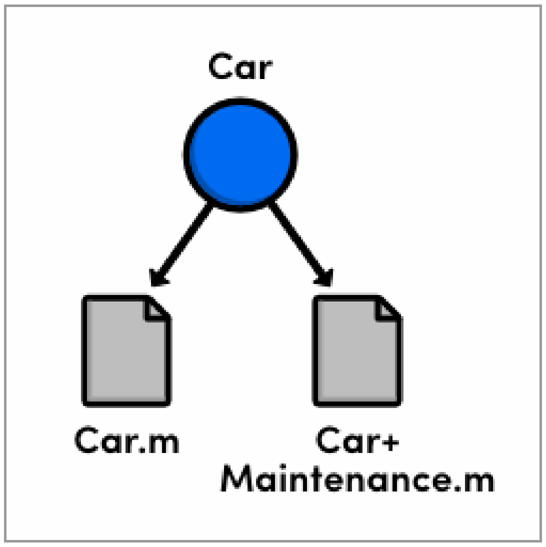
Categories

Categories are a way to split a single class definition into multiple files. Their goal is to ease the burden of maintaining large code bases by modularizing a class. This prevents your source code from becoming monolithic 10000+ line files that are impossible to navigate and makes it easy to assign specific, well-defined portions of a class to individual developers.



Using multiple files to implement a class

In this module, we'll use a category to extend an existing class without touching its original source file. Then, we'll learn how this functionality can be used to emulate protected methods. Extensions are a close relative to categories, so we'll be taking a brief look at those, too.

Setting Up

Before we can start experimenting with categories, we need a base class to work off of. Create or change your existing `Car` interface to the following:

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

@interface Car : NSObject

@property (copy) NSString *model;
@property (readonly) double odometer;

- (void)startEngine;
- (void)drive;
- (void)turnLeft;
- (void)turnRight;

@end
```

The corresponding implementation just outputs some descriptive messages so we can see when different methods get called:

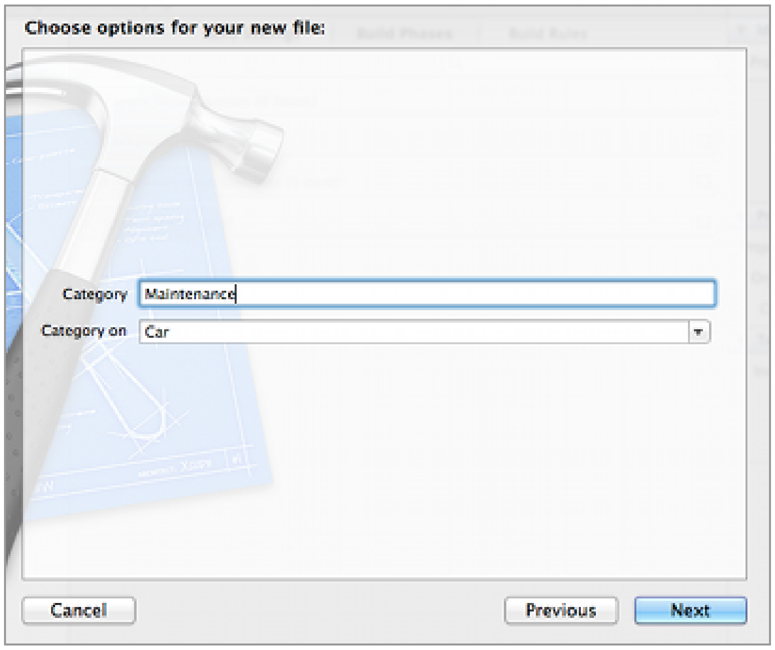
```
// Car.m
#import "Car.h"

@implementation Car

@synthesize model = _model;

- (void)startEngine {
    NSLog(@"Starting the %@'s engine", _model);
}
- (void)drive {
    NSLog(@"The %@ is now driving", _model);
}
- (void)turnLeft {
    NSLog(@"The %@ is turning left", _model);
}
- (void)turnRight {
    NSLog(@"The %@ is turning right", _model);
}
```

```
@end
```

Now, let's say you want to add another set of methods related to car maintenance. Instead of cluttering up these `Car.h` and `Car.m` files, you can place the new methods in a dedicated category.

Creating Categories

Categories work just like normal class definitions in that they are composed of an interface and an implementation. To add a new category to your Xcode project, create a new file and choose the *Objective-C category* template under *iOS > Cocoa Touch*. Use `Maintenance` for the *Category* field and `Car` for *Category on*.



Category: Maintenance
Category on: Car

Creating the `Maintenance` *category*

The only restriction on category names is that they don't conflict with other categories on the same class. The canonical file-naming convention is to use the class name and the category name separated by a plus sign, so you should find a `Car+Maintenance.h` and a `Car+Maintenance.m` in Xcode's *Project Navigator* after saving the above category.

As you can see in `Car+Maintenance.h`, a category interface looks exactly like a normal interface, except the class name is followed by the category name in parentheses. Let's go ahead and add a few methods to the category:

```
// Car+Maintenance.h
#import "Car.h"

@interface Car (Maintenance)

- (BOOL)needsOilChange;
- (void)changeOil;
- (void)rotateTires;
- (void)jumpBatteryUsingCar:(Car *)anotherCar;

@end
```

At runtime, these methods become part of the `Car` class. Even though they're declared in a different file, you will be able to access them as if they were defined in the original `Car.h`.

Of course, you have to implement the category interface for the above methods to actually *do* anything. Again, a category implementation looks almost exactly like a standard implementation, except the category name appears in parentheses after the class name:

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

@implementation Car (Maintenance)

- (BOOL)needsOilChange {
    return YES;
}
- (void)changeOil {
    NSLog(@"Changing oil for the %@", [self model]);
}
- (void)rotateTires {
    NSLog(@"Rotating tires for the %@", [self model]);
}
- (void)jumpBatteryUsingCar:(Car *)anotherCar {
    NSLog(@"Jumped the %@ with a %@", [self model], [anotherCar model]);
}
```

```
@end
```

It's important to note that a category can also be used to override existing methods in the base class (e.g., the `Car` class's `drive` method), but **you should never do this**. The problem is that categories are a flat organizational structure. If you override an existing method in `Car+Maintenance.m`, and then decide you want to change its behavior again with another category, there is no way for Objective-C to know which implementation to use. Subclassing is almost always a better option in such a situation.

Using Categories

Any files that use an API defined in a category need to import that category header just like a normal class interface. After importing `Car+Maintenance.h`, all of its methods will be available directly through the `Car` class:

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

int main(int argc, const char * argv[]) {
    @autoreleasepool {
        Car *porsche = [[Car alloc] init];
        porsche.model = @"Porsche 911 Turbo";
        Car *ford = [[Car alloc] init];
        ford.model = @"Ford F-150";

        // "Standard" functionality from Car.h
        [porsche startEngine];
        [porsche drive];
        [porsche turnLeft];
        [porsche turnRight];

        // Additional methods from Car+Maintenance.h
        if ([porsche needsOilChange]) {
            [porsche changeOil];
        }
        [porsche rotateTires];
        [porsche jumpBatteryUsingCar:ford];
    }
    return 0;
}
```

If you remove the import statement for `Car+Maintenance.h`, the `Car` class will revert to its original state, and the compiler will complain that `needsOilChange`, `changeOil`, and the rest of the methods from the `Maintenance` category don't exist.

"Protected" Methods

But, categories aren't just for spreading a class definition over several files. They are a powerful organizational tool that allow arbitrary files to "opt-in" to a portion of an API by simply importing the category. To everybody else, that API remains hidden.

Recall from the Methods module that protected methods don't actually exist in Objective-C; however, the opt-in behavior of categories can be used to *emulate* protected access modifiers. The idea is to define a "protected" API in a dedicated category, and only import it into subclass implementations. This makes the protected methods available to subclasses, but keeps them hidden from other aspects of the application. For example:

```
// Car+Protected.h
#import "Car.h"

@interface Car (Protected)

- (void)prepareToDrive;

@end
```

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

@implementation Car (Protected)
```

```
- (void)prepareToDrive {
    NSLog(@"Doing some internal work to get the %@ ready to drive",
          [self model]);
}

@end
```

The `Protected` category shown above defines a single method for internal use by `Car` and its subclasses. To see this in action, let's modify `Car.m`'s `drive` method to use the protected `prepareToDrive` method:

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

@implementation Car
...
- (void)drive {
    [self prepareToDrive];
    NSLog(@"The %@ is now driving", _model);
}
...
```

Next, let's take a look at how this protected method works by creating a subclass called `Coupe`. There's nothing special about the interface, but notice how the implementation opts-in to the protected API by importing `Car+Protected.h`. This makes it possible to use the protected `prepareToDrive` method in the subclass. If desired, you can also override the protected method by simply re-defining it in `Coupe.m`.

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

@interface Coupe : Car
// Extra methods defined by the Coupe subclass
@end
```

```
// Coupe.m
#import "Coupe.h"
#import "Car+Protected.h"

@implementation Coupe

- (void)startEngine {
    [super startEngine];
    // Call the protected method here instead of in `drive`
    [self prepareToDrive];
}

- (void)drive {
    NSLog(@"VROOOOOOM!");
}

@end
```

To enforce the protected status of the methods in `Car+Protected.h`, it should only be made available to subclass implementations—do *not* import it into other files. In the following `main.m`, you can see the protected `prepareToDrive` method called by `[ford drive]` and `[porsche startEngine]`, but the compiler will complain if you try to call it directly.

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

int main(int argc, const char * argv[]) {
    @autoreleasepool {
        Car *ford = [[Car alloc] init];
        ford.model = @"Ford F-150";
        [ford startEngine];
        [ford drive]; // Calls the protected method

        Car *porsche = [[Coupe alloc] init];
        porsche.model = @"Porsche 911 Turbo";
        [porsche startEngine]; // Calls the protected method
        [porsche drive];

        // "Protected" methods have not been imported,
        // so this will *not* work
        // [porsche prepareToDrive];

        SEL protectedMethod = @selector(prepareToDrive);
        if ([porsche respondsToSelector:protectedMethod]) {
            // This *will* work
            [porsche performSelector:protectedMethod];
        }


    }
    return 0;
}
```

Notice that you *can* access `prepareToDrive` dynamically through `performSelector:`. Once again, *all* methods in Objective-C are public, and there is no way to truly hide them from client code. Categories are merely a convention-based way to control which parts of an API are visible to which files.

Extensions

Extensions are similar to categories in that they let you add methods to a class outside of the main interface file. But, in contrast to categories, an extension's API must be implemented in the *main* implementation file—it *cannot* be implemented in a category.

Remember that private methods can be emulated by adding them to the implementation but not the interface. This works when you have only a few private methods, but can become unwieldy for larger classes. Extensions solve this problem by letting you declare a *formal* private API.

For example, if you wanted to formally add a private `engineIsWorking` method to the `Car` class defined above, you could include an extension in `Car.m`. The compiler complains if the method isn't defined in the main `@implementation` block, but since it's declared in `Car.m` instead of `Car.h`, it remains a *private* method. The extension syntax looks like an empty category:

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

// The class extension
@interface Car ()
- (BOOL)engineIsWorking;
@end

// The main implementation
@implementation Car

@synthesize model = _model;

- (BOOL)engineIsWorking {
    // In the real world, this would probably return a useful value
    return YES;
}
- (void)startEngine {
    if ([self engineIsWorking]) {
        NSLog(@"Starting the %@'s engine", _model);
    }
}
...
@end
```

In addition to declaring formal private API's, extensions can be used to re-declare properties from the public interface. This is often used to make properties internally behave as read-write properties while remaining read-only to other objects. For instance, if we change the above class extension to:

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

@interface Car ()
@property (readwrite) double odometer;
```

```
- (BOOL)engineIsWorking;
@end
...
```

We can then assign values to `self.odometer` inside of the implementation, but trying to do so outside of `Car.m` will result in a compiler error.

Again, re-declaring properties as read-write and creating formal private API's isn't all that useful for small classes. Their real utility comes into play when you need to organize larger frameworks.

Extensions used to see much more action before Xcode 4.3, back when private methods had to be declared *before* they were used. This was inconvenient for many developers, and extensions provided a workaround by acting as forward-declarations of private methods. So, even if you don't use the above pattern in your own projects, you're likely to encounter it at some point in your Objective-C career.

Summary

This module covered Objective-C categories and extensions. Categories are a way to modularize a class by spreading its implementation over many files. Extensions provide similar functionality, except its API must be declared in the *main* implementation file.

Outside of organizing large code libraries, one of the most common uses of categories is to add methods to built-in data types like `NSString` or `NSArray`. The advantage of this is that you don't have to update existing code to use a new subclass, but you need to be very careful not to override existing functionality. For small personal projects, categories really aren't worth the trouble, and sticking with standard tools like subclassing and protocols will save you some debugging headaches down the road.

In the next module, we'll explore another organizational tool called blocks. Blocks are a way to represent and pass around arbitrary statements. This opens the door to a whole new world of programming paradigms.

Continue to *Blocks* ›