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5.3 Fundamentals of Core Data Versioning

So, what is the magic behind all of this? How does the data migration actually work? As we already explored in the previous chapters, Core Data works with MOM objects that describe the data entities, their attributes, and their relationships. Core Data versioning works with those same MOM objects but takes the design one step further. Each entity version in each data model has a unique hash. When Core Data loads a persistent store from disk, it resolves the matching hashes in the persistent store against the MOM objects included with the application. If the matching MOM is not flagged as the “current” MOM, then data migration kicks in.

How Data Migration Works

Core Data handles data migration in a very straightforward manner. Whenever a persistent store needs to be migrated, there are three steps.

Copying of the Entities with Attributes

In the first pass of the migration, Core Data creates new entities in the new persistent store for every entity in the old store. These entities have their attributes copied over but not their relationships. During this phase, Core Data also keeps a reference to the old unique ID for each entity to be used in phase 2.

Creating Relationships Between the Entities

In the second pass, Core Data builds all the relationships between the entities based on the previous relationships. This is where the reference in phase 1 is used.

Validation of the New Store

During the migration, all validation rules are turned off, and Core Data ignores the child classes defined in the MOM. Therefore, it is possible that some data validation rules got broken during the migration. In the final phase of the migration, Core Data goes back through the store and checks all the validation rules to ensure that the data is in a valid state.

Model Versions and Hashes

The word *versioning* has been used through this chapter as well as other material to describe data migration in Core Data. Unfortunately, it is an inaccurate term. Versioning implies that there is an order or
precedence to the models. This is not accurate when it comes to data model versioning/migration in Core Data.

**Entity Hashes**

Instead of keeping track of a version number, creation date, or some other potentially chronological identifier, Core Data generates a hash for each entity in a model. Those hashes are then stored within the persistent stores created with that model for later comparison. When a persistent store is loaded, the first thing that Core Data does is to retrieve the metadata from that store. Inside that metadata is a list of every entity type in the store along with the hash for that entity. Core Data then compares that list of hashes against the hashes of the “current” MOM. If they match, then everything is fine, and the store is loaded. If they do not match, then Core Data checks the options on the load persistent store call to see whether automatic data migration is requested. If it is not, then the error message from Section 5.1, *Some Maintenance Before We Migrate*, on page 76 is presented to the user.

**Changing the Hash Values**

Surprisingly, not everything that changes inside a MOM causes the hash of the entities inside to change. There are actually quite a few things that we can do to a model that does not trigger data migration at all.

**Changes That Alter the Entity Hash**

If any of the following are changed on an entity, the entity will report a different hash:

- Name: The name of the entity
- Inheritance: Changing who the parent entity is
- Persistent properties: Adding or removing a property

In addition, changing the following for properties will also trigger a change to the entity hash:

- Name: The name of the property
- Optionality/read-only: Changing whether the property is optional or read-only
- Attribute type: Changes to the type of value stored
• Relationship: Changes to the destination, minimum/maximum count, the delete rule, or the inverse

Changes That Do Not Alter the Entity Hash
The following changes to an entity will not trigger a change to the entity hash:

• Class name: Changes to the NSManagedObject subclass
• Transient properties: Properties that are not saved in the persistent store
• User info: Adding, removing, or changing the user info keys/values
• Validation predicates: Adding, removing, or changing the validation rules
• Default values: Adding, removing, or changing the default value of an attribute

In addition, the following changes to the properties of an entity will also not change the hash of the entity:

• User info: Adding, removing, or changing the user info key/values
• Validation predicates: Adding, removing, or changing the validation rules

The general distinction between things that do and do not affect version hashes is whether the changes impact the store schema. Things such as the class name impact only the runtime, not the structure of the persistent data.

Mapping Models
If Core Data detects that an upgrade to the persistent store is needed, it looks for three files in the application bundle:

• The MOM that matches the hash from the persistent store
• The current MOM
• The mapping model for those two MOM objects

Assuming that all three files are located (and if they aren’t, bad things happen), Core Data will then migrate the data in the persistent store from the old MOM to the new MOM. Once the migration is complete, the stack (MOC, PS, and MOM) is fully initialized, and the application
continues. This, of course, is the happy path, and there are several safeguards in place to allow the application developer to control failures.

### 5.4 A More Complex Migration

Now that we have gotten our feet wet with data migration and versioning, it’s time to test the limits of what we can do. To that end, we will create another migration that is far more complex. Specifically, the ingredients really should be in another entity with a many-to-many relationship to the recipe. In addition, the units of measure should also be in their own table. And since we have the engine apart as it were, we can put in the cost of the ingredients as well as the unit size for ordering. This will allow us to estimate the cost per serving.

With these changes in mind, the data model will look like Figure 5.7. As we learned earlier in this chapter, we will need a mapping model to go from version 2 to version 3. But what about users who are still on version 1? For automatic versioning to work, we would also need a mapping model from version 1 to version 3. Since that will be a variation on our version 2 to version 3 model, we will skip it for the moment.
The biggest challenge for this migration is the introduction of the new entities. Unlike the Author entity from before, during this migration, not only are we creating new entities but we are having to extract data from existing entities to build those new entities, and we have to then properly link the new entities back to their source. To make it even more interesting, we do not want these new entities duplicated. This complexity is far beyond the basic migration that we did for version 2, and it is going to require writing a custom NSEntityMigrationPolicy to handle it.

**NSEntityMigrationPolicy**

A NSEntityMigrationPolicy allows us to control exactly how a migration is handled. Although there are quite a few methods that we can override depending on our needs, the two methods that we need for this migration are as follows:

- `(BOOL)createDestinationInstancesForSourceInstance:`
  ```swift
  (NSManagedObject*)source
  (NSEntityMapping*)mapping
  (NSMigrationManager*)manager
  (NSError**)error
  ```

- `(BOOL)createRelationshipsForDestinationInstance:`
  ```swift
  (NSManagedObject*)dInstance
  (NSEntityMapping*)mapping
  (NSMigrationManager*)manager
  (NSError**)error
  ```

**createDestinationInstancesForSourceInstance:**

The first method, `createDestinationInstancesForSourceInstance:` is called for each entity in the source store that is associated with this migration policy. For example, during the migration of the RecipeIngredient entities and the creation of the Ingredient entities, this method would be called for each RecipeIngredient, and it would be expected that an ingredient entity would be created or associated with the incoming RecipeIngredient as a result. The code to implement this breaks down as follows:

```swift
Download GrokkingRecipes_v3/RecipeIngredientToIngredient.m

NSManagedObjectContext *destMOC = [manager destinationContext];
NSString *destEntityName = [mapping destinationEntityName];

// The name of the ingredient
NSString *name = [source valueForKey:@"name"];
```

In the first part of the method, we are simply setting up references that will be needed later. Specifically, we are getting a reference to the destination NSManagedObjectContext, which we will need to create new
entities, the name of the destination entity, and most important the
name value from the incoming entity. Since the incoming entity is a
RecipeIngredient, the name value will be the name of the ingredient that
we now want to reference.

```objective-c
NSMutableDictionary *userInfo = (NSMutableDictionary *)[manager userInfo];
if (!userInfo) {
    userInfo = [NSMutableDictionary dictionary];
    [manager setUserInfo:userInfo];
}
NSMutableDictionary *ingredientLookup = [userInfo valueForKey:@"ingredients"];
if (!ingredientLookup) {
    ingredientLookup = [NSMutableDictionary dictionary];
    [userInfo setValue:ingredientLookup forKey:@"ingredients"];
}
NSManagedObject *dest = [ingredientLookup valueForKey:name];
if (!dest) {
    dest = [NSEntityDescription insertNewObjectForEntityForName:destEntityName
        inManagedObjectContext:destMOC];
    [dest setValue:name forKey:@"name"];
    [ingredientLookup setValue:dest forKey:name];
}
```

In this next section of code, we deal with the possibility that the Ingre-
dient entity that we need to reference has already been created. Ra-
ther than doing a fetch against the destination context every time, we have
a hash built up and stored within the NSMigrationManager. The NSMigra-
tionManager has an NSDictionary called userInfo that is perfectly suited for
this purpose. We first lazily initialize this dictionary, and then we lazily
initialize another NSDictionary inside it to store references to the Ingre-
dient entities using the name of the ingredient as the key. With this, we
can make sure that each Ingredient is created only once. If the Ingre-
dient does not exist yet, then we create it and store it back inside of the
userInfo cache.

```objective-c
[manager associateSourceInstance:source
    withDestinationInstance:dest
    forEntityMapping:mapping];
```

The last thing that we need to do is to tell the manager about the asso-
ciation. Since the manager keeps track of all associations between the
two NSManagedObjectContext objects, we need to inform it of this new
entity that was just created and that it is associated with the source
entity that was passed in. Once that is complete, we return \textsc{yes}, and we are done.

\textbf{createRelationshipsForDestinationInstance:}

In a properly designed data model, this method will rarely if ever be needed. The intention of this method (which is called in the second pass) is to build any relationships for the new destination entity that was created in the previous method. However, if all the relationships in the model are double sided, then this is not necessary because we already set up one side of them. If for some reason there is an entity in the model that is not double sided, then additional code would be required in this method to handle the one-sided relationship. Since we do not need that functionality in our model, we just return \textsc{yes}.

```objc
- (BOOL)createRelationshipsForDestinationInstance:(NSManagedObject*)dInstance
tenentMapping:(NSEntityMapping*)mapping
manager:(NSMigrationManager*)manager
error:(NSError**)error
{
    return \textsc{yes};
}
```

5.5 \textbf{Automatic Data Migration}

If your data migration needs are easy to handle and your application is not coming from Tiger, then automatic migration is probably all that is needed. Automatic migration lets Core Data handle all the details and assumes the following:

- Every persistent store that the application will come up against has hash metadata.

- Every persistent store that the application will come up against has a corresponding model stored inside the application’s bundle.

- Every persistent store that the application will come up against has a mapping model from its MOM to the current MOM.

If the application can meet these three criteria (and any application that has begun its life in Leopard should), then automatic migration should be able to do all of the dirty work for us.

To enable automatic versioning, we need to set a preference on the \texttt{NSPersistentStoreCoordinator} while adding a persistent store. Previously,
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