iOS Mobile Design

Agenda

- Core Data

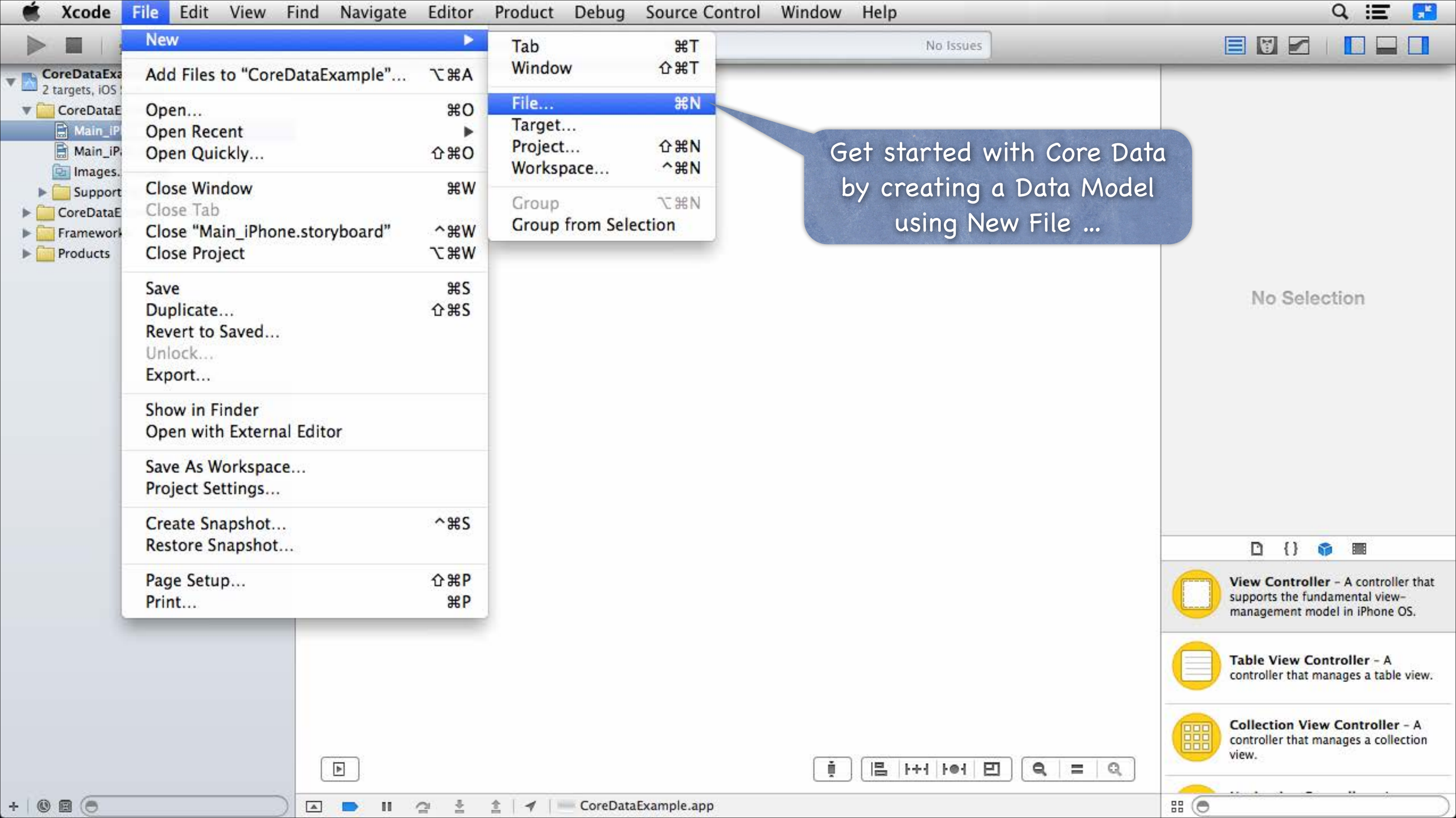
  Storing your Model permanently in an object-oriented database.

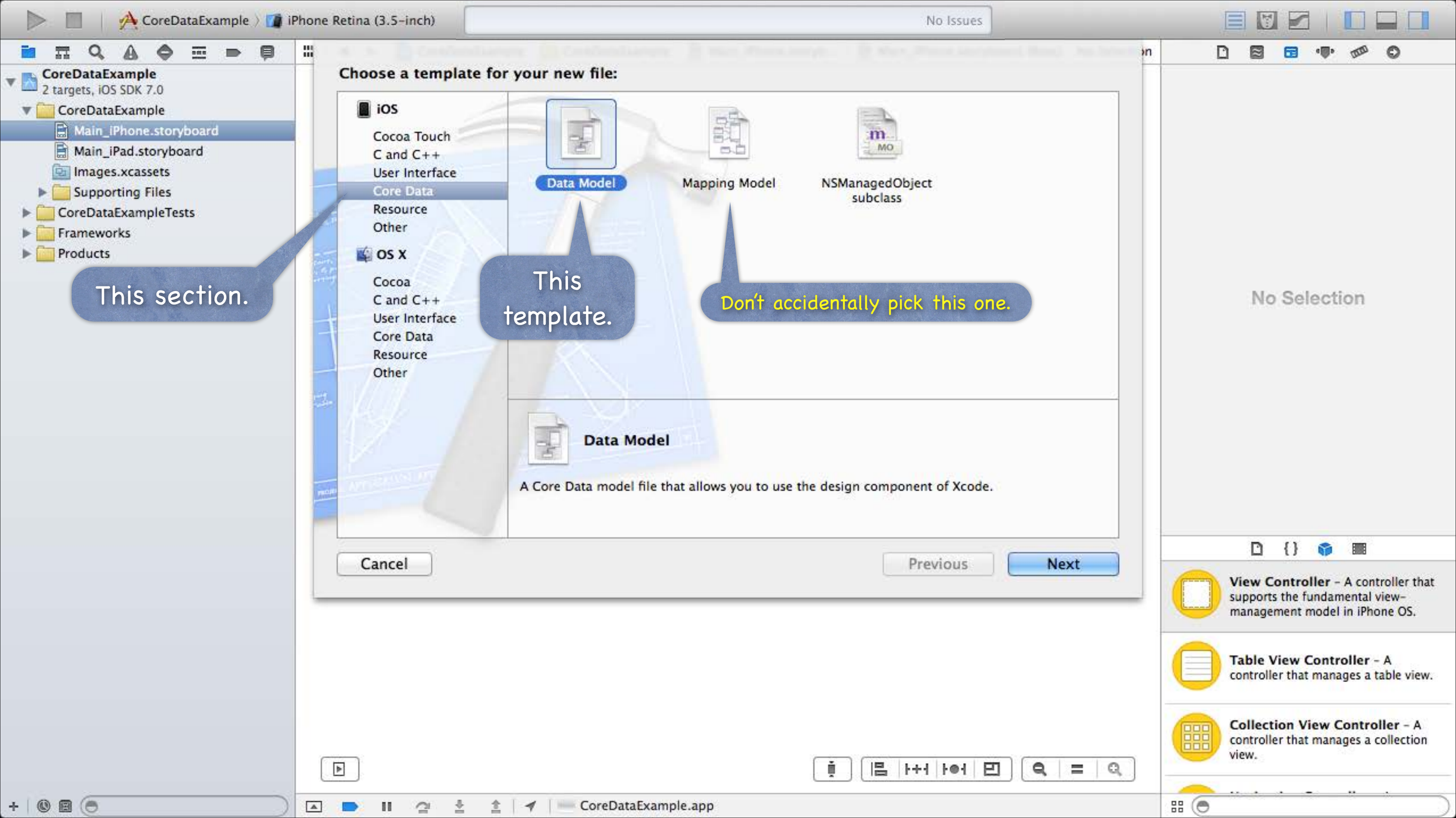
- Next Week

  Multitasking
  Advanced Segueing
  Map Kit?

Core Data

- Database
  - Sometimes you need to store large amounts of data or query it in a sophisticated manner.
  - But we still want it to be object-oriented objects!
- Enter Core Data
  - Object-oriented database.
  - Very, very powerful framework in iOS (we will only be covering the absolute basics).
- It's a way of creating an object graph backed by a database
  - Usually backed by SQL (but also can do XML or just in memory).
- How does it work?
  - Create a visual mapping (using Xcode tool) between database and objects.
  - Create and query for objects using object-oriented API.
  - Access the "columns in the database table" using `@propertys` on those objects.
  - Let's get started by creating that visual map ...


Xcode File Edit View Find Navigate Editor Product Debug Source Control Window Help
New
Add Files to "CoreDataExample"... ⌥⌘A
Open... ⌘O
Open Recent
Open Quickly... ⇧⌘O
Close Window ⌘W
Close Tab
Close "Main_iPhone.storyboard" ^⌘W
Close Project ⌥⌘W
Save ⌘S
Duplicate... ⇧⌘S
Revert to Saved...
Unlock...
Export...
Show in Finder
Open with External Editor
Save As Workspace...
Project Settings...
Create Snapshot... ^⌘S
Restore Snapshot...
Page Setup... ⇧⌘P
Print... ⌘P
Tab ⌘T
Window ⇧⌘T
File... ⌘N
Target...
Project... ⇧⌘N
Workspace... ^⌘N
Group ⌥⌘N
Group from Selection
Get started with Core Data by creating a Data Model using New File ...
No Selection
View Controller – A controller that supports the fundamental view-management model in iPhone OS.
Table View Controller – A controller that manages a table view.
Collection View Controller – A controller that manages a collection view.
CoreDataExample.app


CoreDataExample
iPhone Retina (3.5-inch)
No Issues
CoreDataExample
2 targets, iOS SDK 7.0
CoreDataExample
Main_iPhone.storyboard
Main_iPad.storyboard
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
This section.
Choose a template for your new file:
iOS
Cocoa Touch
C and C++
User Interface
Core Data
Resource
Other
OS X
Cocoa
C and C++
User Interface
Core Data
Resource
Other
Data Model
Mapping Model
NSManagedObject subclass
This template.
Don't accidentally pick this one.
Data Model
A Core Data model file that allows you to use the design component of Xcode.
Cancel
Previous
Next
No Selection
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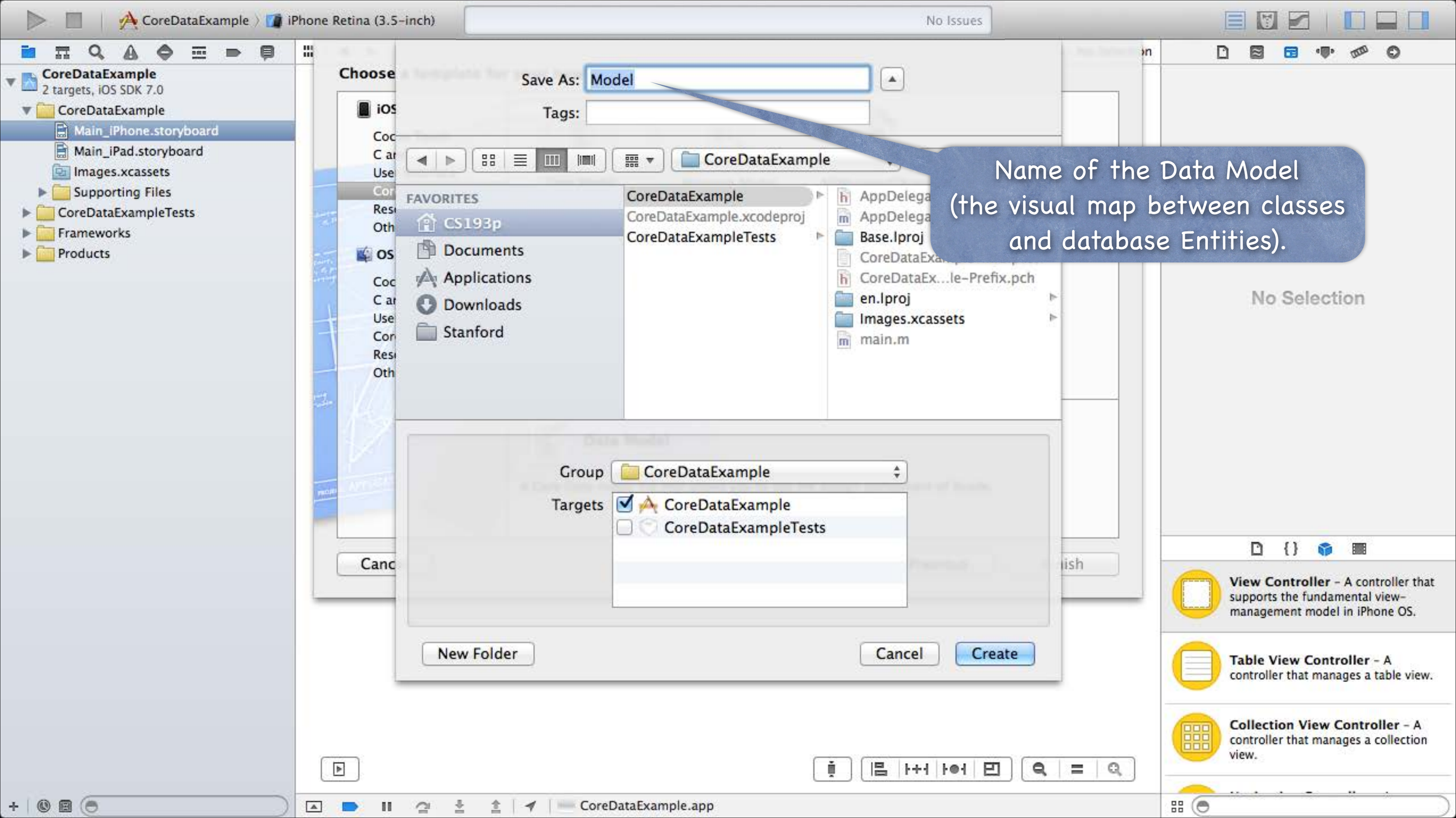
CoreDataExample.app


CoreDataExample
iPhone Retina (3.5-inch)
No Issues
CoreDataExample
2 targets, iOS SDK 7.0
Main_iPhone.storyboard
Main_iPad.storyboard
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
Save As: Model
Tags:
CoreDataExample
FAVORITES
CS193p
Documents
Applications
Downloads
Stanford
CoreDataExample.xcodeproj
CoreDataExampleTests
Base.lproj
en.lproj
Images.xcassets
main.m
Group CoreDataExample
Targets
CoreDataExample
CoreDataExampleTests
New Folder
Cancel
Create
Name of the Data Model
(the visual map between classes
and database Entities).
No Selection
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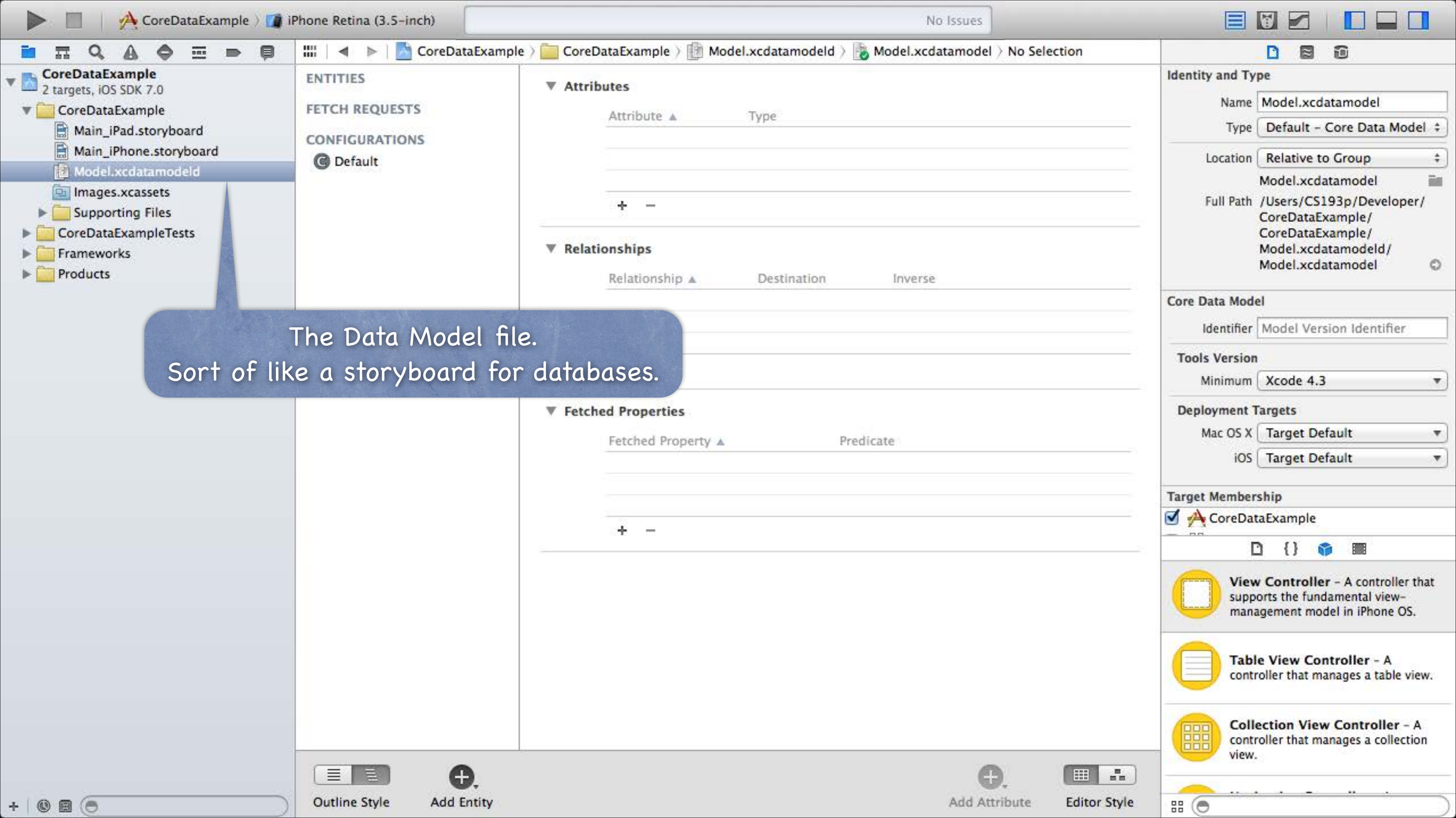
CoreDataExample
iPhone Retina (3.5-inch)
No Issues
CoreDataExample
CoreDataExample
Model.xcdatamodeld
Model.xcdatamodel
No Selection
CoreDataExample
2 targets, iOS SDK 7.0
CoreDataExample
Main_iPad.storyboard
Main_iPhone.storyboard
Model.xcdatamodeld
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
ENTITIES
FETCH REQUESTS
CONFIGURATIONS
Default
Attributes
Attribute
Type
Relationships
Relationship
Destination
Inverse
Fetched Properties
Fetched Property
Predicate
The Data Model file.
Sort of like a storyboard for databases.
Identity and Type
Name
Model.xcdatamodel
Type
Default - Core Data Model
Location
Relative to Group
Model.xcdatamodel
Full Path
/Users/CS193p/Developer/
CoreDataExample/
CoreDataExample/
Model.xcdatamodeld/
Model.xcdatamodel
Core Data Model
Identifier
Model Version Identifier
Tools Version
Minimum
Xcode 4.3
Deployment Targets
Mac OS X
Target Default
iOS
Target Default
Target Membership
CoreDataExample
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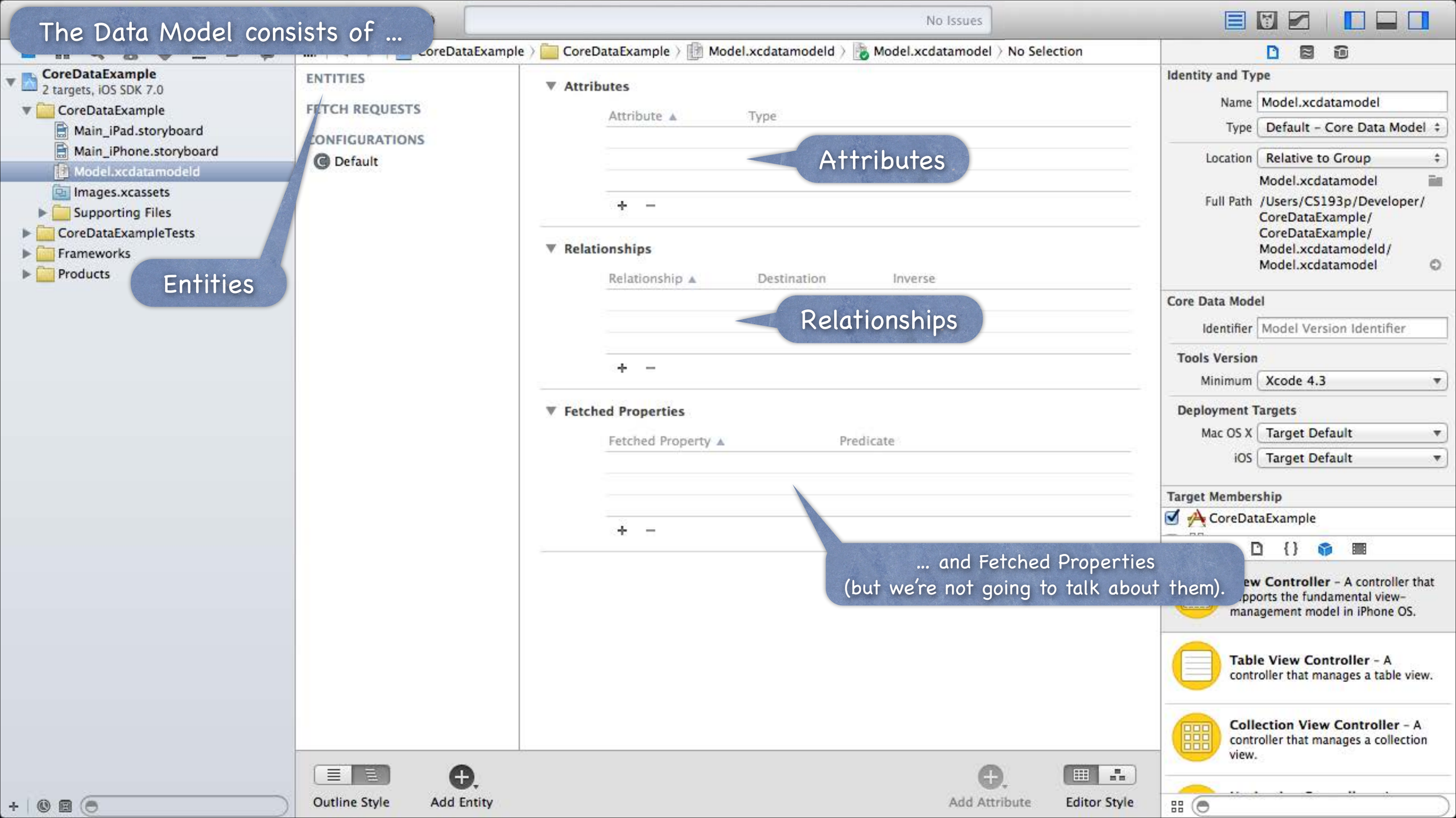
Outline Style
Add Entity
Add Attribute
Editor Style


The Data Model consists of …
No Issues
CoreDataExample 〉 CoreDataExample 〉 Model.xcdatamodeld 〉 Model.xcdatamodel 〉 No Selection
CoreDataExample
2 targets, iOS SDK 7.0
CoreDataExample
Main_iPad.storyboard
Main_iPhone.storyboard
Model.xcdatamodeld
Images.xcassets
Supporting Files
CoreDataExampleTests
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Products
Entities
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FETCH REQUESTS
CONFIGURATIONS
Default
Attributes
Attribute
Type
Attributes
Relationships
Relationship
Destination
Inverse
Relationships
Fetched Properties
Fetched Property
Predicate
… and Fetched Properties
(but we're not going to talk about them).
Identity and Type
Name
Model.xcdatamodel
Type
Default - Core Data Model
Location
Relative to Group
Model.xcdatamodel
Full Path
/Users/CS193p/Developer/CoreDataExample/CoreDataExample/Model.xcdatamodeld/Model.xcdatamodel
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Target Default
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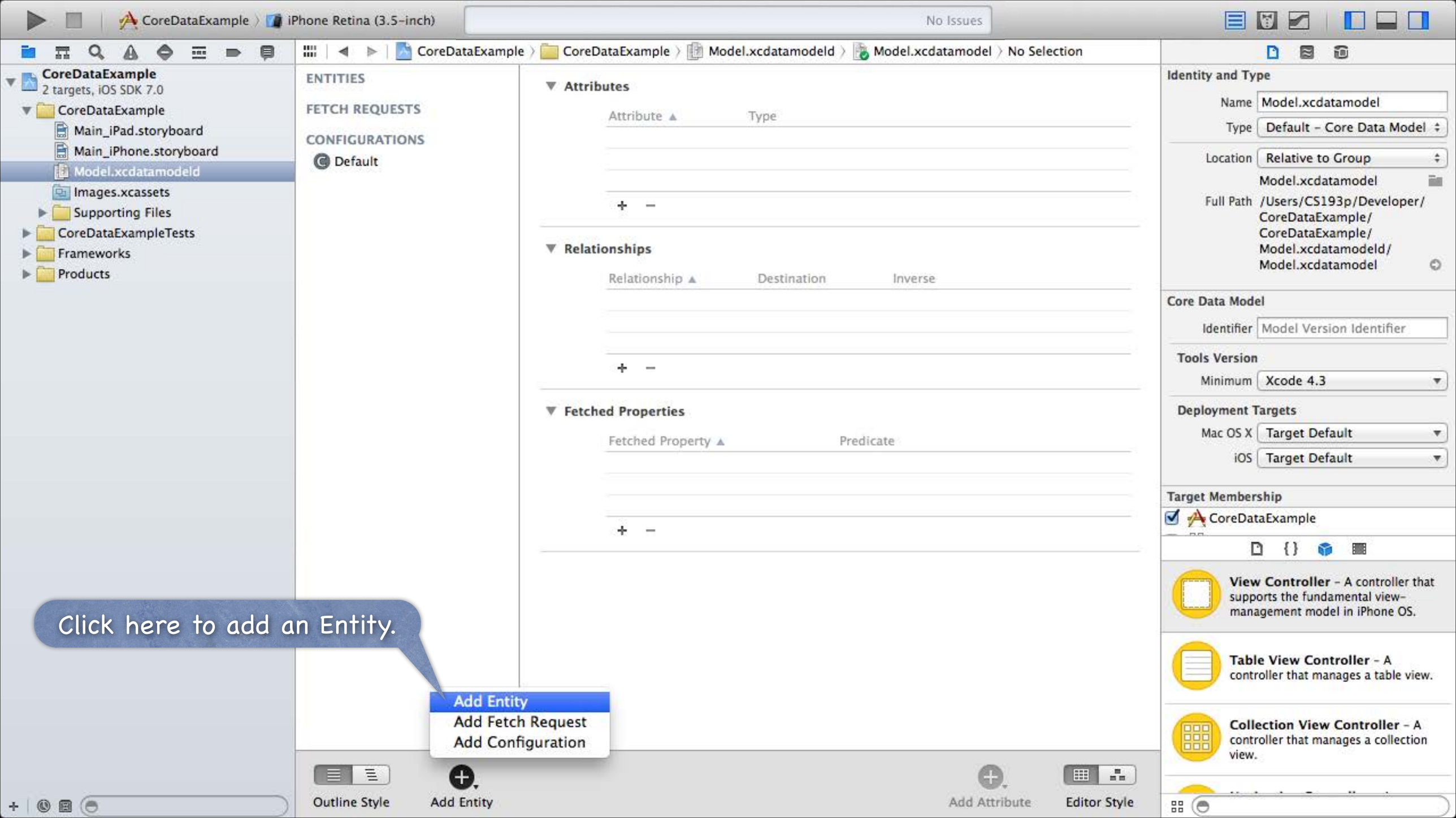
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Fetched Property
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Target Default
Target Membership
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View Controller – A controller that supports the fundamental view-management model in iPhone OS.
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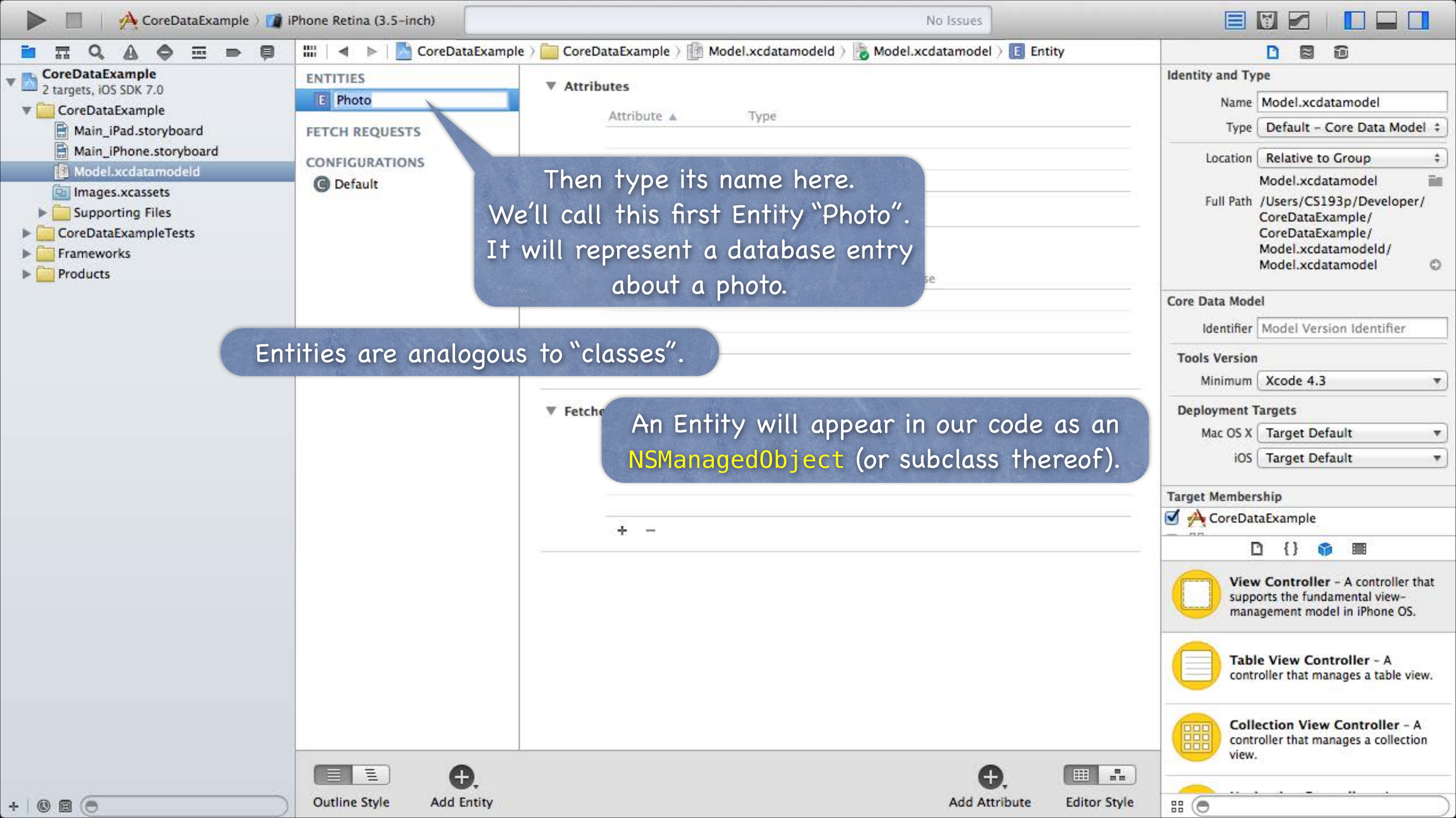
Click here to add an Entity.
Add Entity
Add Fetch Request
Add Configuration
Outline Style
Add Entity
Add Attribute
Editor Style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Model.xcdatamodeld
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
CoreDataExample › CoreDataExample › Model.xcdatamodeld › Model.xcdatamodel › Entity
ENTITIES
Photo
FETCH REQUESTS
CONFIGURATIONS
Default
Attributes
Attribute
Type
Then type its name here.
We'll call this first Entity "Photo".
It will represent a database entry
about a photo.
Entities are analogous to "classes".
An Entity will appear in our code as an
NSManagedObject (or subclass thereof).
Identity and Type
Name
Model.xcdatamodel
Type
Default - Core Data Model
Location
Relative to Group
Model.xcdatamodel
Full Path
/Users/CS193p/Developer/
CoreDataExample/
CoreDataExample/
Model.xcdatamodeld/
Model.xcdatamodel
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Model Version Identifier
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iOS
Target Default
Target Membership
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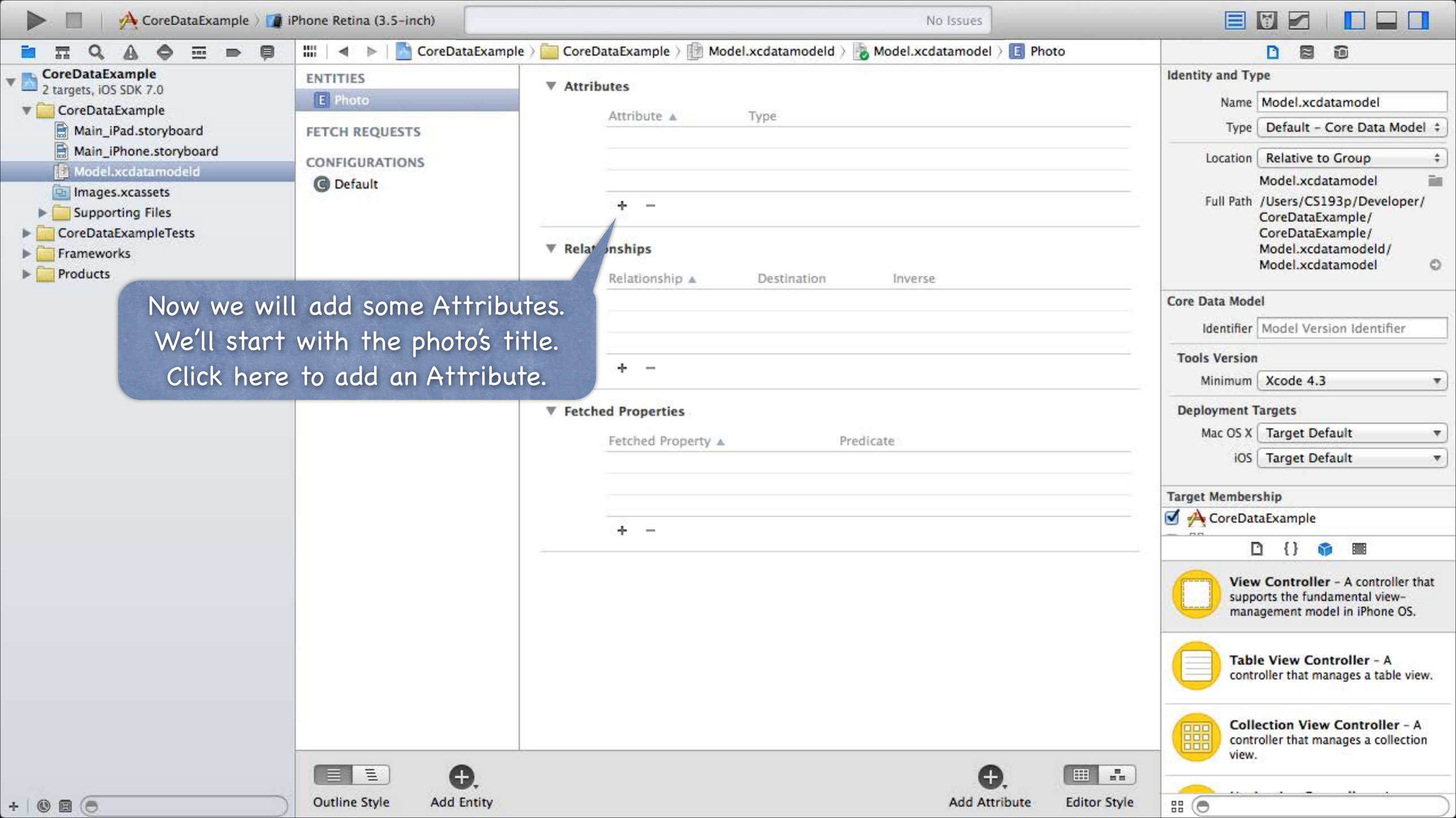
Outline Style
Add Entity
Add Attribute
Editor Style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2 targets, iOS SDK 7.0
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Main_iPhone.storyboard
Model.xcdatamodeld
Images.xcassets
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CoreDataExampleTests
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Products
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Photo
FETCH REQUESTS
CONFIGURATIONS
Default
Attributes
Attribute
Type
Relationships
Relationship
Destination
Inverse
Fetched Properties
Fetched Property
Predicate
Now we will add some Attributes.
We'll start with the photo's title.
Click here to add an Attribute.
Identity and Type
Name
Model.xcdatamodel
Type
Default - Core Data Model
Location
Relative to Group
Model.xcdatamodel
Full Path
/Users/CS193p/Developer/
CoreDataExample/
CoreDataExample/
Model.xcdatamodeld/
Model.xcdatamodel
Core Data Model
Identifier
Model Version Identifier
Tools Version
Minimum
Xcode 4.3
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Target Default
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Target Default
Target Membership
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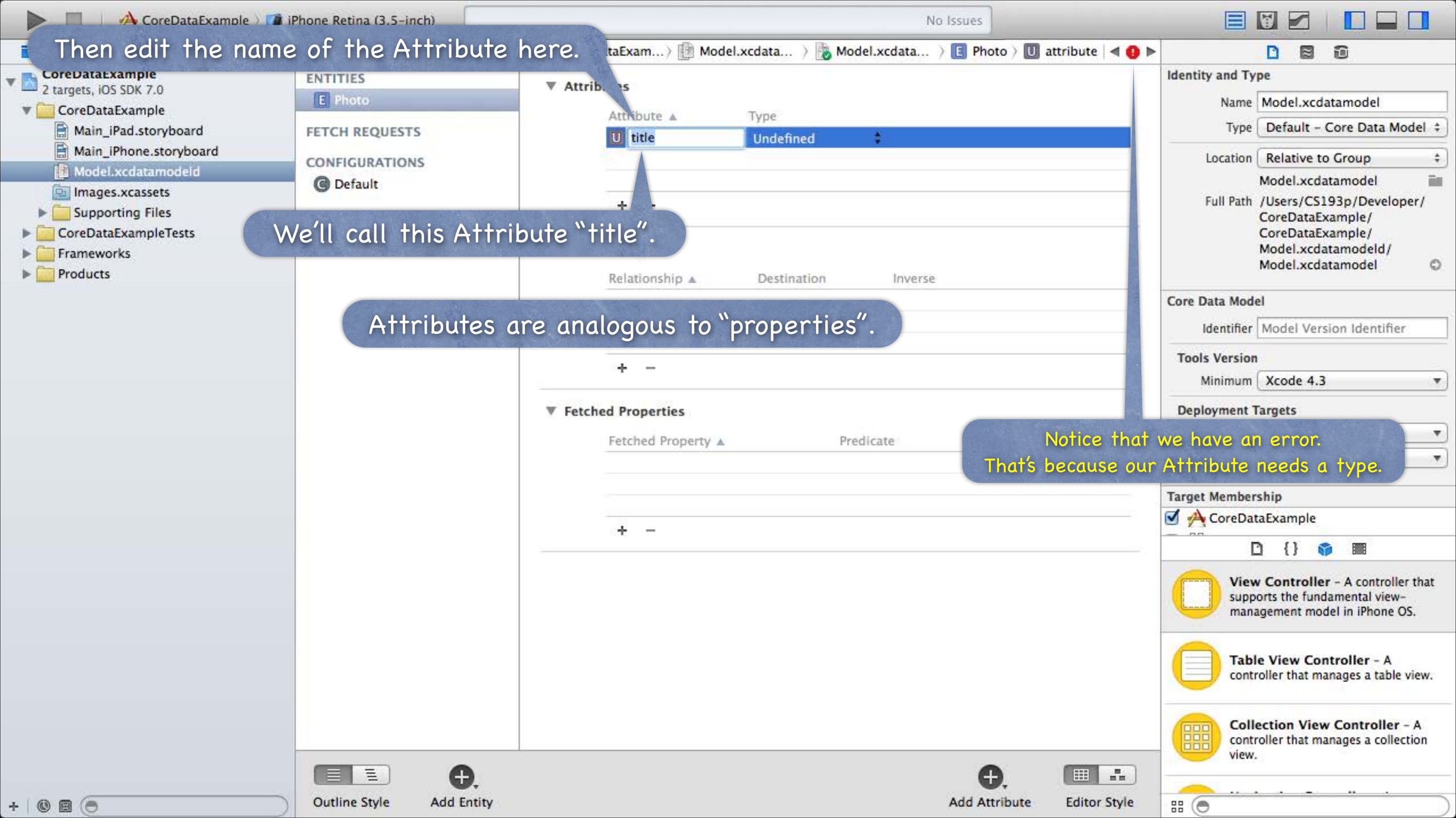
Add Entity
Add Attribute
Editor Style


Then edit the name of the Attribute here.
We'll call this Attribute "title".
Attributes are analogous to "properties".
Notice that we have an error.
That's because our Attribute needs a type.
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iPhone Retina (3.5-inch)
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Main_iPhone.storyboard
Model.xcdatamodeld
Images.xcassets
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Photo
FETCH REQUESTS
CONFIGURATIONS
Default
Model.xcdata...
Photo
attribute
Attributes
Attribute
Type
title
Undefined
Relationship
Destination
Inverse
Fetched Properties
Fetched Property
Predicate
Identity and Type
Name
Model.xcdatamodel
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Default - Core Data Model
Location
Relative to Group
Model.xcdatamodel
Full Path
/Users/CS193p/Developer/CoreDataExample/CoreDataExample/Model.xcdatamodeld/Model.xcdatamodel
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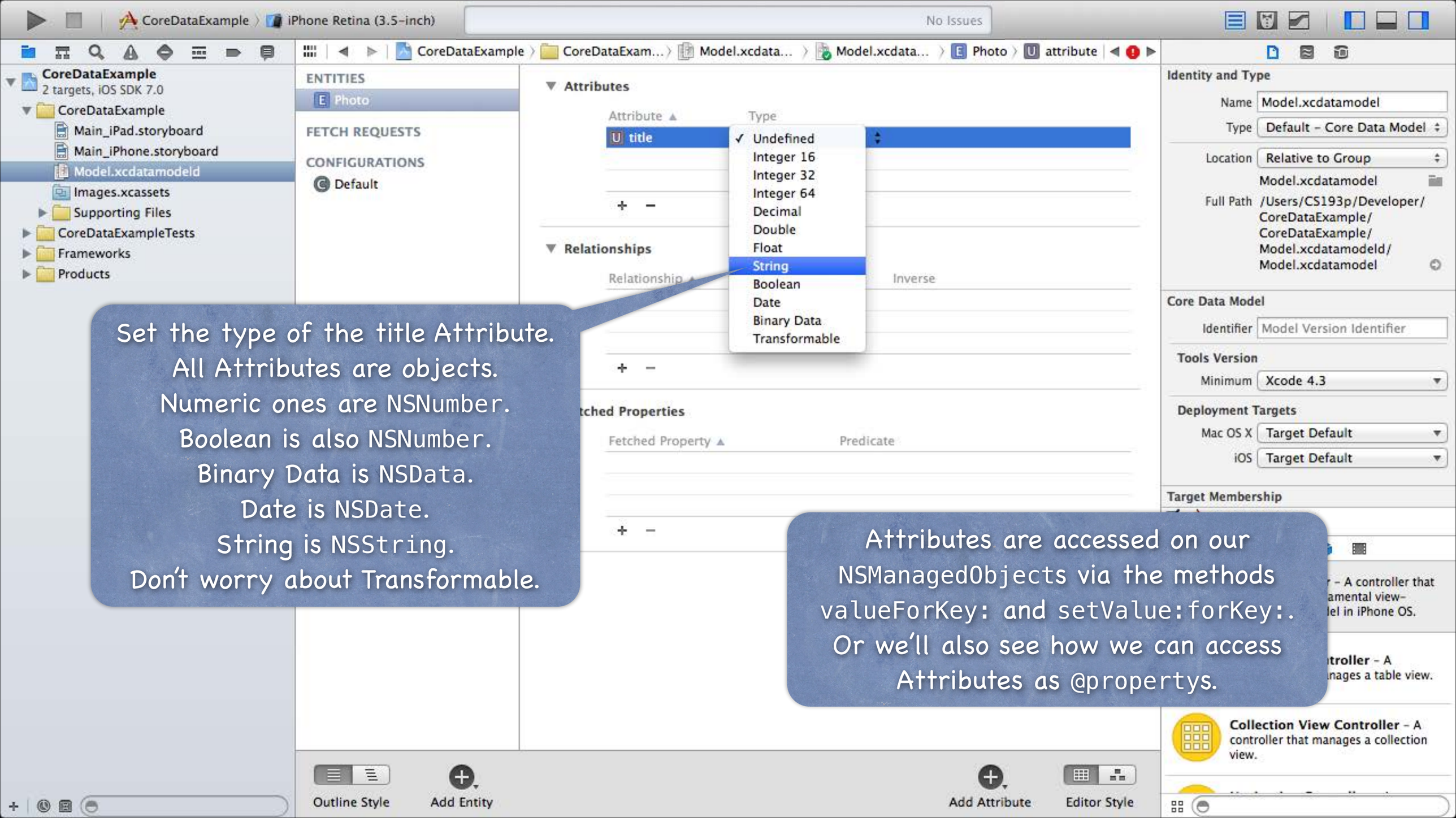
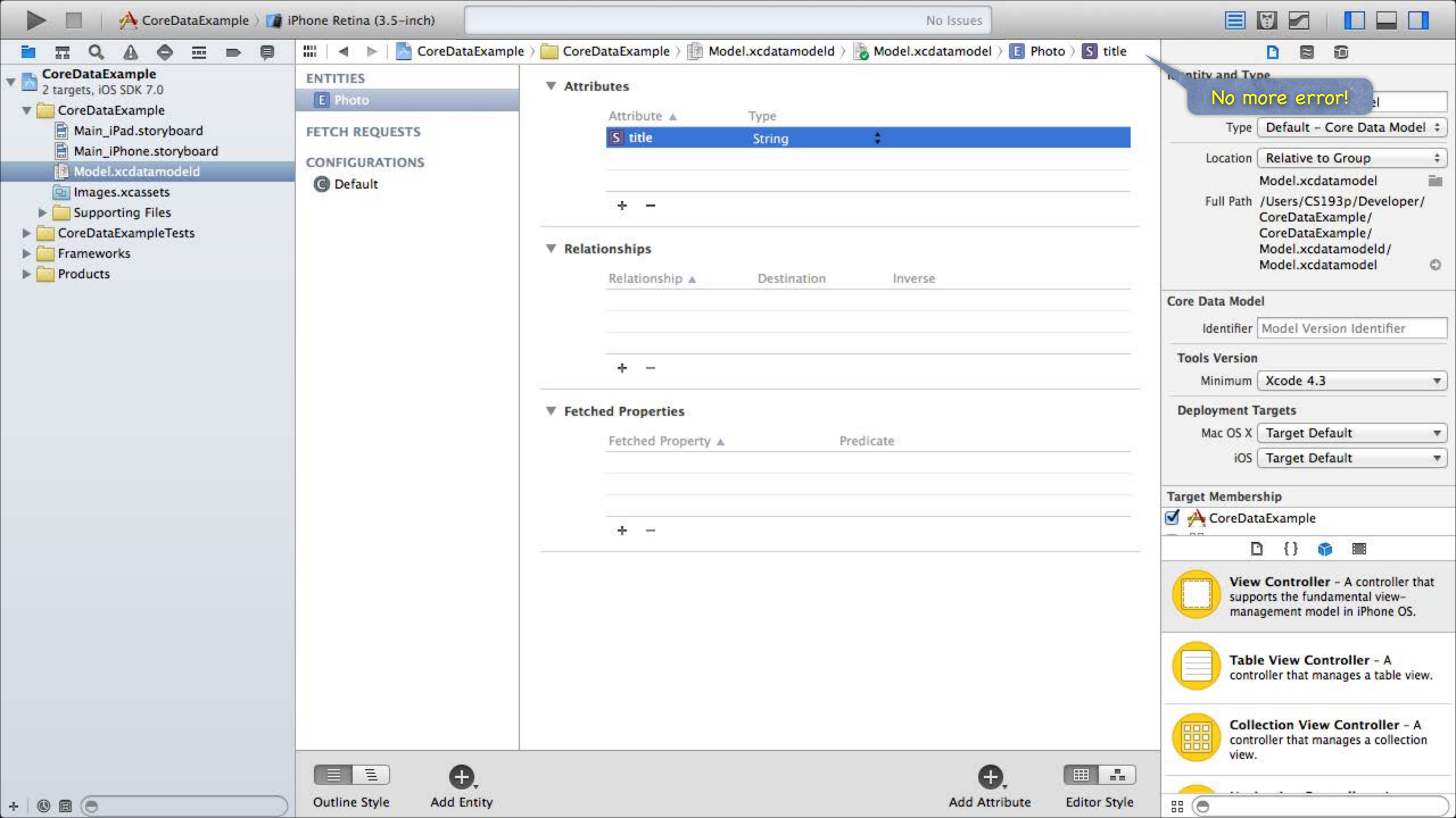


Set the type of the title Attribute.
All Attributes are objects.
Numeric ones are NSNumber.
Boolean is also NSNumber.
Binary Data is NSData.
Date is NSDate.
String is NSString.
Don't worry about Transformable.

Attributes are accessed on our NSManagedObjects via the methods valueForKey: and setValue:forKey:.
Or we'll also see how we can access Attributes as @propertys.


CoreDataExample
iPhone Retina (3.5-inch)
No Issues
CoreDataExample
CoreDataExample
Model.xcdatamodeld
Model.xcdatamodel
Photo
title
No more error!
CoreDataExample
2 targets, iOS SDK 7.0
CoreDataExample
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Main_iPhone.storyboard
Model.xcdatamodeld
Images.xcassets
Supporting Files
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Products
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Photo
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Attributes
Attribute
Type
title
String
Relationships
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Fetched Property
Predicate
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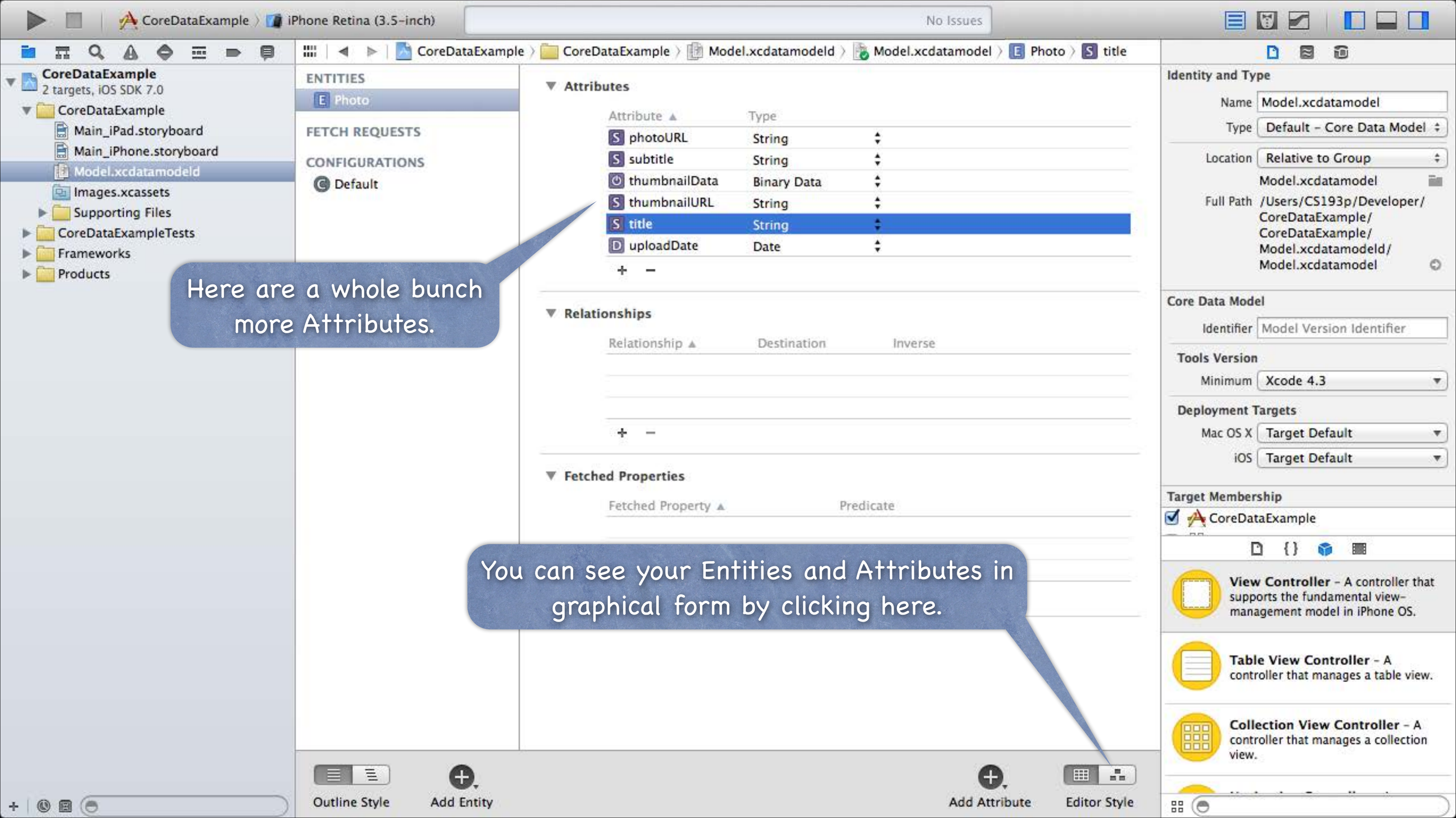
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Photo
FETCH REQUESTS
CONFIGURATIONS
Default
Attributes
Attribute
Type
photoURL
String
subtitle
String
thumbnailData
Binary Data
thumbnailURL
String
title
String
uploadDate
Date
Relationships
Relationship
Destination
Inverse
Fetched Properties
Fetched Property
Predicate
Here are a whole bunch more Attributes.
You can see your Entities and Attributes in graphical form by clicking here.
Identity and Type
Name
Model.xcdatamodel
Type
Default - Core Data Model
Location
Relative to Group
Model.xcdatamodel
Full Path
/Users/CS193p/Developer/CoreDataExample/CoreDataExample/Model.xcdatamodeld/Model.xcdatamodel
Core Data Model
Identifier
Model Version Identifier
Tools Version
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Xcode 4.3
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Target Membership
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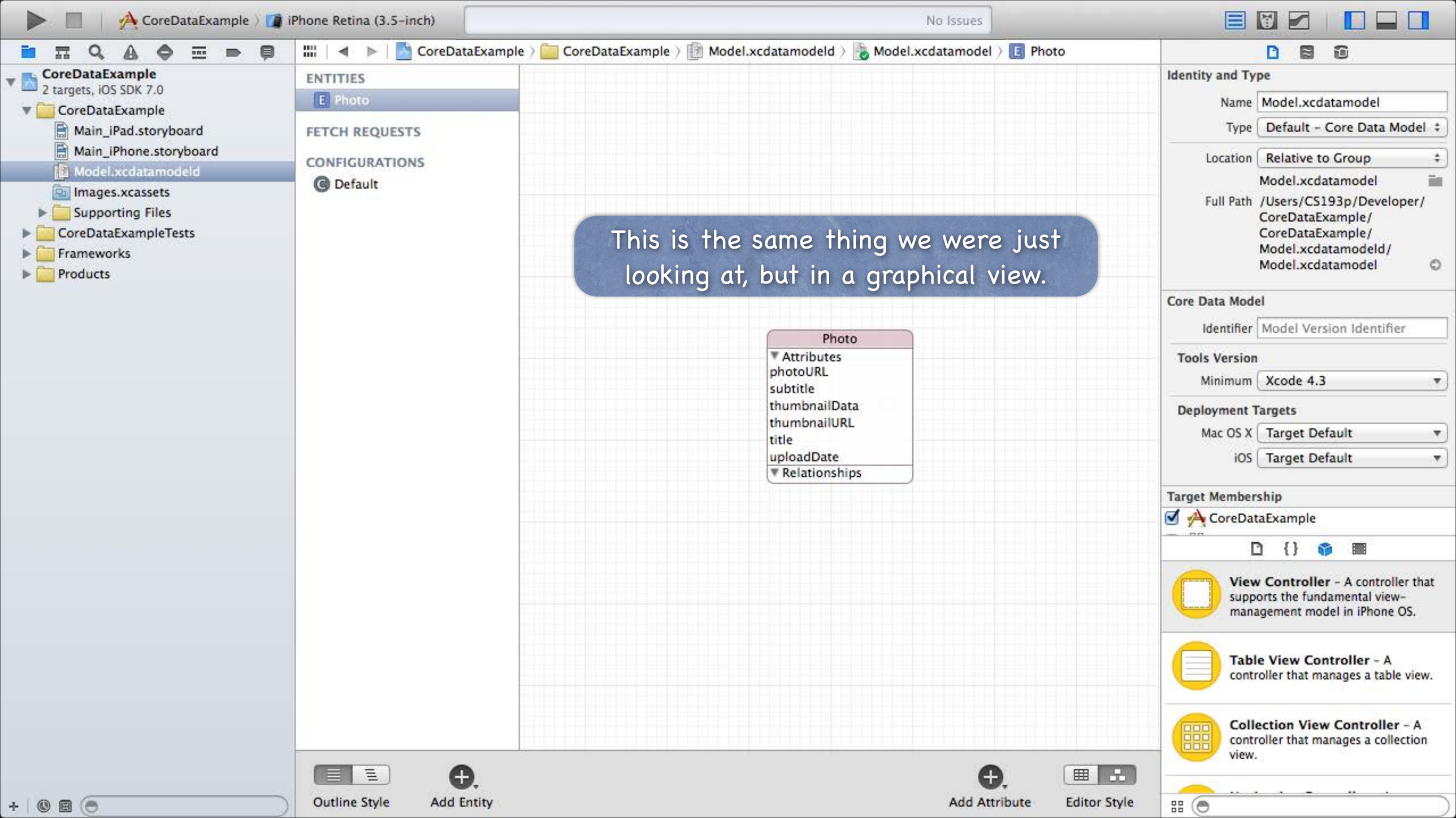
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CoreDataExample
CoreDataExample
Model.xcdatamodeld
Model.xcdatamodel
Photo
ENTITIES
Photo
FETCH REQUESTS
CONFIGURATIONS
Default
This is the same thing we were just looking at, but in a graphical view.
Photo
Attributes
photoURL
subtitle
thumbnailData
thumbnailURL
title
uploadDate
Relationships
Identity and Type
Name
Model.xcdatamodel
Type
Default - Core Data Model
Location
Relative to Group
Model.xcdatamodel
Full Path
/Users/CS193p/Developer/CoreDataExample/CoreDataExample/Model.xcdatamodeld/Model.xcdatamodel
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Model Version Identifier
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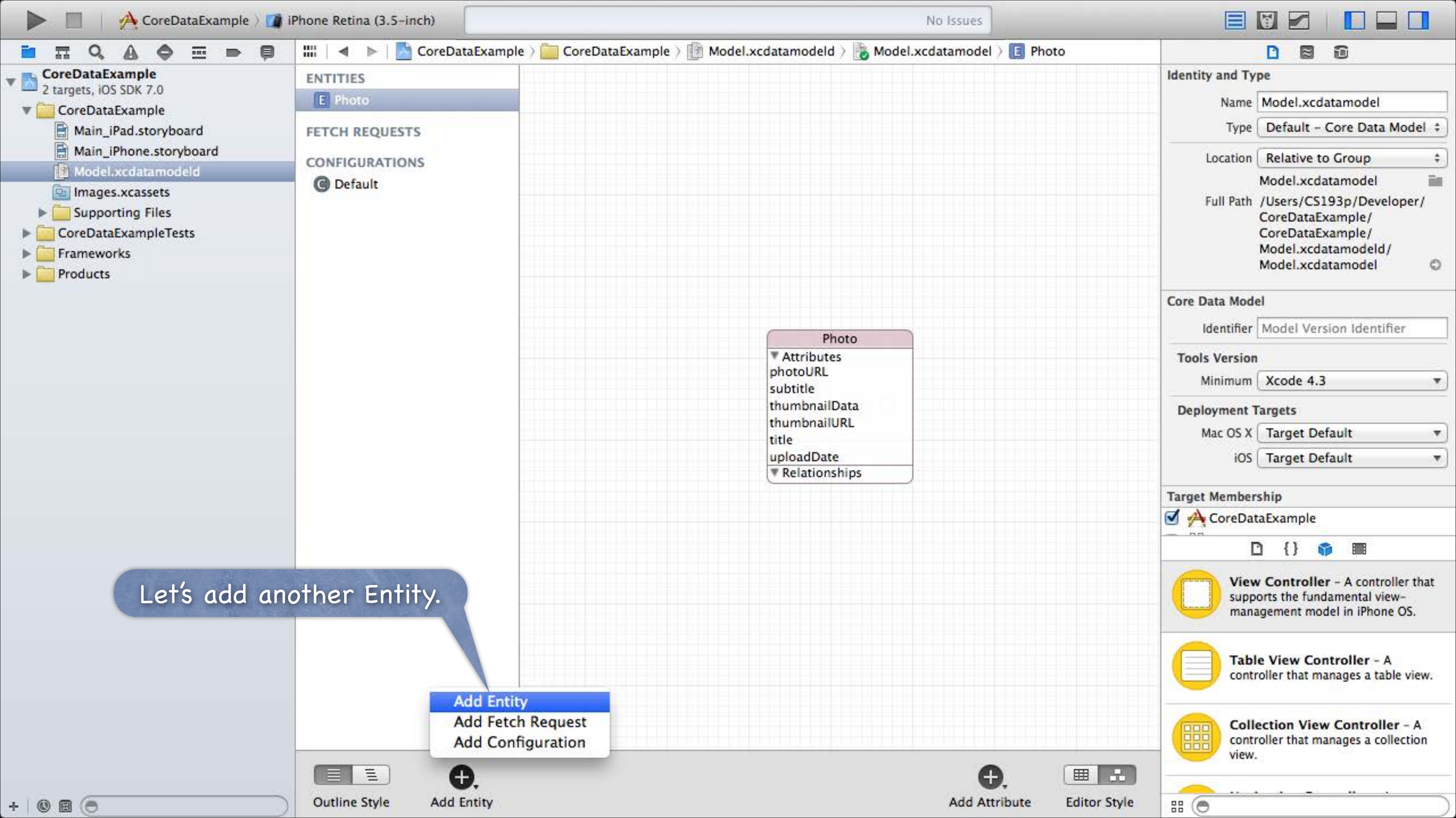
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CoreDataExample
CoreDataExample
Model.xcdatamodeld
Model.xcdatamodel
Photo
ENTITIES
Photo
FETCH REQUESTS
CONFIGURATIONS
Default
Photo
Attributes
photoURL
subtitle
thumbnailData
thumbnailURL
title
uploadDate
Relationships
Let's add another Entity.
Add Entity
Add Fetch Request
Add Configuration
Outline Style
Add Entity
Add Attribute
Editor Style
Identity and Type
Name
Model.xcdatamodel
Type
Default - Core Data Model
Location
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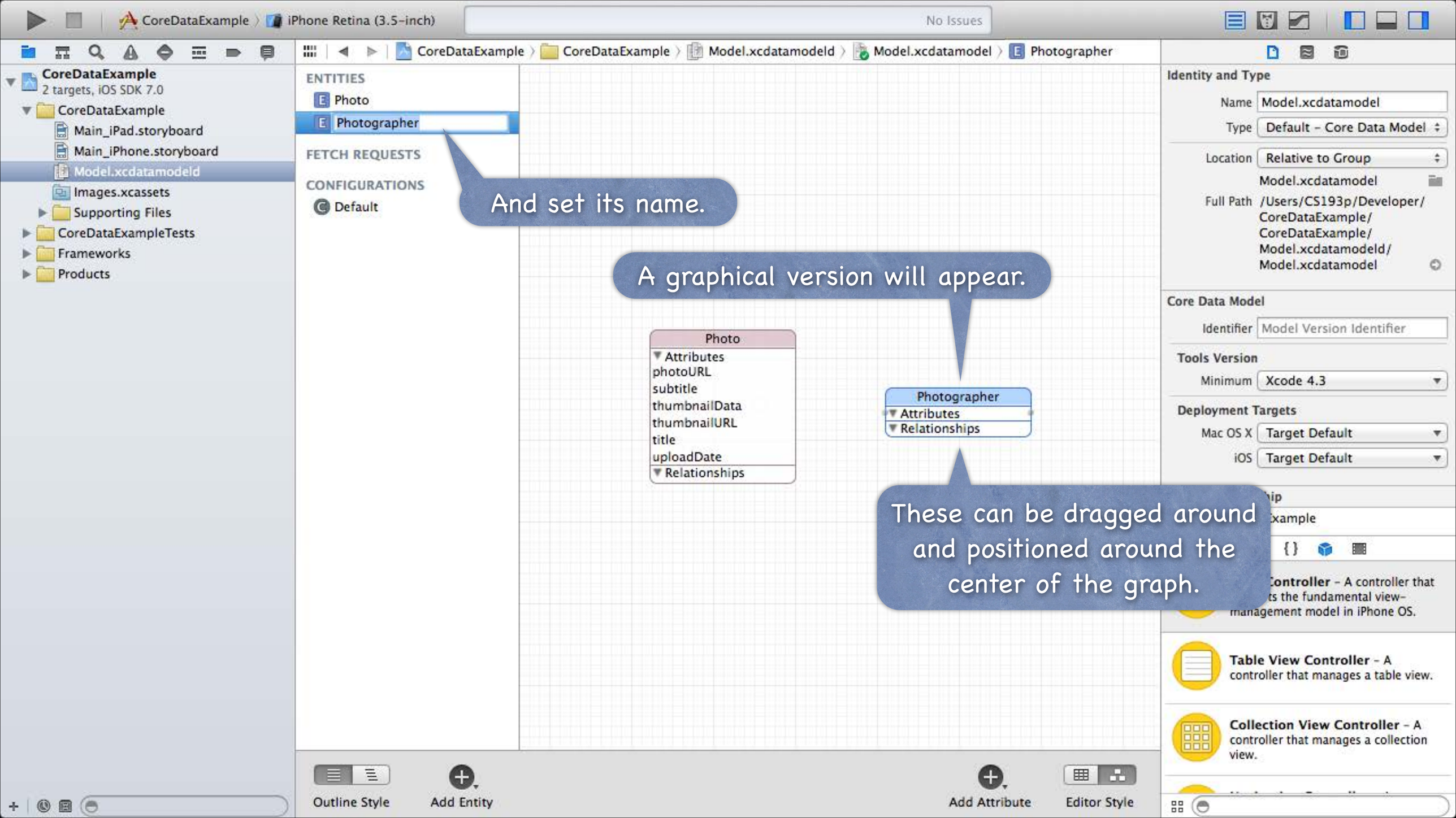
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CoreDataExample
Model.xcdatamodeld
Model.xcdatamodel
Photographer
ENTITIES
Photo
Photographer
FETCH REQUESTS
CONFIGURATIONS
Default
And set its name.
A graphical version will appear.
Photo
Attributes
photoURL
subtitle
thumbnailData
thumbnailURL
title
uploadDate
Relationships
Photographer
Attributes
Relationships
These can be dragged around and positioned around the center of the graph.
Identity and Type
Name
Model.xcdatamodel
Type
Default - Core Data Model
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Full Path
/Users/CS193p/Developer/CoreDataExample/CoreDataExample/Model.xcdatamodeld/Model.xcdatamodel
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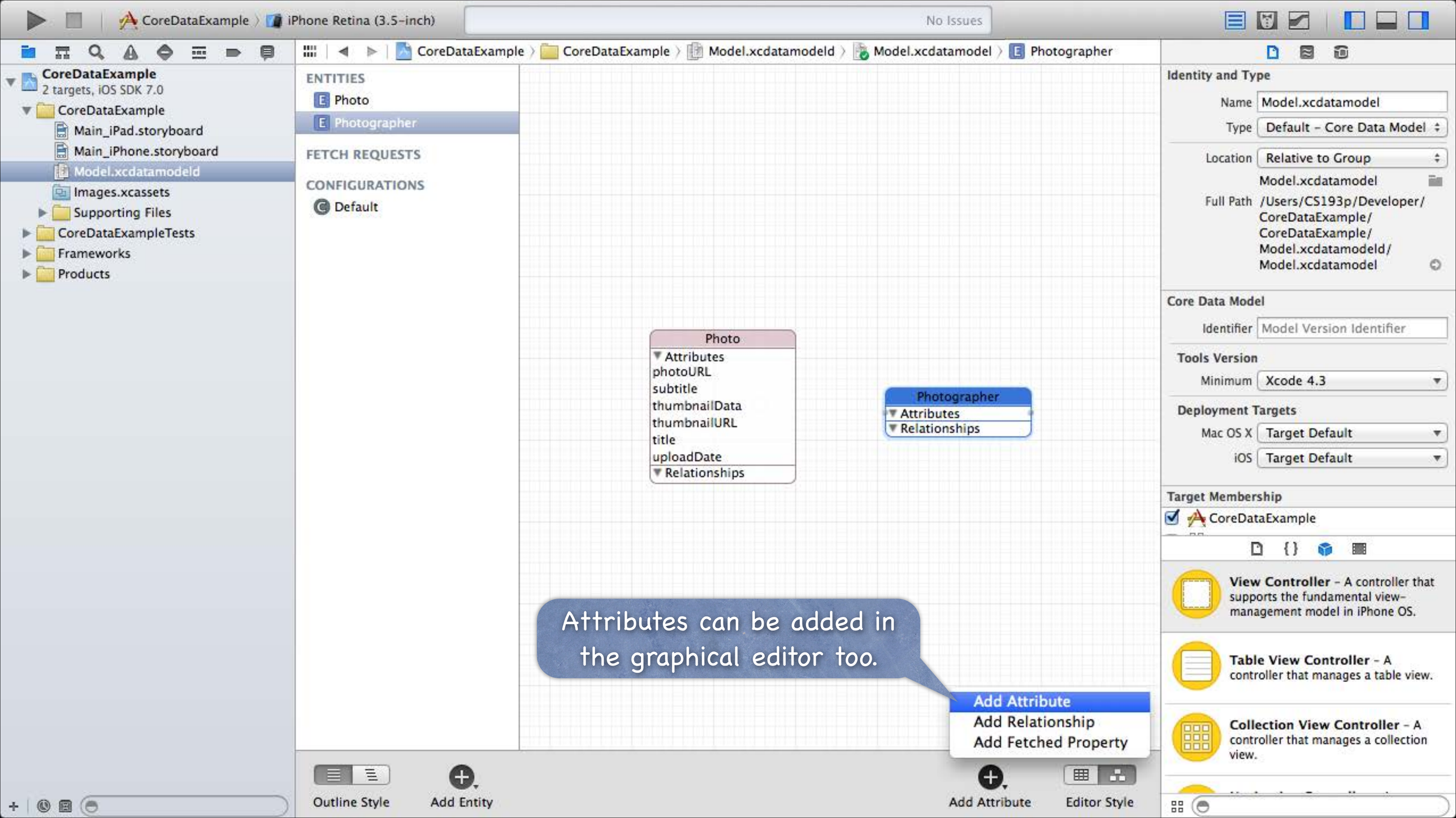
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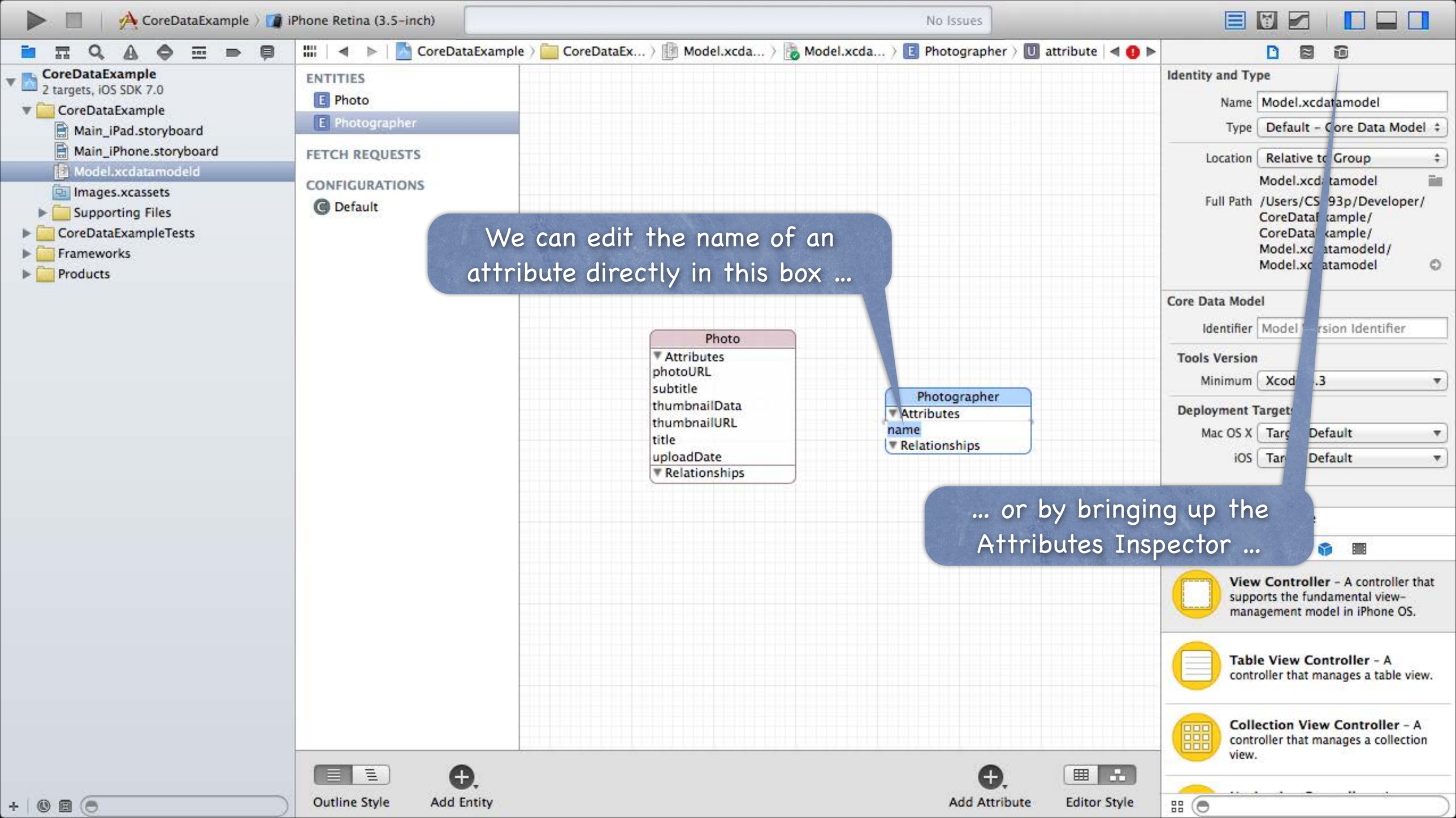
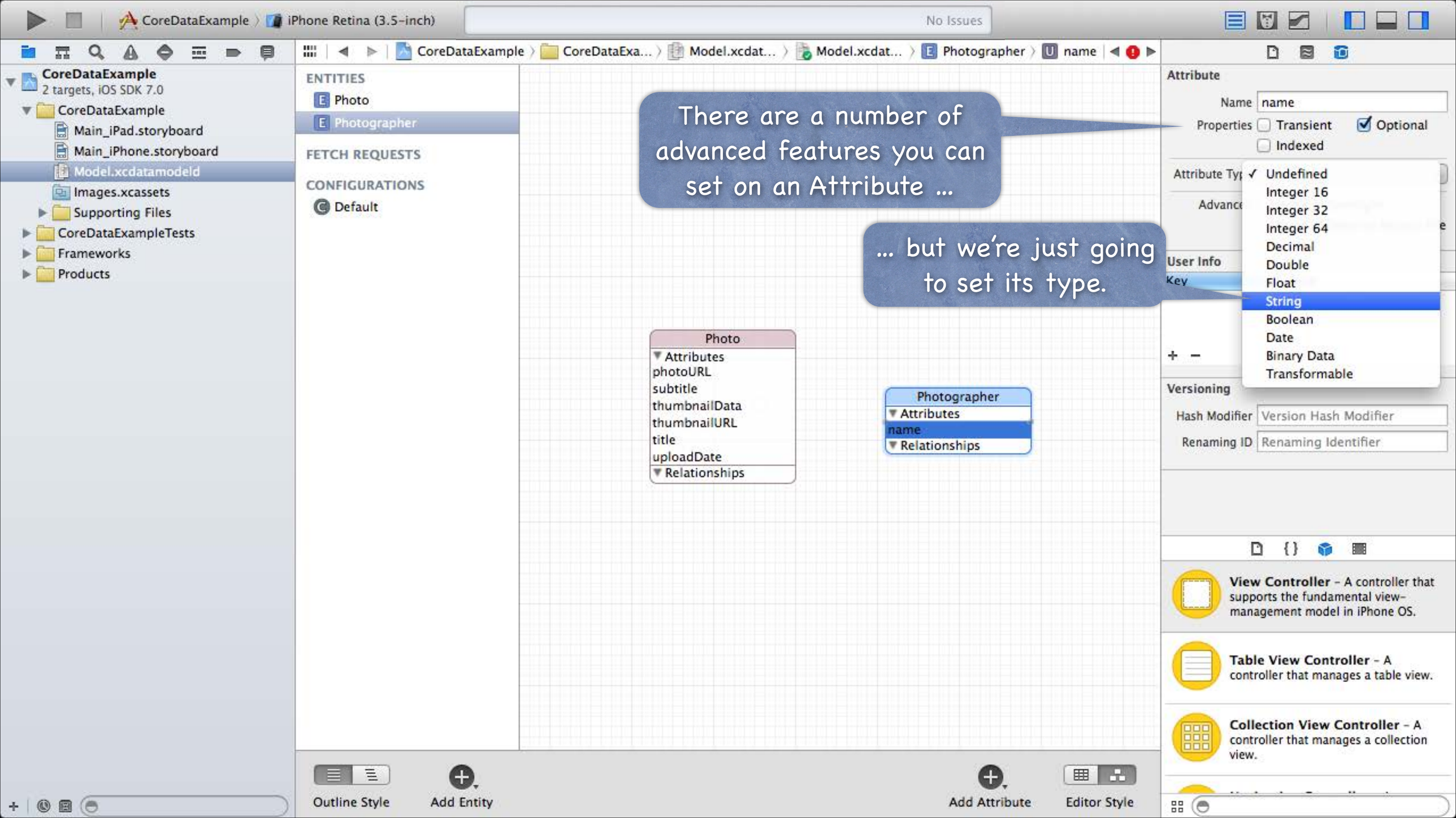
CoreDataExample › CoreDataExample › Model.xcdatamodeld › Model.xcdatamodel › Photographer
ENTITIES
Photo
Photographer
FETCH REQUESTS
CONFIGURATIONS
Default
Photo
Attributes
photoURL
subtitle
thumbnailData
thumbnailURL
title
uploadDate
Relationships
Photographer
Attributes
Relationships
Attributes can be added in the graphical editor too.
Add Attribute
Add Relationship
Add Fetched Property
Outline Style
Add Entity
Add Attribute
Editor Style
Identity and Type
Name Model.xcdatamodel
Type Default - Core Data Model
Location Relative to Group
Model.xcdatamodel
Full Path /Users/CS193p/Developer/CoreDataExample/CoreDataExample/Model.xcdatamodeld/Model.xcdatamodel
Core Data Model
Identifier Model Version Identifier
Tools Version
Minimum Xcode 4.3
Deployment Targets
Mac OS X Target Default
iOS Target Default
Target Membership
CoreDataExample
View Controller - A controller that supports the fundamental view-management model in iPhone OS.
Table View Controller - A controller that manages a table view.
Collection View Controller - A controller that manages a collection view.


CoreDataExample
iPhone Retina (3.5-inch)
No Issues
CoreDataExample
2 targets, iOS SDK 7.0
CoreDataExample
Main_iPad.storyboard
Main_iPhone.storyboard
Model.xcdatamodeld
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
ENTITIES
Photo
Photographer
FETCH REQUESTS
CONFIGURATIONS
Default
We can edit the name of an attribute directly in this box ...
Photo
Attributes
photoURL
subtitle
thumbnailData
thumbnailURL
title
uploadDate
Relationships
Photographer
Attributes
name
Relationships
... or by bringing up the Attributes Inspector ...
Identity and Type
Name
Model.xcdatamodel
Type
Location
Full Path
Core Data Model
Identifier
Tools Version
Minimum
Deployment Targets
Mac OS X
iOS
View Controller – A controller that supports the fundamental view-management model in iPhone OS.
Table View Controller – A controller that manages a table view.
Collection View Controller – A controller that manages a collection view.
Outline Style
Add Entity
Add Attribute
Editor Style


CoreDataExample
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No Issues
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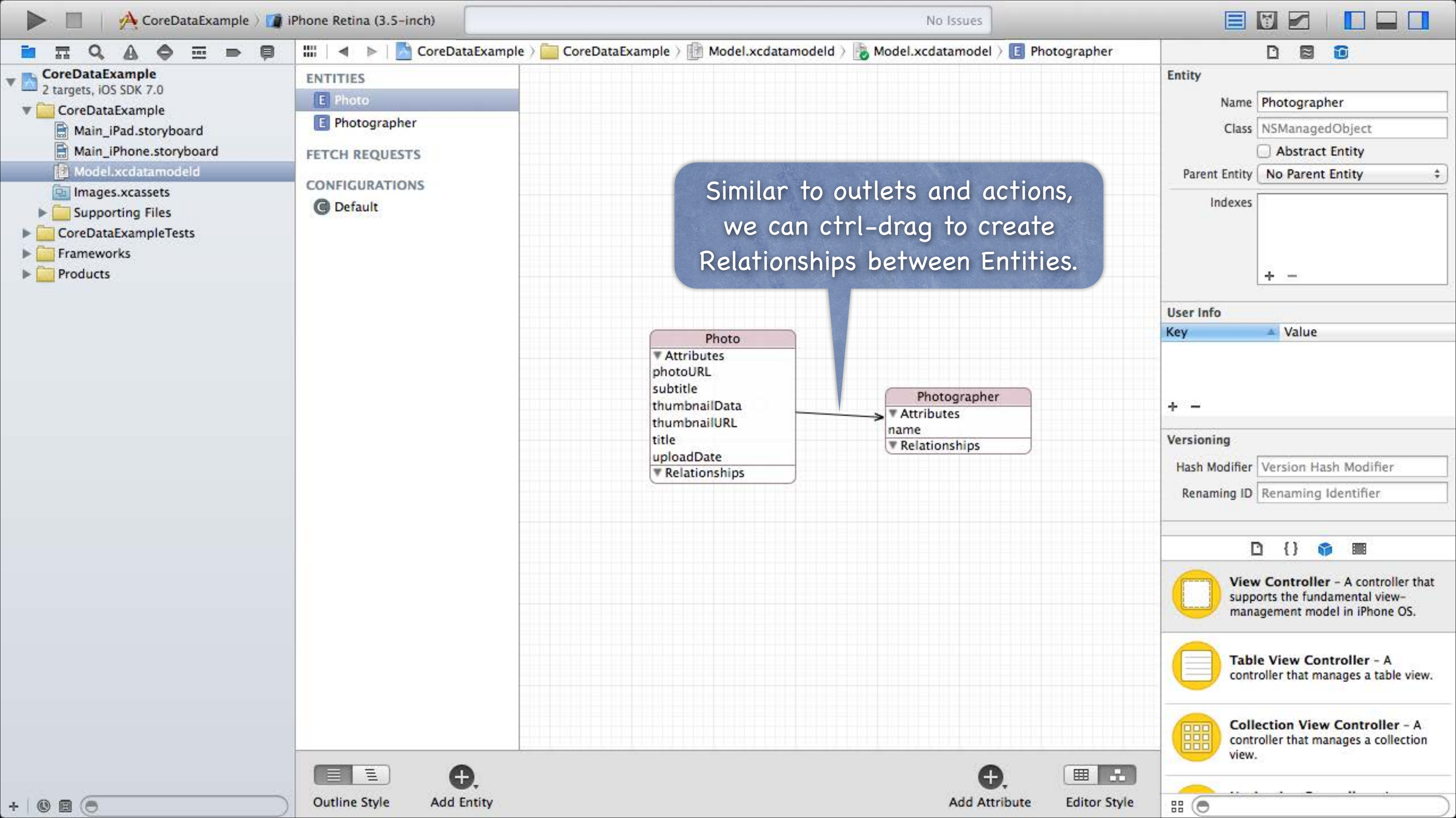
Main_iPhone.storyboard
Model.xcdatamodeld
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
ENTITIES
Photo
Photographer
FETCH REQUESTS
CONFIGURATIONS
Default
There are a number of advanced features you can set on an Attribute ...
... but we're just going to set its type.
Photo
Attributes
photoURL
subtitle
thumbnailData
thumbnailURL
title
uploadDate
Relationships
Photographer
Attributes
name
Relationships
Attribute
Name
name
Properties
Transient
Optional
Indexed
Attribute Type
Undefined
Integer 16
Integer 32
Integer 64
Decimal
Double
Float
String
Boolean
Date
Binary Data
Transformable
User Info
Key
Versioning
Hash Modifier
Version Hash Modifier
Renaming ID
Renaming Identifier
View Controller – A controller that supports the fundamental view-management model in iPhone OS.
Table View Controller – A controller that manages a table view.
Collection View Controller – A controller that manages a collection view.
Outline Style
Add Entity
Add Attribute
Editor Style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No Issues
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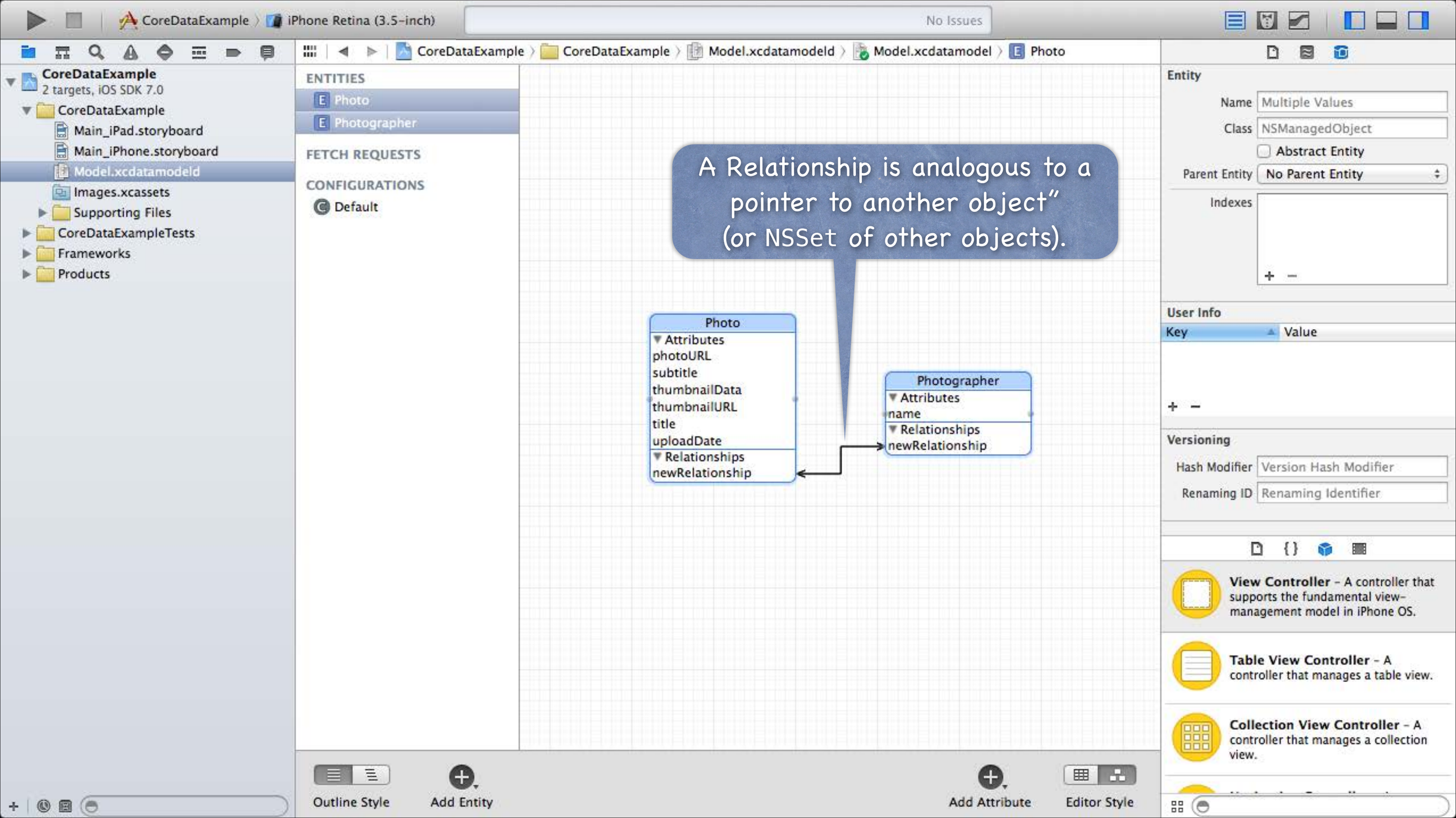
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
CoreDataExample
CoreDataExample
Model.xcdatamodeld
Model.xcdatamodel
Photographer
ENTITIES
Photo
Photographer
FETCH REQUESTS
CONFIGURATIONS
Default
Similar to outlets and actions, we can ctrl-drag to create Relationships between Entities.
Photo
Attributes
photoURL
subtitle
thumbnailData
thumbnailURL
title
uploadDate
Relationships
Photographer
Attributes
name
Relationships
Entity
Name
Photographer
Class
NSManagedObject
Abstract Entity
Parent Entity
No Parent Entity
Indexes
User Info
Key
Value
Versioning
Hash Modifier
Version Hash Modifier
Renaming ID
Renaming Identifier
View Controller – A controller that supports the fundamental view-management model in iPhone OS.
Table View Controller – A controller that manages a table view.
Collection View Controller – A controller that manages a collection view.
Outline Style
Add Entity
Add Attribute
Editor Style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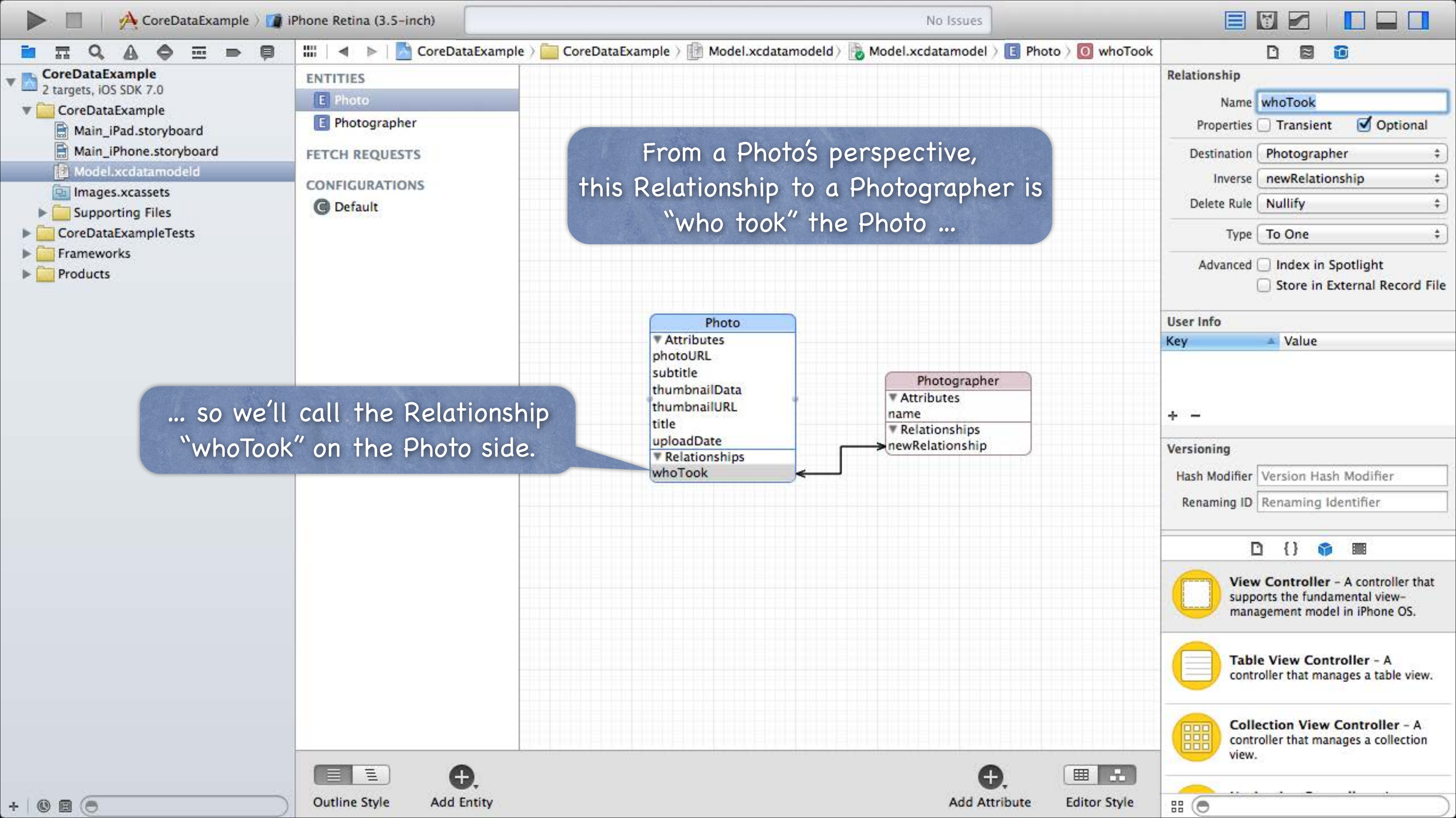
CoreDataExample
Main_iPad.storyboard
Main_iPhone.storyboard
Model.xcdatamodeld
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
CoreDataExample
CoreDataExample
Model.xcdatamodeld
Model.xcdatamodel
Photo
ENTITIES
Photo
Photographer
FETCH REQUESTS
CONFIGURATIONS
Default
A Relationship is analogous to a pointer to another object" (or NSSet of other objects).
Photo
Attributes
photoURL
subtitle
thumbnailData
thumbnailURL
title
uploadDate
Relationships
newRelationship
Photographer
Attributes
name
Relationships
newRelationship
Entity
Name
Multiple Values
Class
NSManagedObject
Abstract Entity
Parent Entity
No Parent Entity
Indexes
User Info
Key
Value
Versioning
Hash Modifier
Version Hash Modifier
Renaming ID
Renaming Identifier
View Controller – A controller that supports the fundamental view-management model in iPhone OS.
Table View Controller – A controller that manages a table view.
Collection View Controller – A controller that manages a collection view.
Outline Style
Add Entity
Add Attribute
Editor Style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2 targets, iOS SDK 7.0
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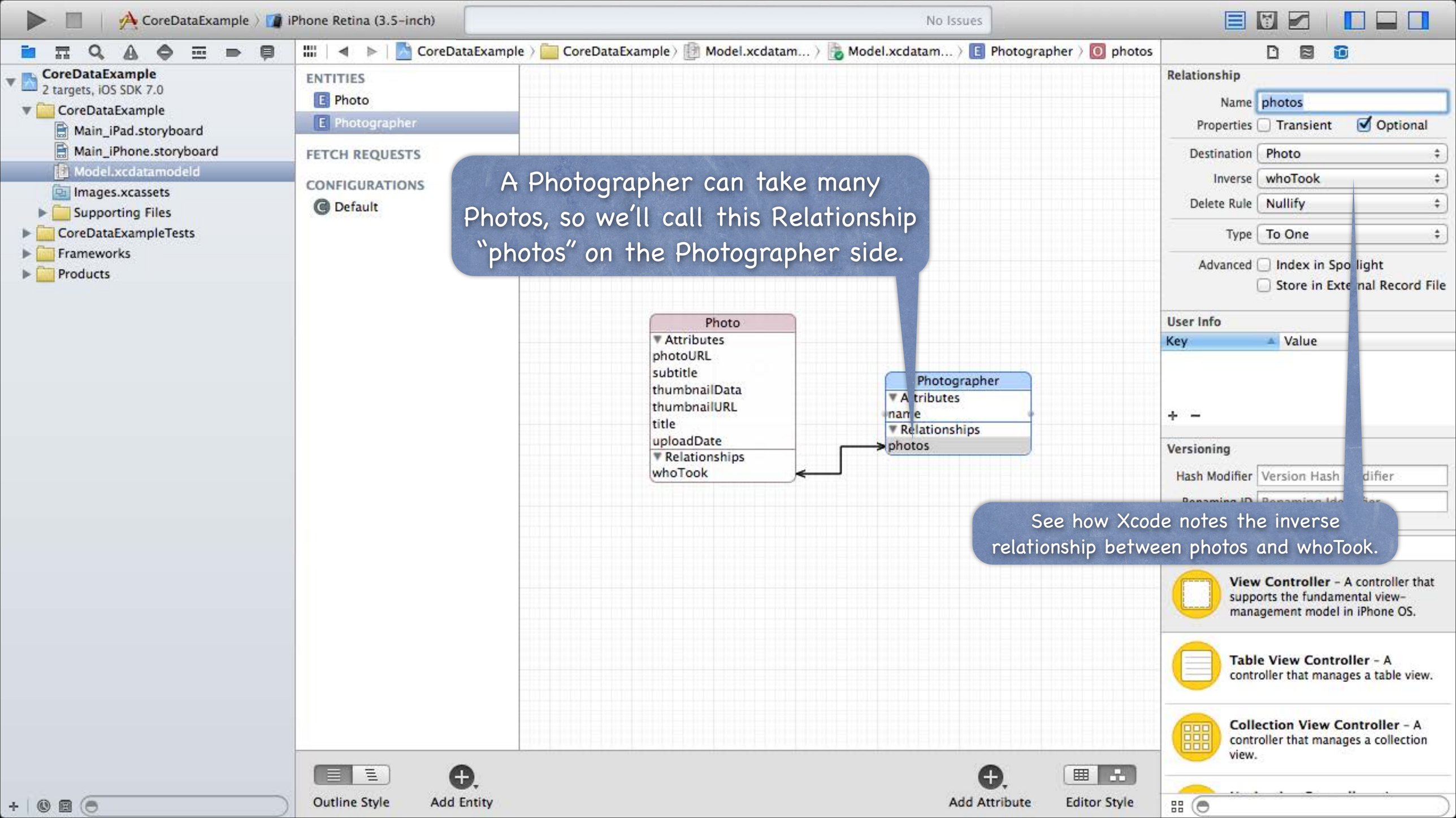
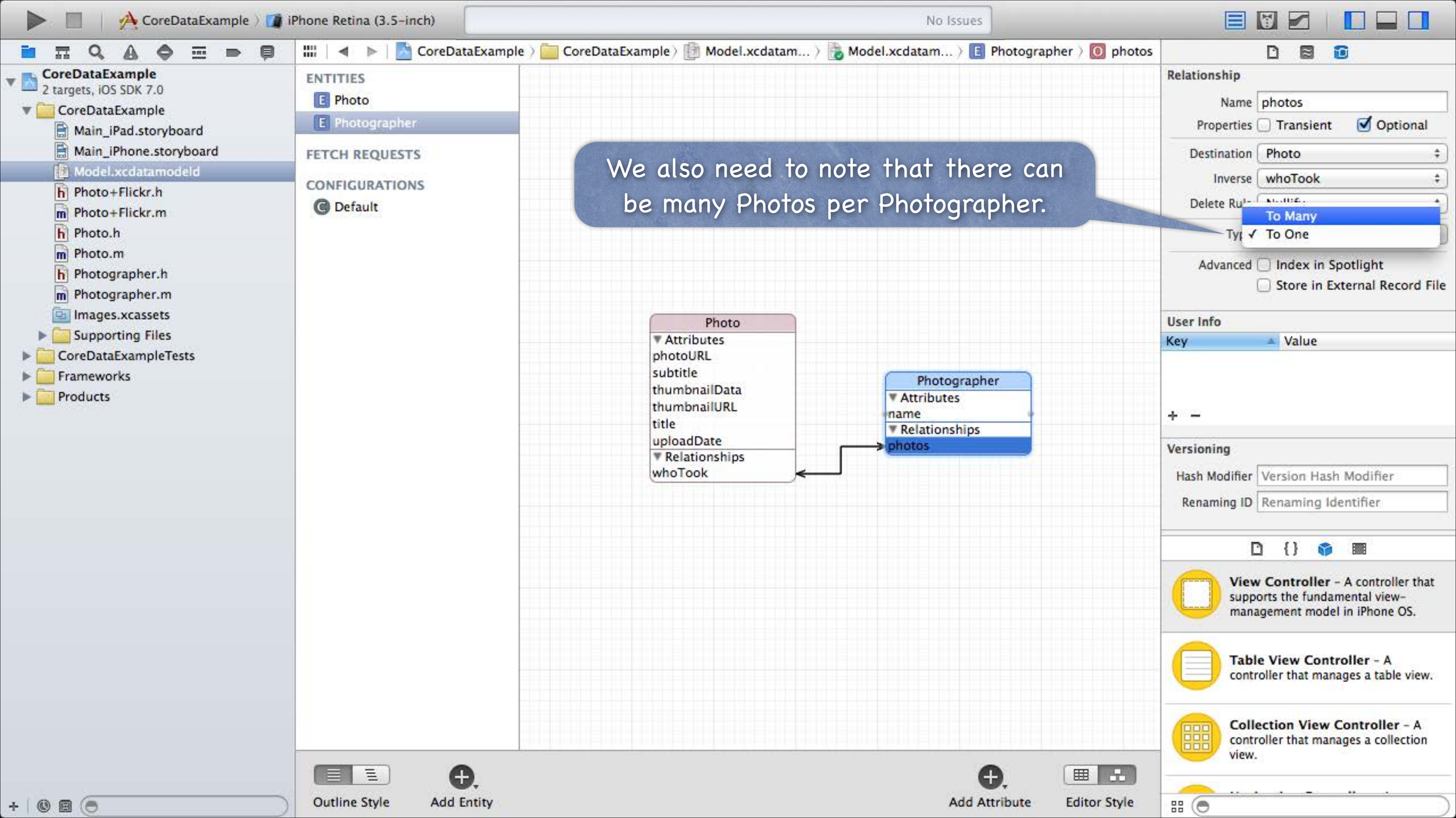
Main_iPad.storyboard
Main_iPhone.storyboard
Model.xcdatamodeld
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
CoreDataExample › CoreDataExample › Model.xcdatamodeld › Model.xcdatamodel › Photo › whoTook
ENTITIES
Photo
Photographer
FETCH REQUESTS
CONFIGURATIONS
Default
From a Photo's perspective, this Relationship to a Photographer is "who took" the Photo ...
... so we'll call the Relationship "whoTook" on the Photo side.
Photo
Attributes
photoURL
subtitle
thumbnailData
thumbnailURL
title
uploadDate
Relationships
whoTook
Photographer
Attributes
name
Relationships
newRelationship
Relationship
Name whoTook
Properties Transient Optional
Destination Photographer
Inverse newRelationship
Delete Rule Nullify
Type To One
Advanced Index in Spotlight
Store in External Record File
User Info
Key
Value
Versioning
Hash Modifier Version Hash Modifier
Renaming ID Renaming Identifier
View Controller – A controller that supports the fundamental view-management model in iPhone OS.
Table View Controller – A controller that manages a table view.
Collection View Controller – A controller that manages a collection view.
Outline Style
Add Entity
Add Attribute
Editor Style


CoreDataExample
iPhone Retina (3.5-inch)
No Issues
CoreDataExample
2 targets, iOS SDK 7.0
CoreDataExample
Main_iPad.storyboard
Main_iPhone.storyboard
Model.xcdatamodeld
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
ENTITIES
Photo
Photographer
FETCH REQUESTS
CONFIGURATIONS
Default
A Photographer can take many Photos, so we'll call this Relationship "photos" on the Photographer side.
Photo
Attributes
photoURL
subtitle
thumbnailData
thumbnailURL
title
uploadDate
Relationships
whoTook
Photographer
Attributes
name
Relationships
photos
Relationship
Name photos
Properties Transient Optional
Destination Photo
Inverse whoTook
Delete Rule Nullify
Type To One
Advanced Index in Spotlight
Store in External Record File
User Info
Key
Value
Versioning
Hash Modifier
See how Xcode notes the inverse relationship between photos and whoTook.
View Controller – A controller that supports the fundamental view-management model in iPhone OS.
Table View Controller – A controller that manages a table view.
Collection View Controller – A controller that manages a collection view.
Outline Style
Add Entity
Add Attribute
Editor Style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iPhone Retina (3.5-inch)
No Issues
CoreDataExample
2 targets, iOS SDK 7.0
CoreDataExample
Main_iPad.storyboard
Main_iPhone.storyboard
Model.xcdatamodeld
Photo+Flickr.h
Photo+Flickr.m
Photo.h
Photo.m
Photographer.h
Photographer.m
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
CoreDataExample
CoreDataExample
Model.xcdatam...
Model.xcdatam...
Photographer
photos
ENTITIES
Photo
Photographer
FETCH REQUESTS
CONFIGURATIONS
Default
We also need to note that there can be many Photos per Photographer.
Photo
Attributes
photoURL
subtitle
thumbnailData
thumbnailURL
title
uploadDate
Relationships
whoTook
Photographer
Attributes
name
Relationships
photos
Relationship
Name photos
Properties Transient Optional
Destination Photo
Inverse whoTook
To Many
To One
Advanced Index in Spotlight
Store in External Record File
User Info
Key
Value
Versioning
Hash Modifier Version Hash Modifier
Renaming ID Renaming Identifier
View Controller – A controller that supports the fundamental view-management model in iPhone OS.
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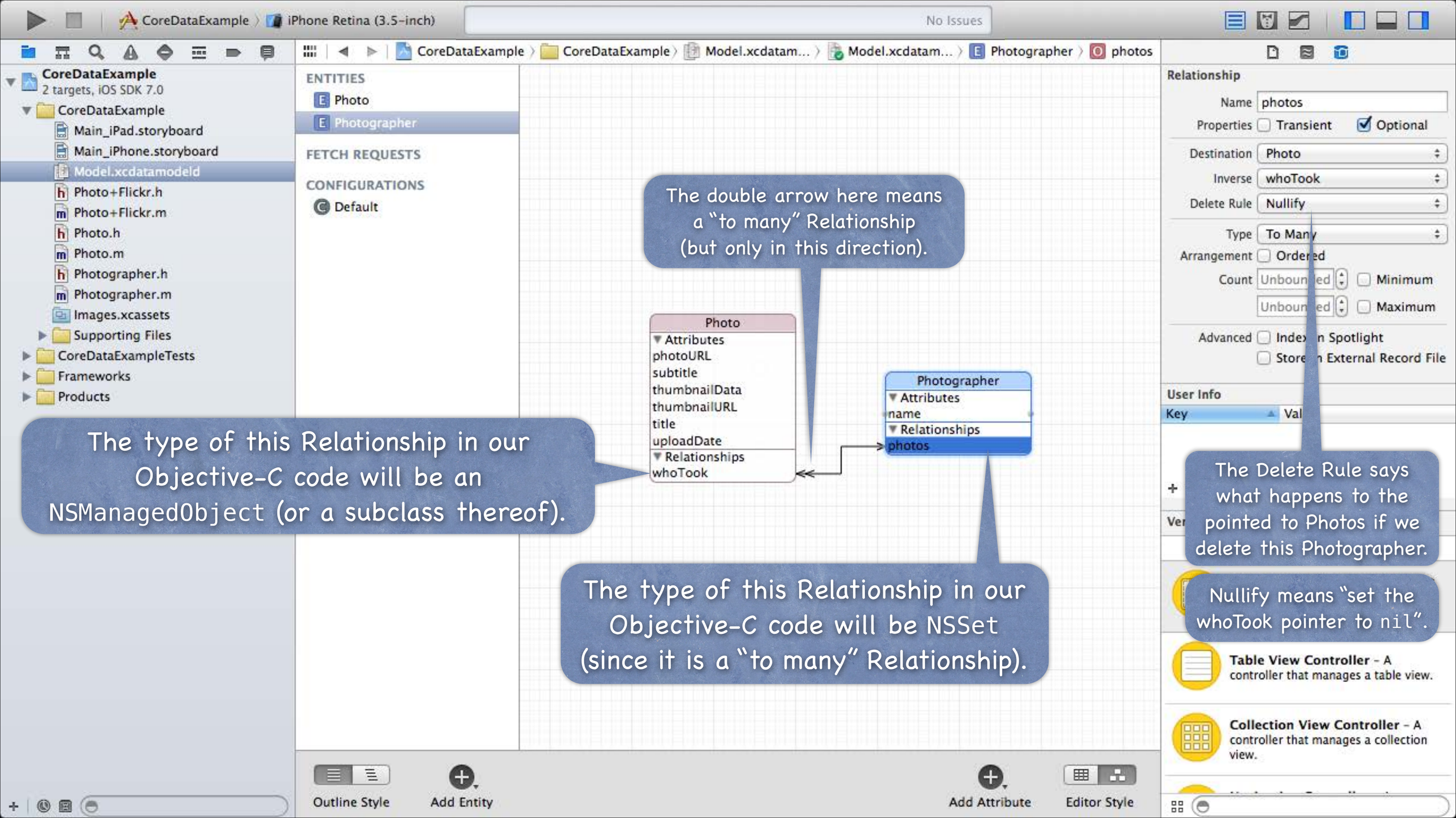
Collection View Controller – A controller that manages a collection view.
Outline Style
Add Entity
Add Attribute
Editor Style


CoreDataExample
iPhone Retina (3.5-inch)
No Issues
CoreDataExample
2 targets, iOS SDK 7.0
CoreDataExample
Main_iPad.storyboard
Main_iPhone.storyboard
Model.xcdatamodeld
Photo+Flickr.h
Photo+Flickr.m
Photo.h
Photo.m
Photographer.h
Photographer.m
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
ENTITIES
Photo
Photographer
FETCH REQUESTS
CONFIGURATIONS
Default
The double arrow here means a "to many" Relationship (but only in this direction).
Photo
Attributes
photoURL
subtitle
thumbnailData
thumbnailURL
title
uploadDate
Relationships
whoTook
Photographer
Attributes
name
Relationships
photos
The type of this Relationship in our Objective-C code will be an NSManagedObject (or a subclass thereof).
The type of this Relationship in our Objective-C code will be NSSet (since it is a "to many" Relationship).
Relationship
Name photos
Properties Transient Optional
Destination Photo
Inverse whoTook
Delete Rule Nullify
Type To Many
Arrangement Ordered
Count Minimum
Maximum
Advanced Index in Spotlight
Store in External Record File
User Info
Key
The Delete Rule says what happens to the pointed to Photos if we delete this Photographer.
Nullify means "set the whoTook pointer to nil".
Table View Controller – A controller that manages a table view.
Collection View Controller – A controller that manages a collection view.
Outline Style
Add Entity
Add Attribute
Editor Style

Core Data

- There are lots of other things you can do
  But we are going to focus on creating Entities, Attributes and Relationships.
- So how do you access all of this stuff in your code?
  You need an `NSManagedObjectContext`.
  It is the hub around which all Core Data activity turns.
- How do I get one?
  There are two ways …
  1. Create a `UIManagedDocument` and ask for its `managedObjectContext` (a `@property`).
  2. Click the "Use Core Data" button when you create a project (only works with certain templates)
     (then your `AppDelegate` will have a `managedObjectContext` `@property`).
  If you study what the template (e.g. Master-Detail template) does, you'll get an idea how it works.
  We're going to focus on doing the first one.

UIManagedDocument

- UIManagedDocument

  It inherits from UIDocument which provides a lot of mechanism for the management of storage.
  If you use UIManagedDocument, you'll be on the fast-track to iCloud support.
  Think of a UIManagedDocument as simply a container for your Core Data database.

- Creating a UIManagedDocument

```
NSFileManager *fileManager = [NSFileManager defaultManager];
NSURL *documentsDirectory = [[fileManager URLsForDirectory:NSDocumentDirectory
                                                 inDomains:NSUserDomainMask] firstObject];
NSString *documentName = @"MyDocument";
NSURL *url = [documentsDirectory URLByAppendingPathComponent:documentName];
UIManagedDocument *document = [[UIManagedDocument alloc] initWithFileURL:url];
```

  This creates the UIManagedDocument instance, but does not open nor create the underlying file.

UIManagedDocument

- How to open or create a UIManagedDocument

  First, check to see if the UIManagedDocument's underlying file exists on disk …

```
BOOL fileExists = [[NSFileManager defaultManager] fileExistsAtPath:[url path]];
```

  … if it does, open the document using …

```
[document openWithCompletionHandler:^(BOOL success) { /* block to execute when open */ }];
```

  … if it does not, create the document using …

```
[document saveToURL:url                // could (should?) use document.fileURL property here
   forSaveOperation:UIDocumentSaveForCreating
   competionHandler:^(BOOL success) { /* block to execute when create is done */ }];
```

- What is that completionHander?

  Just a block of code to execute when the open/save completes.

  That's needed because the open/save is asynchronous (i.e. happens on its own queue).

  Do not ignore this fact!

UIManagedDocument

- Example

```
self.document = [[UIManagedDocument alloc] initWithFileURL:(URL *)url];
if ([[NSFileManager defaultManager] fileExistsAtPath:[url path]]) {
    [document openWithCompletionHandler:^(BOOL success) {
        if (success) [self documentIsReady];
        if (!success) NSLog(@“couldn’t open document at %@”, url);
    }];
} else {
    [document saveToURL:url forSaveOperation:UIDocumentSaveForCreating
      completionHandler:^(BOOL success) {
        if (success) [self documentIsReady];
        if (!success) NSLog(@“couldn’t create document at %@”, url);
    }];
}
// can’t do anything with the document yet (do it in documentIsReady).
```

UIManagedDocument

- Once document is open/created, you can start using it

  But you might want to check the documentState when you do …

```
- (void)documentIsReady
{
    if (self.document.documentState == UIDocumentStateNormal) {
        // start using document
    }
}
```

- Other documentStates

  UIDocumentStateClosed (you haven't done the open or create yet)
  UIDocumentStateSavingError (success will be NO in completion handler)
  UIDocumentStateEditingDisabled (temporary situation, try again)
  UIDocumentStateInConflict (e.g., because some other device changed it via iCloud)
  We don't have time to address these (you can ignore in homework), but know that they exist.

UIManagedDocument

- Okay, document is ready to use, now what?

  Now you can get a managedObjectContext from it and use it to do Core Data stuff!

```
- (void)documentIsReady
{
    if (self.document.documentState == UIDocumentStateNormal) {
       NSManagedObjectContext *context = self.document.managedObjectContext;
       // start doing Core Data stuff with context
    }
}
```

  Okay, just a couple of more UIManagedDocument things before we start using that context …

UIManagedDocument

- Saving the document

  UIManagedDocuments AUTOSAVE themselves!

  However, if, for some reason you wanted to manually save (asynchronous!) …

```
[document saveToURL:document.fileURL
   forSaveOperation:UIDocumentSaveForOverwriting
   competionHandler:^(BOOL success) { /* block to execute when save is done */ }];
```

  Note that this is almost identical to creation (just UIDocumentSaveForOverwriting is different).

  This is a UIKit class and so this method must be called on the main queue.

- Closing the document

  Will automatically close if there are no strong pointers left to it.

  But you can explicitly close with (asynchronous!) …

```
[self.document closeWithCompletionHandler:^(BOOL success) {
    if (!success) NSLog(@“failed to close document %@”, self.document.localizedName);
}];
```

  UIManagedDocument’s localizedName method …

```
@property (strong) NSString *localizedName; // suitable for UI (but only valid once saved)
```

UIManagedDocument

- Multiple instances of `UIManagedDocument` on the same document

  This is perfectly legal, but understand that they will not share an `NSManagedObjectContext`.
  Thus, changes in one will not automatically be reflected in the other.

  You'll have to refetch in other `UIManagedDocuments` after you make a change in one.

  Conflicting changes in two different `UIManagedDocuments` would have to be resolved by you!
  It's exceedingly rare to have two "writing" instances of `UIManagedDocument` on the same file.
  But a single writer and multiple readers? Less rare. But you need to know when to refetch.

  You can watch (via "radio station") other documents' `managedObjectContexts` (then refetch).
  Or you can use a single `UIManagedDocument` instance (per actually document) throughout.

NSNotification

- How would you watch a document's managedObjectContext?

```
- (void)viewDidAppear:(BOOL)animated
{
    [super viewDidAppear:animated];
    [center addObserver:self
               selector:@selector(contextChanged:)
                   name:NSManagedObjectContextDidSaveNotification
                 object:document.managedObjectContext];  // don't pass nil here!
}
- (void)viewWillDisappear:(BOOL)animated
{
    [center removeObserver:self
                      name:NSManagedObjectContextDidSaveNotification
                    object:document.managedObjectContext];
    [super viewWillDisappear:animated];
}
```

NSNotification

- NSManagedObjectContextDidSaveNotification

```
- (void)contextChanged:(NSNotification *)notification
{
    // The notification.userInfo object is an NSDictionary with the following keys:
    NSInsertedObjectsKey // an array of objects which were inserted
    NSUpdatedObjectsKey  // an array of objects whose attributes changed
    NSDeletedObjectsKey  // an array of objects which were deleted
}
```

- Merging changes

If you get notified that another NSManagedObjectContext has changed your database …
… you can just refetch (if you haven't changed anything in your NSMOC, for example).
… or you can use the NSManagedObjectContext method:

```
- (void)mergeChangesFromContextDidSaveNotification:(NSNotification *)notification;
```

Core Data

- Okay, we have an `NSManagedObjectContext`, now what?
  - We grabbed it from an open `UIManagedDocument`'s `managedObjectContext` `@property`.
  - Now we use it to insert/delete objects in the database and query for objects in the database.

Core Data

- Inserting objects into the database

```
NSManagedObjectContext *context = aDocument.managedObjectContext;
NSManagedObject *photo =
    [NSEntityDescription insertNewObjectForEntityForName:@“Photo”
                                  inManagedObjectContext:context];
```

Note that this `NSEntityDescription` class method returns an `NSManagedObject` instance.
All objects in the database are represented by `NSManagedObjects` or subclasses thereof.

An instance of `NSManagedObject` is a manifestation of an Entity in our Core Data Model*.
Attributes of a newly-inserted object will start out `nil` (unless you specify a default in Xcode).

* i.e., the Data Model that we just graphically built in Xcode!

Core Data

- How to access Attributes in an `NSManagedObject` instance
  - You can access them using the following two `NSKeyValueCoding` protocol methods …
  - `- (id)valueForKey:(NSString *)key;`
  - `- (void)setValue:(id)value forKey:(NSString *)key;`
  - You can also use `valueForKeyPath:`/`setValue:forKeyPath:` and it will follow your Relationships!
- The `key` is an Attribute name in your data mapping
  - For example, `@"thumbnailURL"` or `@"title"`.
- The `value` is whatever is stored (or to be stored) in the database
  - It'll be `nil` if nothing has been stored yet (unless Attribute has a default value in Xcode).
  - Note that all values are objects (numbers and booleans are `NSNumber` objects).
  - Binary data values are `NSData` objects.
  - Date values are `NSDate` objects.
  - "To-many" mapped relationships are `NSSet` objects (or `NSOrderedSet` if ordered).
  - Non-"to-many" relationships are `NSManagedObject`s.

Core Data

- Changes (writes) only happen in memory, until you save

  Remember, `UIManagedDocument` autosaves.

  When the document is saved, the context is saved and your changes get written to the database.

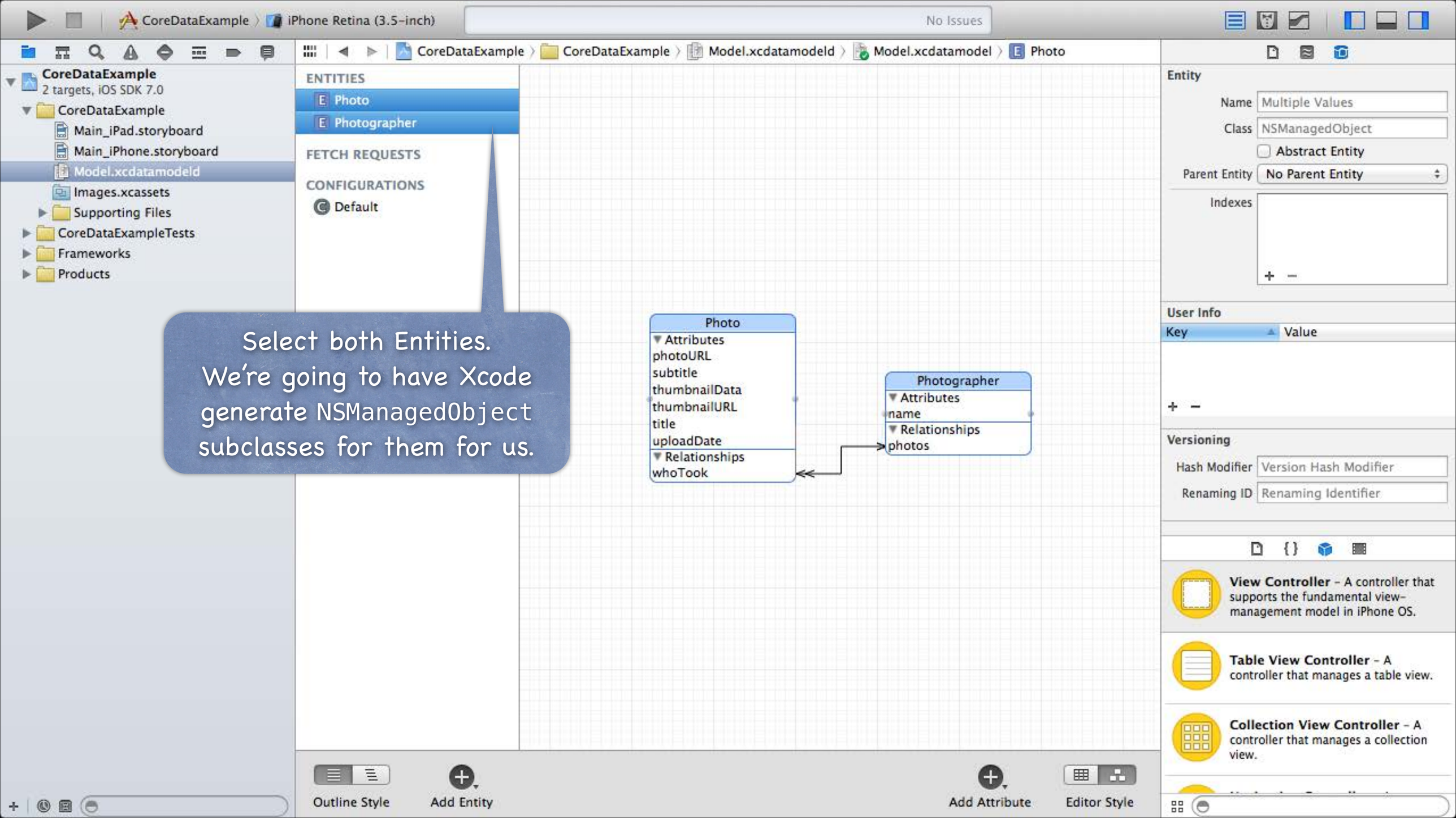
  `UIManagedDocumentDidSaveNotification` will be "broadcast" at that point.

  Be careful during development where you press "Stop" in Xcode (sometimes autosave is pending).

Core Data

- But calling `valueForKey:/setValue:forKey:` is pretty ugly
  - There's no type-checking.
  - And you have a lot of literal strings in your code (e.g. `@"thumbnailURL"`)
- What we really want is to set/get using `@property`s!
- No problem … we just create a subclass of `NSManagedObject`
  - The subclass will have `@property`s for each attribute in the database.
  - We name our subclass the same name as the Entity it matches (not strictly required, but do it).

  And, as you might imagine, we can get Xcode to generate both the header file `@property` entries, and the corresponding implementation code (which is not `@synthesize`, so watch out!).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CoreDataExample
CoreDataExample
Model.xcdatamodeld
Model.xcdatamodel
Photo
ENTITIES
Photo
Photographer
FETCH REQUESTS
CONFIGURATIONS
Default
Select both Entities.
We're going to have Xcode
generate NSManagedObject
subclasses for them for us.
Photo
Attributes
photoURL
subtitle
thumbnailData
thumbnailURL
title
uploadDate
Relationships
whoTook
Photographer
Attributes
name
Relationships
photos
Entity
Name
Multiple Values
Class
NSManagedObject
Abstract Entity
Parent Entity
No Parent Entity
Indexes
User Info
Key
Value
Versioning
Hash Modifier
Version Hash Modifier
Renaming ID
Renaming Identifier
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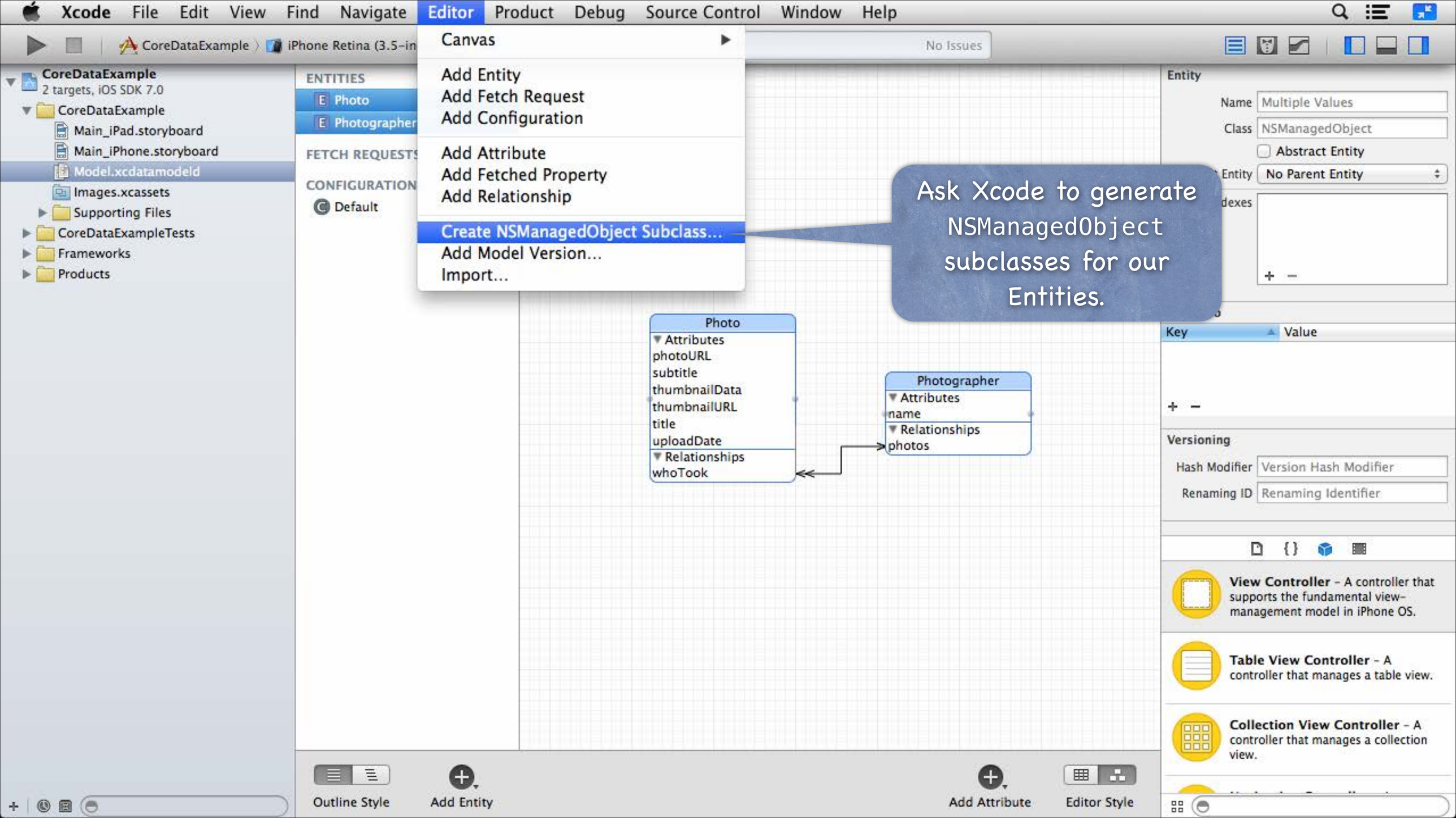
Add Entity
Add Attribute
Editor Style


Xcode File Edit View Find Navigate Editor Product Debug Source Control Window Help
Canvas
Add Entity
Add Fetch Request
Add Configuration
Add Attribute
Add Fetched Property
Add Relationship
Create NSManagedObject Subclass...
Add Model Version...
Import...
Ask Xcode to generate NSManagedObject subclasses for our Entities.
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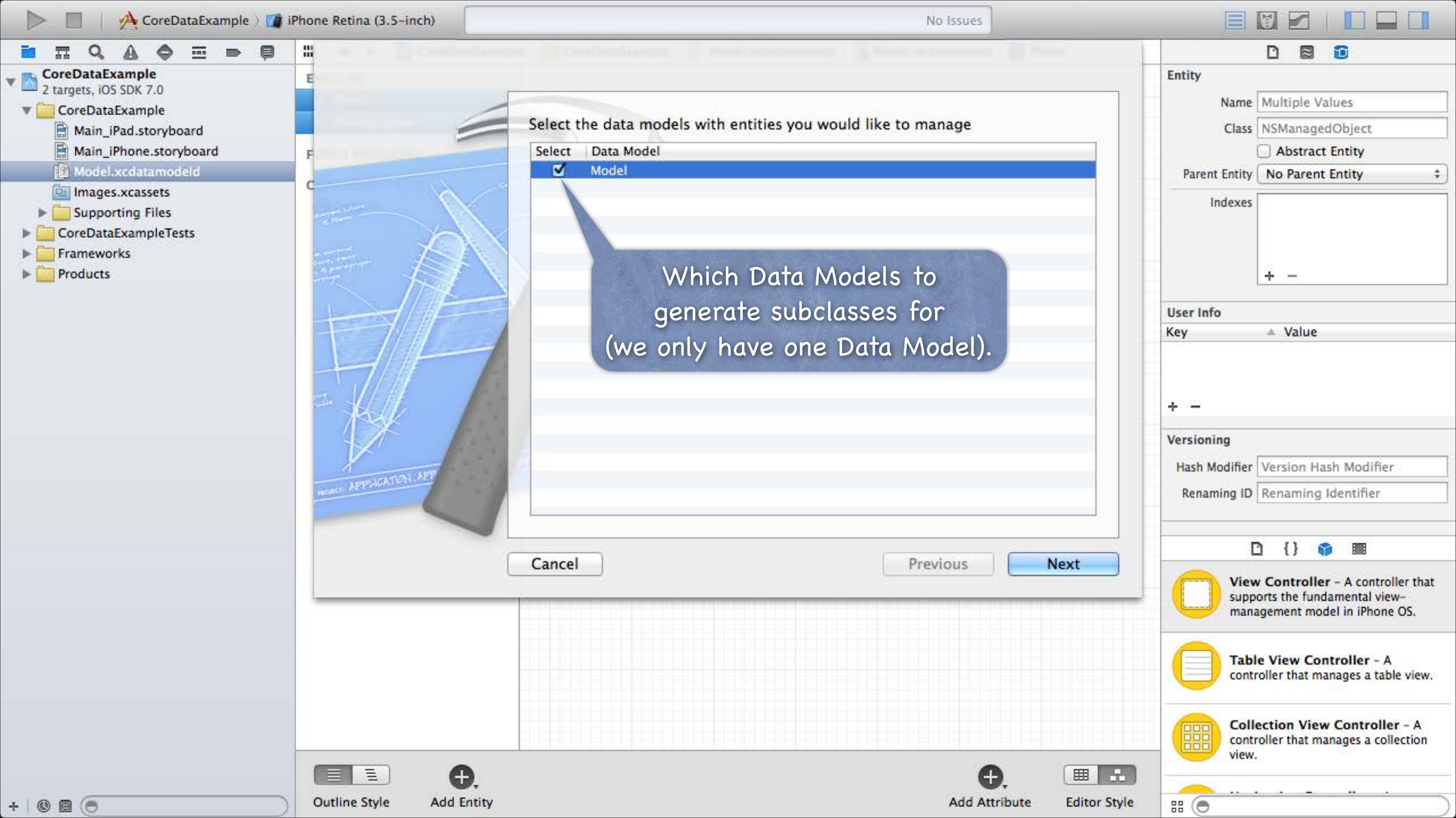
Main_iPhone.storyboard
Model.xcdatamodeld
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
ENTITIES
Photo
Photographer
FETCH REQUESTS
CONFIGURATION
Default
Photo
Attributes
photoURL
subtitle
thumbnailData
thumbnailURL
title
uploadDate
Relationships
whoTook
Photographer
Attributes
name
Relationships
photos
Entity
Name Multiple Values
Class NSManagedObject
Abstract Entity
Entity No Parent Entity
Key Value
Versioning
Hash Modifier Version Hash Modifier
Renaming ID Renaming Identifier
View Controller – A controller that supports the fundamental view-management model in iPhone OS.
Table View Controller – A controller that manages a table view.
Collection View Controller – A controller that manages a collection view.
Outline Style
Add Entity
Add Attribute
Editor Style


CoreDataExample
iPhone Retina (3.5-inch)
No Issues
CoreDataExample
2 targets, iOS SDK 7.0
CoreDataExample
Main_iPad.storyboard
Main_iPhone.storyboard
Model.xcdatamodeld
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
Select the data models with entities you would like to manage
Select
Data Model
Model
Which Data Models to generate subclasses for (we only have one Data Model).
Cancel
Previous
Next
Entity
Name
Multiple Values
Class
NSManagedObject
Abstract Entity
Parent Entity
No Parent Entity
Indexes
User Info
Key
Value
Versioning
Hash Modifier
Version Hash Modifier
Renaming ID
Renaming Identifier
View Controller – A controller that supports the fundamental view-management model in iPhone OS.
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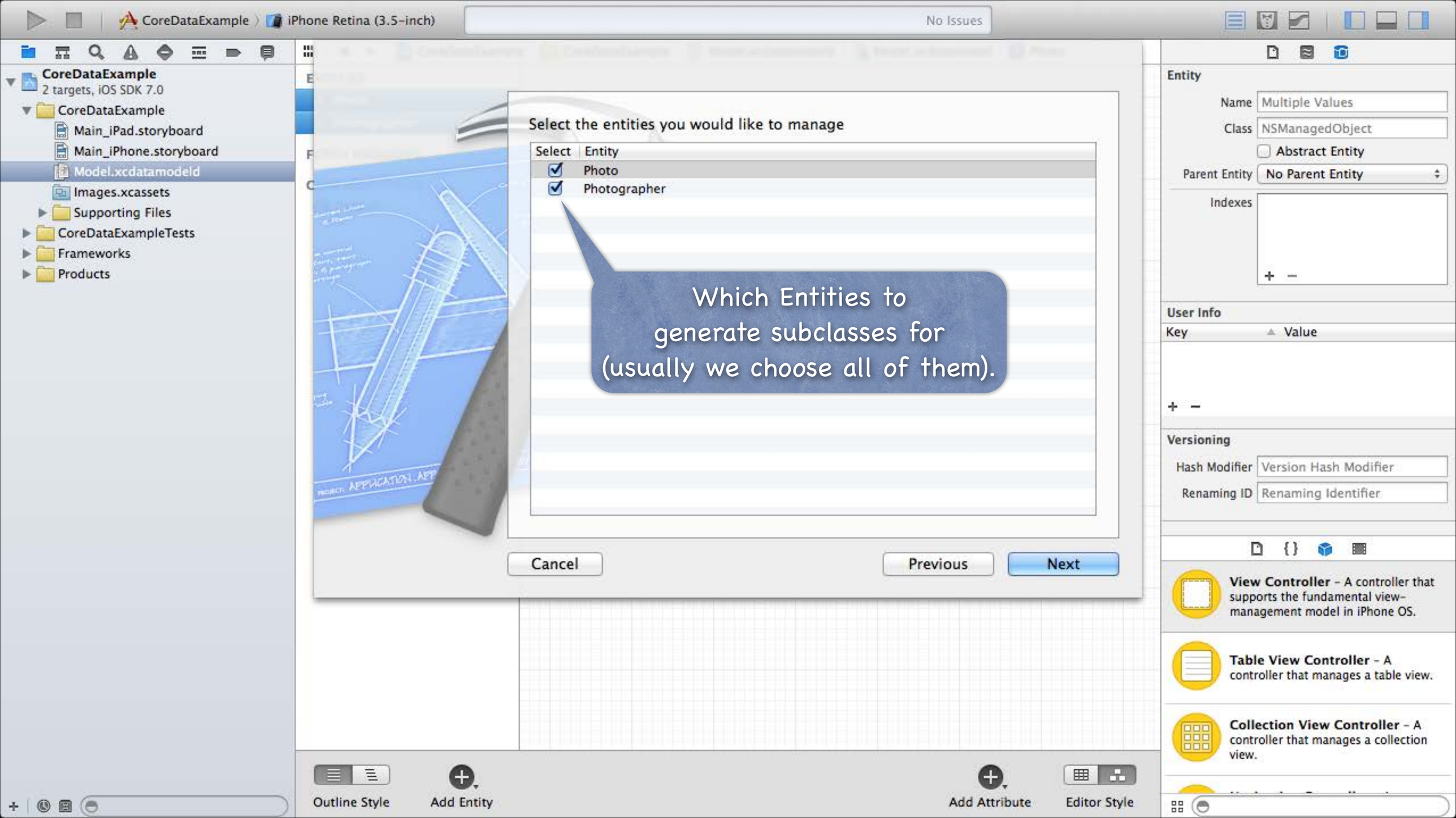
Outline Style
Add Entity
Add Attribute
Editor Style


CoreDataExample
iPhone Retina (3.5-inch)
No Issues
CoreDataExample
2 targets, iOS SDK 7.0
CoreDataExample
Main_iPad.storyboard
Main_iPhone.storyboard
Model.xcdatamodeld
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
Select the entities you would like to manage
Select
Entity
Photo
Photographer
Which Entities to generate subclasses for (usually we choose all of them).
Cancel
Previous
Next
Entity
Name
Multiple Values
Class
NSManagedObject
Abstract Entity
Parent Entity
No Parent Entity
Indexes
User Info
Key
Value
Versioning
Hash Modifier
Version Hash Modifier
Renaming ID
Renaming Identifier
View Controller – A controller that supports the fundamental view-management model in iPhone OS.
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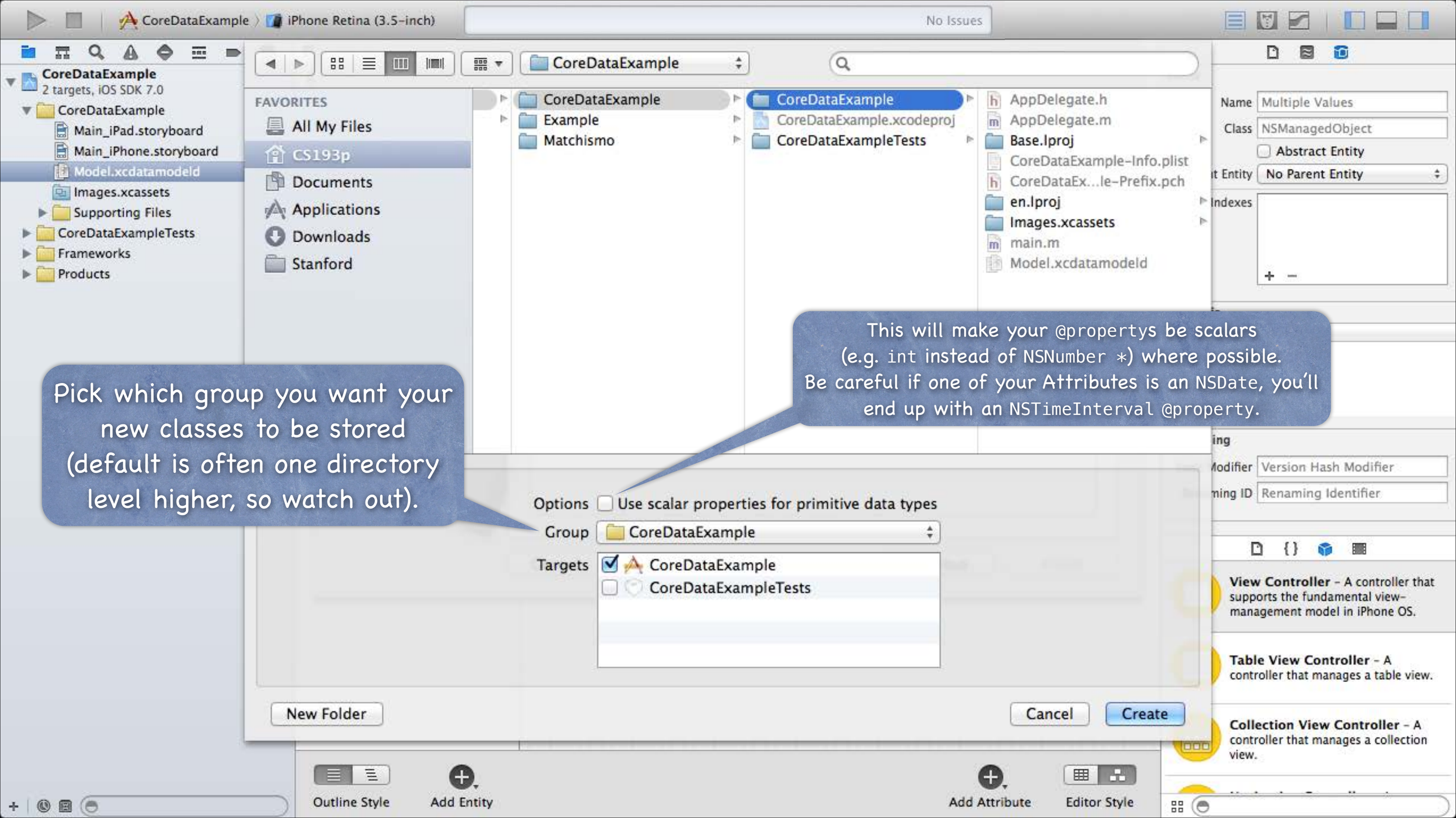
Outline Style
Add Entity
Add Attribute
Editor Style


CoreDataExample
iPhone Retina (3.5-inch)
No Issues
CoreDataExample
2 targets, iOS SDK 7.0
CoreDataExample
Main_iPad.storyboard
Main_iPhone.storyboard
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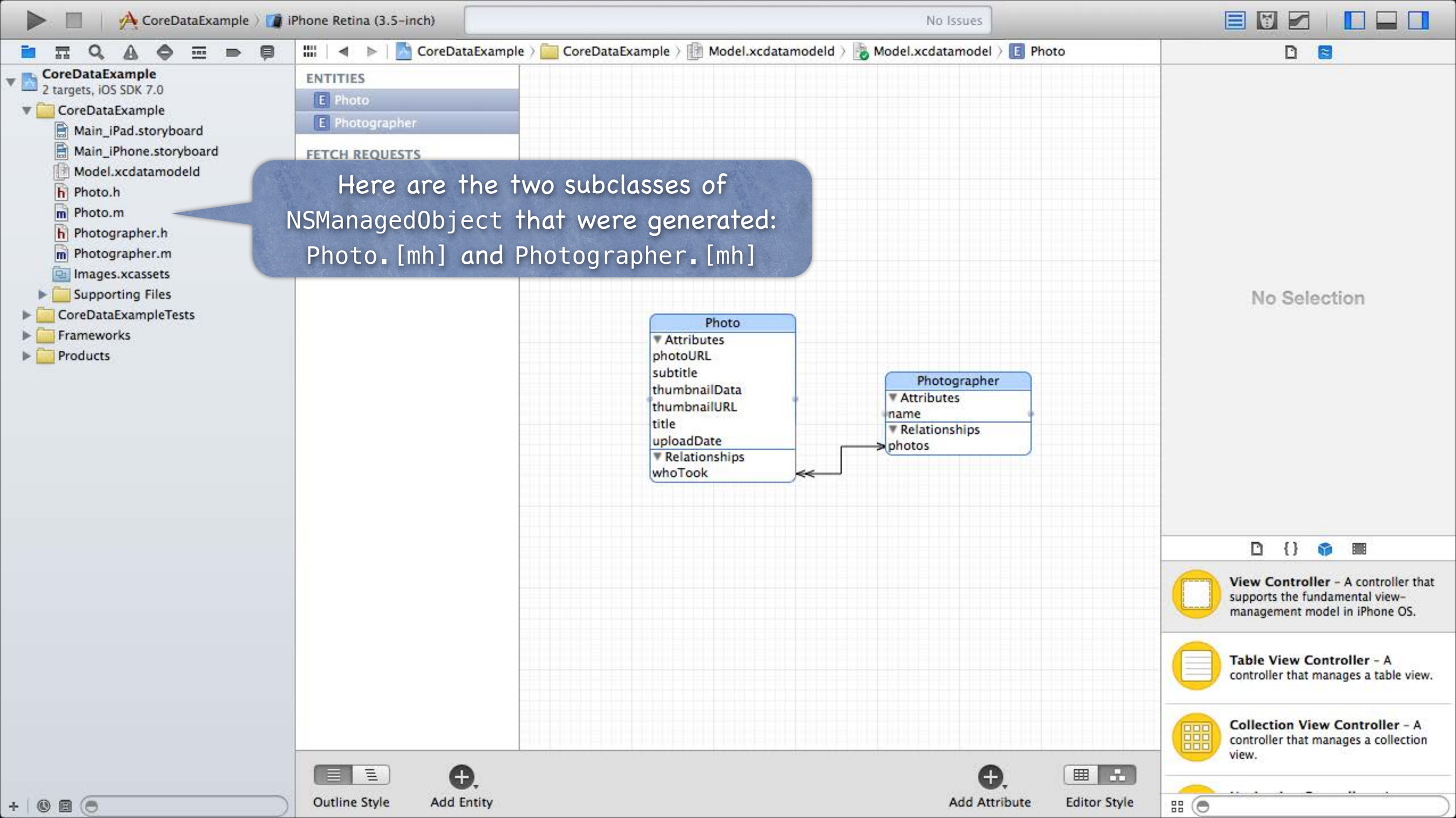
Products
FAVORITES
All My Files
CS193p
Documents
Applications
Downloads
Stanford
CoreDataExample
Example
Matchismo
CoreDataExample
CoreDataExample.xcodeproj
CoreDataExampleTests
AppDelegate.h
AppDelegate.m
Base.lproj
CoreDataExample-Info.plist
CoreDataEx...le-Prefix.pch
en.lproj
Images.xcassets
main.m
Model.xcdatamodeld
Name
Multiple Values
Class
NSManagedObject
Abstract Entity
Entity
No Parent Entity
Indexes
This will make your @propertys be scalars (e.g. int instead of NSNumber *) where possible. Be careful if one of your Attributes is an NSDate, you'll end up with an NSTimeInterval @property.
Pick which group you want your new classes to be stored (default is often one directory level higher, so watch out).
Options
Use scalar properties for primitive data types
Group
CoreDataExample
Targets
CoreDataExample
CoreDataExampleTests
New Folder
Cancel
Create
Modifier
Version Hash Modifier
Renaming ID
Renaming Identifier
View Controller – A controller that supports the fundamental view-management model in iPhone OS.
Table View Controller – A controller that manages a table view.
Collection View Controller – A controller that manages a collection view.
Outline Style
Add Entity
Add Attribute
Editor Style


CoreDataExample
iPhone Retina (3.5-inch)
No Issues
CoreDataExample
CoreDataExample
Model.xcdatamodeld
Model.xcdatamodel
Photo
CoreDataExample
2 targets, iOS SDK 7.0
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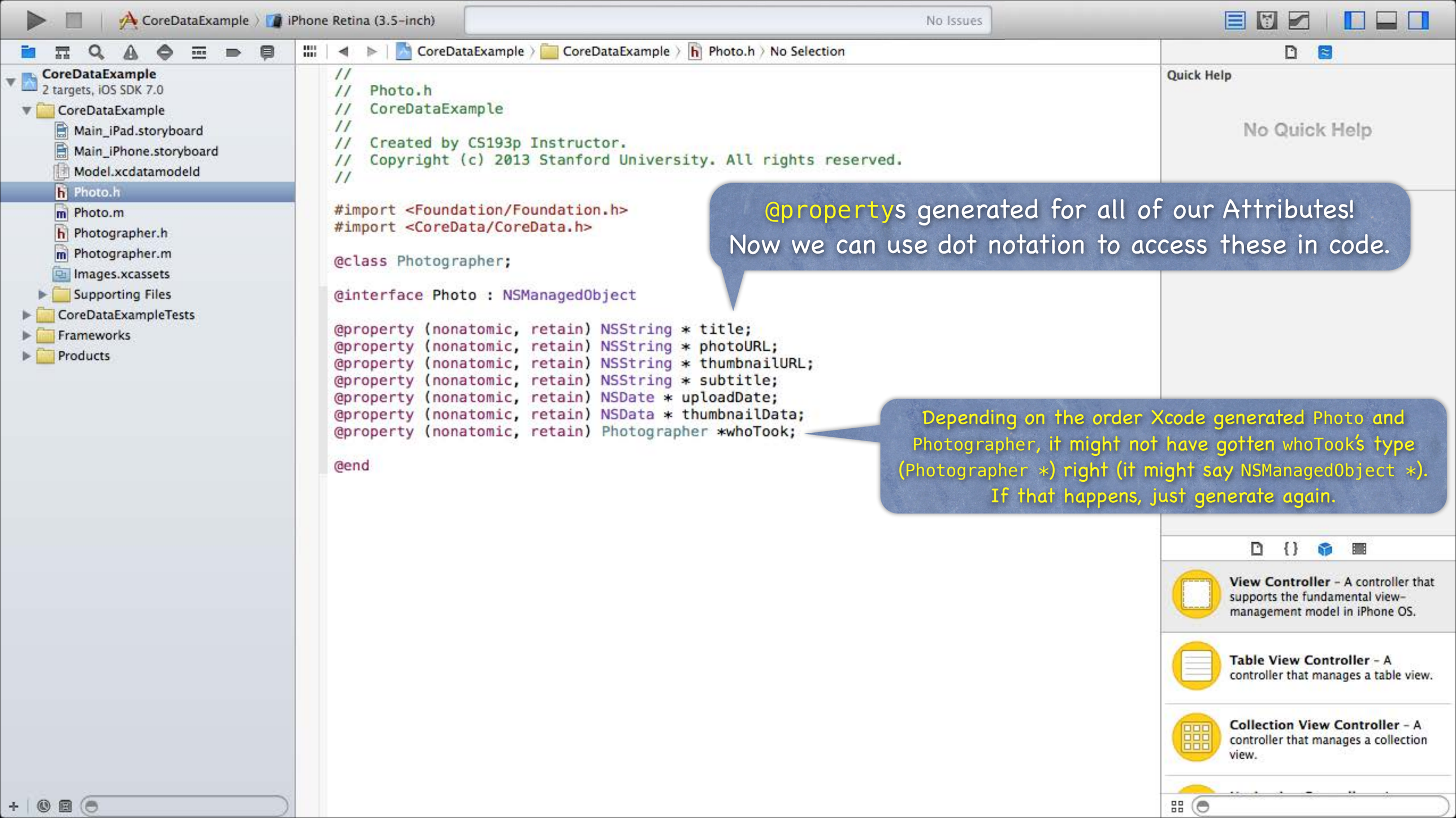
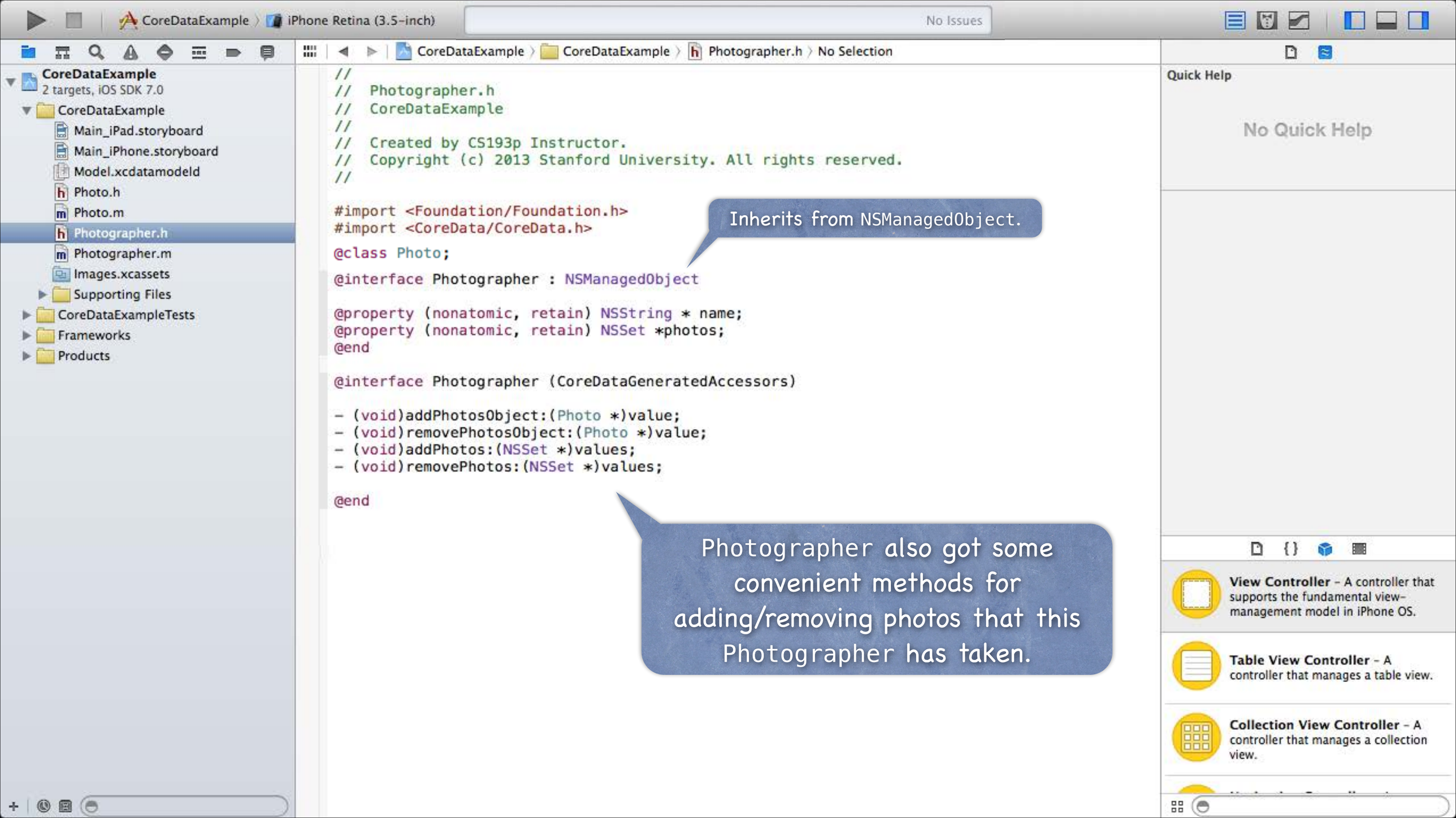
Main_iPad.storyboard
Main_iPhone.storyboard
Model.xcdatamodeld
Photo.h
Photo.m
Photographer.h
Photographer.m
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
ENTITIES
Photo
Photographer
FETCH REQUESTS
Here are the two subclasses of NSManagedObject that were generated: Photo.[mh] and Photographer.[mh]
Photo
Attributes
photoURL
subtitle
thumbnailData
thumbnailURL
title
uploadDate
Relationships
whoTook
Photographer
Attributes
name
Relationships
photos
No Selection
View Controller – A controller that supports the fundamental view-management model in iPhone OS.
Table View Controller – A controller that manages a table view.
Collection View Controller – A controller that manages a collection view.
Outline Style
Add Entity
Add Attribute
Editor Style


CoreDataExample
iPhone Retina (3.5-inch)
No Issues
CoreDataExample
CoreDataExample
Photo.h
No Selection
CoreDataExample
2 targets, iOS SDK 7.0
CoreDataExample
Main_iPad.storyboard
Main_iPhone.storyboard
Model.xcdatamodeld
Photo.h
Photo.m
Photographer.h
Photographer.m
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
//
// Photo.h
// CoreDataExample
//
// Created by CS193p Instructor.
// Copyright (c) 2013 Stanford University. All rights reserved.
//
#import <Foundation/Foundation.h>
#import <CoreData/CoreData.h>
@class Photographer;
@interface Photo : NSManagedObject
@property (nonatomic, retain) NSString * title;
@property (nonatomic, retain) NSString * photoURL;
@property (nonatomic, retain) NSString * thumbnailURL;
@property (nonatomic, retain) NSString * subtitle;
@property (nonatomic, retain) NSDate * uploadDate;
@property (nonatomic, retain) NSData * thumbnailData;
@property (nonatomic, retain) Photographer *whoTook;
@end
@propertys generated for all of our Attributes!
Now we can use dot notation to access these in code.
Depending on the order Xcode generated Photo and Photographer, it might not have gotten whoTook's type (Photographer *) right (it might say NSManagedObject *). If that happens, just generate again.
Quick Help
No Quick Help
View Controller – A controller that supports the fundamental view-management model in iPhone OS.
Table View Controller – A controller that manages a table view.
Collection View Controller – A controller that manages a collection view.


CoreDataExample
iPhone Retina (3.5-inch)
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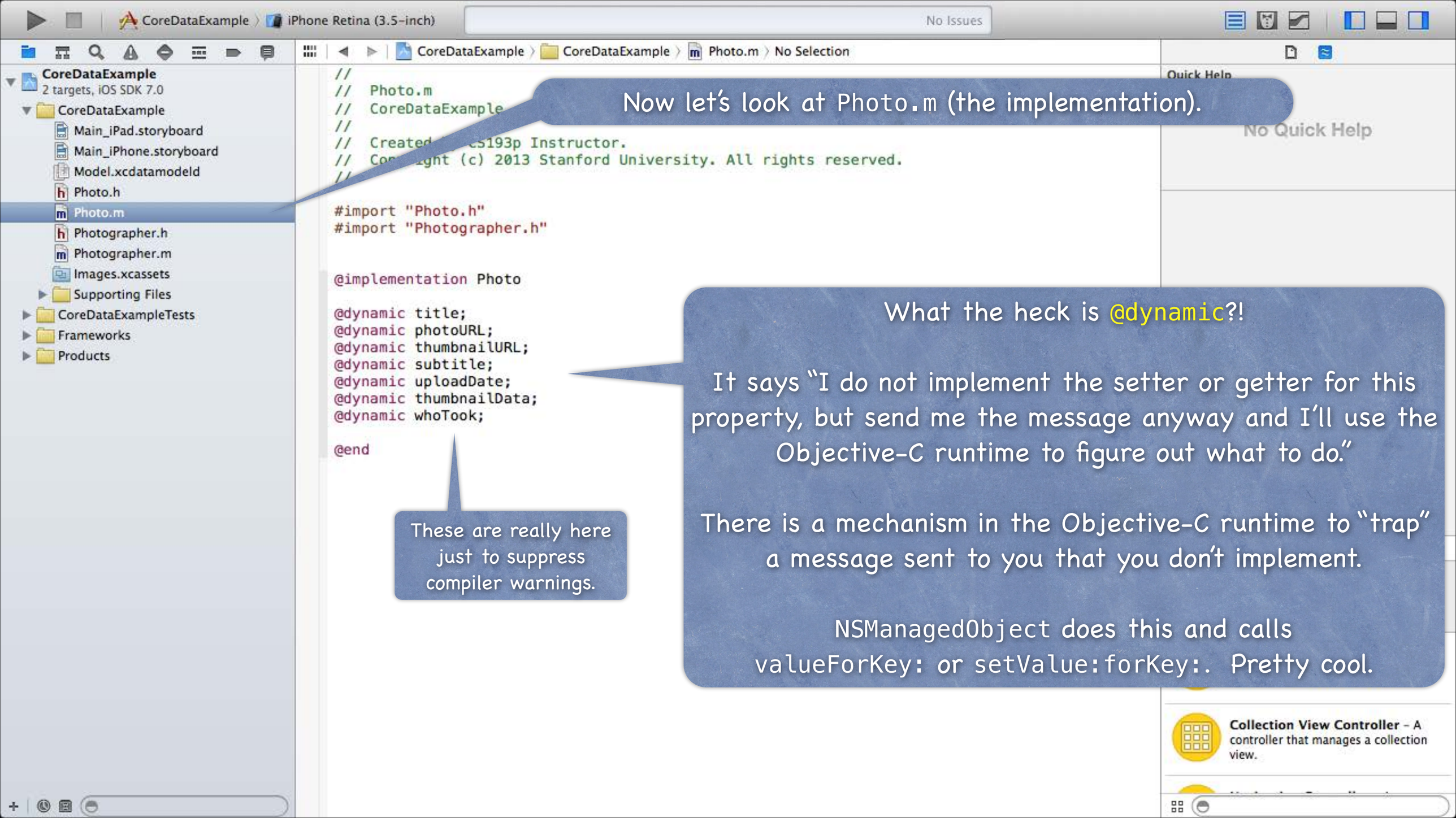
Products
//
// Photographer.h
// CoreDataExample
//
// Created by CS193p Instructor.
// Copyright (c) 2013 Stanford University. All rights reserved.
//
#import <Foundation/Foundation.h>
#import <CoreData/CoreData.h>
@class Photo;
@interface Photographer : NSManagedObject
@property (nonatomic, retain) NSString * name;
@property (nonatomic, retain) NSSet *photos;
@end
@interface Photographer (CoreDataGeneratedAccessors)
- (void)addPhotosObject:(Photo *)value;
- (void)removePhotosObject:(Photo *)value;
- (void)addPhotos:(NSSet *)values;
- (void)removePhotos:(NSSet *)values;
@end
Inherits from NSManagedObject.
Photographer also got some convenient methods for adding/removing photos that this Photographer has taken.
Quick Help
No Quick Help
View Controller – A controller that supports the fundamental view-management model in iPhone OS.
Table View Controller – A controller that manages a table view.
Collection View Controller – A controller that manages a collection view.


CoreDataExample
iPhone Retina (3.5-inch)
No Issues
CoreDataExample
CoreDataExample
Photo.m
No Selection
CoreDataExample
2 targets, iOS SDK 7.0
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Main_iPhone.storyboard
Model.xcdatamodeld
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Photo.m
Photographer.h
Photographer.m
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Supporting Files
CoreDataExampleTests
Frameworks
Products
//
// Photo.m
// CoreDataExample
//
// Created by CS193p Instructor.
// Copyright (c) 2013 Stanford University. All rights reserved.
//
#import "Photo.h"
#import "Photographer.h"
@implementation Photo
@dynamic title;
@dynamic photoURL;
@dynamic thumbnailURL;
@dynamic subtitle;
@dynamic uploadDate;
@dynamic thumbnailData;
@dynamic whoTook;
@end
Now let's look at Photo.m (the implementation).
What the heck is @dynamic?!
It says "I do not implement the setter or getter for this property, but send me the message anyway and I'll use the Objective-C runtime to figure out what to do."
There is a mechanism in the Objective-C runtime to "trap" a message sent to you that you don't implement.
NSManagedObject does this and calls valueForKey: or setValue:forKey:. Pretty cool.
These are really here just to suppress compiler warnings.
Quick Help
No Quick Help
Collection View Controller – A controller that manages a collection view.

Core Data

- So how do I access my Entities' Attributes with dot notation?

```
// let's create an instance of the Photo Entity in the database …
NSManagedObjectContext *context = document.managedObjectContext;
Photo *photo = [NSEntityDescription insertNewObjectForEntityForName:@"Photo"
                                             inManagedObjectContext:context];

// then set the attributes in our Photo using, say, an NSDictionary we got from Flickr …
e.g. photo.title = [flickrData objectForKey:FLICKR_PHOTO_TITLE];
// the information will automatically be saved (i.e. autosaved) into our document by Core Data

// now here's some other things we could do too …
NSString *myThumbnail = photo.thumbnailURL;
photo.lastViewedDate = [NSDate date];
photo.whoTook = …; // a Photographer object we created or got by querying
photo.whoTook.name = @"CS193p Instructor"; // yes, multiple dots will follow relationships!
```

Core Data

- What if I want to add code to my NSManagedObject subclass?

  For example, we might want to add a method or two (to the @propertys added by Xcode).

  It would be especially nice to add class methods to create and set up an object in the database
  (e.g. set all the properties of a Photo or Photographer using an NSDictionary from Flickr).
  Or maybe to derive new @propertys based on ones in the database
  (e.g. a UIImage based on a URL in the database).

  But that could be a problem if we edited Photo.m or Photographer.m …
  Because you might want to modify your schema and re-generate those .h and .m files from Xcode!

  To get around this, we need to use an Objective-C feature called "categories".
  So let's take a moment to learn about that …

Categories

- Categories are an Objective-C syntax for adding to a class …
  - Without subclassing it.
  - Without even having to have access to the code of the class (e.g. you don't need its `.m`).
- Examples
  - `NSAttributedString`'s `drawAtPoint:` method.
    - Added by UIKit (since it's a UI method) even though `NSAttributedString` is in Foundation.
  - `NSIndexPath`'s `row` and `section` properties (used in `UITableView`-related code).
    - Added by UIKit too, even though `NSIndexPath` is also in Foundation.
- Syntax

```
@interface Photo (AddOn)
- (UIImage *)image;
@property (readonly) BOOL isOld;
@end
```

  - Categories have their own `.h` and `.m` files (usually `ClassName+PurposeOfExtension.[mh]`).
  - Categories cannot have instance variables!

Categories

- Implementation

```
@implementation Photo (AddOn)
- (UIImage *)image  // image is not an attribute in the database, but photoURL is
{
    NSURL *imageURL = [NSURL URLWithString:self.photoURL];
    NSData *imageData = [NSData dataWithContentsOfURL:imageURL];
    return [UIImage imageWithData:imageData];
}
- (BOOL)isOld  // whether this Photo was uploaded more than a day ago
{
    return [self.uploadDate timeIntervalSinceNow] > -24*60*60;
}
@end
```

Other examples … sometimes we add `@propertys` to an `NSManagedObject` subclass via categories
to make accessing `BOOL` attributes (which are `NSNumbers`) more cleanly.

Or we add `@propertys` to convert `NSDatas` to whatever the bits represent.

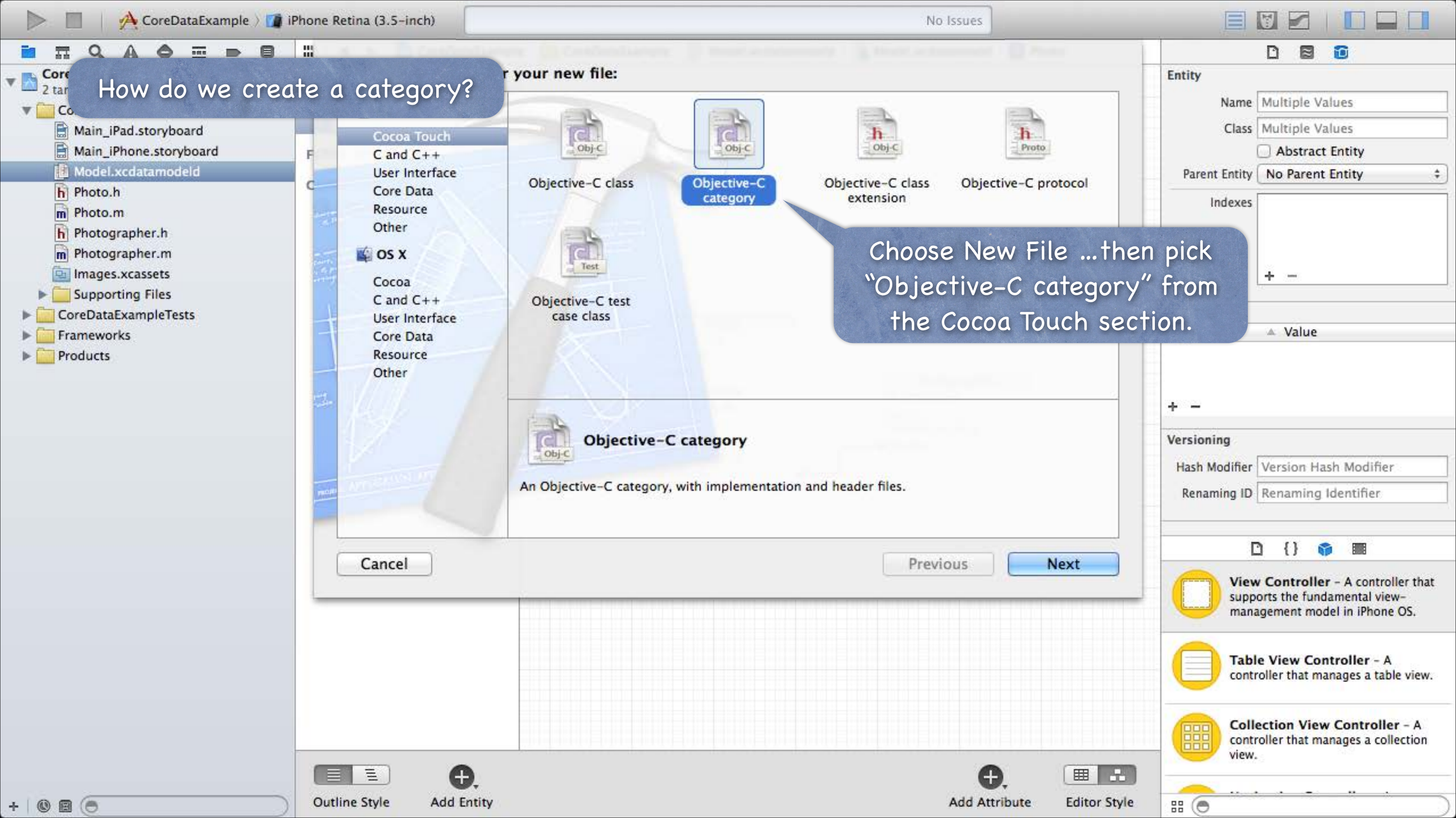
Any class can have a category added to it, but don't overuse/abuse this mechanism.

Categories

- Most common category on an NSManagedObject subclass?

Creation …

```
@implementation Photo (Create)
+ (Photo *)photoWithFlickrData:(NSDictionary *)flickrData
        inManagedObjectContext:(NSManagedObjectContext *)context
{
    Photo *photo = ...; // see if a Photo for that Flickr data is already in the database
    if (!photo) {
        photo = [NSEntityDescription insertNewObjectForEntityForName:@“Photo”
                                              inManagedObjectContext:context];
        // initialize the photo from the Flickr data
        // perhaps even create other database objects (like the Photographer)
    }
    return photo;
}
@end
```


How do we create a category?
CoreDataExample
iPhone Retina (3.5-inch)
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Main_iPad.storyboard
Main_iPhone.storyboard
Model.xcdatamodeld
Photo.h
Photo.m
Photographer.h
Photographer.m
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
your new file:
Cocoa Touch
C and C++
User Interface
Core Data
Resource
Other
OS X
Cocoa
C and C++
User Interface
Core Data
Resource
Other
Objective-C class
Objective-C category
Objective-C class extension
Objective-C protocol
Objective-C test case class
Objective-C category
An Objective-C category, with implementation and header files.
Cancel
Previous
Next
Choose New File ...then pick "Objective-C category" from the Cocoa Touch section.
Entity
Name
Multiple Values
Class
Multiple Values
Abstract Entity
Parent Entity
No Parent Entity
Indexes
Value
Versioning
Hash Modifier
Version Hash Modifier
Renaming ID
Renaming Identifier
View Controller – A controller that supports the fundamental view-management model in iPhone OS.
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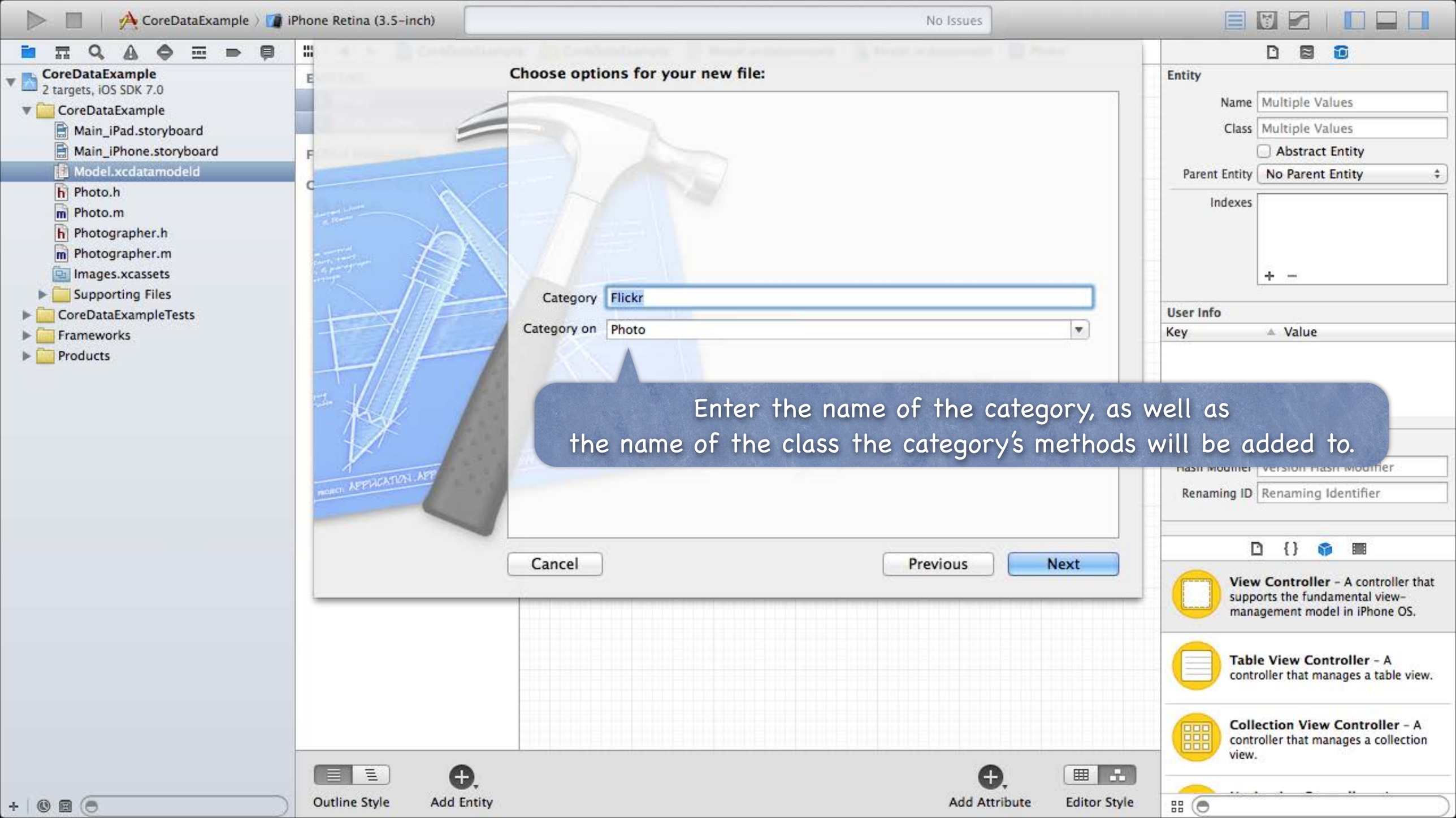
Collection View Controller – A controller that manages a collection view.
Outline Style
Add Entity
Add Attribute
Editor Style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Model.xcdatamodeld
Photo.h
Photo.m
Photographer.h
Photographer.m
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
Choose options for your new file:
Category
Flickr
Category on
Photo
Cancel
Previous
Next
Enter the name of the category, as well as
the name of the class the category's methods will be added to.
Entity
Name
Multiple Values
Class
Multiple Values
Abstract Entity
Parent Entity
No Parent Entity
Indexes
User Info
Key
Value
Renaming ID
Renaming Identifier
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Outline Style
Add Entity
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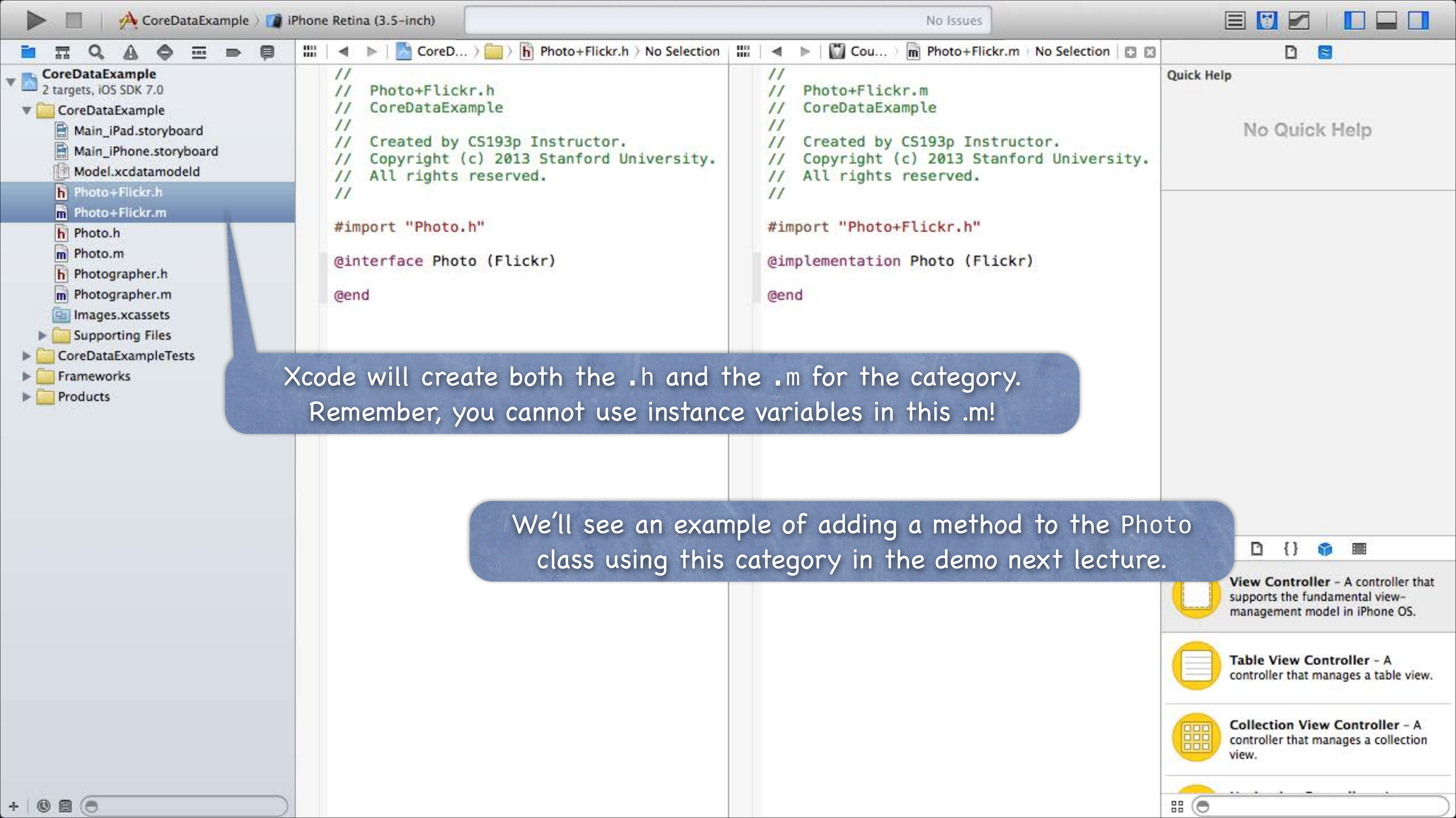
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Photo+Flickr.h
Photo+Flickr.m
Photo.h
Photo.m
Photographer.h
Photographer.m
Images.xcassets
Supporting Files
CoreDataExampleTests
Frameworks
Products
CoreD...
Photo+Flickr.h
No Selection
//
// Photo+Flickr.h
// CoreDataExample
//
// Created by CS193p Instructor.
// Copyright (c) 2013 Stanford University.
// All rights reserved.
//
#import "Photo.h"
@interface Photo (Flickr)
@end
Cou...
Photo+Flickr.m
No Selection
//
// Photo+Flickr.m
// CoreDataExample
//
// Created by CS193p Instructor.
// Copyright (c) 2013 Stanford University.
// All rights reserved.
//
#import "Photo+Flickr.h"
@implementation Photo (Flickr)
@end
Quick Help
No Quick Help
Xcode will create both the .h and the .m for the category.
Remember, you cannot use instance variables in this .m!
We'll see an example of adding a method to the Photo
class using this category in the demo next lecture.
View Controller – A controller that supports the fundamental view-management model in iPhone OS.
Table View Controller – A controller that manages a table view.
Collection View Controller – A controller that manages a collection view.

Deletion

- Deletion

  Deleting objects from the database is easy (sometimes too easy!)

  ```
  [aDocument.managedObjectContext deleteObject:photo];
  ```

  Make sure that the rest of your objects in the database are in a sensible state after this.

  Relationships will be updated for you (if you set Delete Rule for relationship attributes properly).

  And don't keep any `strong` pointers to `photo` after you delete it!

- `prepareForDeletion`

  This is another method we sometimes put in a category of an `NSManagedObject` subclass …

  ```
  @implementation Photo (Deletion)
  - (void)prepareForDeletion
  {
      // we don't need to set our whoTook to nil or anything here (that will happen automatically)
      // but if Photographer had, for example, a "number of photos taken" attribute,
      //     we might adjust it down by one here (e.g. self.whoTook.photoCount--).
  }
  @end
  ```

Querying

- So far you can …
  - Create objects in the database with `insertNewObjectForEntityForName:inManagedObjectContext:`.
  - Get/set properties with `valueForKey:`/`setValue:forKey:` or `@property`s in a custom subclass.
  - Delete objects using the `NSManagedObjectContext` `deleteObject:` method.
- One very important thing left to know how to do: QUERY
  - Basically you need to be able to retrieve objects from the database, not just create new ones
  - You do this by executing an `NSFetchRequest` in your `NSManagedObjectContext`
- Four important things involved in creating an `NSFetchRequest`
  1. `Entity` to fetch (required)
  2. How many objects to fetch at a time and/or maximum to fetch (optional, default: all)
  3. `NSSortDescriptor`s to specify the order in which the array of fetched objects are returned
  4. `NSPredicate` specifying which of those Entities to fetch (optional, default is all of them)

Querying

- Creating an `NSFetchRequest`

  We'll consider each of these lines of code one by one …

```
NSFetchRequest *request = [NSFetchRequest fetchRequestWithEntityName:@"Photo"];
request.fetchBatchSize = 20;
request.fetchLimit = 100;
request.sortDescriptors = @[sortDescriptor];
request.predicate = ...;
```

- Specifying the kind of Entity we want to fetch

  A given fetch returns objects all of the same Entity.

  You can't have a fetch that returns some `Photos` and some `Photographers` (it's one or the other).

- Setting fetch sizes/limits

  If you created a fetch that would match 1000 objects, the request above faults 20 at a time.

  And it would stop fetching after it had fetched 100 of the 1000.

Querying

- NSSortDescriptor

  When we execute a fetch request, it's going to return an `NSArray` of `NSManagedObjects`.
  `NSArrays` are "ordered," so we should specify the order when we fetch.

  We do that by giving the fetch request a list of "sort descriptors" that describe what to sort by.

```
NSSortDescriptor *sortDescriptor =
    [NSSortDescriptor sortDescriptorWithKey:@"title"
                                  ascending:YES
                                   selector:@selector(localizedStandardCompare:)];
```

  The `selector:` argument is just a method (conceptually) sent to each object to compare it to others.
  Some of these "methods" might be smart (i.e. they can happen on the database side).
  `localizedStandardCompare:` is for ordering strings like the Finder on the Mac does (very common).

  We give an array of these `NSSortDescriptors` to the `NSFetchRequest` because sometimes
  we want to sort first by one key (e.g. last name), then, within that sort, by another (e.g. first name).
  Examples: `@[sortDescriptor]` or `@[lastNameSortDescriptor, firstNameSortDescriptor]`

Querying

- NSPredicate

  This is the guts of how we specify exactly which objects we want from the database.

- Predicate formats

  Creating one looks a lot like creating an NSString, but the contents have semantic meaning.

```
NSString *serverName = @“flickr-5”;
NSPredicate *predicate =
    [NSPredicate predicateWithFormat:@“thumbnailURL contains %@”, serverName];
```

- Examples

```
@“uniqueId = %@”, [flickrInfo objectForKey:@“id”] // unique a photo in the database
@“name contains[c] %@”, (NSString *) // matches name case insensitively
@“viewed > %@”, (NSDate *) // viewed is a Date attribute in the data mapping
@“whoTook.name = %@”, (NSString *) // Photo search (by photographer’s name)
@“any photos.title contains %@”, (NSString *) // Photographer search (not a Photo search)
```

  Many more options. Look at the class documentation for NSPredicate.

Querying

- NSCompoundPredicate

  You can use AND and OR inside a predicate string, e.g. `@"(name = %@) OR (title = %@)"`

  Or you can combine NSPredicate objects with special NSCompoundPredicates.

```
NSArray *array = @[predicate1, predicate2];
NSPredicate *predicate = [NSCompoundPredicate andPredicateWithSubpredicates:array];
```

  This predicate is "predicate1 AND predicate2". Or available too, of course.

Advanced Querying

- Key Value Coding

  Can actually do predicates like `@“photos.@count > 5”` (Photographers with more than 5 photos).

  `@count` is a function (there are others) executed in the database itself.

  https://developer.apple.com/library/ios/documentation/cocoa/conceptual/KeyValueCoding/Articles/CollectionOperators.html.

  By the way, all this stuff (and more) works on dictionaries, arrays and sets too …

  e.g. `[propertyListResults valueForKeyPath:@“photos.photo.@avg.latitude”]` on Flickr results

  returns the average latitude of all of the photos in the results (yes, really)

  e.g. `@“photos.photo.title.length"` would return an array of the lengths of the titles of the photos

- NSExpression

  Advanced topic. Can do sophisticated data gathering from the database.

  No time to cover it now, unfortunately.

  If interested, for both NSExpression and Key Value Coding queries, investigate …

```
NSFetchRequest *request = [NSFetchRequest fetchRequestWithEntityName:@“…”];
[request setResultType:NSDictionaryResultType]; // fetch returns array of dicts instead of NSMO’s
[request setPropertiesToFetch:@[@“name”, expression, etc.]];
```

Querying

- Putting it all together

  Let's say we want to query for all Photographers …

```
NSFetchRequest *request = [NSFetchRequest fetchRequestWithEntityName:@“Photographer”];
```

  … who have taken a photo in the last 24 hours …

```
NSDate *yesterday = [NSDate dateWithTimeIntervalSinceNow:-24*60*60];
request.predicate = [NSPredicate predicateWithFormat:@“any photos.uploadDate > %@”, yesterday];
```

  … sorted by the Photographer's name …

```
request.sortDescriptors = @[[NSSortDescriptor sortDescriptorWithKey:@“name” ascending:YES]];
```

Querying

- Executing the fetch

```
NSManagedObjectContext *context = aDocument.managedObjectContext;
NSError *error;
NSArray *photographers = [context executeFetchRequest:request error:&error];
```

Returns `nil` if there is an error (check the `NSError` for details).
Returns an empty array (not `nil`) if there are no matches in the database.
Returns an `NSArray` of `NSManagedObjects` (or subclasses thereof) if there were any matches.
You can pass `NULL` for `error:` if you don't care why it fails.

That's it. Very simple really.

Query Results

- Faulting

  The above fetch does not necessarily fetch any actual data.

  It could be an array of "as yet unfaulted" objects, waiting for you to access their attributes.

  Core Data is very smart about "faulting" the data in as it is actually accessed.

  For example, if you did something like this …

```
for (Photographer *photographer in photographers) {
    NSLog(@"fetched photographer %@", photographer);
}
```

  You may or may not see the names of the photographers in the output

  (you might just see "unfaulted object", depending on whether it prefetched them)

  But if you did this …

```
for (Photographer *photographer in photographers) {
    NSLog(@"fetched photographer named %@", photographer.name);
}
```

  … then you would definitely fault all the Photographers in from the database.

  That's because in the second case, you actually access the `NSManagedObject`'s data.

Core Data Thread Safety

- NSManagedObjectContext is not thread safe
  - Luckily, Core Data access is usually very fast, so multithreading is only rarely needed.
  - Usually we create NSManagedObjectContext using a queue-based concurrency model.
  - This means that you can only touch a context and its NSMO's in the queue it was created on.
- Thread-Safe Access to an NSManagedObjectContext

```
[context performBlock:^{  // or performBlockAndWait:
    // do stuff with context in its safe queue (the queue it was created on)
}];
```

  - Note that the Q might well be the main Q, so you're not necessarily getting "multithreaded."
- Parent Context (advanced)
  - Some contexts (including UIManagedDocument ones) have a parentContext (a @property on NSMOC).
  - This parentContext will almost always be on a separate queue, but access the same database.
  - This means you can performBlock: on it to access the database off the main queue (e.g.).
  - But it is still a different context, so you'll have to refetch in the child context to see any changes.

Core Data

- There is so much more (that we don't have time to talk about)!
  - Optimistic locking (`deleteConflictsForObject:`)
  - Rolling back unsaved changes
  - Undo/Redo
  - Staleness (how long after a fetch until a refetch of an object is required?)

Coming Up

- Next Week
  - Multitasking
  - Advanced Segueing
  - Map Kit?