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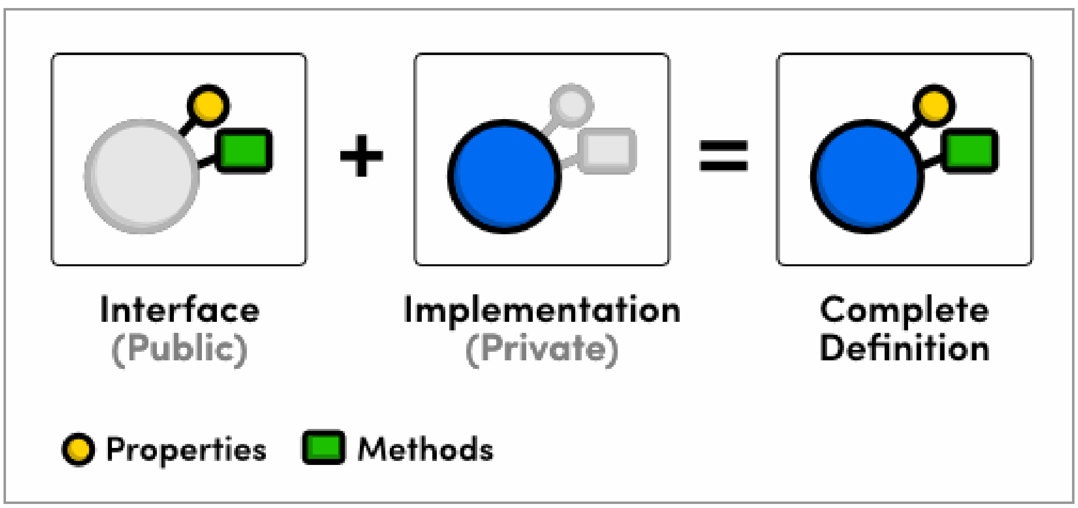
Classes

As in any other object-oriented programming language, Objective-C classes provide the blueprint for creating objects. First, you define a reusable set of properties and behaviors inside of a class. Then, you instantiate objects from that class to interact with those properties and behaviors.

Objective-C is similar to C++ in that it abstracts a class's interface from its implementation. An **interface** declares the public properties and methods of a class, and the corresponding **implementation** defines the code that actually makes these properties and methods work. This is the same separation of concerns that we saw with functions.



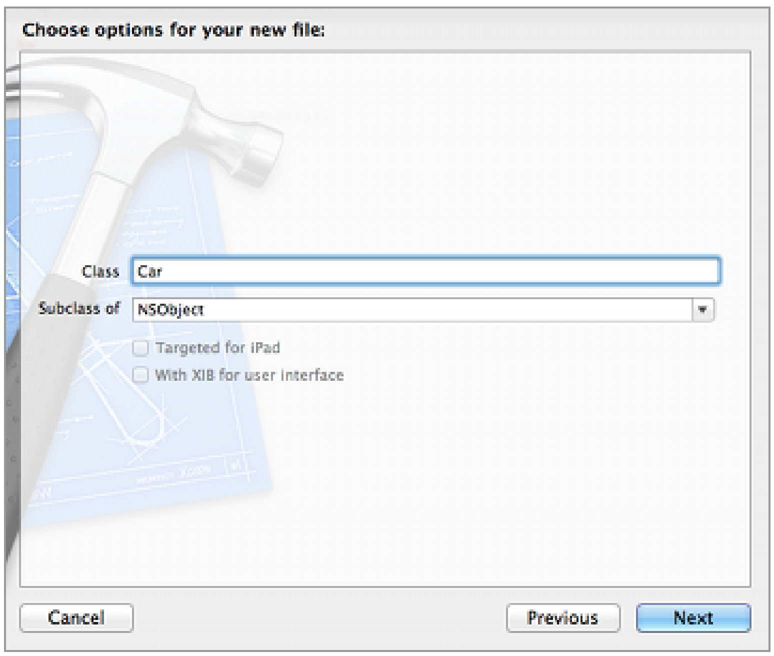
A class's interface and implementation

In this module, we'll explore the basic syntax for class interfaces, implementations, properties, and methods, as well as the canonical way to instantiate objects. We'll also introduce some of Objective-C's introspection and reflection capabilities.

Creating Classes

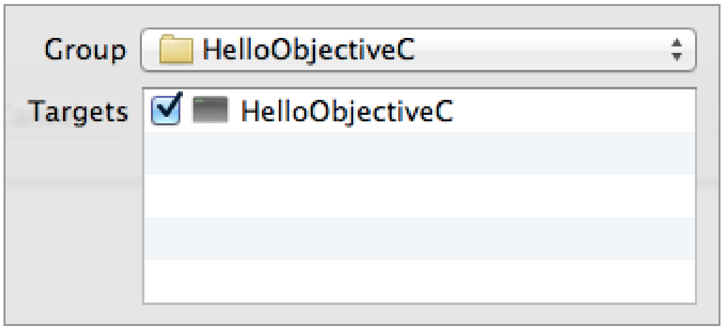
We'll be working with a class called `Car` whose interface resides in a file named `Car.h` (also called a "header") and whose implementation resides in `Car.m`. These are the standard file extensions for Objective-C classes. The class's header file is what other classes use when they need to interact with it, and its implementation file is used only by the compiler.

Xcode provides a convenient template for creating new classes. To create our `Car` class, navigate to *File > New > File...* or use the *Cmd+N* shortcut. For the template, choose *Objective-C class* under the *iOS > Cocoa Touch* category. After that, you'll be presented with some configuration options:



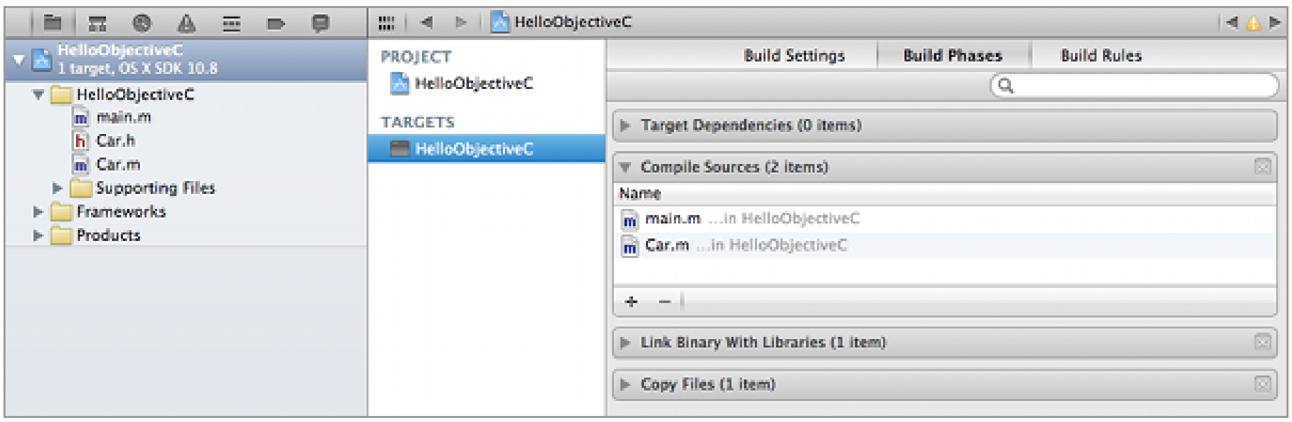
Creating the `Car` class

Use `Car` for the *Class* field and `NSObject` for the *Subclass of* field. `NSObject` is Objective-C's top-level class from which all others inherit. Clicking *Next* will prompt you to select a location for the file. Save it in the top-level of the project directory. At the bottom of that dialog, make sure that your project is checked in the *Targets* section. This is what actually adds the class to the list of compiled sources.



Adding the class to the build target

After clicking *Next*, you should see new `Car.h` and `Car.m` files in Xcode's *Project Navigator*. If you select the project name in the navigator, you'll also find `Car.m` in the *Build Phases* tab under the *Compile Sources* section. Any files that you want the compiler to see must be in this list (if you didn't create your source files through Xcode, this is where you can manually add them).



The list of compiled source files

Interfaces

`Car.h` contains some template code, but let's go ahead and change it to the following. This declares a property called `model` and a method called `drive`.

```
// Car.h
#import <Foundation/Foundation.h>

@interface Car : NSObject {
    // Protected instance variables (not recommended)
}
```

```
@property (copy) NSString *model;

- (void)drive;

@end
```

An interface is created with the `@interface` directive, after which come the class and the superclass name, separated by a colon. Protected variables can be defined inside of the curly braces, but most developers treat instance variables as implementation details and prefer to store them in the `.m` file instead of the interface.

The `@property` directive declares a public property, and the `(copy)` attribute defines its memory management behavior. In this case, the value assigned to `model` will be stored as a copy instead of a direct pointer. The Properties module discusses this in more detail. Next come the property's data type and name, just like a normal variable declaration.

The `-(void)drive` line declares a method called `drive` that takes no parameters, and the `(void)` portion defines its return type. The minus sign prepended to the method marks it as an *instance* method (opposed to a *class* method).

Implementations

The first thing any class implementation needs to do is import its corresponding interface. The `@implementation` directive is similar to `@interface`, except you don't need to include the super class. Private instance variables can be stored between curly braces after the class name:

```
// Car.m
#import "Car.h"

@implementation Car {
    // Private instance variables
    double _odometer;
}

@synthesize model = _model;    // Optional for Xcode 4.4+
```

```
- (void)drive {
    NSLog(@"Driving a %@. Vrooooom!", self.model);
}

@end
```

`@synthesize` is a convenience directive that automatically generates accessor methods for the property. By default, the getter is simply the property name (`model`), and the setter is the capitalized name with the `set` prefix (`setModel`). This is much easier than manually creating accessors for every property. The `_model` portion of the synthesize statement defines the private instance variable name to use for the property.

As of Xcode 4.4, properties declared with `@property` will be automatically synthesized, so it's safe to omit the `@synthesize` line if you're ok with the default instance variable naming conventions.

The `drive` implementation has the same signature as the interface, but it's followed by whatever code should be executed when the method is called. Note how we accessed the value via `self.model` instead of the `_model` instance variable. This is a best practice step because it utilizes the property's accessor methods. Typically, the only place you'll need to directly access instance variables is in `init` methods and the `dealloc` method.

The `self` keyword refers to the instance calling the method (like `this` in C++ and Java). In addition to accessing properties, this can be used to call other methods defined on the same class (e.g., `[self anotherMethod]`). We'll see many examples of this throughout the tutorial.

Instantiation and Usage

Any files that need access to a class must import its header file (`Car.h`)—they should never, ever try to access the implementation file directly. That would defeat the goal of separating the public API from its underlying implementation. So, to see our `Car` class in action, change `main.m` to the following.

```
// main.m
```

```
#import <Foundation/Foundation.h>
#import "Car.h"

int main(int argc, const char * argv[]) {
    @autoreleasepool {
        Car *toyota = [[Car alloc] init];

        [toyota setModel:@"Toyota Corolla"];
        NSLog(@"Created a %@", [toyota model]);

        toyota.model = @"Toyota Camry";
        NSLog(@"Changed the car to a %@", toyota.model);

        [toyota drive];

    }
    return 0;
}
```

After the interface has been imported with the `#import` directive, you can instantiate objects with the `alloc`/`init` pattern shown above. As you can see, instantiation is a two-step process: first you must allocate some memory for the object by calling the `alloc` method, then you need to initialize it so it's ready to use. You should never use an uninitialized object.

It's worth repeating that *all* objects must be stored as pointers. This is why we used `Car *toyota` instead of `Car toyota` to declare the variable.

To call a method on an Objective-C object, you place the instance and the method in square brackets, separated by a space. Arguments are passed after the method name, preceded by a colon. So, if you're coming from a C++, Java, or Python background, the `[toyota setModel:@"Toyota Corolla"]` call would translate to:

```
toyota.setModel("Toyota Corolla");
```

This square-bracket syntax can be unsettling for newcomers to the language, but rest assured, you'll be more than comfortable with Objective-C's method conventions after reading through the Methods module.

This example also shows you both ways to work with an object's properties. You can either use the synthesized `model` and `setModel` accessor methods, or you can use the convenient dot-syntax, which should be more familiar to developers who have been using Simula-style languages.

Class Methods and Variables

The above snippets define instance-level properties and methods, but it's also possible to define class-level ones. These are commonly called "static" methods/properties in other programming languages (not to be confused with the static keyword).

Class method declarations look just like instance methods, except they are prefixed with a plus sign instead of a minus sign. For example, let's add the following class-level method to `Car.h`:

```
// Car.h
+ (void)setDefaultModel:(NSString *)aModel;
```

Similarly, a class method *implementation* is also preceded by a plus sign. While there is technically no such thing as a class-level variable in Objective-C, you can emulate one by declaring a `static` variable before defining the implementation:

```
// Car.m
#import "Car.h"

static NSString *_defaultModel;

@implementation Car {
...

+ (void)setDefaultModel:(NSString *)aModel {
    _defaultModel = [aModel copy];
}

@end
```

The `[aModel copy]` call creates a copy of the parameter instead of assigning it directly. This is what's going on under the hood when we used the `(copy)` attribute on the `model` property.

Class methods use the same square-bracket syntax as instance methods, but they must be called directly on the class, as shown below. They *cannot* be called on an instance of that class (`[toyota setDefaultModel:@"Model T"]` will throw an error).

```
// main.m
[Car setDefaultModel:@"Nissan Versa"];
```

"Constructor" Methods

There are no constructor methods in Objective-C. Instead, an object is **initialized** by calling the `init` method immediately after it's allocated. This is why instantiation is always a two-step process: allocate, then initialize. There is also a class-level initialization method that will be discussed in a moment.

`init` is the default initialization method, but you can also define your own versions to accept configuration parameters. There's nothing special about custom initialization methods—they're just normal instance methods, except the method name should always begin with `init`. An exemplary "constructor" method is shown below.

```
// Car.h
- (id)initWithModel:(NSString *)aModel;
```

To implement this method, you should follow the canonical initialization pattern shown in `initWithModel:` below. The `super` keyword refers to the parent class, and again, the `self` keyword refers to the instance calling the method. Go ahead and add the following methods to `Car.m`.

```
// Car.m
- (id)initWithModel:(NSString *)aModel {
    self = [super init];
    if (self) {
        // Any custom setup work goes here
        _model = [aModel copy];
```

```
        _odometer = 0;
    }
    return self;
}

- (id)init {
    // Forward to the "designated" initialization method
    return [self initWithModel:_defaultModel];
}
```

Initialization methods should always return a reference to the object itself, and if it cannot be initialized, it should return `nil`. This is why we need to check if `self` exists before trying to use it. There should typically only be one initialization method that needs to do this, and the rest should forward calls to this **designated initializer**. This eliminates boilerplate code when you have several custom `init` methods.

Also notice how we directly assigned values to the `_model` and `_odometer` instance variables in `initWithModel:`. Remember that this is one of the only places you should do this—in the rest of your methods you should be using `self.model` and `self.odometer`.

Class-Level Initialization

The `initialize` method is the class-level equivalent of `init`. It gives you a chance to set up the class before anyone uses it. For example, we can use this to populate the `_defaultModel` variable with a valid value, like so:

```
// Car.m
+ (void)initialize {
    if (self == [Car class]) {
        // Makes sure this isn't executed more than once
        _defaultModel = @"Nissan Versa";
    }
}
```

The `initialize` class method is called once for every class before the class is used. This includes all subclasses of `Car`, which means that `Car` will get two `initialize` calls if one of its subclasses didn't re-implement it. As a result, it's good practice to use the `self == [Car class]` conditional to ensure that the initialization code is only run once. Also note that in class methods, the `self` keyword refers to the *class itself*, not an instance.

Objective-C doesn't force you to mark methods as overrides. Even though `init` and `initialize` are both defined by its superclass, `NSObject`, the compiler won't complain when you redefine them in `Car.m`.

The next iteration of `main.m` shows our custom initialization methods in action. Before the first time the class is used, `[Car initialize]` is called automatically, setting `_defaultModel` to `@"Nissan Versa"`. This can be seen in the first `NSLog()`. You can also see the result of the custom initialization method (`initWithModel:`) in the second log output.

```
// main.m
#import <Foundation/Foundation.h>
#import "Car.h"

int main(int argc, const char * argv[]) {
    @autoreleasepool {

        // Instantiating objects
        Car *nissan = [[Car alloc] init];
        NSLog(@"Created a %@", [nissan model]);

        Car *chevy = [[Car alloc] initWithModel:@"Chevy Corvette"];
        NSLog(@"Created a %@, too.", chevy.model);

    }
    return 0;
}
```

Dynamic Typing

Classes themselves are represented as objects, which makes it possible to query their properties (introspection), or even change their behavior on-the-fly (reflection). These are very powerful dynamic typing capabilities, as they let you call methods and set properties on objects even when you don't know what type of object they are.

The easiest way to get a class object is via the `class` class-level method (apologies for the redundant terminology). For example, `[Car class]` returns an object representing the `Car` class. You can pass this object around to methods like `isMemberOfClass:` and `isKindOfClass:` to get information about other instances. A comprehensive example is included below.

```
// main.m
#import <Foundation/Foundation.h>
#import "Car.h"

int main(int argc, const char * argv[]) {
    @autoreleasepool {
        Car *delorean = [[Car alloc] initWithModel:@"DeLorean"];

        // Get the class of an object
        NSLog(@"%@ is an instance of the %@ class",
              [delorean model], [delorean class]);

        // Check an object against a class and all subclasses
        if ([delorean isKindOfClass:[NSObject class]]) {
            NSLog(@"%@ is an instance of NSObject or one "
                  "of its subclasses",
                  [delorean model]);
        } else {
            NSLog(@"%@ is not an instance of NSObject or "
                  "one of its subclasses",
                  [delorean model]);
        }

        // Check an object against a class, but not its subclasses
        if ([delorean isMemberOfClass:[NSObject class]]) {
            NSLog(@"%@ is a instance of NSObject",
                  [delorean model]);
        } else {
            NSLog(@"%@ is not an instance of NSObject",
                  [delorean model]);
        }

        // Convert between strings and classes
```

```
        if (NSClassFromString(@"Car") == [Car class]) {
            NSLog(@"I can convert between strings and classes!");
        }
    }
    return 0;
}
```

The `NSClassFromString()` function is an alternative way to get your hands on a class object. This is very flexible, as it lets you dynamically request class objects at runtime; however, it's also rather inefficient. For this reason, you should opt for the `class` method whenever possible.

If you're interested in dynamic typing, be sure to check out Selectors and The `id` Type.

Summary

In this module, we learned how to create classes, instantiate objects, define initialization methods, and work with class-level methods and variables. We also took a brief look at dynamic typing.

The previous module mentioned that Objective-C doesn't support namespaces, which is why the Cocoa functions require prefixes like `NS`, `CA`, `AV`, etc to avoid naming collisions. This applies to classes, too. The recommended convention is to use a three-letter prefix for your application-specific classes (e.g., `XYZCar`).

While this is pretty much everything you need to know to start writing your own classes, we did skim over some important details, so don't worry if you're feeling not entirely comfortable with properties or methods. The next module will begin filling in these holes with a closer look at the `@property` directive and all of the attributes that affect its behavior.

Continue to *Properties* ›