▸ ▸ ▸ Module 1
Objectstore Mechanism

Mastering Object-Oriented Analysis and Design with UML

Appendix: ObjectStore Mechanism

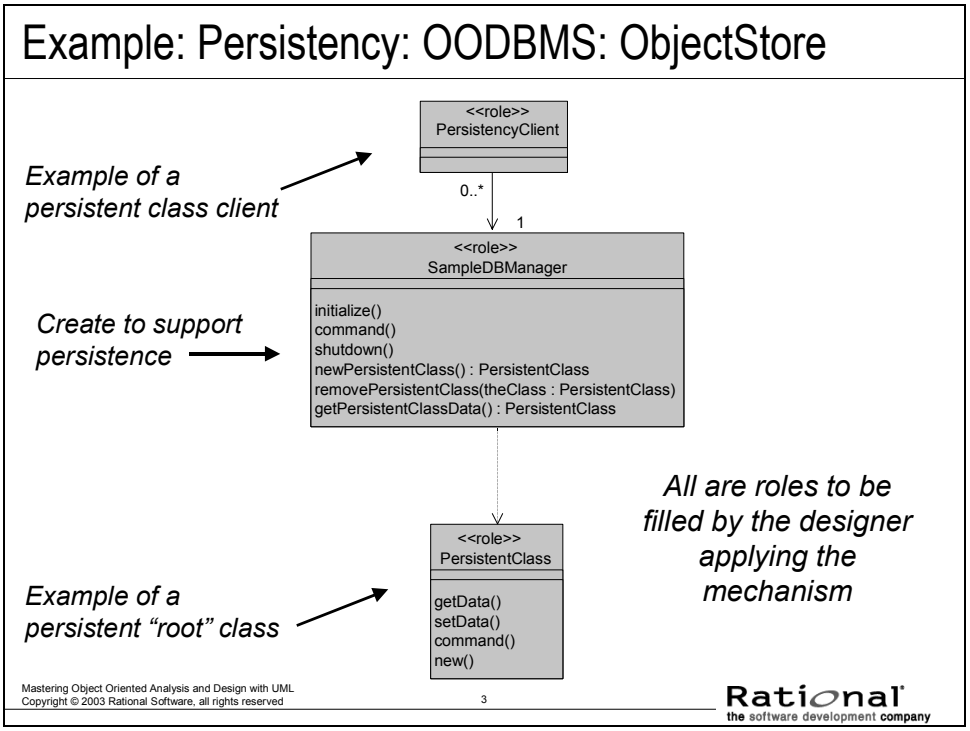
Topics

Identify Design Mechanisms Slides

Identify Design Mechanisms Slides

The following slides can be inserted during the Identify Design Mechanisms module

Example: Persistency: OODBMS: ObjectStore



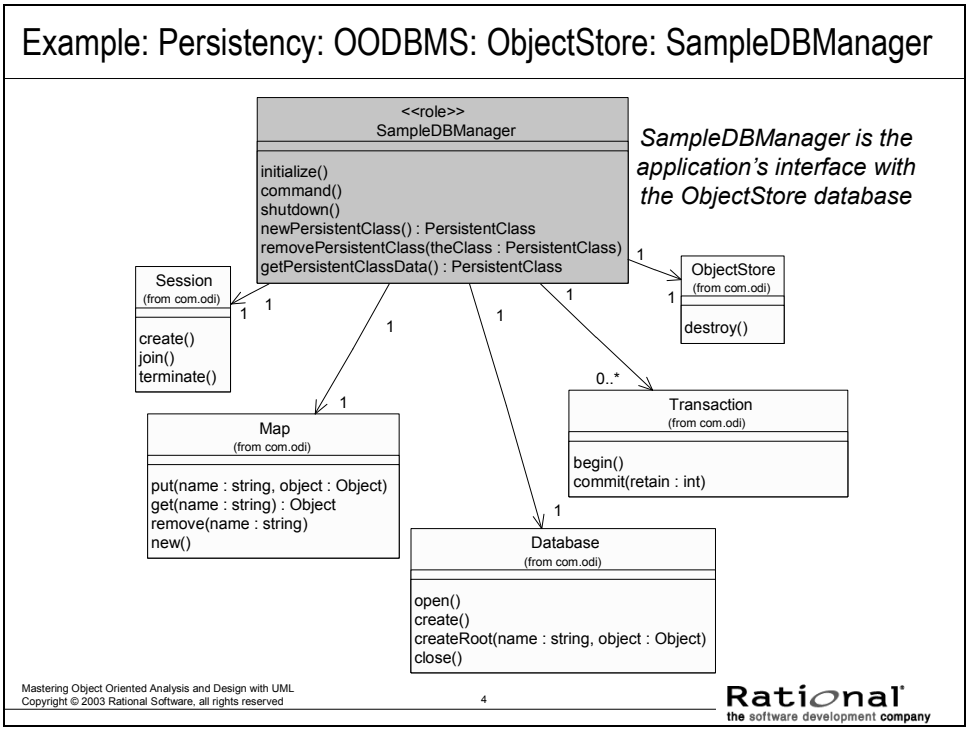
The next few slides demonstrate the pattern of use of the persistent mechanism chosen for the OODBMS classes in our example: ObjectStore. The <<role>> stereotype is used to which classes are roles that should be filled by the designer as they apply the mechanism.

The SampleDBManager provides a single entry point into a specific ObjectStore database. There is one SampleDBManager class per ObjectStore database instance. Clients interface with the SampleDBManager class to get access to PersistentClass objects in the database. The client can create a new PersistentClass instance with the "newClass( )" operation, or invoke a PersistentClass command with a "command( )" operation (the "command( )" operation is replaced with operations from the PersistentClass). The client initializes and shuts down the ObjectStore database through the SampleDBManager class, but does not need to be aware of any of the database details.

In the context of the ObjectStore database, the PersistentClass is considered the "root class".

You define the PersistentClass for persistent use the same way you define it for transient use. Other than the required "import com.odi.*" statement, there is almost no special code for persistent use of the PersistentClass. Once you import the ObjectStore classes, a special post-processor modifies the Java byte code to handle all the persistence. No other changes are required.

Example: Persistency: OODBMS: ObjectStore: SampleDBManager



The above diagram provides a more detailed look at the SampleDBManager class that must be defined by the designer (hence the <<role>> stereotype). The **SampleDBManager** class contains most of the database-specific code, such as starting and ending transactions. The SampleDBManager class has static members that keep track of the Database that is open. It also has a number of static methods, each of which executes a transaction in the ObjectStore database.

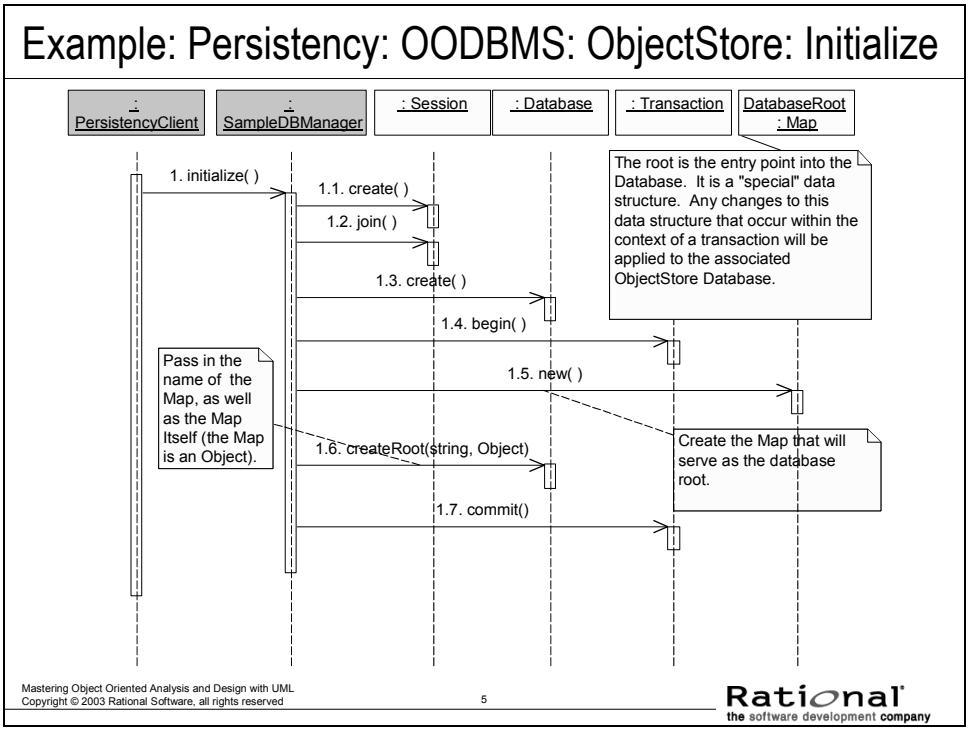
The **Database** class is an ObjectStore class that represents the actual ObjectStore database. Before you begin creating persistent objects, you must create a database to hold the objects. An application can access more that one Database instance at a time.

The **Map** is a persistent map container classes that stores key/value pairs with a unique key. You do not have to use the Map class as the collection. You can use any number of collections that ObjectStore provides, or you can define your own. We have chosen to use the Map.

The **ObjectStore** class defines system-level operations that are not specific to any database.

A database **Session** must be created in order to access the database and any persistent data. A session is the context in which ObjectStore databases are created or opened, and in which transactions are executed. All persistent objects must be accessed within an ObjectStore **Transaction**. Only one transaction at a time can exist in a session.

Example: Persistency: OODBMS: ObjectStore: Initialize



Initialize must occur before any persistent class can be accessed.

Once the session has been created and joined, the SampleDBManager must open and create the new database.

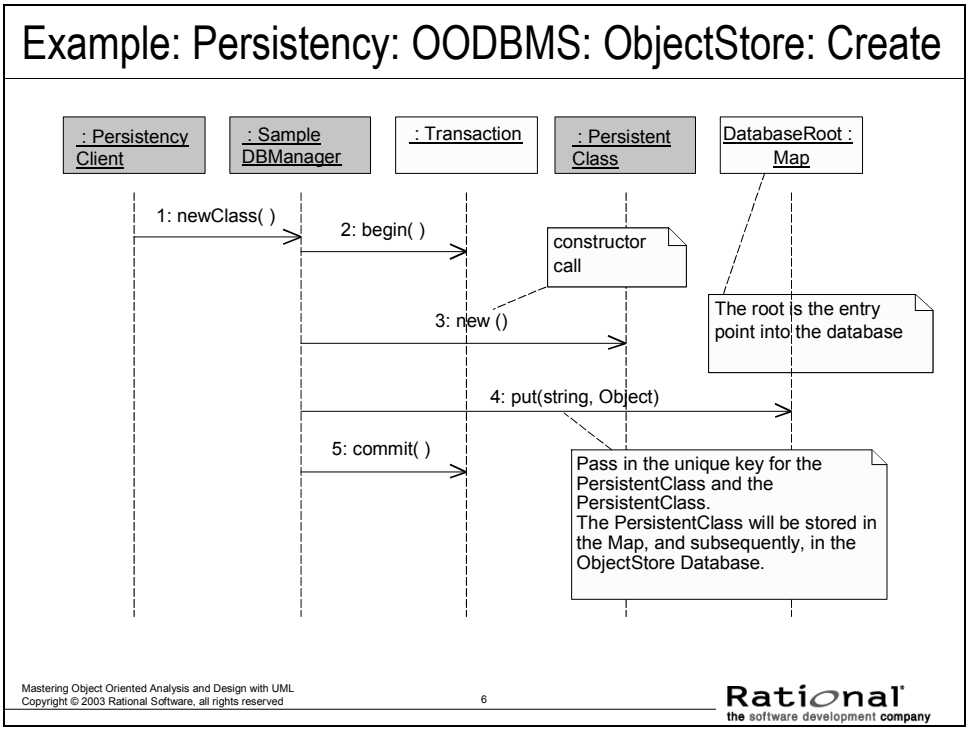
To create the database, the SampleDBManager creates a new transaction and creates the "root" of the database with the "createRoot()" operation.

The root is the entry point into the Database (the root class is the top-level class in the object database). It is a "special" data structure. Any changes to this data structure that occur within the context of a transaction will be applied to the associated ObjectStore Database. There may be multiple database roots.

In the above example, a Map was chosen. It will contain instances of the root class and all “reachable” classes.

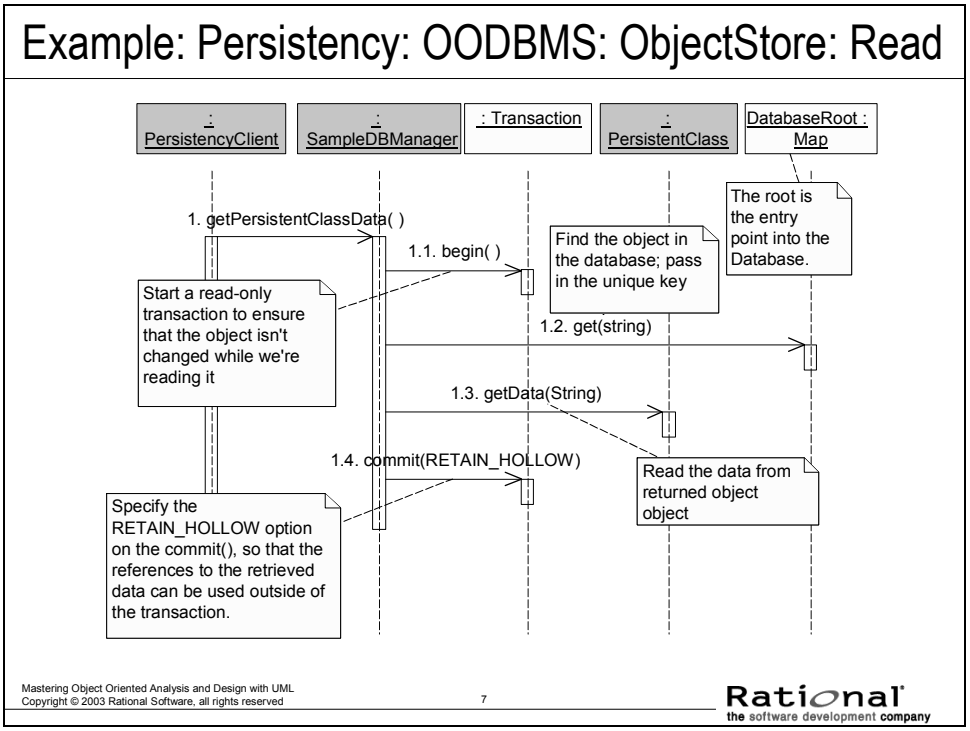
Once the root has been created, the transaction is committed.

Example: Persistency: OODBMS: ObjectStore: Create



To create a new instance of PersistentClass in the database, the SampleDBManager first creates a transaction and then calls the constructor for PersistentClass. Once the class has been constructed the class is added to the database via the root "put()" operation. The transaction is then committed.

Example: Persistency: OODBMS: ObjectStore: Read



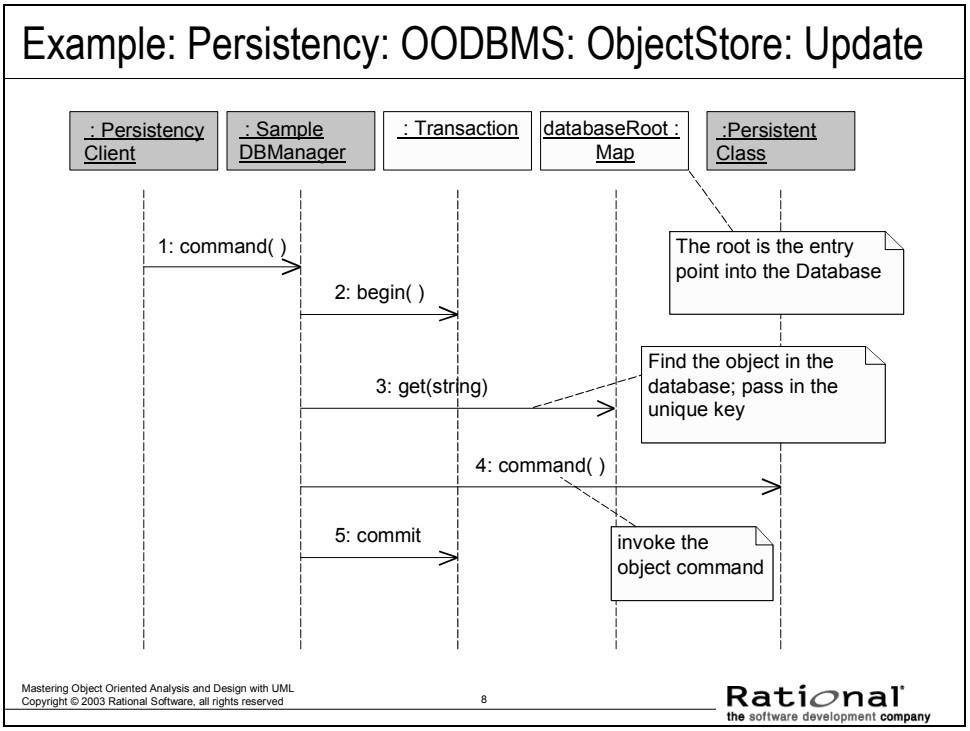
To read an object , the SampleDBManager first creates a new read-only transaction then looks up the object using the database root "get()" operation. Once the object has been found it can be read with the "getData()" method and the transaction committed. Once the transaction is committed the object can then be updated.

To read an object , the SampleDBManager first creates a new read-only transaction then looks up the object using the Map "get()" operation. Once the object has been found it can be read with the "getData()" operation, and the transaction committed. RETAIN_HOLLOW is specified for the commit, so the references to the object and the retrieved data can be used outside of the retrieval transaction. Once the transaction is committed the object can then be updated.

Note: Even though RETAIN_HOLLOW is specified, it does not guarantee the integrity of the reference outside of the transaction. There is still some risk that the reference could be outdated. RETAIN_HOLLOW basically says "I'm consciously taking such a risk". If that option was not used, then the references would not be available.

Other possible values for the retain parameter include the following: ObjectStore.RETAIN_STALE, ObjectStore.RETAIN_HOLLOW, OjectStore.RETAIN_READONLY, ObjectStore.RETAIN_UPDATE, and ObjectStore.RETAIN_TRANSIENT.

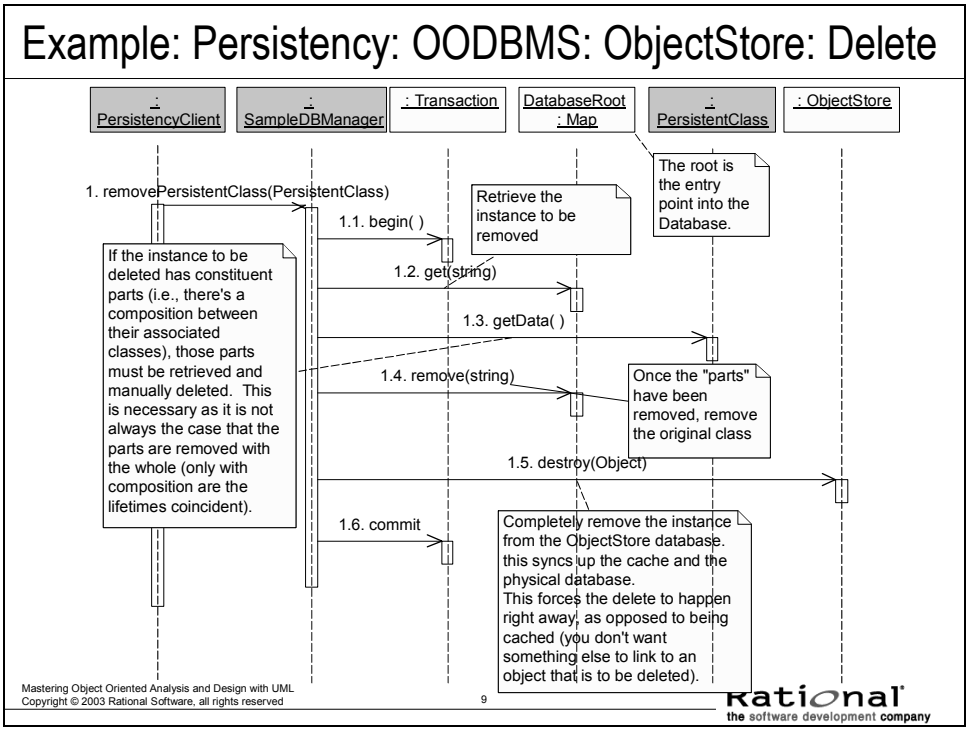
Example: Persistency: OODBMS: ObjectStore: Update



To update an object , the SampleDBManager first creates a new transaction then looks up the object using the database root "get()" operation (the string parameter is the unique ID for the class associated with the invoked SampleDBManager command(); knowing what this is is the SampleDBManager's responsibility). Once the object has been found a command can be invoked on it (the command() operation shown above is just a placeholder for some command you might do on the PersistentClass). When the command is complete the transaction is committed.

A separate put() to the Map is not necessary as the get() operation returns a reference to the persistent object and any changes to that object, if made in the context of a transaction, are automatically committed to the database.

Example: Persistency: OODBMS: ObjectStore: Delete

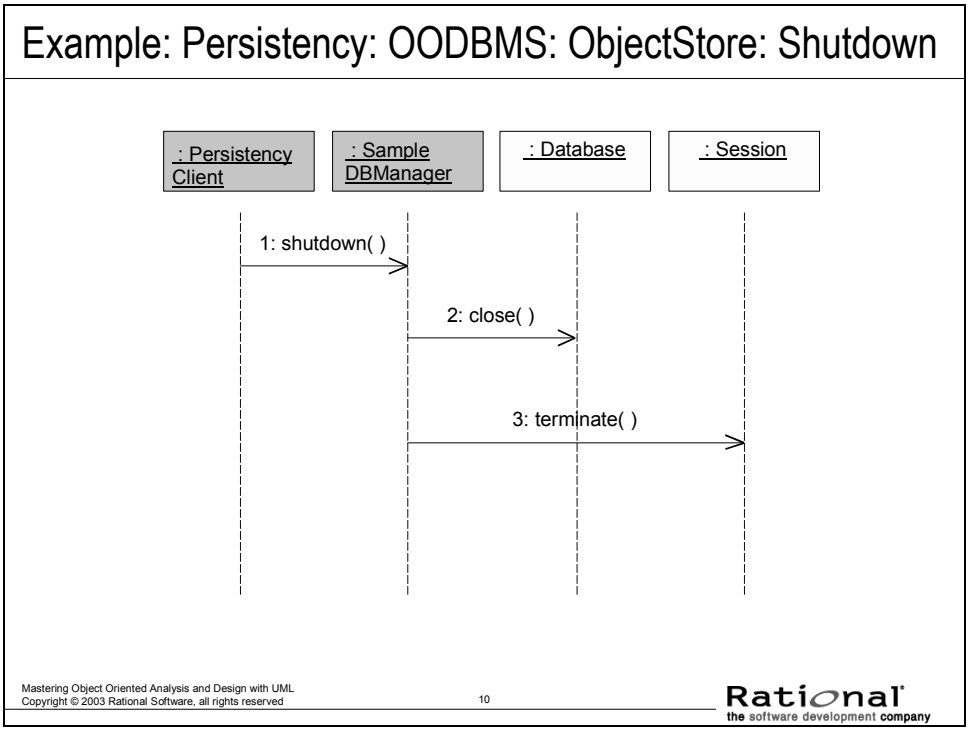


To delete an object from the database, the SampleDBManager first creates a new transaction, removes any constituent parts, and then removes the object using the database root "remove()" operation. The object is then completely removed from the ObjectStore database immediately via ObjectStore.destroy (). Once the object has been removed, the transaction is committed.

Thus, in ObjectStore, delete really has two steps -- removal from the container class that is the database in memory, and removal from the physical database. That is because you want the deletion to occur right away, as opposed to being cached.

Note: In case you are wondering why there is a retrieve from the database prior to deleting the object (e.g., message 1.2 get(string()). This is necessary for the following reason: If the transaction that obtained the reference to the PersistentClass was committed with RETAIN_HOLLOW, then we could just use the reference that's passed in. If not, then we have to get a fresh reference from the database based on the parameter passed into the delete operation.

Example: Persistency: OODBMS: ObjectStore: Shutdown



To shutdown the database, the SampleDBManager must close the database and terminate the session.

Incorporating ObjectStore: Steps

Incorporating ObjectStore: Steps

- Provide access to the class libraries needed to implement ObjectStore access
  - *Dependency on com.odi*
- Select the database root class(es)
  - *Student class*
- Select the container class(es) that will serve as the database root(s) (contains the selected root class(es)
  - *Map (from com.odi)*
  - *Key will be Student ID*

(continued)

The above is a summary of the steps that can be used to implement the OODBMS Persistency mechanism (ObjectStore). The italicized text describes the architectural decisions made with regards to Objectstore for our Course Registration example.

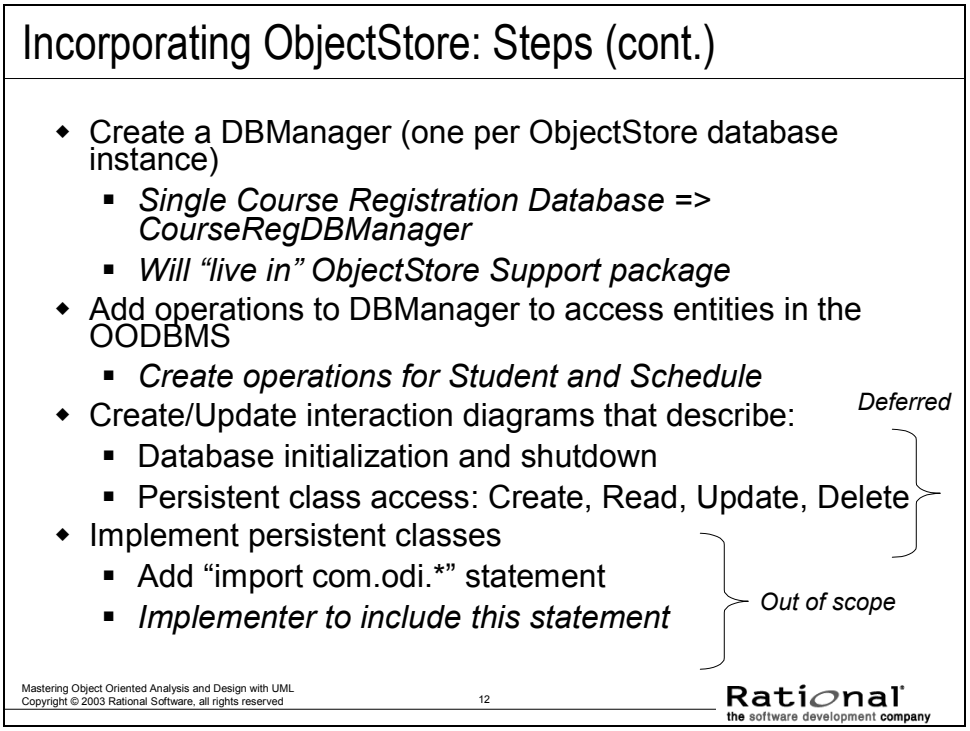
One of the most important decisions that must be made when incorporating ObjectStore into your design is what the root class(es) are going to be, and what container class will serve as the database root, where these classes will be stored. Remember the database root (the selected container class) is a special data structure. It is associated with a specific ObjectStore database (see the Initialize interaction diagram provided earlier in this module). Any changes to this "special" data structure that occur within the context of a transaction will be applied to the associated ObjectStore Database. There may be multiple database roots

For the Course Registration System, a single root class was chosen -- Student.

The selected container was the Map, where the unique key to access the Students will be StudentID.

The remaining steps are described on the following slide.

Incorporating ObjectStore: Steps (cont.)



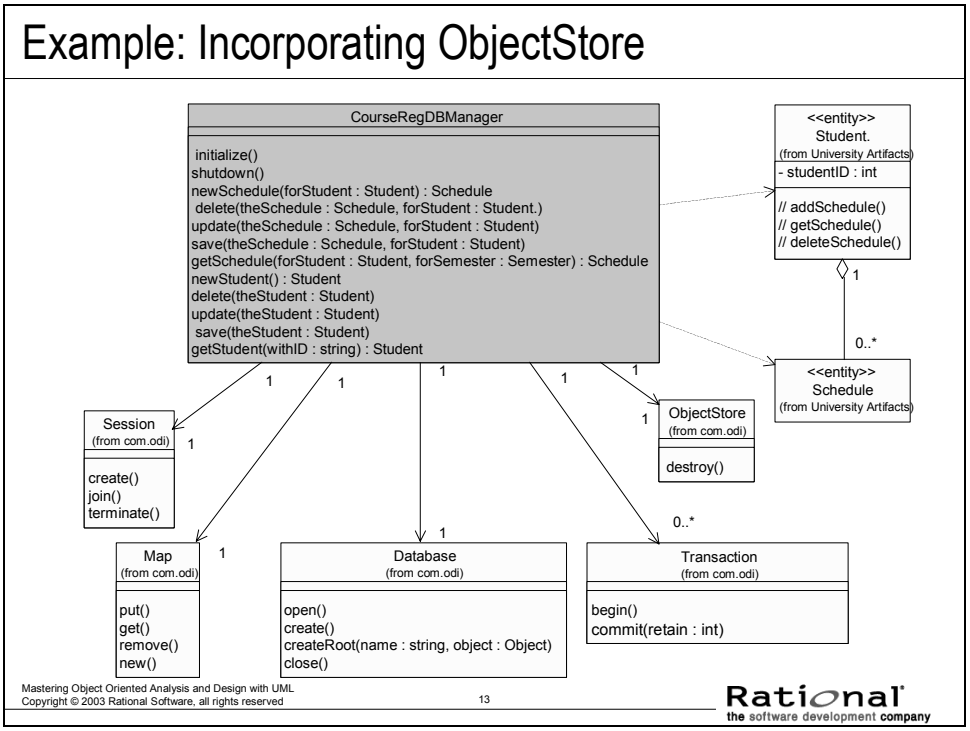
There is one DBManager class per ObjectStore database instance. For the Course Registration System example, there will be one ObjectStore database, the Course Registration Database, that contains student (and schedule) information for the university. Thus, there will be one CourseRegDBManager that will be in a new ObjectStore Support package.

Operations must be added to the DBManager class to access the OODBMS persistent entities in the database. For the CourseRegBDManager class, operations will be added to access Student and Schedule information since that is required for the core system functionality.

The PersistentClass is defined for persistent use the same way it is defined for transient use, with the addition of the required "import com.odi.*" statement.. Once you import the ObjectStore classes, a special post-processor modifies the Java byte code to handle all the persistence. Implementing the persistent classes is out of the scope of this course (it is part of Implementation, not Analysis and Design).

At this point, the architect provides guidance to the designers and makes sure that the architecture has the necessary infrastructure to support the mechanism. Thus, the DBManager and the supporting architectural packages are defined, but the actual incorporation of the mechanism and the development of the detailed interaction diagrams are deferred until detailed design.

Example: Incorporating ObjectStore



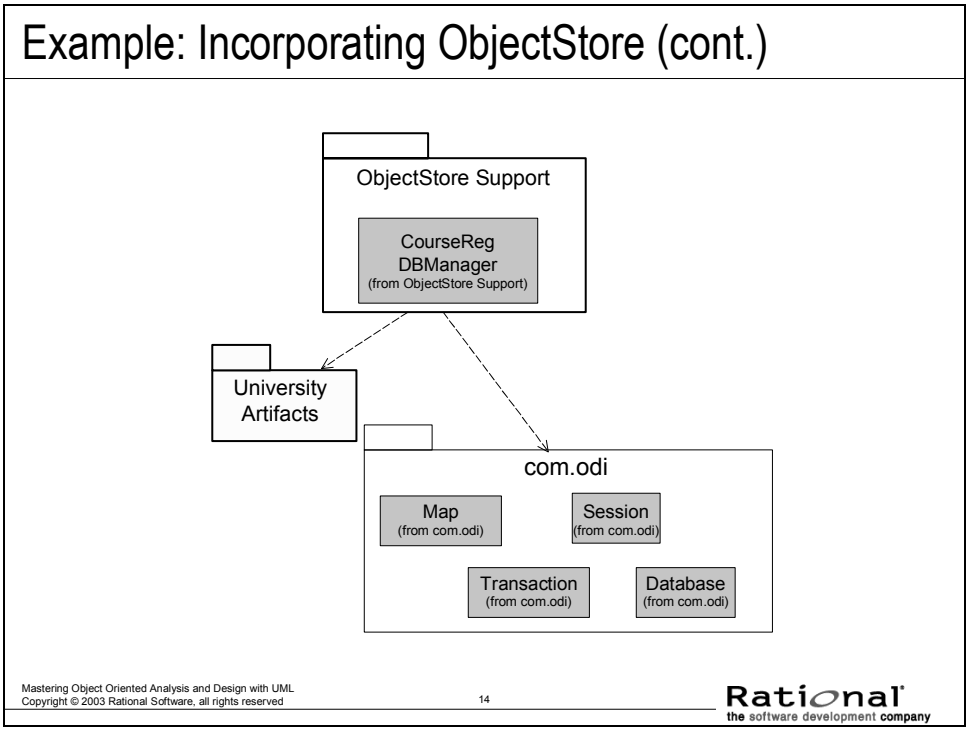
The above diagram shows the defined CourseRegDBManager which will control access to the persistent class, Student, and the Student's Schedules.

Remember, Student was selected as the "root class", and StudentID was selected as the unique id into the selected container class, the Map.

Operations to access Schedule were added to the CourseRegDBManager for easier design incorporation. The CourseRegDBManager manages the details of loading the appropriate Student (the selected root class) before accessing Schedule.

Note: In the above diagram, some attributes and operations have been suppressed for clarity.

Example: Incorporating ObjectStore (cont.)



The above diagram demonstrates the architectural implications (specifically, the package dependency implications) of incorporating ObjectStore into the course Registration System design:

- The ObjectStore Support package was created. It will contain the business-specific design elements that support the ObjectStore OODBMS persistency mechanism. This includes the previously created CourseRegDBManager.
- The CourseRegDBManager will need to the design elements that support the ObjectStore OODBMS persistency mechanism, so a dependency was added from the ObjectStore Support package to the com.odi package.

The name of the com.odi package in the model reflects the naming convention for third party Java software (i.e., use the reverse of the domain name). The Java language suggests this scheme so that different vendors don't step on each other with their Java classes. The idea is that domain names are unique so they're won't be any name clashes. Thus, com.odi has nothing to do with Microsoft COM/DCOM. "odi" stands for Object Design, Inc. which is the name of the company that makes ObjectStore.

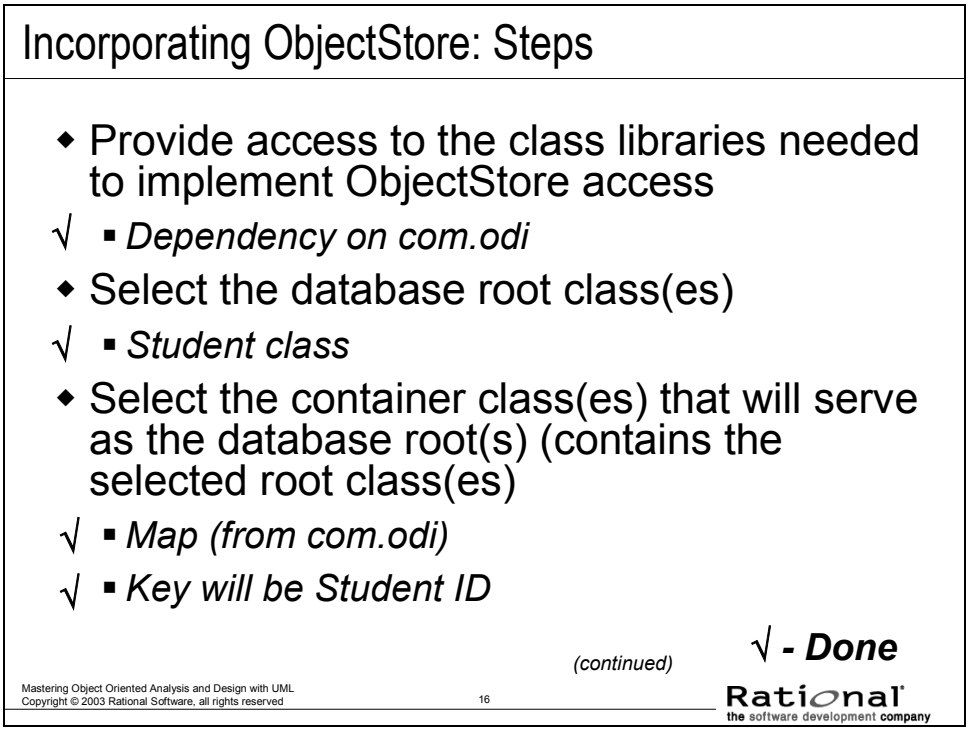
- The CourseRegDBManager will need to have access to the persistent classes, so a dependency from the ObjectStore Support package to the the UniveristyArtifacts package was added.

Use-Case Design Slides

Use-Case Design Slides

The following slides can be inserted during the Use-Case Design module

Incorporating ObjectStore: Steps



The above is a summary of the steps that can be used to implement the OODBMS Persistency mechanism (ObjectStore). The italicized text describes the architectural decisions made with regards to Objectstore for our Course Registration example.

These steps were introduced in Identify Design Mechanisms. They are repeated here for convenience. The check marks indicate what steps have been completed. In Use-Case Design, where will continue incorporate this mechanism.

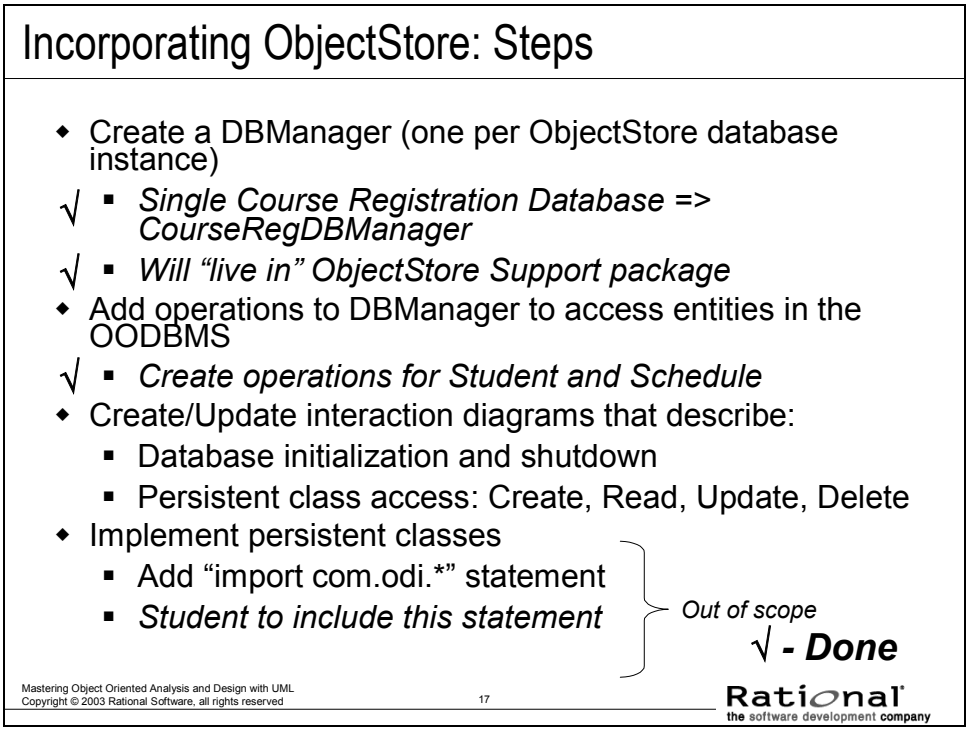
One of the most important decisions that must be made when incorporating ObjectStore into your design is what the root class(es) are going to be, and what container class will serve as the database root, where these classes will be stored. Remember the database root (the selected container class) is a special data structure. It is associated with a specific ObjectStore database (see the Initialize interaction diagram provided earlier in this module). Any changes to this "special" data structure that occur within the context of a transaction will be applied to the associated ObjectStore Database. There may be multiple database roots

For the Course Registration System, a single root class was chosen -- Student.

The selected container was the Map, where the unique key to access the Students will be StudentID.

The remaining steps are described on the following slide.

Incorporating ObjectStore: Steps



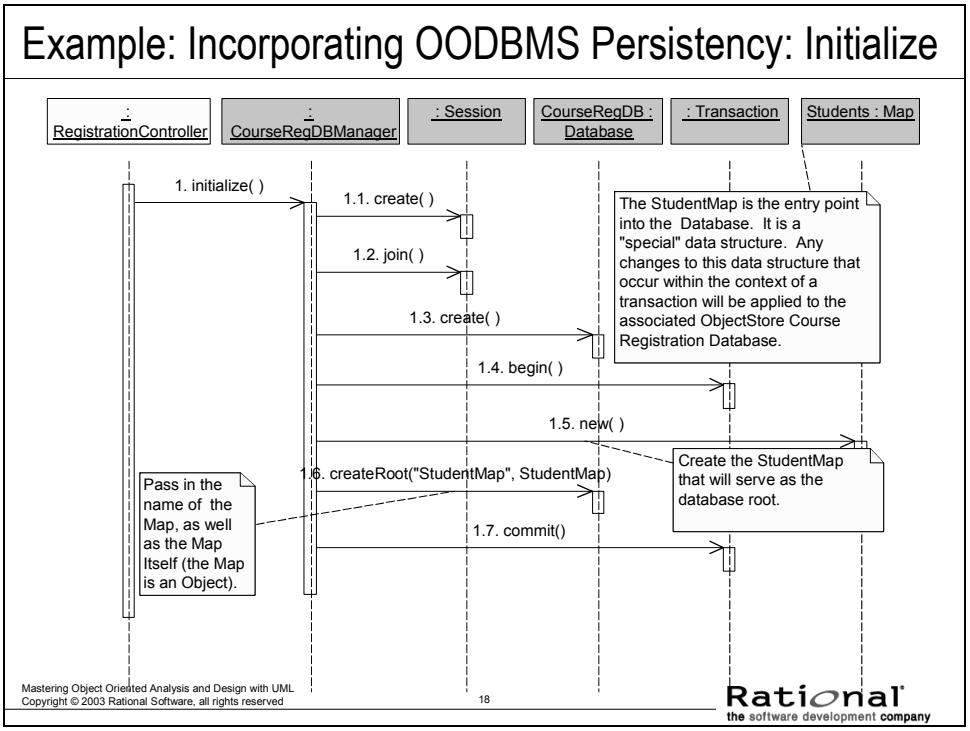
There is one DBManager class per ObjectStore database instance. For the Course Registration System example, there will be one ObjectStore database, the Course Registration Database, that contains student (and schedule) information for the university. Thus, there will be one CourseRegBDManager that will be in a new ObjectStore Support package.

Operations must be added to the DBManager class to access the OODBMS persistent entities in the database. For the CourseRegBDManager class, operations will be added to access Student and Schedule information since that is required for the core system functionality.

The interaction diagrams provide a means to verify that all required database functionality is supported by the design elements.
The sample interaction diagrams provided for the persistency architectural mechanisms during Identify Design Mechanisms will serve as a starting point for the specific interaction diagrams that we will now define.

The PersistentClass should be defined for persistent use the same it is defined for transient use. Other than the required "import com.odi.*" statement, there is almost no special code for persistent use of the PersistentClass. Once you import the ObjectStore classes, a special post-processor modifies the Java byte code to handle all the persistence. No other changes are required. Implementing the persistent classes is out of the scope of this course. It is part of Implementation, not Analysis and Design, so it is out of scope of this course.

Example: Incorporating OODBMS Persistency: Initialize



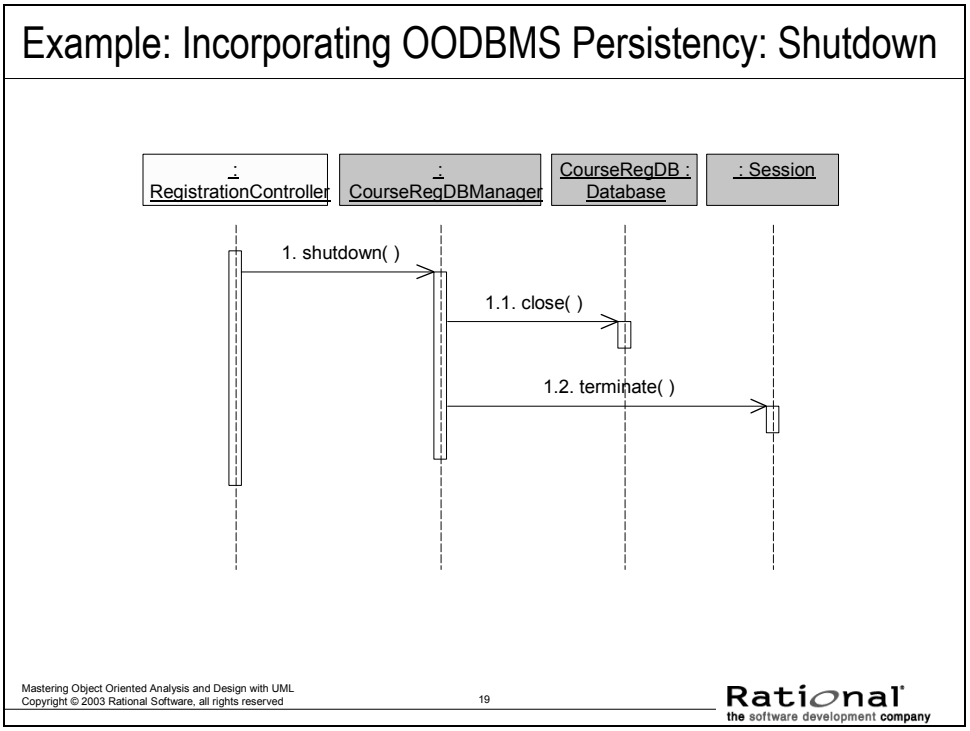
The above diagram demonstrates how the ObjectStore database is initialized at system start-up. Initialization must occur before any persistent class can be accessed. Database initialization was not addressed during analysis, so this diagram does not have a counterpart in Use-Case Analysis.

Once the session has been created and joined, the CourseRegDBManager must open and create the new database.

To create the database, the CourseRegDBManager creates a new transaction and creates the "root" of the database with the "createRoot()" operation. In our example, the root will be the StudentMap data structure. It will contain instances of the Student class and all “reachable” classes (including Schedules). Remember, the root is the entry point into the Course Registration Database. It is a "special" data structure. Any changes to this data structure that occur within the context of a transaction will be applied to the associated Course Registration ObjectStore Database.

Once the root has been created, the transaction is committed.

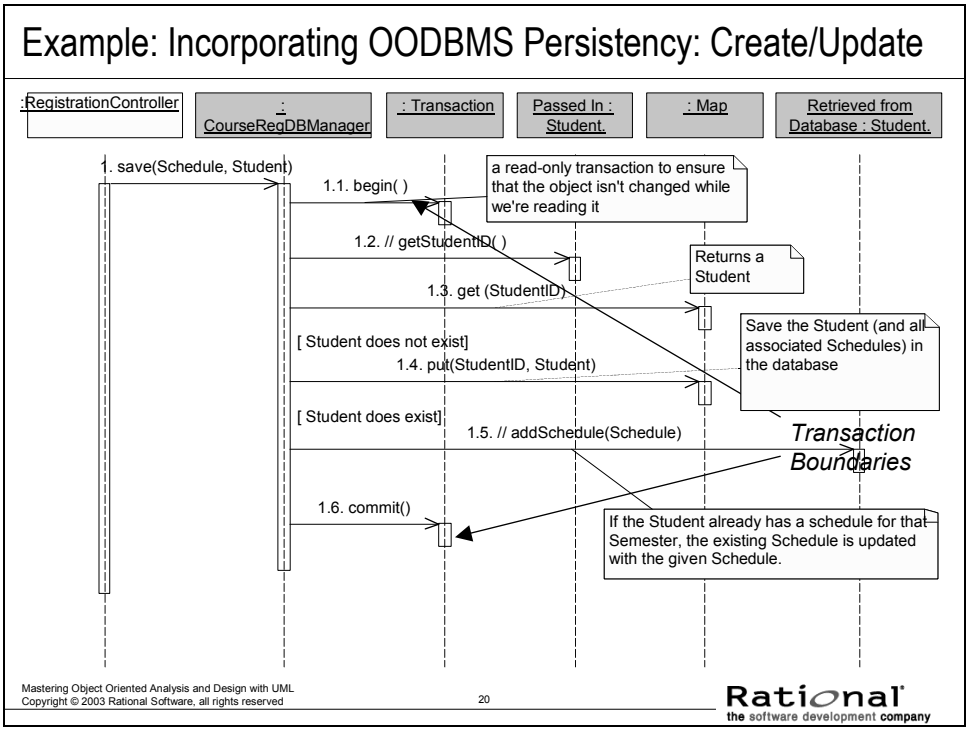
Example: Incorporating OODBMS Persistency: Shutdown



The above diagram demonstrates how the ObjectStore database is shutdown at system shutdown. Database shutdown was not addressed during analysis, so this diagram does not have a counterpart in Use-Case Analysis.

To shutdown the database, the CourseRegDBManager must close the database and terminate the session.

Example: Incorporating OODBMS Persistency: Create/Update

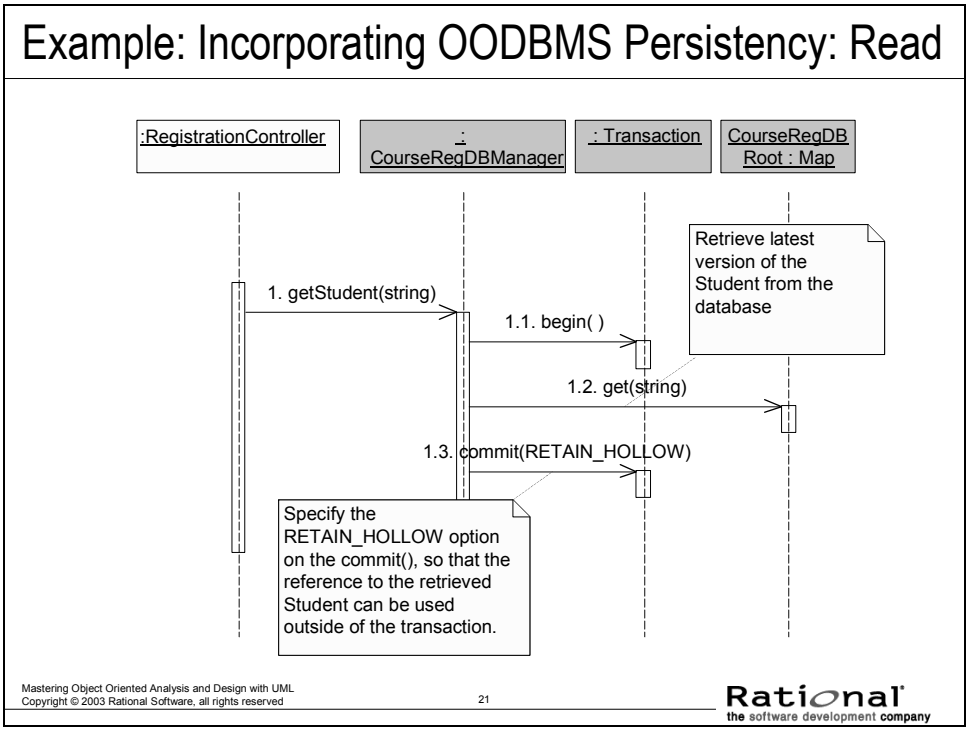


The above example is a fragment of the Register for Courses use-case realization. It describes what happens when a new Schedule is saved, or an existing Schedule is updated.

Remember, a separate put() to the Map is not necessary in the case of an update as the get() operation returns a reference to the Student and any changes to that Student (like adding a Schedule), if made in the context of a transaction, are automatically committed to the database..

Note: The example is unchanged with or without the application of the distribution mechanism, as the distribution is between controllers, and occurs before the above flow is invoked. The incorporation of the distribution mechanism is described in the RMI Mechanism module of the Additional Information appendix.

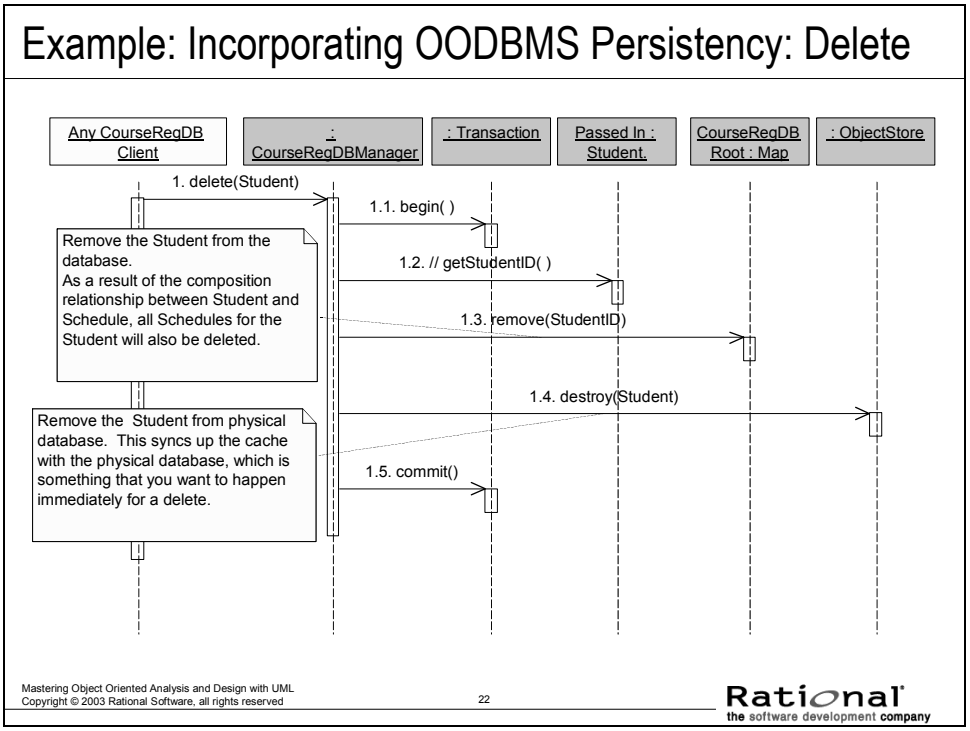
Example: Incorporating OODBMS Persistency: Read



The above example is a fragment of the Register for Courses use-case realization. It describes what happens when a particular Student is retrieved. Remember, because Student is the root class, when it is retrieved, all classes associated with it are retrieved, as well.

Note: The example is unchanged with or without the application of the distribution mechanism, as the distribution is between controllers, and occurs before the above flow is invoked. The incorporation of the distribution mechanism is described in the RMI Mechanism module of the Additional Information appendix.

Example: Incorporating OODBMS Persistency: Delete

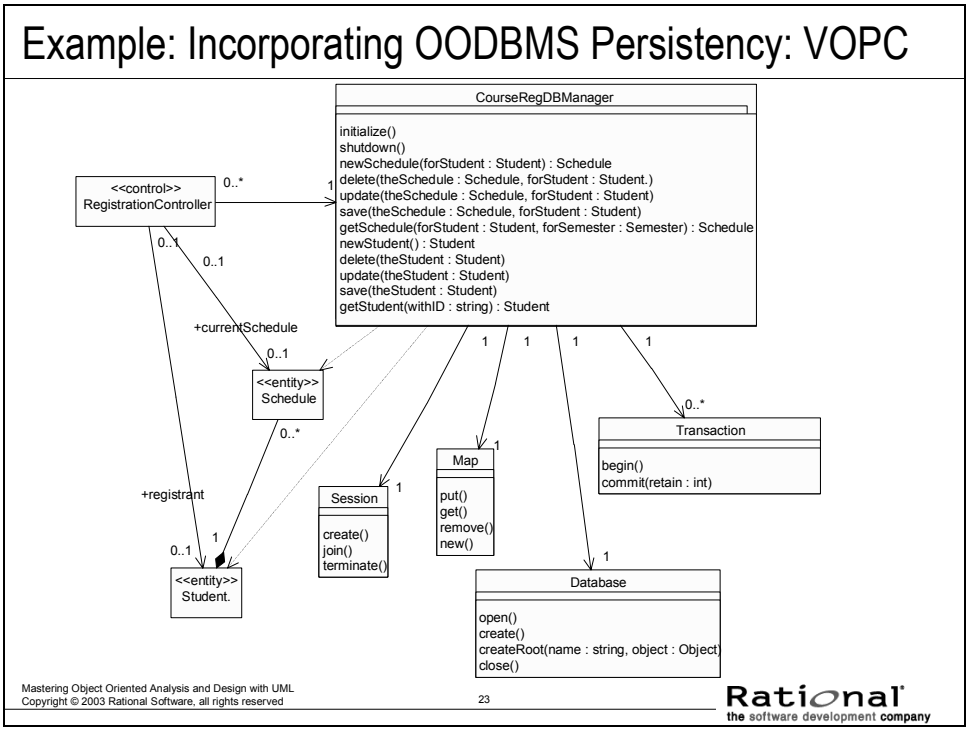


The above diagram describes what happens when a Student is to be deleted.

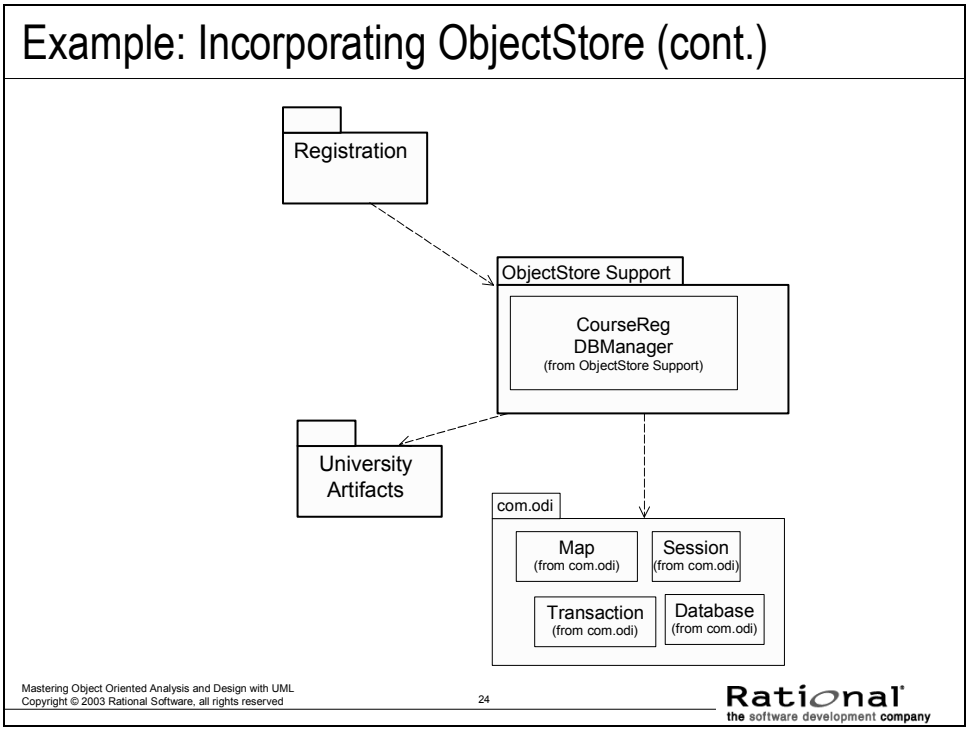
Note: This flow of events was not part of the original use cases we have been analyzing, but it is shown here for completeness (to show how an ObjectStore delete would work).

Remember: Deleting from an ObjectStore database really has two steps -- removal from the container class that is the database in memory (the Map, in our example), and removal from the physical database. That is because you want the deletion to occur right away, as opposed to being cached.

Example: Incorporating OODBMS Persistency: VOPC



Example: Incorporating ObjectStore (cont.)



The above diagram demonstrates the changes that must be made to the Course Registration Model to incorporate the ObjectStore persistency mechanism:

As discussed in Identify Design Mechanisms:

- The ObjectStore Support package contains the business-specific design elements that support the ObjectStore OODBMS persistency mechanism(i.e., the CourseRegDBManager). The CourseRegDBManager contains operations for persistent classes
- The CourseRegDBManager will need to have access to the persistent classes, so a dependency on the UniversityArtifacts package is needed.
- The com.odi package contains the design elements that support the ObjectStore OODBMS persistency mechanism.
- The CourseRegDBManager will need to access the design elements that support the ObjectStore OODBMS persistency mechanism, so a dependency was added from the ObjectStore Support package to the com.odi package.

For the Course Registration System, the persistency class clients are the control classes that “live” in the application packages. Thus, a dependency was added from the Registration package to the ObjectStore Support package to provide the persistency clients access to the CourseRegDBManager.