of this function.

Declared In
runtime.h

class_getVersion

Returns the version number of a class definition.

```
int class_getVersion(Class theClass)
```

Parameters
theClass
A pointer to an Class (page 48) data structure. Pass the class definition for which you wish to obtain the version.

Return Value
An integer indicating the version number of the class definition.

Discussion
You can use the version number of the class definition to provide versioning of the interface that your class represents to other classes. This is especially useful for object serialization (that is, archiving of the object in a flattened form), where it is important to recognize changes to the layout of the instance variables in different class-definition versions.

Classes derived from the Foundation framework `NSObject` class can obtain the class-definition version number using the `getVersion` class method, which is implemented using the `class_getVersion` function.

Declared In
`runtime.h`

class_getWeakIvarLayout

Returns a description of the layout of weak `Ivar`s for a given class.

```
const char *class_getWeakIvarLayout(Class cls)
```

Parameters

cls
The class to inspect.

Return Value
A description of the layout of the weak `Ivar`s for *cls*.

Declared In
`runtime.h`

class_isMetaClass

Returns a Boolean value that indicates whether a class object is a metaclass.

```
BOOL class_isMetaClass(Class cls)
```

Parameters

cls
A class object.

Return Value
`YES` if *cls* is a metaclass, `NO` if *cls* is a non-meta class, `NO` if *cls* is `Nil`.

Declared In
`runtime.h`

class_replaceMethod

Replaces the implementation of a method for a given class.

```
IMP class_replaceMethod(Class cls, SEL name, IMP imp, const char *types)
```

Parameters

cls
The class you want to modify.

name
A selector that identifies the method whose implementation you want to replace.

imp
The new implementation for the method identified by *name* for the class identified by *cls*.

types

An array of characters that describe the types of the arguments to the method. For possible values, see *Objective-C Runtime Programming Guide* > Type Encodings. Since the function must take at least two arguments—`self` and `_cmd`, the second and third characters must be "`@:`" (the first character is the return type).

Return Value
The previous implementation of the method identified by *name* for the class identified by *cls*.

Discussion
This function behaves in two different ways:

- If the method identified by *name* does not yet exist, it is added as if `class_addMethod` (page 15) were called. The type encoding specified by *types* is used as given.
- If the method identified by *name* does exist, its IMP is replaced as if `method_setImplementation` (page 30) were called. The type encoding specified by *types* is ignored.

Declared In
`runtime.h`

class_respondsToSelector

Returns a Boolean value that indicates whether instances of a class respond to a particular selector.

```
BOOL class_respondsToSelector(Class cls, SEL sel)
```

Parameters

cls

The class you want to inspect.

sel

A selector.

Return Value
`YES` if instances of the class respond to the selector, otherwise `NO`.

Discussion
You should usually use `NSObject`'s `respondsToSelector:` or `instancesRespondToSelector:` methods instead of this function.

Declared In
`runtime.h`

class_setIvarLayout

Sets the `Ivar` layout for a given class.

```
void class_setIvarLayout(Class cls, const char *layout)
```

Parameters

cls

The class to modify.

layout
The layout of the `Ivar`s for *cls*.

Declared In
`runtime.h`

class_setSuperclass

Sets the superclass of a given class.

```
Class class_setSuperclass(Class cls, Class newSuper)
```

Parameters

cls
The class whose superclass you want to set.

newSuper
The new superclass for *cls*.

Return Value
The old superclass for *cls*.

Special Considerations

You should not use this function.

Declared In
`runtime.h`

class_setVersion

Sets the version number of a class definition.

```
void class_setVersion(Class theClass, int version)
```

Parameters

theClass
A pointer to an `Class` (page 48) data structure. Pass the class definition for which you wish to set the version.

version
An integer. Pass the new version number of the class definition.

Discussion
You can use the version number of the class definition to provide versioning of the interface that your class represents to other classes. This is especially useful for object serialization (that is, archiving of the object in a flattened form), where it is important to recognize changes to the layout of the instance variables in different class-definition versions.

Classes derived from the Foundation framework `NSObject` class can set the class-definition version number using the `setVersion:` class method, which is implemented using the `class_setVersion` function.

Declared In
`runtime.h`

class_setWeakIvarLayout

Sets the layout for weak `Ivar`s for a given class.

```
void class_setWeakIvarLayout(Class cls, const char *layout)
```

Parameters

cls

The class to modify.

layout

The layout of the weak `Ivar`s for *cls*.

Declared In

`runtime.h`

ivar_getName

Returns the name of an instance variable.

```
const char * ivar_getName(Ivar ivar)
```

Return Value

A C string containing the instance variable's name.

Declared In

`runtime.h`

ivar_getOffset

Returns the offset of an instance variable.

```
ptrdiff_t ivar_getOffset(Ivar ivar)
```

Discussion

For instance variables of type `id` or other object types, call `object_getIvar` (page 41) and `object_setIvar` (page 42) instead of using this offset to access the instance variable data directly.

Declared In

`runtime.h`

ivar_getTypeEncoding

Returns the type string of an instance variable.

```
const char * ivar_getTypeEncoding(Ivar ivar)
```

Return Value

A C string containing the instance variable's type encoding.

Discussion

For possible values, see *Objective-C Runtime Programming Guide* > Type Encodings.

Declared In

`runtime.h`

method_copyArgumentType

Returns a string describing a single parameter type of a method.

```
char * method_copyArgumentType(Method method, unsigned int index)
```

Parameters

method

The method to inspect.

index

The index of the parameter to inspect.

Return Value

A C string describing the type of the parameter at index *index*, or `NULL` if *method* has no parameter index *index*. You must free the string with `free()`.

Declared In

`runtime.h`

method_copyReturnType

Returns a string describing a method's return type.

```
char * method_copyReturnType(Method method)
```

Parameters

method

The method to inspect.

Return Value

A C string describing the return type. You must free the string with `free()`.

Declared In

`runtime.h`

method_exchangeImplementations

Exchanges the implementations of two methods.

```
void method_exchangeImplementations(Method m1, Method m2)
```

Discussion

This is an atomic version of the following:

```
IMP imp1 = method_getImplementation(m1);
IMP imp2 = method_getImplementation(m2);
method_setImplementation(m1, imp2);
method_setImplementation(m2, imp1);
```

Declared In

`runtime.h`

method_getArgumentType

Returns by reference a string describing a single parameter type of a method.

```
void method_getArgumentType(Method method, unsigned int index, char *dst, size_t dst_len)
```

Discussion
The parameter type string is copied to *dst*. *dst* is filled as if `strncpy(dst, parameter_type, dst_len)` were called. If the method contains no parameter with that index, *dst* is filled as if `strncpy(dst, "", dst_len)` were called.

Declared In
`runtime.h`

method_getImplementation

Returns the implementation of a method.

```
IMP method_getImplementation(Method method)
```

Parameters

method
The method to inspect.

Return Value
A function pointer of type `IMP`.

Declared In
`runtime.h`

method_getName

Returns the name of a method.

```
SEL method_getName(Method method)
```

Parameters

method
The method to inspect.

Return Value
A pointer of type SEL.

Discussion
To get the method name as a C string, call `sel_getName(method_getName(method))`.

Declared In
`runtime.h`

method_getNumberOfArguments

Returns the number of arguments accepted by a method.

```
unsigned method_getNumberOfArguments(Method method)
```

Parameters

method

A pointer to a `Method` (page 49) data structure. Pass the method in question.

Return Value

An integer containing the number of arguments accepted by the given method.

method_getReturnType

Returns by reference a string describing a method's return type.

```
void method_getReturnType(Method method, char *dst, size_t dst_len)
```

Discussion

The method's return type string is copied to *dst*. *dst* is filled as if `strncpy(dst, parameter_type, dst_len)` were called.

Declared In

`runtime.h`

method_getTypeEncoding

Returns a string describing a method's parameter and return types.

```
const char * method_getTypeEncoding(Method method)
```

Parameters

method

The method to inspect.

Return Value

A C string. The string may be `NULL`.

Declared In

`runtime.h`

method_setImplementation

Sets the implementation of a method.

```
IMP method_setImplementation(Method method, IMP imp)
```

Return Value

The previous implementation of the method.

Declared In

`runtime.h`

objc_allocateClassPair

Creates a new class and metaclass.

```
objc_allocateClassPair(Class superclass, const char *name, size_t extraBytes)
```

Parameters

superclass

The class to use as the new class's superclass, or `Nil` to create a new root class.

name

The string to use as the new class's name. The string will be copied.

extraBytes

The number of bytes to allocate for indexed ivars at the end of the class and metaclass objects. This should usually be `0`.

Return Value

The new class, or `Nil` if the class could not be created (for example, the desired name is already in use).

Discussion

You can get a pointer to the new metaclass by calling `object_getClass(newClass)`.

To create a new class, start by calling `objc_allocateClassPair`. Then set the class's attributes with functions like `class_addMethod` (page 15) and `class_addIvar` (page 15). When you are done building the class, call `objc_registerClassPair` (page 37). The new class is now ready for use.

Instance methods and instance variables should be added to the class itself. Class methods should be added to the metaclass.

Declared In

`runtime.h`

objc_copyProtocolList

Returns an array of all the protocols known to the runtime.

```
Protocol **objc_copyProtocolList(unsigned int *outCount)
```

Parameters

outCount

Upon return, contains the number of protocols in the returned array.

Return Value

A C array of all the protocols known to the runtime. The array contains `*outCount` pointers followed by a `NULL` terminator. You must free the list with `free()`.

Discussion

This function acquires the runtime lock.

Declared In

`runtime.h`

objc_duplicateClass

Used by Foundation's Key-Value Observing.

`objc_duplicateClass`

Special Considerations

Do not call this function yourself.

Declared In

`runtime.h`

objc_getAssociatedObject

Returns the value associated with a given object for a given key.

```
id objc_getAssociatedObject(id object, void *key)
```

Parameters

object

The source object for the association.

key

The key for the association.

Return Value

The value associated with the key *key* for *object*.

See Also

`objc_setAssociatedObject` (page 38)

objc_getClass

Returns the class definition of a specified class.

```
id objc_getClass(const char *name)
```

Parameters

name

The name of the class to look up.

Return Value

The Class object for the named class, or `nil` if the class is not registered with the Objective-C runtime.

Discussion

`objc_getClass` is different from `objc_lookUpClass` (page 35) in that if the class is not registered, `objc_getClass` calls the class handler callback and then checks a second time to see whether the class is registered. `objc_lookUpClass` (page 35) does not call the class handler callback.

Special Considerations

Earlier implementations of this function (prior to Mac OS X v10.0) terminate the program if the class does not exist.

objc_getClassList

Obtains the list of registered class definitions.

```
int objc_getClassList(Class *buffer, int bufferLen)
```

Parameters

buffer

An array of `Class` values. On output, each `Class` value points to one class definition, up to either `bufferLen` or the total number of registered classes, whichever is less. You can pass `NULL` to obtain the total number of registered class definitions without actually retrieving any class definitions.

bufferLen

An integer value. Pass the number of pointers for which you have allocated space in `buffer`. On return, this function fills in only this number of elements. If this number is less than the number of registered classes, this function returns an arbitrary subset of the registered classes.

Return Value

An integer value indicating the total number of registered classes.

Discussion

The Objective-C runtime library automatically registers all the classes defined in your source code. You can create class definitions at runtime and register them with the `objc_addClass` function.

Listing 1 demonstrates how to use this function to retrieve all the class definitions that have been registered with the Objective-C runtime in the current process.

Listing 1 Using objc_getClassList

```
int numClasses;
Class * classes = NULL;

classes = NULL;
numClasses = objc_getClassList(NULL, 0);

if (numClasses > 0 )
{
    classes = malloc(sizeof(Class) * numClasses);
    numClasses = objc_getClassList(classes, numClasses);
    free(classes);
}
```

Special Considerations

You cannot assume that class objects you get from this function are classes that inherit from `NSObject`, so you cannot safely call any methods on such classes without detecting that the method is implemented first.

objc_getFutureClass

Used by CoreFoundation's toll-free bridging.

```
Class objc_getFutureClass(const char *name)
```

Special Considerations

Do not call this function yourself.

Declared In

`runtime.h`

objc_getMetaClass

Returns the metaclass definition of a specified class.

```
id objc_getMetaClass(const char *name)
```

Parameters

name

The name of the class to look up.

Return Value

The `Class` object for the metaclass of the named class, or `nil` if the class is not registered with the Objective-C runtime.

Discussion

If the definition for the named class is not registered, this function calls the class handler callback and then checks a second time to see if the class is registered. However, every class definition must have a valid metaclass definition, and so the metaclass definition is always returned, whether it's valid or not.

objc_getProtocol

Returns a specified protocol.

```
Protocol *objc_getProtocol(const char *name)
```

Parameters

name

The name of a protocol.

Return Value

The protocol named *name*, or `NULL` if no protocol named *name* could be found.

Discussion

This function acquires the runtime lock.

Declared In

`runtime.h`

objc_getRequiredClass

Returns the class definition of a specified class.

```
id objc_getRequiredClass(const char *name)
```

Parameters

name

The name of the class to look up.

Return Value

The Class object for the named class.

Discussion

This function is the same as `objc_getClass` (page 32), but kills the process if the class is not found.

This function is used by ZeroLink, where failing to find a class would be a compile-time link error without ZeroLink.

Declared In
`runtime.h`

objc_lookUpClass

Returns the class definition of a specified class.

```
id objc_lookUpClass(const char *name)
```

Parameters

name
: The name of the class to look up.

Return Value
The Class object for the named class, or `nil` if the class is not registered with the Objective-C runtime.

Discussion
`objc_getClass` (page 32) is different from this function in that if the class is not registered, `objc_getClass` (page 32) calls the class handler callback and then checks a second time to see whether the class is registered. This function does not call the class handler callback.

objc_msgSend

Sends a message with a simple return value to an instance of a class.

```
id objc_msgSend(id theReceiver, SEL theSelector, ...)
```

Parameters

theReceiver
: A pointer that points to the instance of the class that is to receive the message.

theSelector
: The selector of the method that handles the message.

...
: A variable argument list containing the arguments to the method.

Return Value
The return value of the method.

Discussion
When it encounters a method call, the compiler generates a call to one of the functions `objc_msgSend`, `objc_msgSend_stret`, `objc_msgSendSuper`, or `objc_msgSendSuper_stret`. Messages sent to an object's superclass (using the `super` keyword) are sent using `objc_msgSendSuper`; other messages are sent using `objc_msgSend`. Methods that have data structures as return values are sent using `objc_msgSendSuper_stret` and `objc_msgSend_stret`.

objc_msgSendSuper

Sends a message with a simple return value to the superclass of an instance of a class.

```
id objc_msgSendSuper(struct objc_super *super, SEL op,  ...)
```

Parameters

super

A pointer to an objc_super (page 52) data structure. Pass values identifying the context the message was sent to, including the instance of the class that is to receive the message and the superclass at which to start searching for the method implementation.

op

A pointer of type SEL (page 50). Pass the selector of the method that will handle the message.

...

A variable argument list containing the arguments to the method.

Return Value

The return value of the method identified by *op*.

Discussion

When it encounters a method call, the compiler generates a call to one of the functions objc_msgSend, objc_msgSend_stret, objc_msgSendSuper, or objc_msgSendSuper_stret. Messages sent to an object's superclass (using the super keyword) are sent using objc_msgSendSuper; other messages are sent using objc_msgSend. Methods that have data structures as return values are sent using objc_msgSendSuper_stret and objc_msgSend_stret.

objc_msgSendSuper_stret

Sends a message with a data-structure return value to the superclass of an instance of a class.

```
void objc_msgSendSuper_stret(struct objc_super *super, SEL op, ...)
```

Parameters

super

A pointer to an objc_super (page 52) data structure. Pass values identifying the context the message was sent to, including the instance of the class that is to receive the message and the superclass at which to start searching for the method implementation.

op

A pointer of type SEL (page 50). Pass the selector of the method.

...

A variable argument list containing the arguments to the method.

Discussion

When it encounters a method call, the compiler generates a call to one of the functions objc_msgSend, objc_msgSend_stret, objc_msgSendSuper, or objc_msgSendSuper_stret. Messages sent to an object's superclass (using the super keyword) are sent using objc_msgSendSuper; other messages are sent using objc_msgSend. Methods that have data structures as return values are sent using objc_msgSendSuper_stret and objc_msgSend_stret.

objc_msgSend_fpret

Sends a message with a floating-point return value to an instance of a class.

```
double objc_msgSend_fpret(id self, SEL op, ...)
```

Parameters

self

A pointer that points to the instance of the class that is to receive the message.

op

The selector of the method that handles the message.

...

A variable argument list containing the arguments to the method.

Discussion

On the i386 platform, the ABI for functions returning a floating-point value is incompatible with that for functions returning an integral type. On the i386 platform, therefore, you *must* use `objc_msgSend_fpret` for functions that for functions returning non-integral type. For `float` or `long double` return types, cast the function to an appropriate function pointer type first.

This function is not used on the PPC or PPC64 platforms.

Declared In

`objc-runtime.h`

objc_msgSend_stret

Sends a message with a data-structure return value to an instance of a class.

```
void objc_msgSend_stret(void * stretAddr, id theReceiver, SEL theSelector,  ...)
```

Parameters

stretAddr

On input, a pointer that points to a block of memory large enough to contain the return value of the method. On output, contains the return value of the method.

theReceiver

A pointer to the instance of the class that is to receive the message.

theSelector

A pointer of type `SEL` (page 50). Pass the selector of the method that handles the message.

...

A variable argument list containing the arguments to the method.

Discussion

When it encounters a method call, the compiler generates a call to one of the functions `objc_msgSend`, `objc_msgSend_stret`, `objc_msgSendSuper`, or `objc_msgSendSuper_stret`. Messages sent to an object's superclass (using the `super` keyword) are sent using `objc_msgSendSuper`; other messages are sent using `objc_msgSend`. Methods that have data structures as return values are sent using `objc_msgSendSuper_stret` and `objc_msgSend_stret`.

objc_registerClassPair

Registers a class that was allocated using `objc_allocateClassPair`.

```
void objc_registerClassPair(Class cls)
```

Parameters

cls

The class you want to register.

Declared In

runtime.h

objc_removeAssociatedObjects

Removes all associations for a given object.

```
void objc_removeAssociatedObjects(id object)
```

Parameters

object

An object that maintains associated objects.

Discussion

The main purpose of this function is to make it easy to return an object to a "pristine state". You should not use this function for general removal of associations from objects, since it also removes associations that other clients may have added to the object. Typically you should use `objc_setAssociatedObject` (page 38) with a `nil` value to clear an association.

See Also

`objc_setAssociatedObject` (page 38)

`objc_getAssociatedObject` (page 32)

objc_setAssociatedObject

Sets an associated value for a given object using a given key and association policy.

```
void objc_setAssociatedObject(id object, void *key, id value, objc_AssociationPolicy
 policy)
```

Parameters

object

The source object for the association.

key

The key for the association.

value

The value to associate with the key *key* for *object*. Pass *nil* to clear an existing association.

policy

The policy for the association. For possible values, see "Associative Object Behaviors" (page 54).

See Also

`objc_setAssociatedObject` (page 38)

`objc_removeAssociatedObjects` (page 38)

objc_setFutureClass

Used by CoreFoundation's toll-free bridging.

```
void objc_setFutureClass(Class cls, const char *name)
```

Special Considerations

Do not call this function yourself.

Declared In

`runtime.h`

object_copy

Returns a copy of a given object.

```
id object_copy(id obj, size_t size)
```

Parameters

obj
: An Objective-C object.

size
: The size of the object *obj*.

Return Value

A copy of *obj*.

Declared In

`runtime.h`

object_dispose

Frees the memory occupied by a given object.

```
id object_dispose(id obj)
```

Parameters

obj
: An Objective-C object.

Return Value

`nil`.

Declared In

`runtime.h`

object_getClass

Returns the class of an object.

```
Class object_getClass(id object)
```

Parameters

object

The object you want to inspect.

Return Value

The class object of which *object* is an instance, or `Nil` if *object* is `nil`.

Declared In

`runtime.h`

object_getClassName

Returns the class name of a given object.

```
const char *object_getClassName(id obj)
```

Parameters

obj

An Objective-C object.

Return Value

The name of the class of which *obj* is an instance.

Declared In

`runtime.h`

object_getIndexedIvars

Returns a pointer to any extra bytes allocated with a instance given object.

```
OBJC_EXPORT void *object_getIndexedIvars(id obj)
```

Parameters

obj

An Objective-C object.

Return Value

A pointer to any extra bytes allocated with *obj*. If *obj* was not allocated with any extra bytes, then dereferencing the returned pointer is undefined.

Discussion

This function returns a pointer to any extra bytes allocated with the instance (as specified by `class_createInstance` (page 19) with extraBytes>0). This memory follows the object's ordinary ivars, but may not be adjacent to the last ivar.

The returned pointer is guaranteed to be pointer-size aligned, even if the area following the object's last ivar is less aligned than that. Alignment greater than pointer-size is never guaranteed, even if the area following the object's last ivar is more aligned than that.

In a garbage-collected environment, the memory is scanned conservatively.

Declared In

`runtime.h`

object_getInstanceVariable

Obtains the value of an instance variable of a class instance.

```
Ivar object_getInstanceVariable(id obj, const char *name, void **outValue)
```

Parameters

obj

A pointer to an instance of a class. Pass the object containing the instance variable whose value you wish to obtain.

name

A C string. Pass the name of the instance variable whose value you wish to obtain.

outValue

On return, contains a pointer to the value of the instance variable.

Return Value

A pointer to the `Ivar` (page 49) data structure that defines the type and name of the instance variable specified by `name`.

Declared In

`runtime.h`

object_getIvar

Reads the value of an instance variable in an object.

```
id object_getIvar(id object, Ivar ivar)
```

Parameters

object

The object containing the instance variable whose value you want to read.

ivar

The Ivar describing the instance variable whose value you want to read.

Return Value

The value of the instance variable specified by *ivar*, or `nil` if *object* is `nil`.

Discussion

`object_getIvar` is faster than `object_getInstanceVariable` (page 41) if the Ivar for the instance variable is already known.

Declared In

`runtime.h`

object_setClass

Sets the class of an object.

```
Class object_setClass(id object, Class cls)
```

Parameters

object

The object to modify.

sel
A class object.

Return Value
The previous value of *object*'s class, or `Nil` if *object* is `nil`.

Declared In
`runtime.h`

object_setInstanceVariable

Changes the value of an instance variable of a class instance.

```
Ivar object_setInstanceVariable(id obj, const char *name, void *value)
```

Parameters

obj
A pointer to an instance of a class. Pass the object containing the instance variable whose value you wish to modify.

name
A C string. Pass the name of the instance variable whose value you wish to modify.

value
The new value for the instance variable.

Return Value
A pointer to the `Ivar` (page 49) data structure that defines the type and name of the instance variable specified by `name`.

Declared In
`runtime.h`

object_setIvar

Sets the value of an instance variable in an object.

```
void object_setIvar(id object, Ivar ivar, id value)
```

Parameters

object
The object containing the instance variable whose value you want to set.

ivar
The Ivar describing the instance variable whose value you want to set.

value
The new value for the instance variable.

Discussion
`object_setIvar` is faster than `object_setInstanceVariable` (page 42) if the Ivar for the instance variable is already known.

Declared In
`runtime.h`

property_getAttributes

Returns the attribute string of an property.

```
const char *property_getAttributes(objc_property_t property)
```

Return Value
A C string containing the property's attributes.

Discussion
The format of the attribute string is described in Declared Properties in *Objective-C Runtime Programming Guide*.

Declared In
`runtime.h`

property_getName

Returns the name of a property.

```
const char *property_getName(objc_property_t property)
```

Return Value
A C string containing the property's name.

Declared In
`runtime.h`

protocol_conformsToProtocol

Returns a Boolean value that indicates whether one protocol conforms to another protocol.

```
BOOL protocol_conformsToProtocol(Protocol *proto, Protocol *other)
```

Parameters

proto
A protocol.

other
A protocol.

Return Value
`YES` if *proto* conforms to *other*, otherwise `NO`.

Discussion
One protocol can incorporate other protocols using the same syntax that classes use to adopt a protocol:

```
@protocol ProtocolName < protocol list >
```

All the protocols listed between angle brackets are considered part of the ProtocolName protocol.

Declared In
`runtime.h`

protocol_copyMethodDescriptionList

Returns an array of method descriptions of methods meeting a given specification for a given protocol.

```
struct objc_method_description *protocol_copyMethodDescriptionList(Protocol *p,
BOOL isRequiredMethod, BOOL isInstanceMethod, unsigned int *outCount)
```

Parameters

p

A protocol.

isRequiredMethod

A Boolean value that indicates whether returned methods should be required methods (pass `YES` to specify required methods).

isInstanceMethod

A Boolean value that indicates whether returned methods should be instance methods (pass `YES` to specify instance methods).

outCount

Upon return, contains the number of method description structures in the returned array.

Return Value

A C array of `objc_method_description` structures containing the names and types of *p*'s methods specified by *isRequiredMethod* and *isInstanceMethod*. The array contains `*outCount` pointers followed by a `NULL` terminator. You must free the list with `free()`.

If the protocol declares no methods that meet the specification, `NULL` is returned and `*outCount` is `0`.

Discussion

Methods in other protocols adopted by this protocol are not included.

Declared In

`runtime.h`

protocol_copyPropertyList

Returns an array of the properties declared by a protocol.

```
objc_property_t * protocol_copyPropertyList(Protocol *protocol, unsigned int
*outCount)
```

Parameters

proto

A protocol.

outCount

Upon return, contains the number of elements in the returned array.

Return Value

A C array of pointers of type `objc_property_t` describing the properties declared by *proto*. Any properties declared by other protocols adopted by this protocol are not included. The array contains `*outCount` pointers followed by a `NULL` terminator. You must free the array with `free()`.

If the protocol declares no properties, `NULL` is returned and `*outCount` is `0`.

Declared In

`runtime.h`

protocol_copyProtocolList

Returns an array of the protocols adopted by a protocol.

```
Protocol **protocol_copyProtocolList(Protocol *proto, unsigned int *outCount)
```

Parameters

proto

A protocol.

outCount

Upon return, contains the number of elements in the returned array.

Return Value

A C array of protocols adopted by *proto*. The array contains `*outCount` pointers followed by a `NULL` terminator. You must free the array with `free()`.

If the protocol declares no properties, `NULL` is returned and `*outCount` is `0`.

Declared In

`runtime.h`

protocol_getMethodDescription

Returns a method description structure for a specified method of a given protocol.

```
struct objc_method_description protocol_getMethodDescription(Protocol *p, SEL aSel,
 BOOL isRequiredMethod, BOOL isInstanceMethod)
```

Parameters

p

A protocol.

aSel

A selector

isRequiredMethod

A Boolean value that indicates whether *aSel* is a required method.

isInstanceMethod

A Boolean value that indicates whether *aSel* is an instance method.

Return Value

An `objc_method_description` structure that describes the method specified by *aSel*, *isRequiredMethod*, and *isInstanceMethod* for the protocol *p*.

If the protocol does not contain the specified method, returns an `objc_method_description` structure with the value `{NULL, NULL}`.

Discussion

Methods in other protocols adopted by this protocol are not included.

Declared In

`runtime.h`

protocol_getName

Returns a the name of a protocol.

```
const char *protocol_getName(Protocol *p)
```

Parameters

p

A protocol.

Return Value

The name of the protocol *p* as a C string.

Declared In

`runtime.h`

protocol_getProperty

Returns the specified property of a given protocol.

```
objc_property_t protocol_getProperty(Protocol *proto, const char *name, BOOL
isRequiredProperty, BOOL isInstanceProperty)
```

Parameters

proto

A protocol.

name

The name of a property.

isRequiredProperty

A Boolean value that indicates whether *name* is a required property.

isInstanceProperty

A Boolean value that indicates whether *name* is a required property.

Return Value

The property specified by *name*, *isRequiredProperty*, and *isInstanceProperty* for *proto*, or `NULL` if none of *proto*'s properties meets the specification.

Declared In

`runtime.h`

protocol_isEqual

Returns a Boolean value that indicates whether two protocols are equal.

```
BOOL protocol_isEqual(Protocol *proto, Protocol *other)
```

Parameters

proto

A protocol.

other

A protocol.

Return Value
`YES` if *`proto`* is the same as *`other`*, otherwise `NO`.

Declared In
`runtime.h`

sel_getName

Returns the name of the method specified by a given selector.

```
const char* sel_getName(SEL aSelector)
```

Parameters

`aSelector`
A pointer of type `SEL` (page 50). Pass the selector whose name you wish to determine.

Return Value
A C string indicating the name of the selector.

Declared In
`runtime.h`

sel_getUid

Registers a method name with the Objective-C runtime system.

```
SEL sel_getUid(const char *str)
```

Parameters

`str`
A pointer to a C string. Pass the name of the method you wish to register.

Return Value
A pointer of type `SEL` (page 50) specifying the selector for the named method.

Discussion
The implementation of this method is identical to the implementation of `sel_registerName` (page 48).

Version Notes
Prior to Mac OS X version 10.0, this method tried to find the selector mapped to the given name and returned `NULL` if the selector was not found. This was changed for safety, because it was observed that many of the callers of this function did not check the return value for `NULL`.

Declared In
`runtime.h`

sel_isEqual

Returns a Boolean value that indicates whether two selectors are equal.

```
BOOL sel_isEqual(SEL lhs, SEL rhs)
```

Parameters

lhs

The selector to compare with *rhs*.

rhs

The selector to compare with *lhs*.

Return Value

`YES` if *rhs* and *rhs* are equal, otherwise `NO`.

Discussion

`sel_isEqual` is equivalent to `==`.

Declared In

`runtime.h`

sel_registerName

Registers a method with the Objective-C runtime system, maps the method name to a selector, and returns the selector value.

```
SEL sel_registerName(const char *str)
```

Parameters

str

A pointer to a C string. Pass the name of the method you wish to register.

Return Value

A pointer of type `SEL` (page 50) specifying the selector for the named method.

Discussion

You must register a method name with the Objective-C runtime system to obtain the method's selector before you can add the method to a class definition. If the method name has already been registered, this function simply returns the selector.

Declared In

`runtime.h`

Data Types

Class-Definition Data Structures

Class

An opaque type that represents an Objective-C class.

```
typedef struct objc_class *Class;
```

Declared In
objc.h

Method

An opaque type that represents a method in a class definition.

```
typedef struct objc_method *Method;
```

Declared In
runtime.h

Ivar

An opaque type that represents an instance variable.

```
typedef struct objc_ivar *Ivar;
```

Declared In
runtime.h

Category

An opaque type that represents a category.

```
typedef struct objc_category *Category;
```

Declared In
runtime.h

objc_property_t

An opaque type that represents an Objective-C declared property.

```
typedef struct objc_property *objc_property_t;
```

Declared In
runtime.h

IMP

A pointer to the start of a method implementation.

```
id (*IMP)(id, SEL, ...)
```

Discussion
This data type is a pointer to the start of the function that implements the method. This function uses standard C calling conventions as implemented for the current CPU architecture. The first argument is a pointer to `self` (that is, the memory for the particular instance of this class, or, for a class method, a pointer to the metaclass). The second argument is the method selector. The method arguments follow.

SEL

Defines an opaque type that represents a method selector.

```
typedef struct objc_selector     *SEL;
```

Discussion
Method selectors are used to represent the name of a method at runtime. A method selector is a C string that has been registered (or "mapped") with the Objective-C runtime. Selectors generated by the compiler are automatically mapped by the runtime when the class is loaded.

You can add new selectors at runtime and retrieve existing selectors using the function `sel_registerName` (page 48).

When using selectors, you must use the value returned from `sel_registerName` (page 48) or the Objective-C compiler directive `@selector()`. You cannot simply cast a C string to `SEL`.

Declared In
`objc.h`

objc_method_list

Contains an array of method definitions.

```
struct objc_method_list
{
    struct objc_method_list *obsolete;
    int method_count;
    struct objc_method method_list[1];
}
```

Fields

`obsolete`
Reserved for future use.

`method_count`
An integer specifying the number of methods in the method list array.

`method_list`
An array of `Method` (page 49) data structures.

objc_cache

Performance optimization for method calls. Contains pointers to recently used methods.

```
struct objc_cache
{
    unsigned int mask;
    unsigned int occupied;
    Method buckets[1];
};
```

Fields

`mask`

An integer specifying the total number of allocated cache buckets (minus one). During method lookup, the Objective-C runtime uses this field to determine the index at which to begin a linear search of the `buckets` array. A pointer to a method's selector is masked against this field using a logical AND operation (`index = (mask & selector)`). This serves as a simple hashing algorithm.

`occupied`

An integer specifying the total number of occupied cache buckets.

`buckets`

An array of pointers to `Method` (page 49) data structures. This array may contain no more than `mask + 1` items. Note that pointers may be `NULL`, indicating that the cache bucket is unoccupied, and occupied buckets may not be contiguous. This array may grow over time.

Discussion

To limit the need to perform linear searches of method lists for the definitions of frequently accessed methods—an operation that can considerably slow down method lookup—the Objective-C runtime functions store pointers to the definitions of the most recently called method of the class in an `objc_cache` data structure.

objc_protocol_list

Represents a list of formal protocols.

```
struct objc_protocol_list
{
    struct objc_protocol_list *next;
    int count;
    Protocol *list[1];
};
```

Fields

`next`

A pointer to another `objc_protocol_list` data structure.

`count`

The number of protocols in this list.

`list`

An array of pointers to `Class` (page 48) data structures that represent protocols.

Discussion

A formal protocol is a class definition that declares a set of methods, which a class must implement. Such a class definition contains no instance variables. A class definition may promise to implement any number of formal protocols.

Instance Data Types

These are the data types that represent objects, classes, and superclasses.

- `id` pointer to an instance of a class.
- `objc_object` (page 52) represents an instance of a class.
- `objc_super` (page 52) specifies the superclass of an instance.

objc_object

Represents an instance of a class.

```
struct objc_object
{
    struct objc_class *isa;
    /* …variable length data containing instance variable values…  */
};
```

Fields

`isa`

A pointer to the class definition of which this object is an instance.

Discussion

When you create an instance of a particular class, the allocated memory contains an `objc_object` data structure, which is directly followed by the data for the instance variables of the class.

The `alloc` and `allocWithZone:` methods of the Foundation framework class NSObject use the function `class_createInstance` (page 19) to create `objc_object` data structures.

objc_super

Specifies the superclass of an instance.

```
struct objc_super
{
    id receiver;
    Class class;
};
```

Fields

`receiver`

A pointer of type `id`. Specifies an instance of a class.

`class`

A pointer to an `Class` (page 48) data structure. Specifies the particular superclass of the instance to message.

Discussion

The compiler generates an `objc_super` data structure when it encounters the `super` keyword as the receiver of a message. It specifies the class definition of the particular superclass that should be messaged.

Boolean Value

BOOL

Type to represent a Boolean value.

```
typedef signed char BOOL;
```

Discussion
`BOOL` is explicitly signed so `@encode(BOOL)` is `c` rather than `C` even if `-funsigned-char` is used.

For values, see "Boolean Values" (page 54).

Special Considerations

Since the type of `BOOL` is actually `char`, it does not behave in the same way as a C `_Bool` value or a C++ *bool* value. For example, the conditional in the following code will be false on i386 (and true on PPC):

```
- (BOOL)value {
    return 256;
}
// then
if ([self value]) doStuff();
```

By contrast, the conditional in the following code will be true on all platforms (even where `sizeof(bool) == 1`):

```
- (bool)value {
    return 256;
}
// then
if ([self value]) doStuff();
```

Availability
Available in Mac OS X v10.1 and later.

Declared In
`wintypes.h`

Associative References

objc_AssociationPolicy

Type to specify behavior the behavior of an association.

```
typedef uintptr_t objc_AssociationPolicy;
```

Discussion
For values, see "Associative Object Behaviors" (page 54).

Constants

Boolean Values

These macros define convenient constants to represent Boolean values.

```
#define YES (BOOL)1
#define NO  (BOOL)0
```

Constants

`YES`

Defines `YES` as `1`.

Available in Mac OS X v10.0 and later.

Declared in `NSObjCRuntime.h`.

`NO`

Defines `NO` as `0`.

Available in Mac OS X v10.0 and later.

Declared in `NSObjCRuntime.h`.

Declared In

`objc.h`

Null Values

These macros define null values for classes and instances.

```
#define nil __DARWIN_NULL
#define Nil __DARWIN_NULL
```

Constants

`nil`

Defines the `id` of a null instance.

Available in Mac OS X v10.0 and later.

Declared in `MacTypes.h`.

`Nil`

Defines the `id` of a null class.

Available in Mac OS X v10.0 through Mac OS X v10.4.

Declared in `NSObjCRuntime.h`.

Declared In

`objc.h`

Associative Object Behaviors

Policies related to associative references.

```
enum {
    OBJC_ASSOCIATION_ASSIGN = 0,
    OBJC_ASSOCIATION_RETAIN_NONATOMIC = 1,
    OBJC_ASSOCIATION_COPY_NONATOMIC = 3,
    OBJC_ASSOCIATION_RETAIN = 01401,
    OBJC_ASSOCIATION_COPY = 01403
};
```

Constants

`OBJC_ASSOCIATION_ASSIGN`
: Specifies a weak reference to the associated object.

`OBJC_ASSOCIATION_RETAIN_NONATOMIC`
: Specifies a strong reference to the associated object, and that the association is not made atomically.

`OBJC_ASSOCIATION_COPY_NONATOMIC`
: Specifies that the associated object is copied, and that the association is not made atomically.

`OBJC_ASSOCIATION_RETAIN`
: Specifies a strong reference to the associated object, and that the association is made atomically.

`OBJC_ASSOCIATION_COPY`
: Specifies that the associated object is copied, and that the association is made atomically.

Mac OS X Version 10.5 Delta

The low-level Objective-C runtime API is significantly updated in Mac OS X version 10.5. Many functions and all existing data structures are replaced with new functions. This document describes the differences between the 10.5 version and previous versions.

Runtime Functions

Basic types

`arith_t`: Changed from `int` to `intptr_t`.

`uarith_t`: Changed from `unsigned` to `uintptr_t`.

Instances

The following functions are unchanged:

- `object_dispose` (page 39)
- `object_getClassName` (page 40)
- `object_getIndexedIvars` (page 40)
- `object_setInstanceVariable` (page 42)
- `object_getInstanceVariable` (page 41)

The following function is modified:

- `object_copy` (page 39) (The *`nBytes`* parameter is changed from `unsigned` to `size_t`.)

The following functions are added:

- `object_getClass` (page 39)
- `object_setClass` (page 41)
- `object_getIvar` (page 41)
- `object_setIvar` (page 42)

The following functions are deprecated:

- object_copyFromZone: deprecated in favor of `object_copy` (page 39)
- object_realloc
- object_reallocFromZone: no substitute
- _alloc: no substitute

_copy: no substitute
_realloc: no substitute
_dealloc: no substitute
_zoneAlloc: no substitute
_zoneRealloc: no substitute
_zoneCopy: no substitute
_error: no substitute

Class Inspection

The following functions are unchanged:

`objc_getClassList` (page 32)
`objc_lookUpClass` (page 35)
`objc_getClass` (page 32)
`objc_getMetaClass` (page 34)
`class_getVersion` (page 23)
`class_getInstanceVariable` (page 21)
`class_getInstanceMethod` (page 20)
`class_getClassMethod` (page 19)

The following function is modified:

class_createInstance: *`idxIvars`* parameter Changed from `unsigned` to `size_t`

The following functions are added:

`class_getName` (page 22)
`class_getSuperclass` (page 23)
`class_isMetaClass` (page 24)
`class_copyMethodList` (page 18)
`class_getMethodImplementation` (page 21)
`class_getMethodImplementation_stret` (page 22)
`class_respondsToSelector` (page 25)
`class_conformsToProtocol` (page 17)
`class_copyProtocolList` (page 18)
`class_copyIvarList` (page 17)

The following functions are deprecated:

`objc_getClasses`: deprecated in favor of `objc_getClassList` (page 32)
`class_createInstanceFromZone`: deprecated in favor of `class_createInstance` (page 19)
`class_nextMethodList`: deprecated in favor of new `class_copyMethodList` (page 18)
`class_lookupMethod`: deprecated in favor of `class_getMethodImplementation` (page 21)
`class_respondsToMethod`: deprecated in favor of `class_respondsToSelector` (page 25)

The following function is used only by ZeroLink:

objc_getRequiredClass

Class Manipulation

The following function is unchanged:

- class_setVersion (page 26)

The following functions are added:

- objc_allocateClassPair (page 30)
- objc_registerClassPair (page 37)
- objc_duplicateClass (page 31)
- class_addMethod (page 15)
- class_addIvar (page 15)
- class_addProtocol (page 16)

The following functions are deprecated:

- objc_addClass: deprecated in favor of objc_allocateClassPair (page 30) and objc_registerClassPair (page 37)
- class_addMethods: deprecated in favor of new class_addMethod (page 15)
- class_removeMethods: deprecated with no substitute
- class_poseAs: deprecated in favor of categories and method_setImplementation (page 30)

Methods

The following function is unchanged:

- method_getNumberOfArguments (page 29)

The following functions are added:

- method_getName (page 29)
- method_getImplementation (page 29)
- method_getTypeEncoding (page 30)
- method_copyReturnType (page 28)
- method_copyArgumentType (page 28)
- method_setImplementation (page 30)

The following functions are deprecated:

- method_getArgumentInfo
- method_getSizeOfArguments

Instance Variables

The following functions are added:

- `ivar_getName` (page 27)
- `ivar_getTypeEncoding` (page 27)
- `ivar_getOffset` (page 27)

Selectors

The following functions are unchanged:

- `sel_getName` (page 47)
- `sel_registerName` (page 48)
- `sel_getUid` (page 47)

The following function is added:

- `sel_isEqual` (page 47)

The following function is deprecated:

- `sel_isMapped`: deprecated with no substitute

Runtime

The following functions are deprecated favor of dyld:

- `objc_loadModules`
- `objc_loadModule`
- `objc_unloadModules`

The following functions are deprecated:

- `objc_setClassHandler`: deprecated with no substitute
- `objc_setMultithreaded`: deprecated with no substitute

The following previously undocumented functions are deprecated with no substitute:

- objc_getOrigClass
- _objc_create_zone
- _objc_error
- _objc_flush_caches
- _objc_resolve_categories_for_class
- _objc_setClassLoader
- _objc_setNilReceiver
- _objc_getNilReceiver
- _objcInit

The following undocumented functions are unchanged:

_objc_getFreedObjectClass
instrumentObjcMessageSends
_objc_debug_class_hash
_class_printDuplicateCacheEntries
_class_printMethodCaches
_class_printMethodCacheStatistics

Messaging

The following functions are unchanged:

`objc_msgSend` (page 35)
`objc_msgSend_stret` (page 37)
`objc_msgSendSuper` (page 35)
`objc_msgSendSuper_stret` (page 36)
`objc_msgSendSuper_stret` (page 36)

The following functions are removed:

`objc_msgSendv`	
`objc_msgSendv_stret`	
`objc_msgSendv_fpret`	

Protocols

The following functions are added:

`objc_getProtocol` (page 34)
`objc_copyProtocolList` (page 31)

Exceptions

The following functions are unchanged:

objc_exception_throw
objc_exception_try_enter
objc_exception_try_exit
objc_exception_extract
objc_exception_match
objc_exception_get_functions
objc_exception_set_functions

Synchronization

The following functions are unchanged:

objc_sync_enter
objc_sync_exit
objc_sync_wait
objc_sync_notify
objc_sync_notifyAll

These functions are only used by the compiler.

NXHashTable and NXMapTable

`NXHashTable` and `NXMapTable` are unchanged. They are limited to 4 billion entries.

Structures

The `objc_super` struct is unchanged:

```
struct objc_super {
    id receiver;
    Class super_class;
};
```

All other structures deprecated in favor of opaque types and functional API. Substitutes are shown in the following tables.

Table A-1 Substitutions for `objc_class`

Variable	Substitution
`struct objc_class *isa;`	object_getClass(), object_setClass()
struct objc_class *super_class;	class_getSuperclass()
const char *name;	class_getName()
long version;	class_getVersion(), class_setVersion()
long info;	class_isMetaClass()
long instance_size;	no substitute
struct objc_ivar_list *ivars;	class_copyIvarList(), class_addIvar()
struct objc_method_list **methodLists;	class_copyMethodList(), class_addMethod()
struct objc_cache *cache;	no substitute

Variable	Substitution
struct objc_protocol_list *protocols;	class_copyProtocolList(), class_addProtocol()

Table A-2 Substitutions for `objc_method`

Variable	Substitution
SEL method_name;	method_getName()
char *method_types;	method_getTypeEncoding()
IMP method_imp;	method_getImplementation(), method_setImplementation()

Table A-3 Substitutions for `objc_ivar`

Variable	Substitution
char *ivar_name;	ivar_getName()
char *ivar_type;	ivar_getTypeEncoding()
int ivar_offset;	ivar_getOffset()

There are no substitutes for the following structs:

objc_object {...};
objc_category {...};
objc_method_list {...};
objc_ivar_list {...};
objc_protocol_list {...};
objc_cache {...};
objc_module {...};
objc_symtab {...};

Document Revision History

This table describes the changes to *Objective-C Runtime Reference*.

Date	Notes
2010-06-17	Removed obsolete functions marg-related API (such as marg_setValue).
2009-10-19	Added functions related to associative references.
2009-06-02	Updated for Mac OS X v10.6.
2008-11-19	Added links to the new Objective-C 2.0 Runtime Programming Guide.
2008-10-15	TBD
2007-12-11	Enhanced description of object_getIndexedIvars.
2007-10-31	Updated for Mac OS X v10.5. Corrected the code example for the objc_getClassList function.
2007-05-25	Included new features in Objective-C 2.0.
2005-10-04	Minor correction to CreateClassDefinition function and definitions of marg_ macros.
2005-08-11	Corrected errors and documented macros.
	Corrected declaration of `class_getClassMethod` (page 19).
	Renamed the "Class Handler Callback" section to `ClassHandlerCallback` and added example function declaration to the description.
	Corrected result description of `method_getArgumentInfo`.
	Documented `YES` and `NO` macros in "Macros".
2004-08-31	New document that describes the data structures and programming interface used in the Objective-C runtime system.
	This document replaces information about the printing system that was published previously in *The Objective-C Programming Language*.

Document Revision History