

Hibernate Architecture, Configuration

Objectives

- ◆ **Understand ORM:** Grasp the core concepts and benefits of object-relational mapping.
- ◆ **Map Entities:** Efficiently map Java classes to database tables and manage relationships.
- ◆ **Control Transactions:** Ensure data integrity with transactions and concurrency handling.
- ◆ **Integrate with Spring:** Leverage Spring Framework for dependency injection and simplified data access.
- ◆ **Gain Practical Experience:** Build projects and experiment with advanced features.

Contents

- ❖ Introduction
- ❖ Key Concepts
- ❖ Annotations
- ❖ Relationships
- ❖ Using Hibernate
- ❖ Demo
- ❖ Advantages and Disadvantages

What is Hibernate ?

- ◆ Hibernate is a powerful object-relational mapping (ORM) framework for the Java programming language.
- ◆ It acts as a bridge between the object-oriented world of Java and the relational world of databases, making it easier for developers to work with persistent data.
- ◆ Hibernate simplifies Java persistence, allowing developers to focus on the business logic of their applications rather than the intricacies of database interactions.

Key Features of Hibernate

- ◆ **ORM:** Maps Java objects to relational database tables, simplifying data access.
- ◆ **JPA Implementation:** Adheres to the JPA standard, ensuring portability and flexibility.
- ◆ **HQL (Hibernate Query Language):** Powerful object-oriented query language for retrieving and manipulating data.
- ◆ **Lazy Loading:** Loads associated data on demand, minimizing data transfer and enhancing responsiveness.
- ◆ **Transaction Management:** Ensures data consistency and integrity through transaction support.
- ◆ **Inheritance Mapping:** Handles various inheritance scenarios, mapping Java class hierarchies to database tables.

Benefits of Using Hibernate

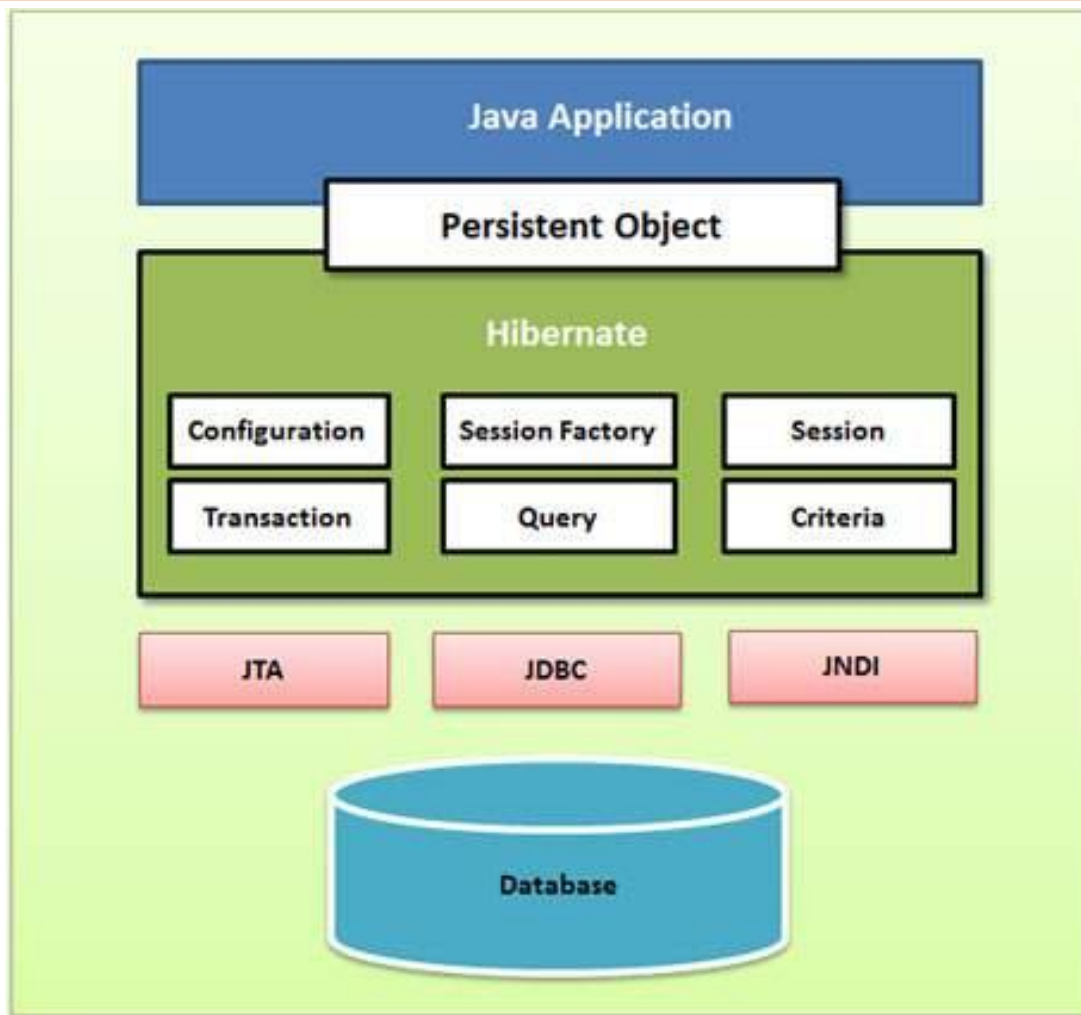
- ◆ **Faster Development:** Spend less time on database code, more time on logic features
- ◆ **Cleaner Code:** Write concise, object-oriented code instead of complex SQL.
- ◆ **Improved Maintainability:** Easier to understand, update, and refactor your codebase.
- ◆ **Database Flexibility:** Switch between different databases without major code changes.

Benefits of Using Hibernate

- ◆ **Performance Boost:** Caching and lazy loading optimize data access for faster applications.
- ◆ **Data Integrity:** Built-in mechanisms ensure data consistency and prevent errors.
- ◆ **Industry Standard:** Widely used in the Java ecosystem, making you job-ready.
- ◆ **Spring Integration:** Works seamlessly with Spring, the leading Java framework.

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Hibernate Architecture



Hibernate Architecture

- ❖ **Session Factory:** Manages configuration and creates Sessions
- ❖ **Session:** Provides data access methods and interacts with persistent object
- ❖ **Persistent Objects:** Java objects representing data stored in the database.
- ❖ **Transaction Management:** Ensures data consistency and integrity.
- ❖ **Connection Provider:** Handles database connections and pooling.
- ❖ **Query API:** Supports HQL, Criteria API, and native SQL for flexible querying
- ❖ **Caching:** Optimizes performance with first-level and second-level caches.
- ❖ **Event System:** Allows customization of persistence lifecycle events.
- ❖ **Dialects:** Generates database-specific SQL for portability.

Hibernate Architecture

❖ SessionFactory

- The SessionFactory is a factory of session and client of ConnectionProvider. It holds second level cache (optional) of data.
- The **org.hibernate.SessionFactory** interface provides factory method to get the object of Session.

❖ Session

- The session object provides an interface between the application and data stored in the database. It is a short-lived object and wraps the JDBC connection. It is factory of Transaction, Query and Criteria. It holds a first-level cache (mandatory) of data.
- The **org.hibernate.Session** interface provides methods to insert, update and delete the object. It also provides factory methods for Transaction, Query and Criteria.

Hibernate Architecture

❖ Transaction

- The transaction object specifies the atomic unit of work. It is optional. The `org.hibernate.Transaction` interface provides methods for transaction management.

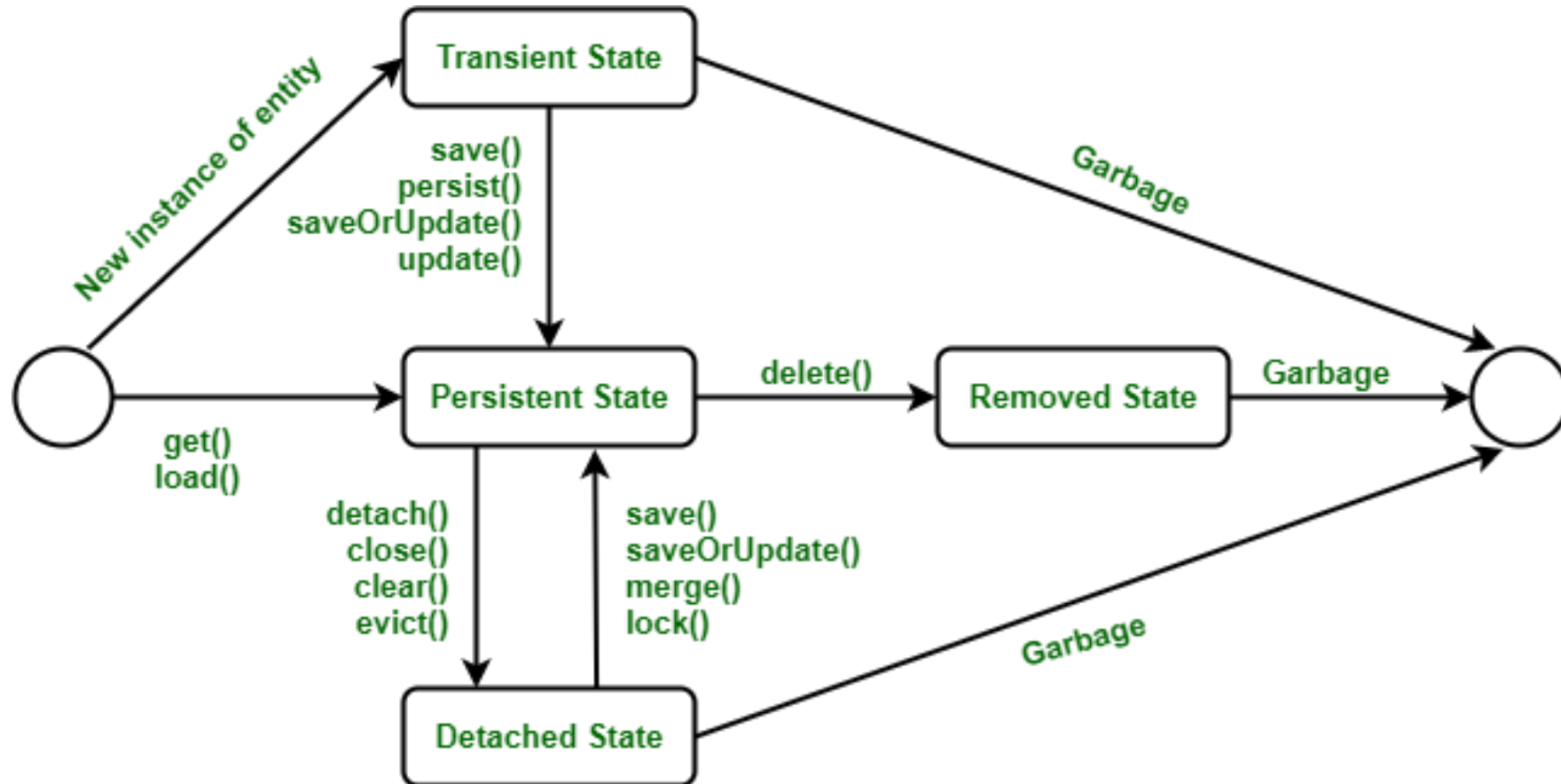
❖ ConnectionProvider

- It is a factory of JDBC connections. It abstracts the application from `DriverManager` or `DataSource`. It is optional.

❖ TransactionFactory

- It is a factory of `Transaction`. It is optional.

Hibernate Lifecycle



Hibernate Lifecycle

- ◆ The Hibernate lifecycle refers to the various states an entity instance goes through during its interaction with the persistence framework. Understanding this lifecycle is crucial for effectively managing data and ensuring data integrity in your applications.
- ◆ Understanding the Hibernate lifecycle is essential for writing efficient and reliable persistence code. By managing entity states and transitions effectively, you can ensure data integrity and optimize the performance of your applications.

Hibernate Lifecycle

1. Transient State

- ❖ An entity instance is in a transient state when it's newly created using the new operator and not yet associated with a Hibernate session.
- ❖ Changes made to a transient instance are not tracked by Hibernate and won't be persisted to the database.

Hibernate Lifecycle

2. Persistent State

- ◆ An entity instance transitions to the persistent state when it's associated with a Hibernate session. This can happen through:
 - **persist() method:** Explicitly makes an instance persistent.
 - **Cascading:** If an associated entity is persisted and cascading is enabled, the current instance becomes persistent as well.
 - **Querying:** When an entity is retrieved from the database using `find()`, `createQuery()`, or other query methods.
- ◆ Changes made to a persistent instance are tracked by Hibernate and will be synchronized with the database upon flushing or transaction commit.

Hibernate Lifecycle

3. Detached State

- ◆ An entity instance becomes detached when it's no longer associated with a Hibernate session. This can occur when:
 - **Session is closed:** Closing the session detaches all persistent instances associated with it.
 - **detach() method:** Explicitly detaches an instance from the session.
 - **Serialization:** Serializing a persistent instance detaches it.
- ◆ Changes made to a detached instance are not tracked by Hibernate and won't be automatically persisted.

Hibernate Lifecycle

4. Removed State

- ◆ An entity instance enters the removed state when it's marked for deletion using the `remove()` method.
- ◆ The actual deletion from the database occurs upon flushing or transaction commit.

JPA vs Hibernate

JPA	Hibernate
Java Persistence API (JP.A) defines the management of relational data in the Java applications.	Hibernate is an Object-Relational Mapping (ORM) tool which is used to save the state of Java object into the database.
It is just a specification. Various ORM tools implement it for data persistence.	It is one of the most frequently used JPA implementation.
It is defined in javax.persistence package.	It is defined in org.hibernate package.
The EntityManagerFactory interface is used to interact with the entity manager factory for the persistence unit. Thus, it provides an entity manager.	It uses SessionFactory interface to create Session instances.
It uses EntityManager interface to create, read, and delete operations for instances of mapped entity classes. This interface interacts with the persistence context.	It uses Session interface to create, read, and delete operations for instances of mapped entity classes. It behaves as a runtime interface between a Java application and Hibernate.
It uses Java Persistence Query Language (JPQL) as an object-oriented query language to perform database operations.	It uses Hibernate Query Language (HQL) as an object-oriented query language to perform database operations.

Hibernate Configuration

- ❖ As Hibernate can operate in different environments, it requires a wide range of configuration parameters. These configurations contain the mapping information that provides different functionalities to Java classes. Generally, we provide database related mappings in the configuration file. Hibernate facilitates to provide the configurations either in an XML file (like `hibernate.cfg.xml`) or properties file (like `hibernate.properties`).
- ❖ An instance of Configuration class allows specifying properties and mappings to applications. This class also builds an immutable **SessionFactory**.

Properties of Hibernate Configuration

◆ Hibernate JDBC Properties

Property	Description
hibernate.connection.driver_class	It represents the JDBC driver class.
hibernate.connection.url	It represents the JDBC URL.
hibernate.connection.username	It represents the database username.
hibernate.connection.password	It represents the database password.
Hibernate.connection.pool_size	It represents the maximum number of connections available in the connection pool.

Properties of Hibernate Configuration

◆ Hibernate Datasource Properties

Property	Description
hibernate.connection.datasource	It represents datasource JNDI name which is used by Hibernate for database properties.
hibernate.jndi.url	It is optional. It represents the URL of the JNDI provider.
hibernate.jndi.class	It is optional. It represents the class of the JNDI InitialContextFactory.

Properties of Hibernate Configuration

Property	Description
hibernate.dialect	It represents the type of database used in hibernate to generate SQL statements for a particular relational database.
hibernate.show_sql	It is used to display the executed SQL statements to console.
hibernate.format_sql	It is used to print the SQL in the log and console.
hibernate.default_catalog	It qualifies unqualified table names with the given catalog in generated SQL.
hibernate.default_schema	It qualifies unqualified table names with the given schema in generated SQL.
hibernate.session_factory_name	The SessionFactory interface automatically bound to this name in JNDI after it has been created.

Properties of Hibernate Configuration

Property	Description
hibernate.default_entity_mode	It sets a default mode for entity representation for all sessions opened from this SessionFactory
hibernate.order_updates	It orders SQL updates on the basis of the updated primary key.
hibernate.use_identifier_rollback	If enabled, the generated identifier properties will be reset to default values when objects are deleted.
hibernate.generate_statistics	If enabled, the Hibernate will collect statistics useful for performance tuning.
hibernate.use_sql_comments	If enabled, the Hibernate generate comments inside the SQL. It is used to make debugging easier.

Hibernate Cache Properties

Property	Description
hibernate.cache.provider_class	It represents the classname of a custom CacheProvider.
hibernate.cache.use_minimal_puts	It is used to optimize the second-level cache. It minimizes writes, at the cost of more frequent reads.
hibernate.cache.use_query_cache	It is used to enable the query cache.
hibernate.cache.use_second_level_cache	It is used to disable the second-level cache, which is enabled by default for classes which specify a mapping.
hibernate.cache.query_cache_factory	It represents the classname of a custom QueryCache interface.
hibernate.cache.region_prefix	It specifies the prefix which is used for second-level cache region names.
hibernate.cache.use_structured_entries	It facilitates Hibernate to store data in the second-level cache in a more human-friendly format.

Properties of Hibernate Configuration

◆ Hibernate Transaction Properties

Property	Description
hibernate.transaction.factory_class	It represents the classname of a TransactionFactory which is used with Hibernate Transaction API.
hibernate.transaction.manager_lookup_class	It represents the classname of a TransactionManagerLookup. It is required when JVM-level caching is enabled.
hibernate.transaction.flush_before_completion	If it is enabled, the session will be automatically flushed during the before completion phase of the transaction.
hibernate.transaction.auto_close_session	If it is enabled, the session will be automatically closed during the after completion phase of the transaction.

Properties of Hibernate Configuration

◆ Other Hibernate Properties

Property	Description
hibernate.connection.provider_class	It represents the classname of a custom ConnectionProvider which provides JDBC connections to Hibernate.
hibernate.connection.isolation	It is used to set the JDBC transaction isolation level.
hibernate.connection.autocommit	It enables auto-commit for JDBC pooled connections. However, it is not recommended.
hibernate.connection.release_mode	It specifies when Hibernate should release JDBC connections.
hibernate.current_session_context_class	It provides a custom strategy for the scoping of the "current" Session.
hibernate.hbm2ddl.auto	It automatically generates a schema in the database with the creation of SessionFactory.

Annotations in Hibernate

Commonly Used Annotations

- ❖ **@Entity:** Marks a class as a persistent entity, indicating that it represents data stored in a database table.
- ❖ **@Table:** Specifies the name of the database table to which the entity is mapped.
- ❖ **@Id:** Identifies the primary key property of the entity.
- ❖ **@GeneratedValue:** Configures the strategy for generating identifier values (e.g., AUTO, SEQUENCE, IDENTITY).
- ❖ **@Column:** Provides details about the mapping of a property to a database column, such as the column name, data type, and nullability.

Commonly Used Annotations

- ❖ **@Basic**: Marks a property as a basic type (e.g., String, int, Date).
- ❖ **@Transient**: Excludes a property from persistence.
- ❖ **@Embedded**: Map embeddable components as value types.
- ❖ **@Temporal**: Specifies the temporal precision of a date/time property.
- ❖ **@Enumerated**: Configures the mapping of an enum type.
- ❖ **@Lob**: Marks a property as a large object (BLOB or CLOB).
- ❖ **@Version**: Enables optimistic locking with a version property.
- ❖ **@CreationTimestamp**, **@UpdateTimestamp**: Automatically set timestamps for creation and update events.

Relationships Annotations in Hibernate

- ❖ **@ManyToOne**: This annotation defines a many-to-one relationship between two entities.
- ❖ **@OneToMany**: This annotation defines a one-to-many relationship between two entities.
- ❖ **@OneToOne**: This annotation defines a one-to-one relationship between two entities.
- ❖ **@ManyToMany**: This annotation defines a many-to-many relationship between two entities.

Hibernate Query Language (HQL)

- ❖ Hibernate Query Language (HQL) is same as SQL (Structured Query Language) but it doesn't depends on the table of the database. Instead of table name, we use class name in HQL. So it is database independent query language.



Advantage of HQL

- ◆ Database independent
- ◆ Supports polymorphic queries
- ◆ Easy to learn for Java Programmer

Query Interface

- ◆ It is an object oriented representation of Hibernate Query. The object of Query can be obtained by calling the `createQuery()` method Session interface.
- **`public int executeUpdate()`** is used to execute the update or delete query.
- **`public List list()`** returns the result of the relation as a list.
- **`public Query setFirstResult(int rowno)`** specifies the row number from where record will be retrieved.

Query Interface

- ◆ **public Query setMaxResult(int rowno)** specifies the no. of records to be retrieved from the relation (table).
- ◆ **public Query setParameter(int position, Object value)** it sets the value to the JDBC style query parameter.
- ◆ **public Query setParameter(String name, Object value)** it sets the value to a named query parameter.

Example of HQL paging

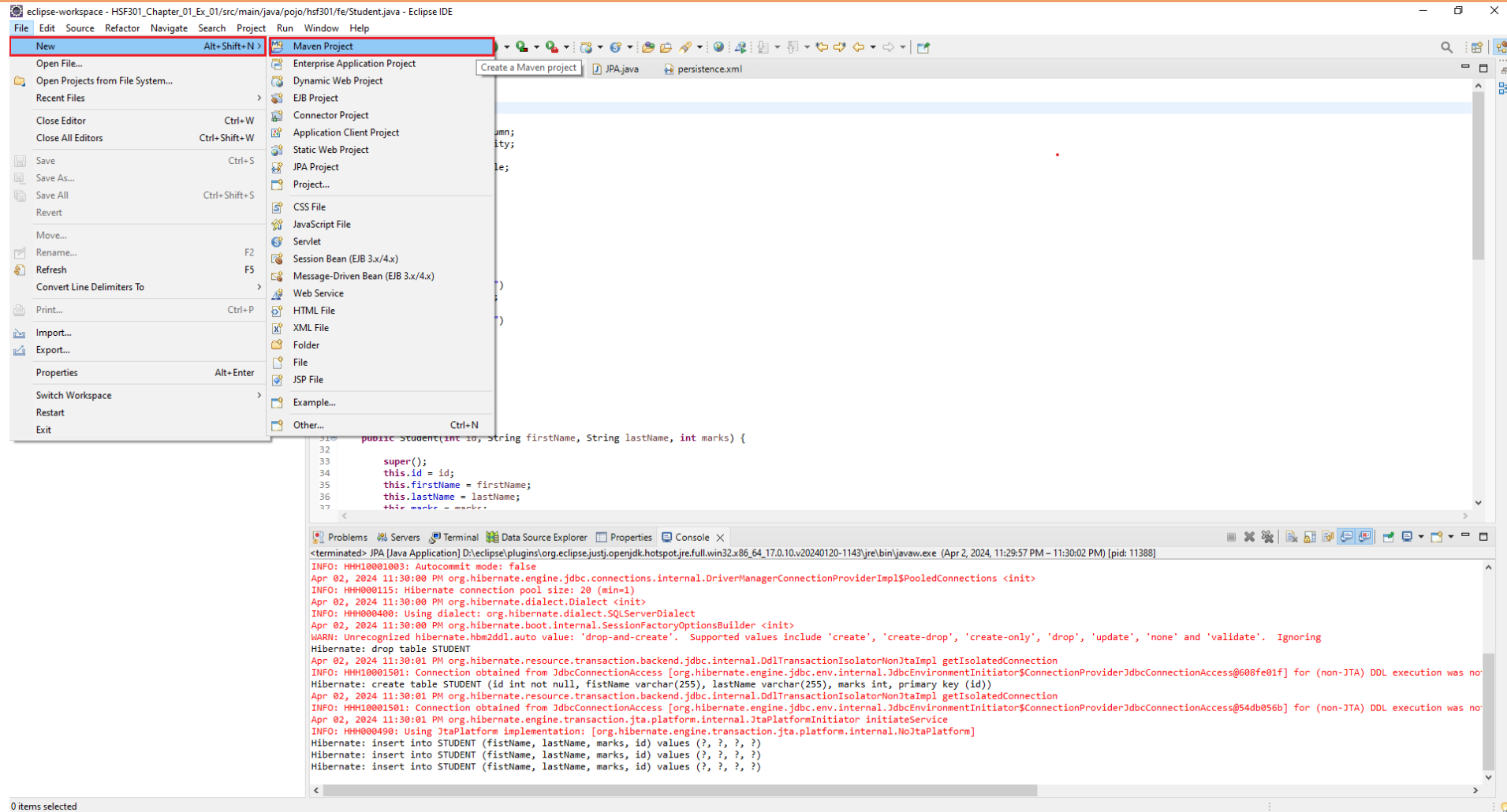
- ◆ Query query=session.createQuery("from Student");
- ◆ query.setFirstResult(5);
- ◆ query.setMaxResult(10);
- ◆ List list=query.list();//will return the records from 5 to 10th number

Example of HQL update query

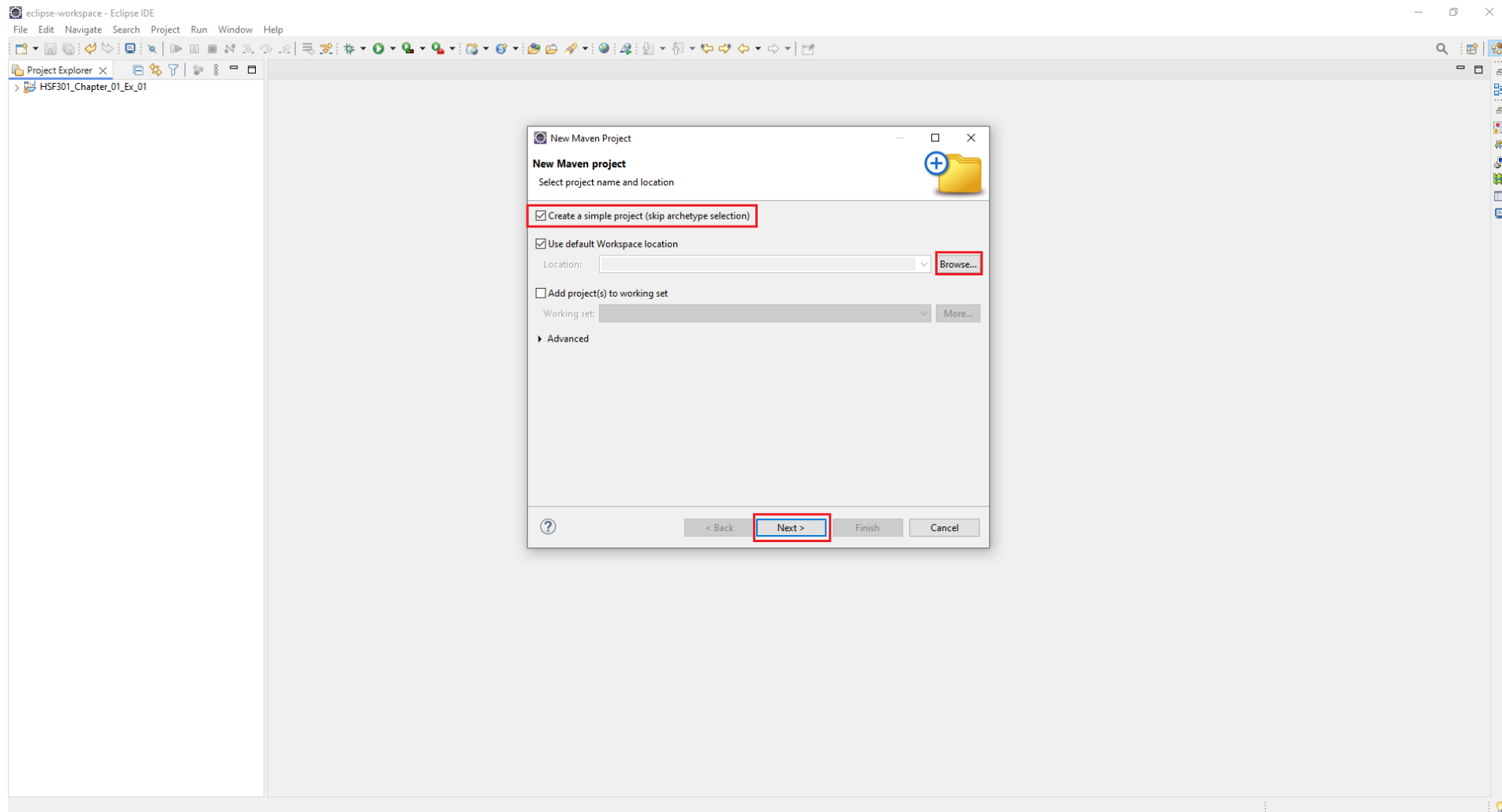
1. *Transaction tx=session.beginTransaction();*
2. *Query q=session.createQuery("update Student set lastName=:n where id=:i");*
3. *q.setParameter("n","Sang");*
4. *q.setParameter("i",1);*
5. ***int** status=q.executeUpdate();*
6. *System.out.println(status);*
7. *tx.commit();*

Demo Hibernate (One To Many)

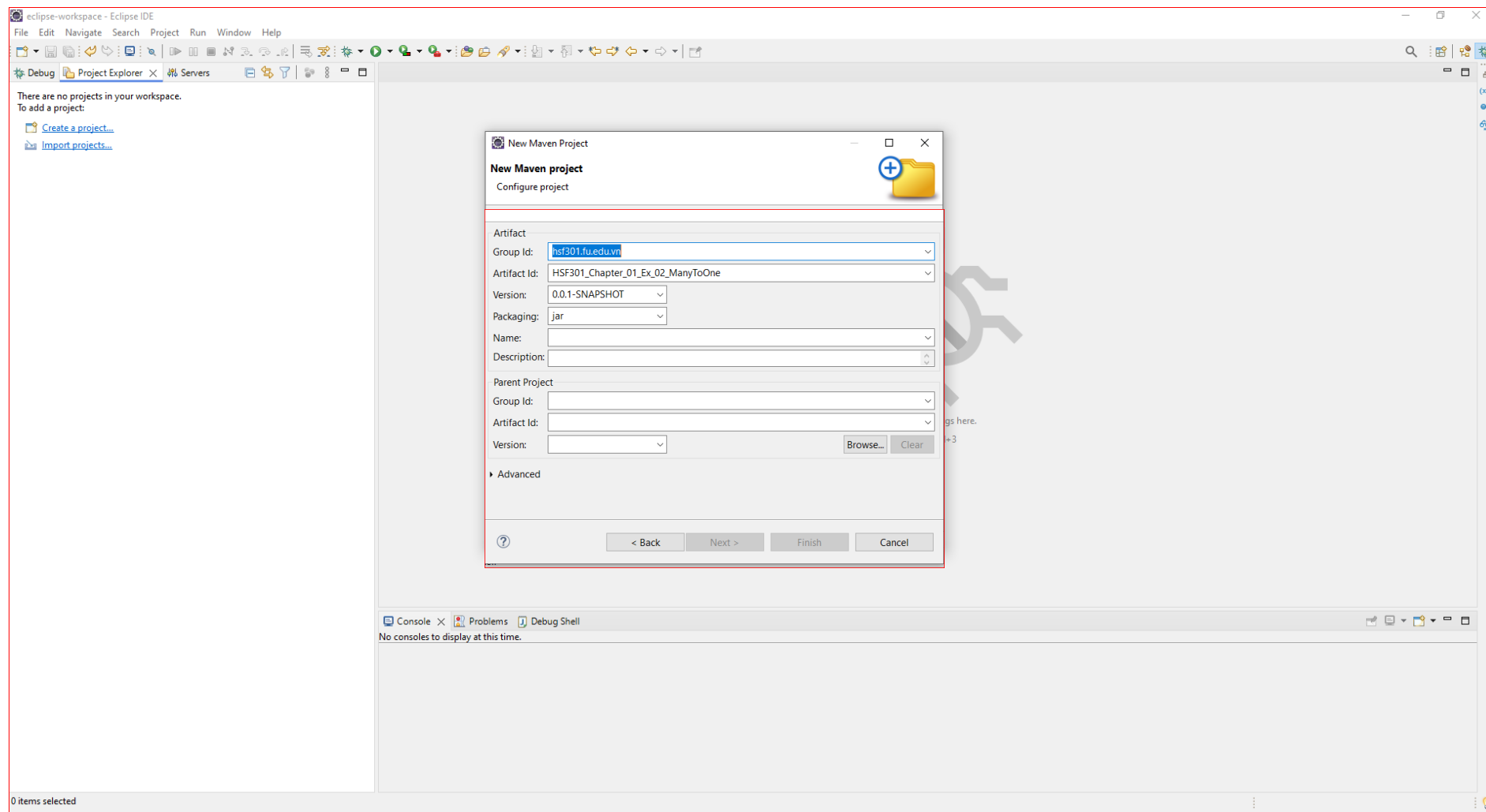
1. Open Eclipse, File | New | Maven Project



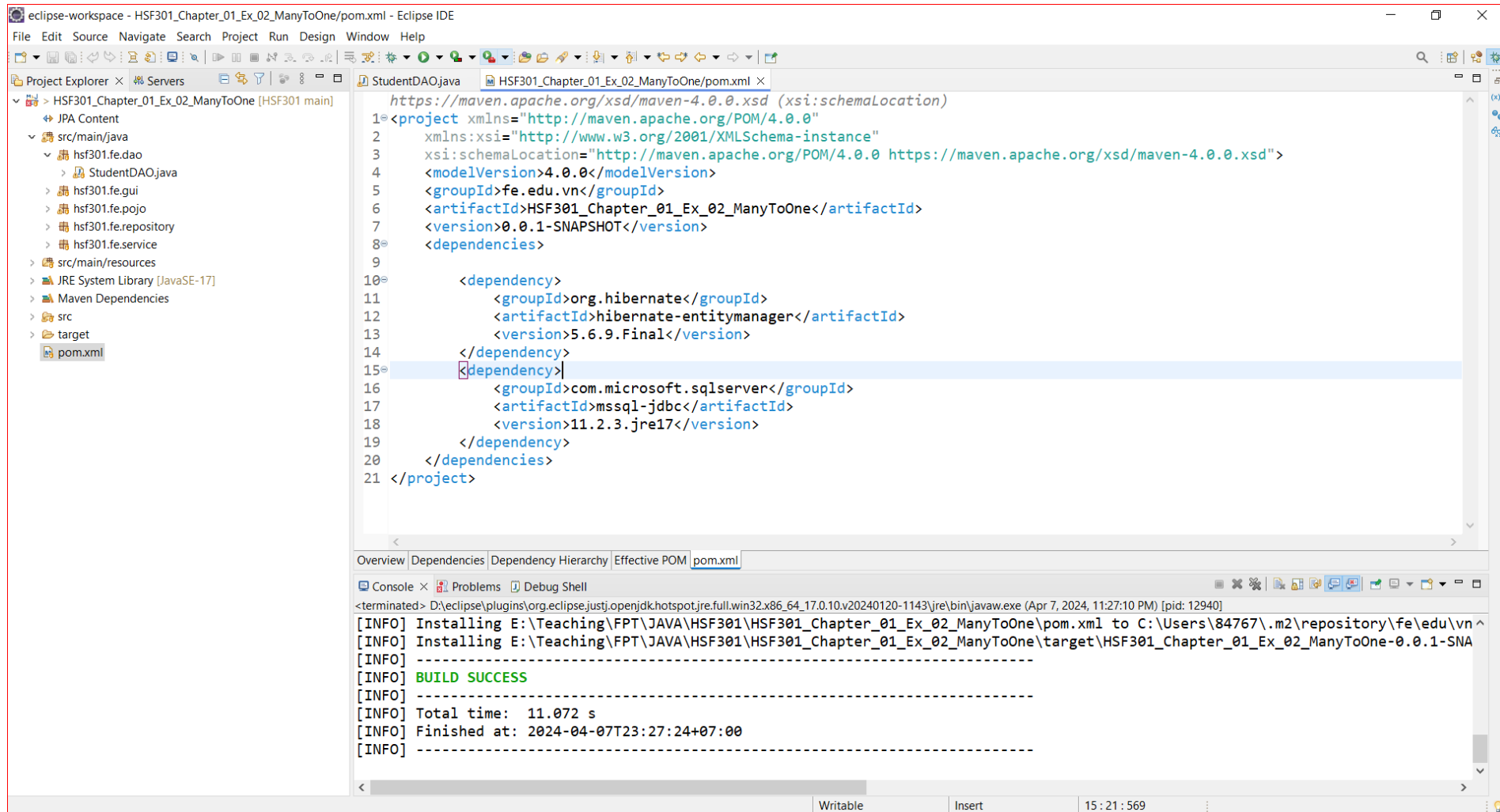
2. Check Create a simple project -> Browse Project -> Next



3. Fill the information Project -> Click Finish



4. Structure of Maven Project



The screenshot displays the Eclipse IDE interface for a Maven project named 'HSF301_Chapter_01_Ex_02_ManyToOne'. The Project Explorer on the left shows the project structure, including the 'pom.xml' file. The main editor window shows the content of 'pom.xml', which is a Maven POM file. The file includes the following XML content:

```
<?xml version="1.0" encoding="UTF-8" ?>
<project xmlns="http://maven.apache.org/POM/4.0.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 https://maven.apache.org/xsd/maven-4.0.0.xsd">
  <modelVersion>4.0.0</modelVersion>
  <groupId>fe.edu.vn</groupId>
  <artifactId>HSF301_Chapter_01_Ex_02_ManyToOne</artifactId>
  <version>0.0.1-SNAPSHOT</version>
  <dependencies>
    <dependency>
      <groupId>org.hibernate</groupId>
      <artifactId>hibernate-entitymanager</artifactId>
      <version>5.6.9.Final</version>
    </dependency>
    <dependency>
      <groupId>com.microsoft.sqlserver</groupId>
      <artifactId>mssql-jdbc</artifactId>
      <version>11.2.3.jre17</version>
    </dependency>
  </dependencies>
</project>
```

The console output at the bottom shows the build process, including the installation of dependencies and the successful completion of the build:

```
[INFO] Installing E:\Teaching\FPT\JAVA\HSF301\HSF301_Chapter_01_Ex_02_ManyToOne\pom.xml to C:\Users\84767\.m2\repository\fe\edu\vn ^
[INFO] Installing E:\Teaching\FPT\JAVA\HSF301\HSF301_Chapter_01_Ex_02_ManyToOne\target\HSF301_Chapter_01_Ex_02_ManyToOne-0.0.1-SNA
[INFO] -----
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 11.072 s
[INFO] Finished at: 2024-04-07T23:27:24+07:00
[INFO] -----
```

5. Create hibernate.cfg.xml

```

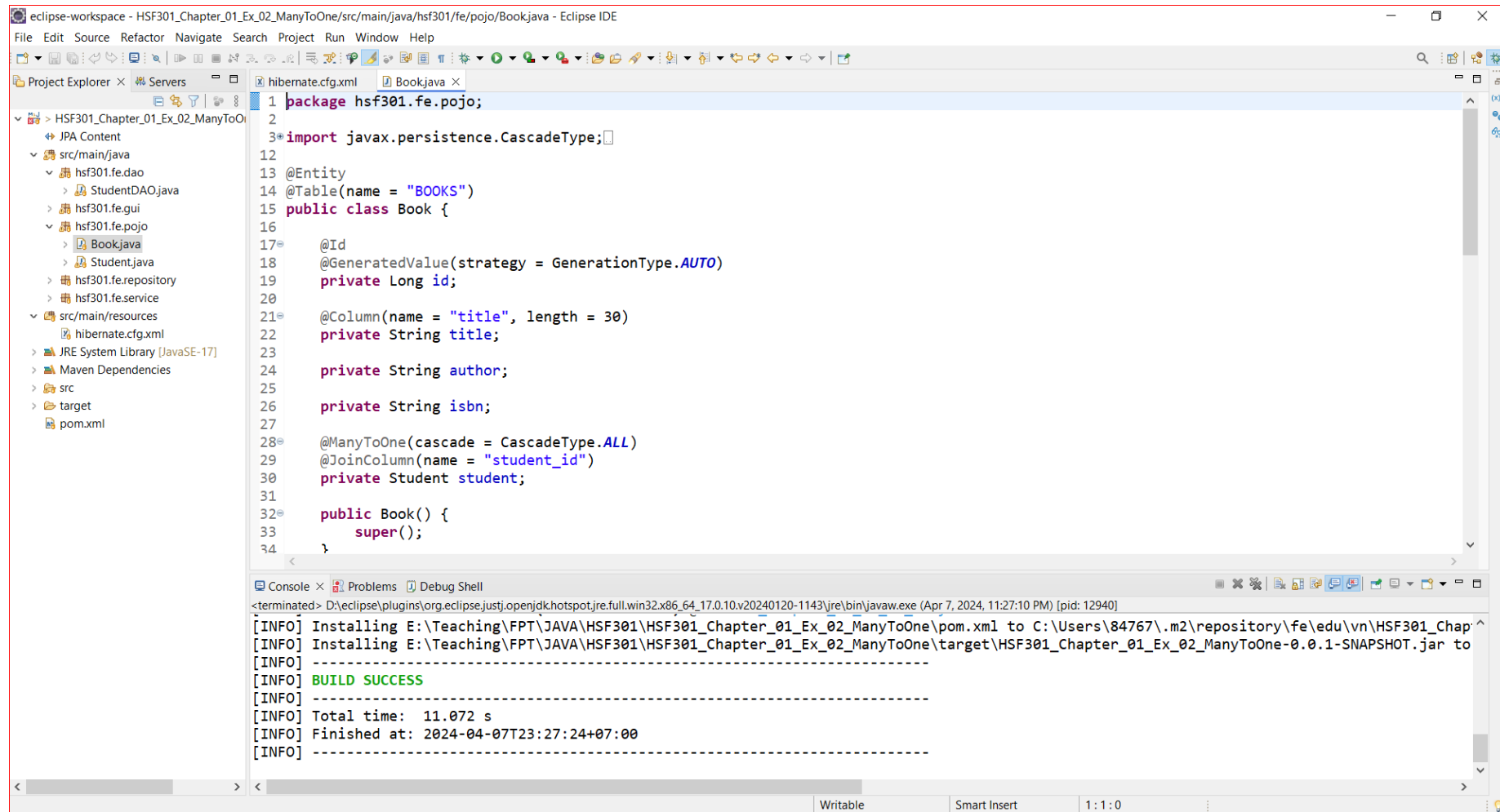
eclipse-workspace - HSF301_Chapter_01_Ex_02_ManyToOne/src/main/resources/hibernate.cfg.xml - Eclipse IDE
File Edit Source Source Navigate Search Project Run Window Help
Project Explorer Servers
HSF301_Chapter_01_Ex_02_ManyToOne
  JPA Content
  src/main/java
    hsf301.fe.dao
      StudentDAO.java
    hsf301.fe.gui
    hsf301.fe.pojo
    hsf301.fe.repository
    hsf301.fe.service
  src/main/resources
    hibernate.cfg.xml
  JRE System Library [JavaSE-17]
  Maven Dependencies
  src
  target
  pom.xml

hibernate.cfg.xml
1 <?xml version="1.0" encoding="utf-8"?>
2 <!DOCTYPE hibernate-configuration SYSTEM
3 "http://www.hibernate.org/dtd/hibernate-configuration-3.0.dtd">
4 <hibernate-configuration>
5   <session-factory>
6     <property name="hbm2ddl.auto">update</property>
7     <property name="dialect">org.hibernate.dialect.SQLServerDialect</property>
8     <property name="connection.url">jdbc:sqlserver://localhost:1433;DatabaseName=tutorial;encrypt=true;trustServerCertificate=true</p
9     <property name="connection.username">sa</property>
10    <property name="connection.password">Aesx5099@@</property>
11    <property name="connection.driver_class">com.microsoft.sqlserver.jdbc.SQLServerDriver</property>
12
13    <mapping class="hsf301.fe.pojo.Student" />
14    <mapping class="hsf301.fe.pojo.Book" />
15
16  </session-factory>
17
18 </hibernate-configuration>

Design Source
Console Problems Debug Shell
<terminated> D:\eclipse\plugins\org.eclipse.justi.openjdk.hotspot.jre.full.win32.x86_64_17.0.10.v20240120-1143\jre\bin\javaw.exe (Apr 7, 2024, 11:27:10 PM) [pid: 12940]
[INFO] Installing E:\Teaching\FPT\JAVA\HSF301\HSF301_Chapter_01_Ex_02_ManyToOne\pom.xml to C:\Users\84767\.m2\repository\fe\edu\vn\HSF301_Chap^
[INFO] Installing E:\Teaching\FPT\JAVA\HSF301\HSF301_Chapter_01_Ex_02_ManyToOne\target\HSF301_Chapter_01_Ex_02_ManyToOne-0.0.1-SNAPSHOT.jar to
[INFO] -----
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 11.072 s
[INFO] Finished at: 2024-04-07T23:27:24+07:00
[INFO] -----

```

6. Create Books in Pojo



The screenshot shows the Eclipse IDE with the following components:

- Project Explorer:** Displays the project structure for 'HSF301_Chapter_01_Ex_02_ManyToOne'. The 'src/main/java' directory contains sub-packages like 'hsf301.fe.dao', 'hsf301.fe.gui', 'hsf301.fe.pojo', and 'hsf301.fe.service'. The 'hsf301.fe.pojo' package contains the 'Book.java' file.
- Editor:** Shows the code for 'Book.java'. The code defines a JPA entity 'Book' with the following attributes and methods:

```
1 package hsf301.fe.pojo;
2
3 import javax.persistence.CascadeType;
4
5 @Entity
6 @Table(name = "BOOKS")
7 public class Book {
8
9     @Id
10    @GeneratedValue(strategy = GenerationType.AUTO)
11    private Long id;
12
13    @Column(name = "title", length = 30)
14    private String title;
15
16    private String author;
17
18    private String isbn;
19
20    @ManyToOne(cascade = CascadeType.ALL)
21    @JoinColumn(name = "student_id")
22    private Student student;
23
24    public Book() {
25        super();
26    }
27 }
```
- Console:** Displays the output of the Maven build process. It shows the installation of dependencies and the successful completion of the build.

```
<terminated> D:\eclipse\plugins\org.eclipse.justi.openjdk.hotspot.jre.full.win32.x86_64_17.0.10.v20240120-1143\jre\bin\javaw.exe (Apr 7, 2024, 11:27:10 PM) [pid: 12940]
[INFO] Installing E:\Teaching\FPT\JAVA\HSF301\HSF301_Chapter_01_Ex_02_ManyToOne\pom.xml to C:\Users\84767\.m2\repository\fe\edu\vn\HSF301_Chap^
[INFO] Installing E:\Teaching\FPT\JAVA\HSF301\HSF301_Chapter_01_Ex_02_ManyToOne\target\HSF301_Chapter_01_Ex_02_ManyToOne-0.0.1-SNAPSHOT.jar to
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 11.072 s
[INFO] Finished at: 2024-04-07T23:27:24+07:00
[INFO] -----
```

7. Create Students in Pojo

The screenshot shows the Eclipse IDE interface. The Project Explorer on the left displays the project structure for 'HSF301_Chapter_01_Ex_02_ManyToOne'. The main editor window shows the 'Student.java' file with the following code:

```

1 package hsf301.fe.pojo;
2
3 import java.util.HashSet;
4
5
6 @Entity
7 @Table(name = "STUDENTS")
8 public class Student {
9
10     @Id
11     @GeneratedValue(strategy = GenerationType.AUTO)
12     @Column(name = "id")
13     private int id;
14
15     @Column(name = "firstName", nullable = false, unique = true)
16     private String firstName;
17
18     @Column(name = "lastName")
19     private String lastName;
20
21     @Column(name = "marks")
22     private int marks;
23
24     @OneToMany(cascade = CascadeType.ALL)
25     @JoinColumn(name = "student_id")
26     private Set<Book> books ;
27
28 }

```

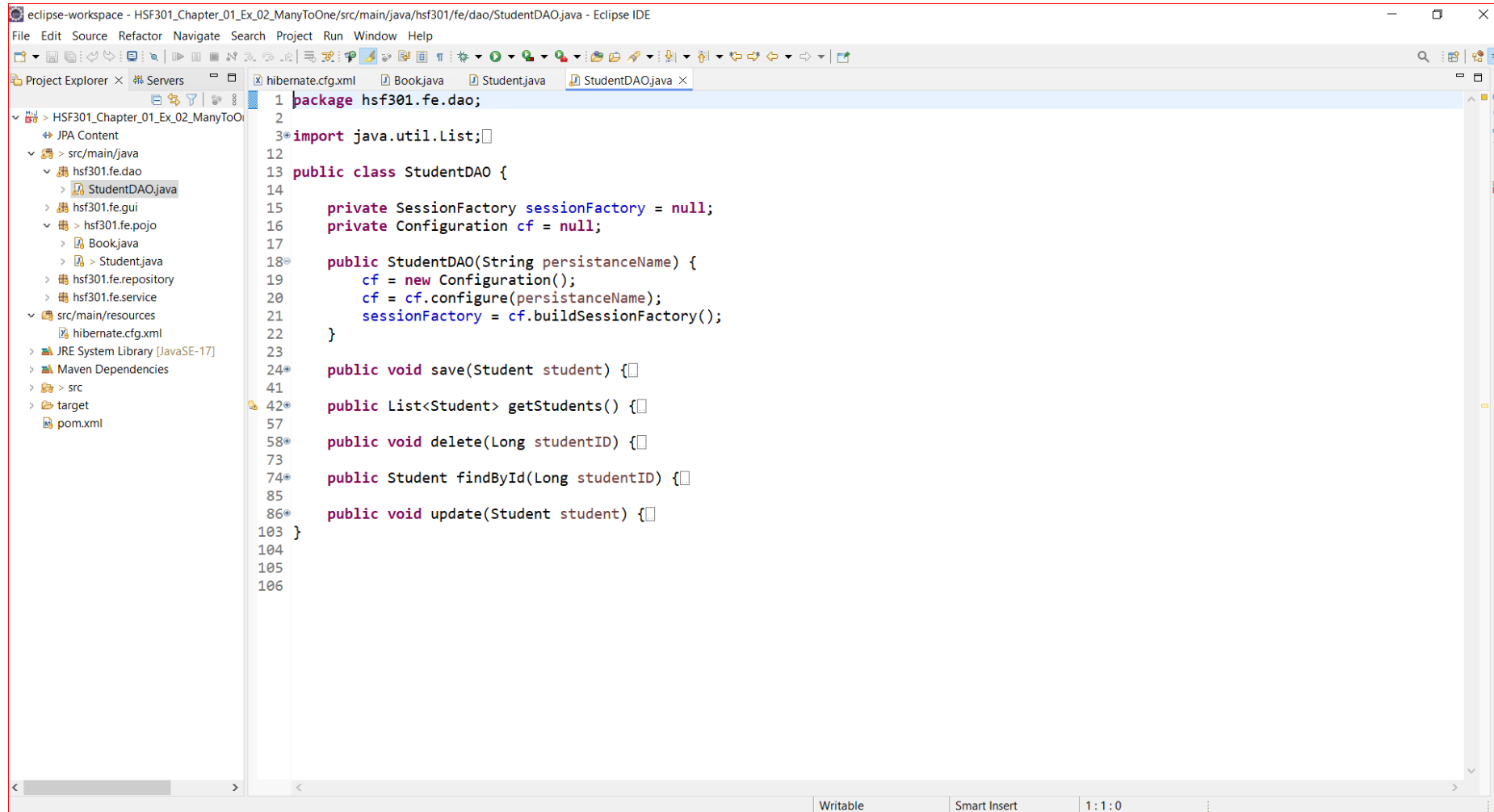
The Console window at the bottom shows the output of a Maven build, indicating a successful build:

```

[INFO] BUILD SUCCESS
[INFO] Total time: 11.072 s
[INFO] Finished at: 2024-04-07T23:27:24+07:00

```

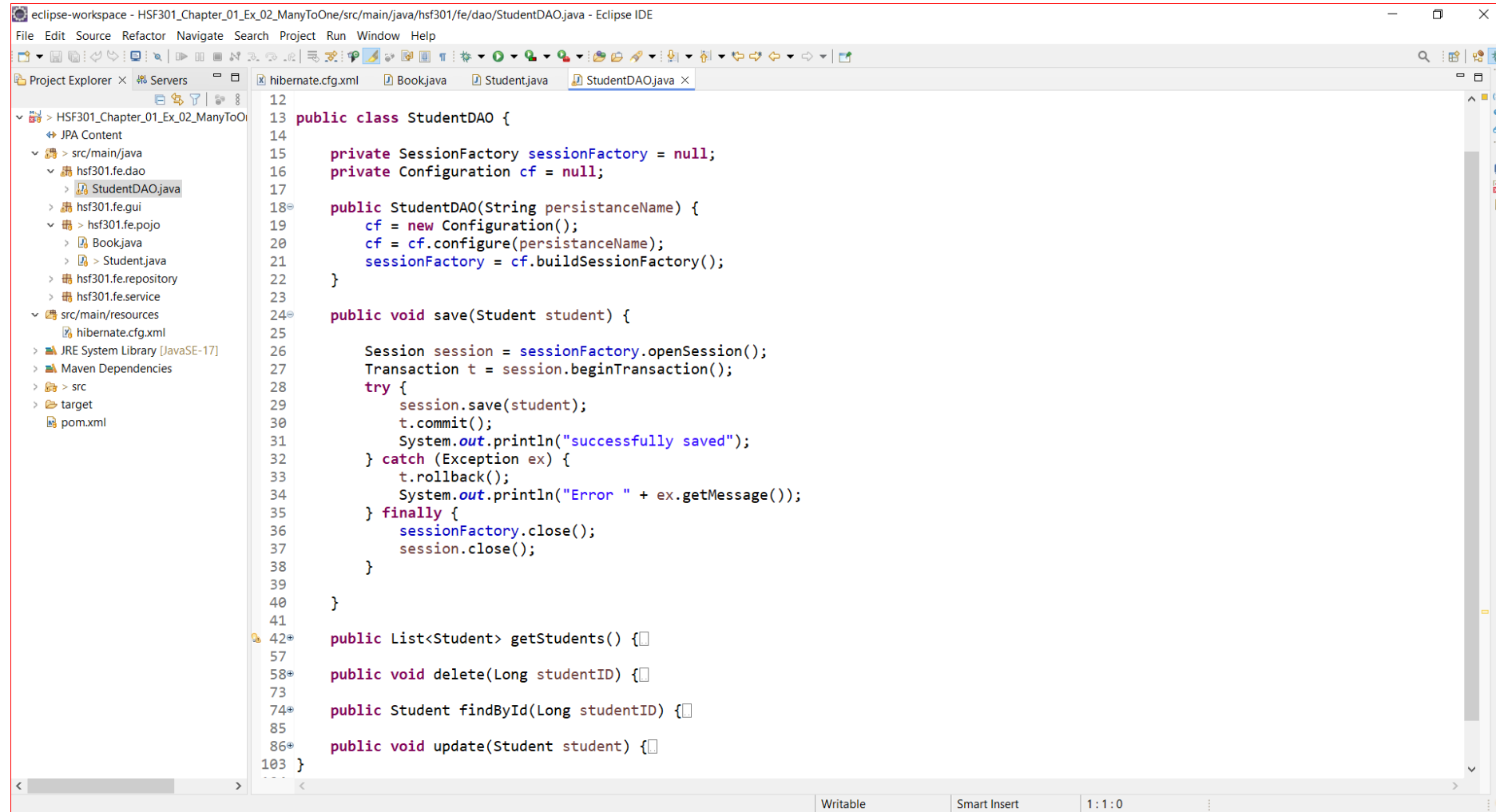
8. Create StudentDAO



The screenshot shows the Eclipse IDE interface. The Project Explorer on the left displays the project structure: HSF301_Chapter_01_Ex_02_ManyToOne, with sub-packages hsf301.fe.dao, hsf301.fe.gui, hsf301.fe.pojo, hsf301.fe.repository, hsf301.fe.service, and hsf301.fe.test. The hsf301.fe.dao package is selected, and the StudentDAO.java file is being created. The main editor shows the following code:

```
1 package hsf301.fe.dao;
2
3 import java.util.List;
4
5 public class StudentDAO {
6
7     private SessionFactory sessionFactory = null;
8     private Configuration cf = null;
9
10    public StudentDAO(String persistenceName) {
11        cf = new Configuration();
12        cf = cf.configure(persistenceName);
13        sessionFactory = cf.buildSessionFactory();
14    }
15
16    public void save(Student student) {}
17
18    public List<Student> getStudents() {}
19
20    public void delete(Long studentID) {}
21
22    public Student findById(Long studentID) {}
23
24    public void update(Student student) {}
25 }
```

9. Save Student in StudentDAO

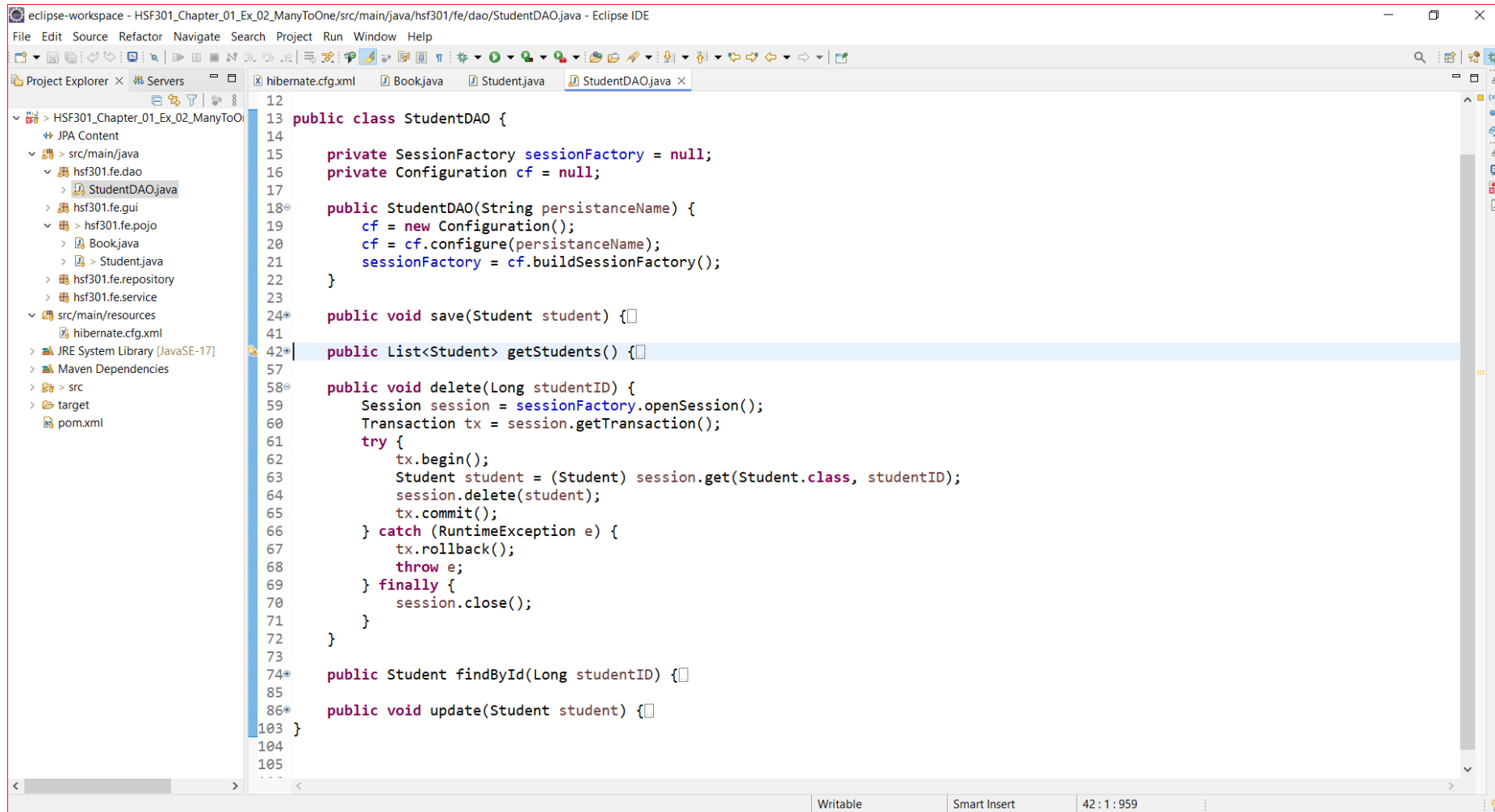


```

12
13 public class StudentDAO {
14
15     private SessionFactory sessionFactory = null;
16     private Configuration cf = null;
17
18     public StudentDAO(String persistenceName) {
19         cf = new Configuration();
20         cf = cf.configure(persistenceName);
21         sessionFactory = cf.buildSessionFactory();
22     }
23
24     public void save(Student student) {
25
26         Session session = sessionFactory.openSession();
27         Transaction t = session.beginTransaction();
28         try {
29             session.save(student);
30             t.commit();
31             System.out.println("successfully saved");
32         } catch (Exception ex) {
33             t.rollback();
34             System.out.println("Error " + ex.getMessage());
35         } finally {
36             sessionFactory.close();
37             session.close();
38         }
39     }
40
41
42     public List<Student> getStudents() {}
43
44
45
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57
58     public void delete(Long studentID) {}
59
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73
74     public Student findById(Long studentID) {}
75
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86     public void update(Student student) {}
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103 }

```

10. Get All Student in StudentDAO

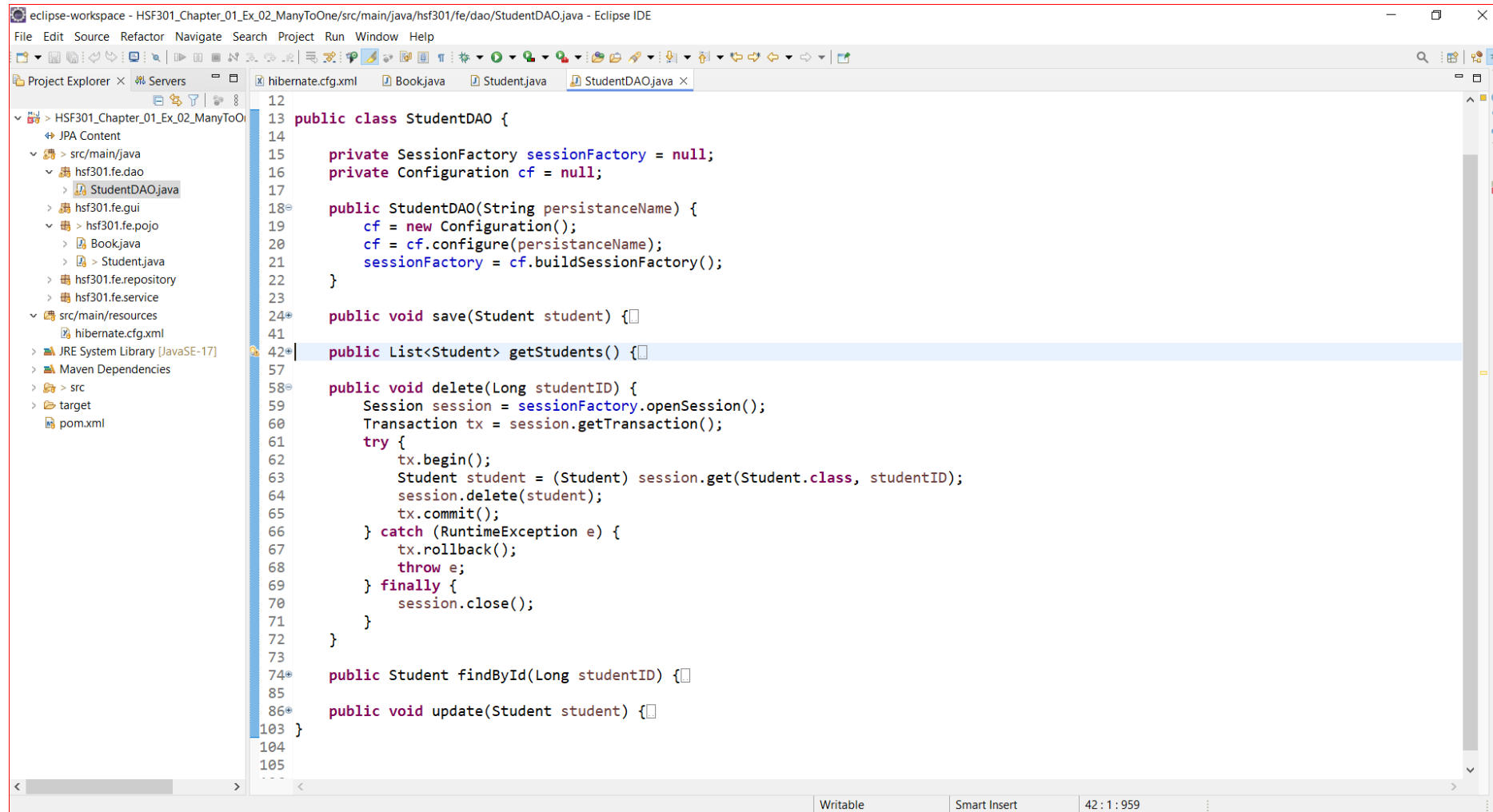


```

12
13 public class StudentDAO {
14
15     private SessionFactory sessionFactory = null;
16     private Configuration cf = null;
17
18     public StudentDAO(String persistenceName) {
19         cf = new Configuration();
20         cf = cf.configure(persistenceName);
21         sessionFactory = cf.buildSessionFactory();
22     }
23
24     public void save(Student student) {}
25
26     public List<Student> getStudents() {}
27
28     public void delete(Long studentID) {
29         Session session = sessionFactory.openSession();
30         Transaction tx = session.getTransaction();
31         try {
32             tx.begin();
33             Student student = (Student) session.get(Student.class, studentID);
34             session.delete(student);
35             tx.commit();
36         } catch (RuntimeException e) {
37             tx.rollback();
38             throw e;
39         } finally {
40             session.close();
41         }
42     }
43
44     public Student findById(Long studentID) {}
45
46     public void update(Student student) {}
47 }

```

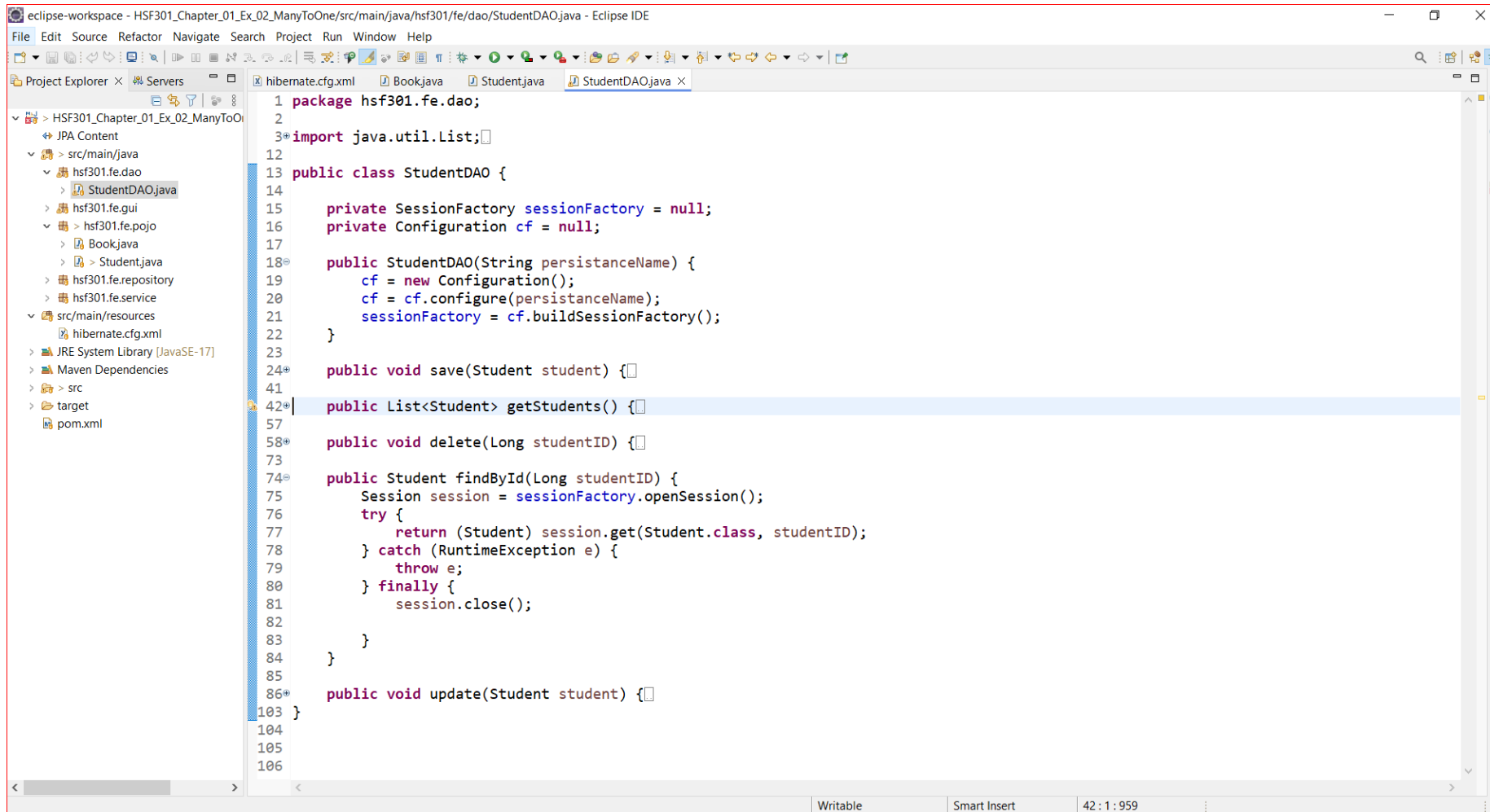

11. Delete Student in StudentDAO



```

12
13 public class StudentDAO {
14
15     private SessionFactory sessionFactory = null;
16     private Configuration cf = null;
17
18     public StudentDAO(String persistenceName) {
19         cf = new Configuration();
20         cf = cf.configure(persistenceName);
21         sessionFactory = cf.buildSessionFactory();
22     }
23
24     public void save(Student student) {}
25
26     public List<Student> getStudents() {}
27
28     public void delete(Long studentID) {
29         Session session = sessionFactory.openSession();
30         Transaction tx = session.getTransaction();
31         try {
32             tx.begin();
33             Student student = (Student) session.get(Student.class, studentID);
34             session.delete(student);
35             tx.commit();
36         } catch (RuntimeException e) {
37             tx.rollback();
38             throw e;
39         } finally {
40             session.close();
41         }
42     }
43
44     public Student findById(Long studentID) {}
45
46     public void update(Student student) {}
47 }
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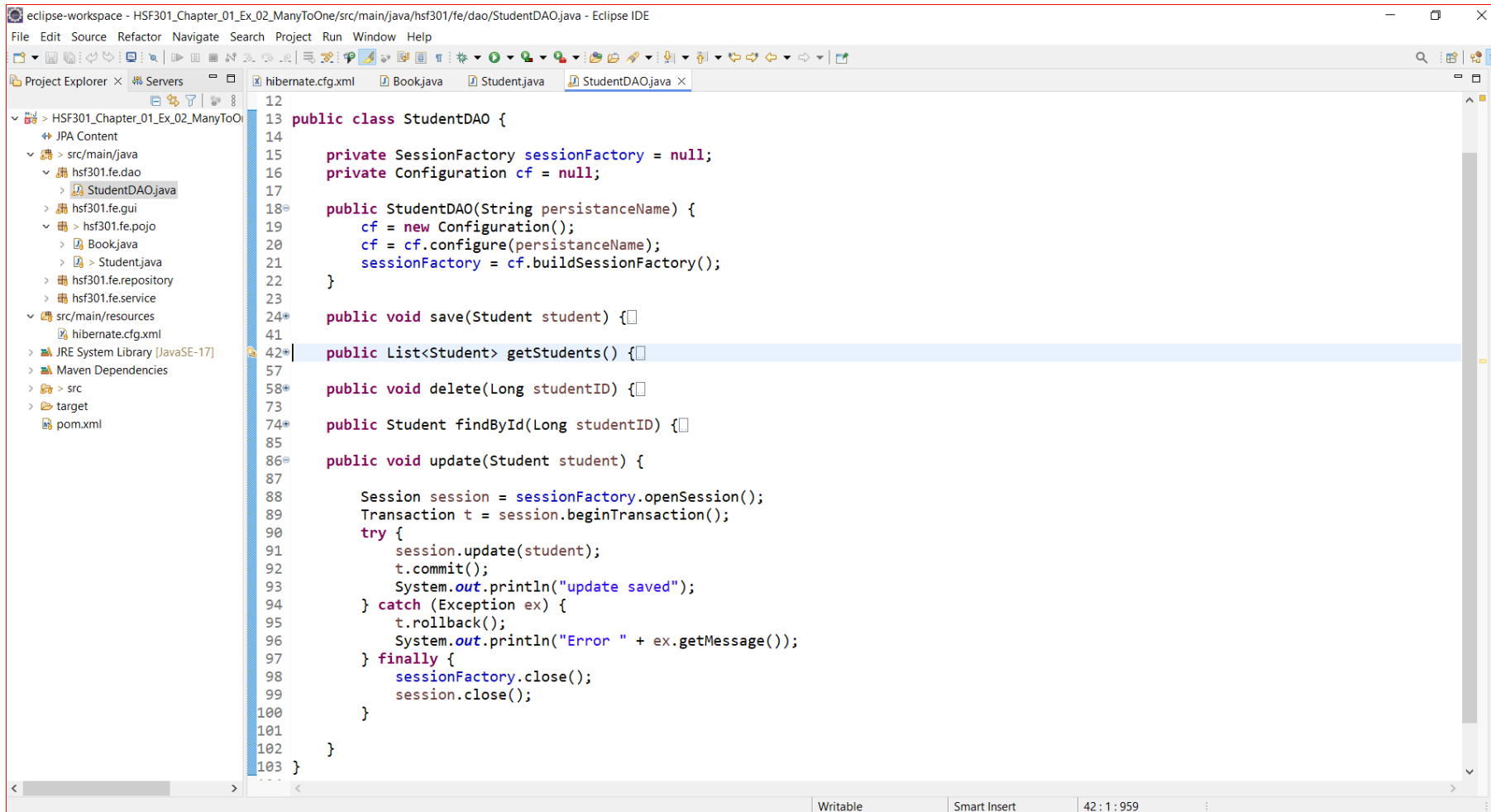

12. Find A Student in StudentDAO



```
eclipse-workspace - HSF301_Chapter_01_Ex_02_ManyToOne/src/main/java/hsf301/fe/dao/StudentDAO.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
Project Explorer Servers
  HSF301_Chapter_01_Ex_02_ManyToOne
    JPA Content
    src/main/java
      hsf301.fe.dao
        StudentDAO.java
      hsf301.fe.gui
      hsf301.fe.pojo
      Book.java
      Student.java
      hsf301.fe.repository
      hsf301.fe.service
    src/main/resources
      hibernate.cfg.xml
    JRE System Library [JavaSE-17]
    Maven Dependencies
    src
    target
    pom.xml

1 package hsf301.fe.dao;
2
3 import java.util.List;
4
12 public class StudentDAO {
13     private SessionFactory sessionFactory = null;
14     private Configuration cf = null;
15
16     public StudentDAO(String persistenceName) {
17         cf = new Configuration();
18         cf = cf.configure(persistenceName);
19         sessionFactory = cf.buildSessionFactory();
20     }
21
22     public void save(Student student) {}
23
24     public List<Student> getStudents() {}
25
26     public void delete(Long studentID) {}
27
28     public Student findById(Long studentID) {
29         Session session = sessionFactory.openSession();
30         try {
31             return (Student) session.get(Student.class, studentID);
32         } catch (RuntimeException e) {
33             throw e;
34         } finally {
35             session.close();
36         }
37     }
38
39     public void update(Student student) {}
40 }
41
42
43
44
45
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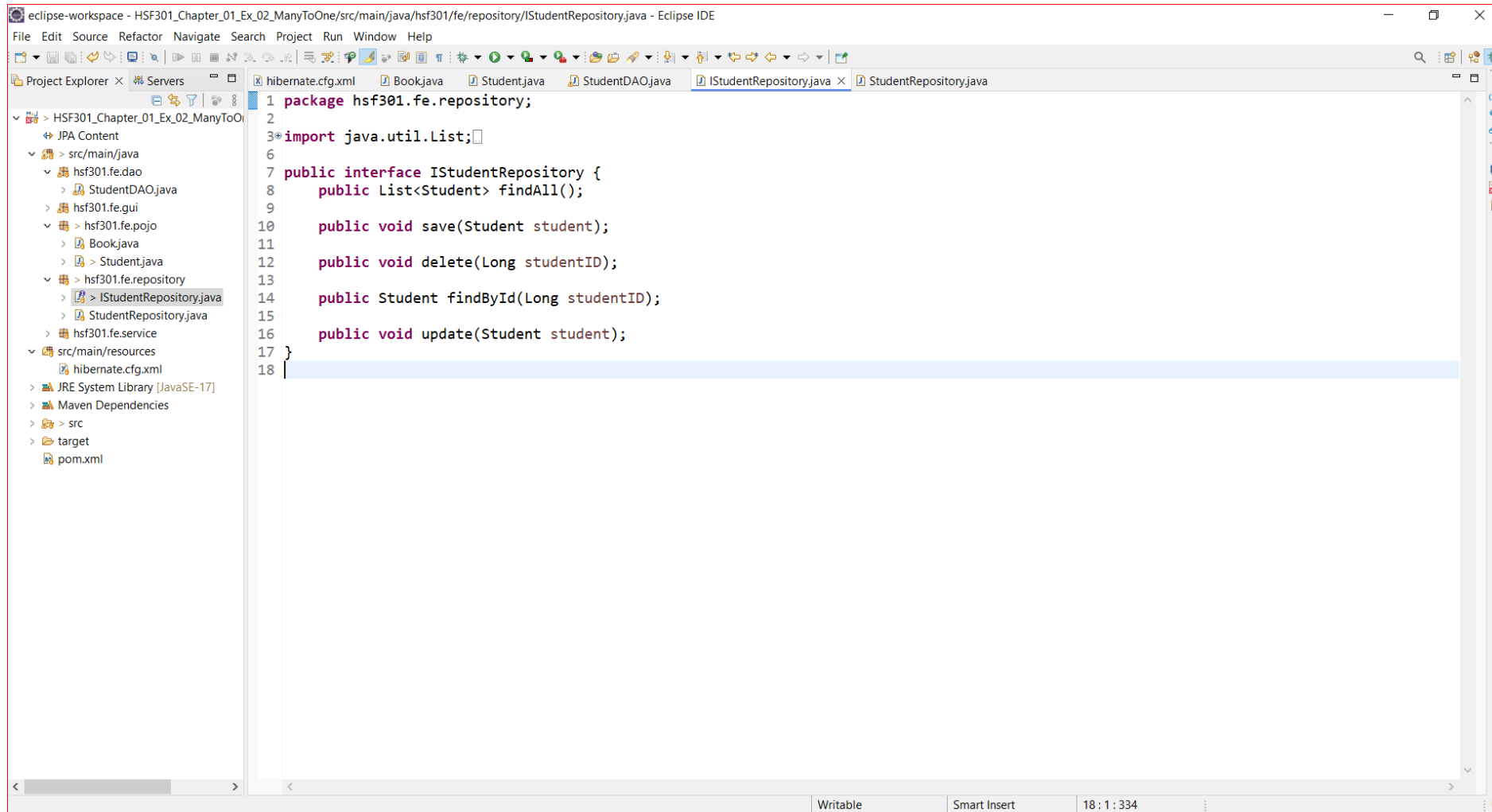
13. Update a Student in StudentDAO



```
eclipse-workspace - HSF301_Chapter_01_Ex_02_ManyToOne/src/main/java/hsf301/fe/dao/StudentDAO.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
hibernate.cfg.xml Bookjava Studentjava StudentDAO.java x
Project Explorer Servers
HSF301_Chapter_01_Ex_02_ManyToOne
  JPA Content
  src/main/java
    hsf301.fe.dao
      StudentDAO.java
    hsf301.fe.gui
    hsf301.fe.pojo
      Bookjava
      Studentjava
    hsf301.fe.repository
    hsf301.fe.service
  src/main/resources
    hibernate.cfg.xml
  JRE System Library [JavaSE-17]
  Maven Dependencies
  src
  target
  pom.xml

12
13 public class StudentDAO {
14
15     private SessionFactory sessionFactory = null;
16     private Configuration cf = null;
17
18     public StudentDAO(String persistenceName) {
19         cf = new Configuration();
20         cf = cf.configure(persistenceName);
21         sessionFactory = cf.buildSessionFactory();
22     }
23
24     public void save(Student student) {}
41
42     public List<Student> getStudents() {}
57
58     public void delete(Long studentID) {}
73
74     public Student findById(Long studentID) {}
85
86     public void update(Student student) {
87
88         Session session = sessionFactory.openSession();
89         Transaction t = session.beginTransaction();
90         try {
91             session.update(student);
92             t.commit();
93             System.out.println("update saved");
94         } catch (Exception ex) {
95             t.rollback();
96             System.out.println("Error " + ex.getMessage());
97         } finally {
98             sessionFactory.close();
99             session.close();
100         }
101     }
102 }
103 }
```

14. Create IStudentRepository

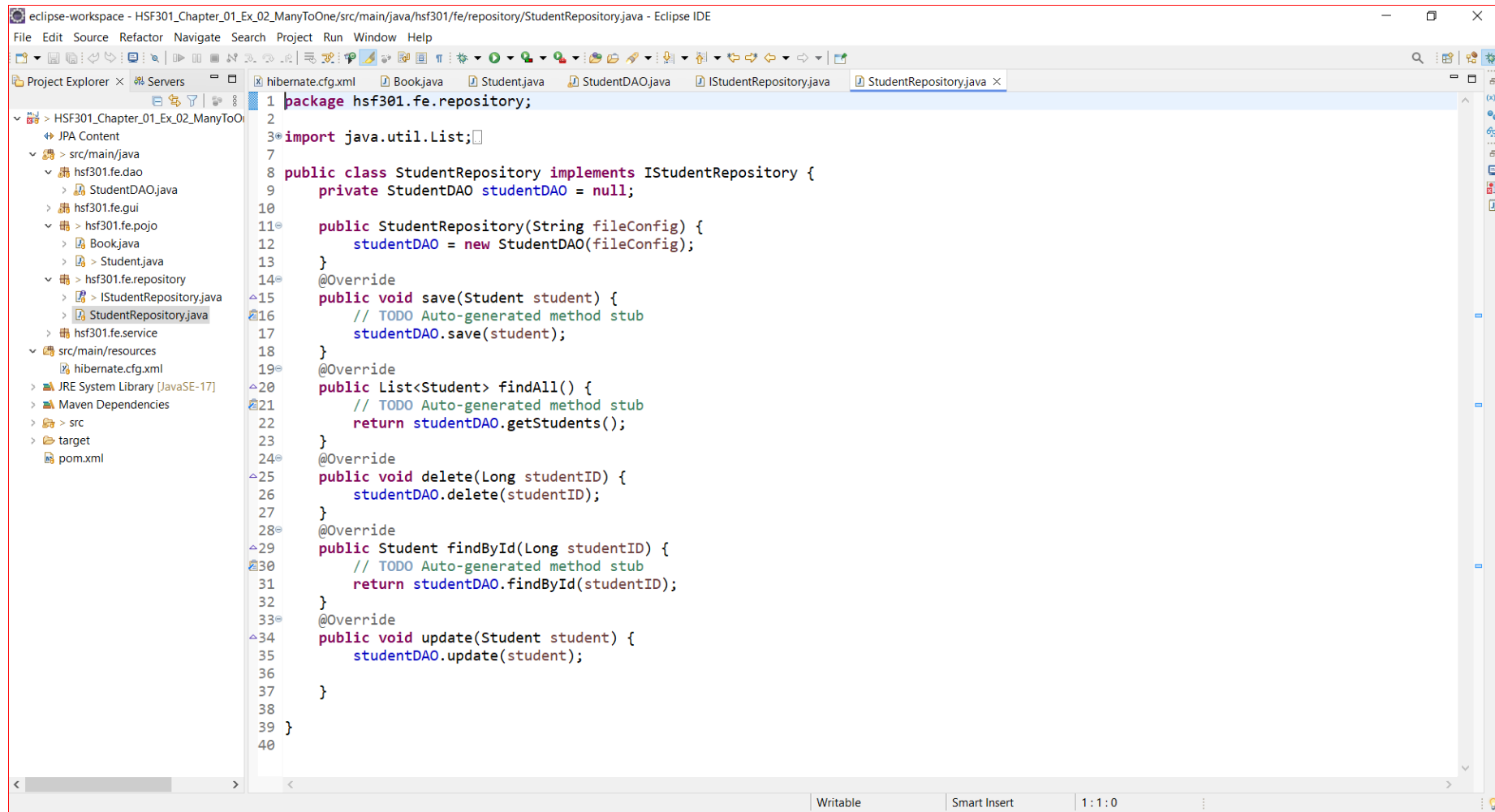


The screenshot shows the Eclipse IDE interface. The Project Explorer on the left displays the project structure for 'HSF301_Chapter_01_Ex_02_ManyToOne'. The 'hsf301.fe.repository' package is selected, and the 'IStudentRepository.java' file is highlighted. The main editor window shows the code for the 'IStudentRepository' interface. The code is as follows:

```
1 package hsf301.fe.repository;
2
3 import java.util.List;
4
5
6 public interface IStudentRepository {
7     public List<Student> findAll();
8
9     public void save(Student student);
10
11     public void delete(Long studentID);
12
13     public Student findById(Long studentID);
14
15     public void update(Student student);
16 }
17
18
```

The status bar at the bottom indicates 'Writable', 'Smart Insert', and the cursor position '18 : 1 : 334'.

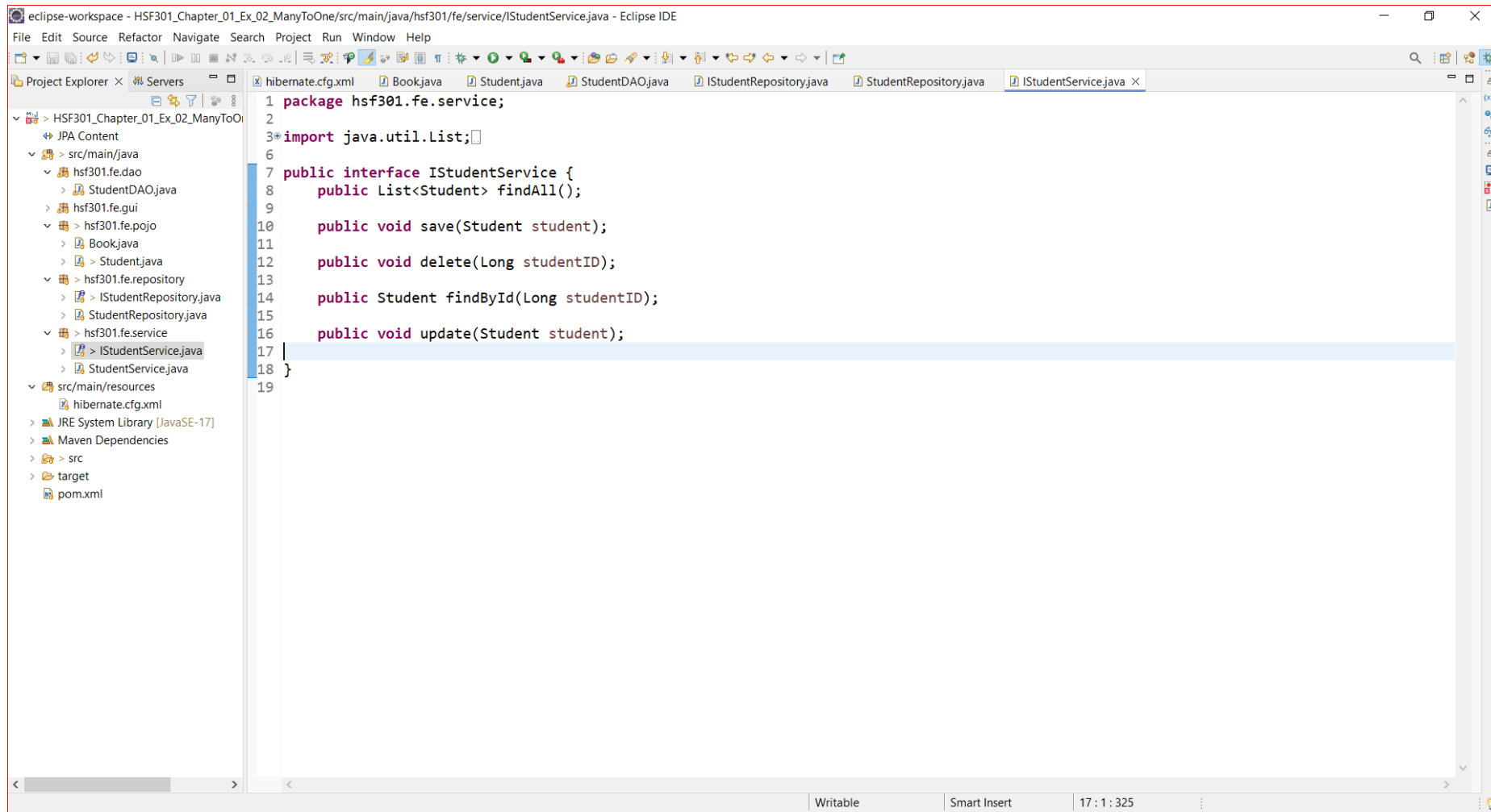
15. Create StudentRepository



The screenshot shows the Eclipse IDE interface. The Project Explorer on the left displays the project structure, with the file `StudentRepository.java` selected under the `hsf301.fe.repository` package. The main editor window shows the code for `StudentRepository.java`. The code defines a `StudentRepository` class that implements the `IStudentRepository` interface. It includes a private `StudentDAO` instance and implements methods for `save`, `findAll`, `delete`, and `findById`. The `save` and `findById` methods are marked as auto-generated stubs with `TODO` comments.

```
1 package hsf301.fe.repository;
2
3 import java.util.List;
4
5 public class StudentRepository implements IStudentRepository {
6     private StudentDAO studentDAO = null;
7
8     public StudentRepository(String fileConfig) {
9         studentDAO = new StudentDAO(fileConfig);
10    }
11
12    @Override
13    public void save(Student student) {
14        // TODO Auto-generated method stub
15        studentDAO.save(student);
16    }
17
18    @Override
19    public List<Student> findAll() {
20        // TODO Auto-generated method stub
21        return studentDAO.getStudents();
22    }
23
24    @Override
25    public void delete(Long studentID) {
26        studentDAO.delete(studentID);
27    }
28
29    @Override
30    public Student findById(Long studentID) {
31        // TODO Auto-generated method stub
32        return studentDAO.findById(studentID);
33    }
34
35    @Override
36    public void update(Student student) {
37        studentDAO.update(student);
38    }
39 }
40
```

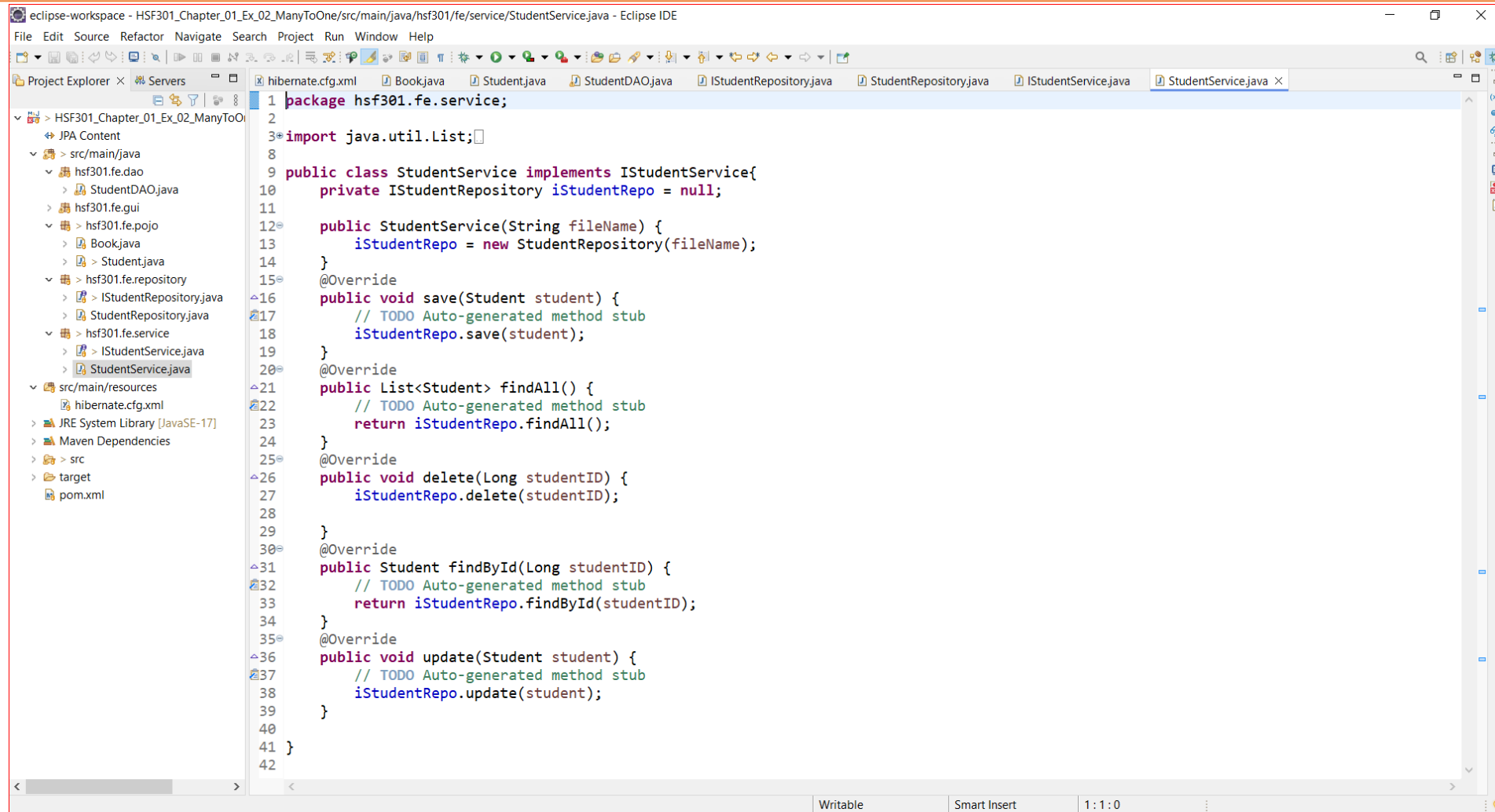
16. Create IStudentService



The screenshot shows the Eclipse IDE interface. The Project Explorer on the left displays the project structure: HSF301_Chapter_01_Ex_02_ManyToOne, with sub-packages like hsf301.fe.dao, hsf301.fe.gui, hsf301.fe.pojo, hsf301.fe.repository, hsf301.fe.service, and hsf301.fe.resources. The hsf301.fe.service package is expanded, showing the IStudentService.java file. The main editor window displays the code for IStudentService.java, which defines a package, imports java.util.List, and declares an interface with five methods: findAll(), save(), delete(), findById(), and update().

```
1 package hsf301.fe.service;
2
3 import java.util.List;
4
5
6
7 public interface IStudentService {
8     public List<Student> findAll();
9
10    public void save(Student student);
11
12    public void delete(Long studentID);
13
14    public Student findById(Long studentID);
15
16    public void update(Student student);
17 }
18
19
```

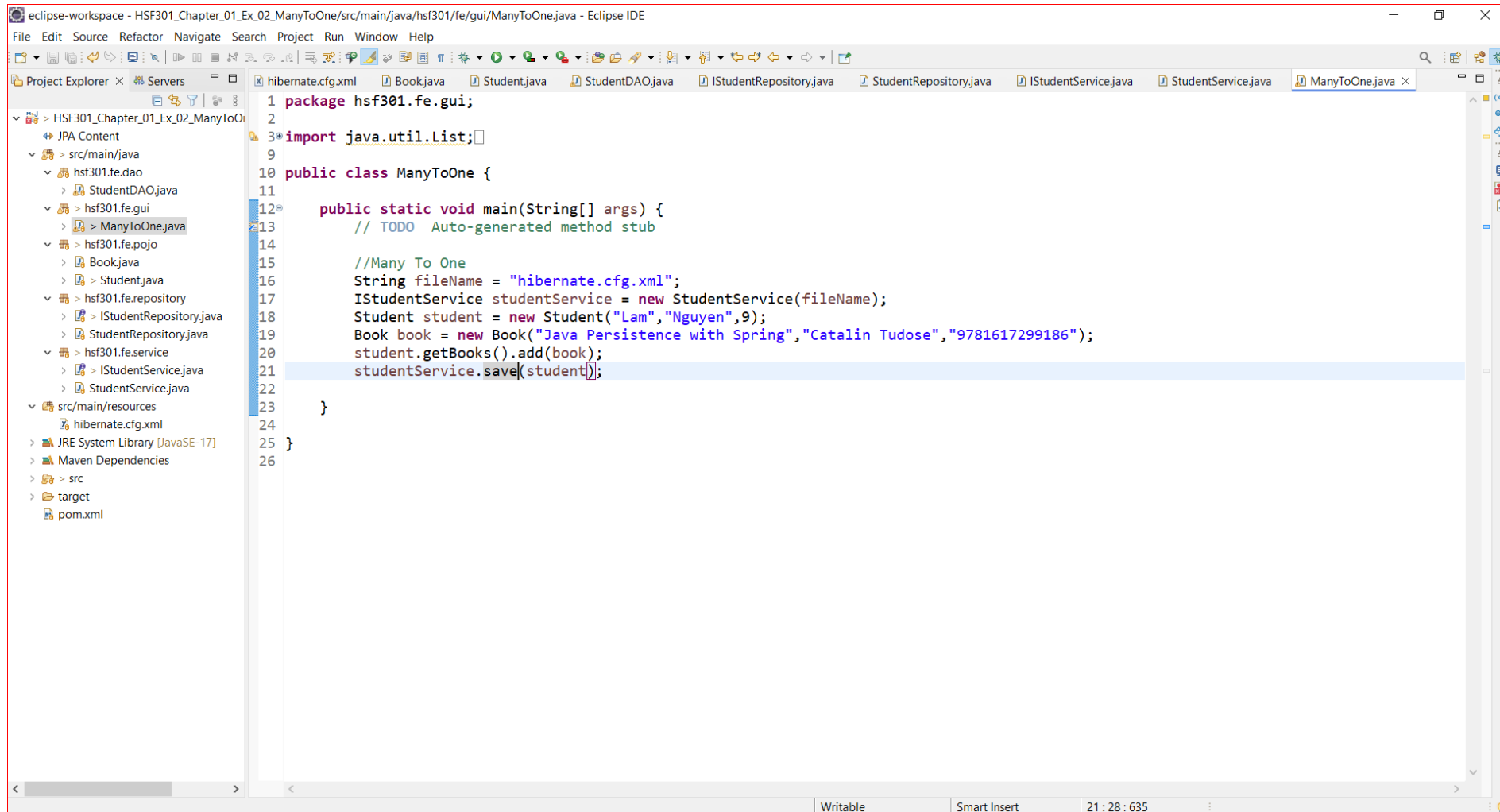
17. Create StudentService



```
eclipse-workspace - HSF301_Chapter_01_Ex_02_ManyToOne/src/main/java/hsf301/fe/service/StudentService.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
Project Explorer Servers
HSF301_Chapter_01_Ex_02_ManyToOne
  JPA Content
  > src/main/java
    hsf301.fe.dao
      StudentDAO.java
    hsf301.fe.gui
    > hsf301.fe.pojo
      Book.java
      Student.java
    > hsf301.fe.repository
      IStudentRepository.java
      StudentRepository.java
    > hsf301.fe.service
      IStudentService.java
      StudentService.java
  src/main/resources
    hibernate.cfg.xml
  JRE System Library [JavaSE-17]
  Maven Dependencies
  > src
  target
  pom.xml

1 package hsf301.fe.service;
2
3 import java.util.List;
4
5
6
7
8
9 public class StudentService implements IStudentService{
10     private IStudentRepository iStudentRepo = null;
11
12     public StudentService(String fileName) {
13         iStudentRepo = new StudentRepository(fileName);
14     }
15     @Override
16     public void save(Student student) {
17         // TODO Auto-generated method stub
18         iStudentRepo.save(student);
19     }
20     @Override
21     public List<Student> findAll() {
22         // TODO Auto-generated method stub
23         return iStudentRepo.findAll();
24     }
25     @Override
26     public void delete(Long studentID) {
27         iStudentRepo.delete(studentID);
28     }
29
30     @Override
31     public Student findById(Long studentID) {
32         // TODO Auto-generated method stub
33         return iStudentRepo.findById(studentID);
34     }
35     @Override
36     public void update(Student student) {
37         // TODO Auto-generated method stub
38         iStudentRepo.update(student);
39     }
40
41 }
42
```

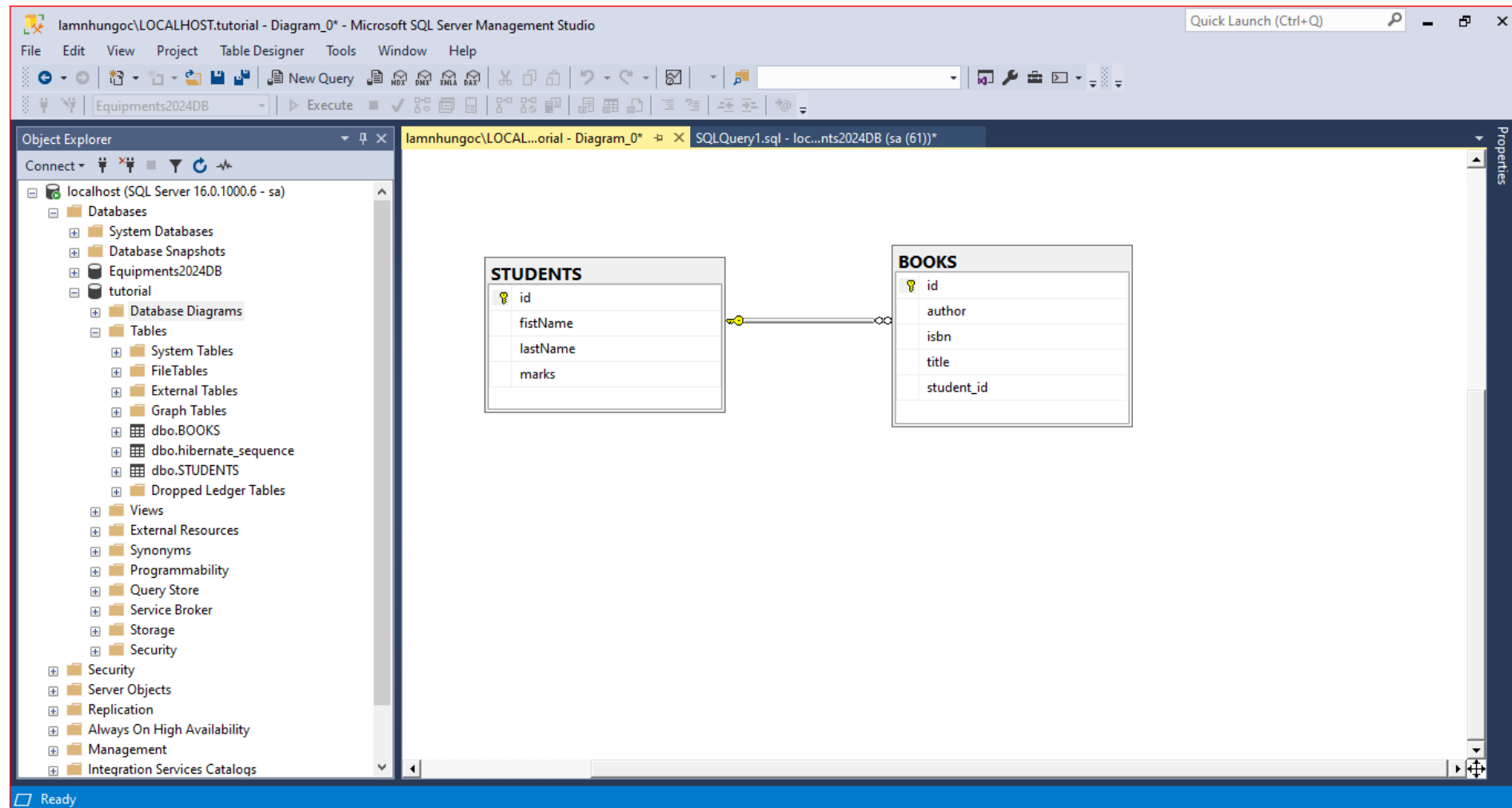
18. Create Main function



The screenshot shows the Eclipse IDE with the file `ManyToOne.java` open. The code defines a package `hsf301.fe.gui` and a class `ManyToOne` with a `main` method. The `main` method initializes a `StudentService`, creates a `Student` object, adds a `Book` to its `getBooks()` list, and saves the student.

```
1 package hsf301.fe.gui;
2
3 import java.util.List;
4
5
6
7
8
9
10 public class ManyToOne {
11
12     public static void main(String[] args) {
13         // TODO Auto-generated method stub
14
15         //Many To One
16         String fileName = "hibernate.cfg.xml";
17         IStudentService studentService = new StudentService(fileName);
18         Student student = new Student("Lam", "Nguyen", 9);
19         Book book = new Book("Java Persistence with Spring", "Catalin Tudose", "9781617299186");
20         student.getBooks().add(book);
21         studentService.save(student);
22     }
23 }
24
25
26
```

19. Result



20. Result

SQLQuery1.sql - localhost.tutorial (sa (53)) - Microsoft SQL Server Management Studio

File Edit View Query Project Tools Window Help

tutorial

Execute

100 %

Results Messages

localhost (SQL Server 16.0.1000.6 - sa)

Databases

System Databases

Database Snapshots

Equipments2024DB

tutorial

Database Diagrams

Tables

System Tables

FileTables

External Tables

Graph Tables

dbo.BOOKS

dbo.hibernate_sequence

dbo.STUDENTS

Dropped Ledger Tables

Views

External Resources

Synonyms

Programmability

Query Store

Service Broker

Storage

Security

Security

Server Objects

Replication

Always On High Availability

Management

Integration Services Catalogs

SQLQuery1.sql - loca...st.tutorial (sa (53))

SELECT TOP (1000) [id]

,[author]

,[isbn]

,[title]

,[student_id]

FROM [tutorial].[dbo].[BOOKS]

Results

Messages

id	author	isbn	title	student_id
1	2	Catalin Tudose	Java Persistence with Spring	1

Query executed successfully.

SQLQuery2.sql - localhost.tutorial (sa (62)) - Microsoft SQL Server Management Studio

File Edit View Query Project Tools Window Help

tutorial

Execute

100 %

Results Messages

localhost (SQL Server 16.0.1000.6 - sa)

Databases

System Databases

Database Snapshots

Equipments2024DB

tutorial

Database Diagrams

Tables

System Tables

FileTables

External Tables

Graph Tables

dbo.BOOKS

dbo.hibernate_sequence

dbo.STUDENTS

Dropped Ledger Tables

Views

External Resources

Synonyms

Programmability

Query Store

Service Broker

Storage

Security

Security

Server Objects

Replication

Always On High Availability

Management

Integration Services Catalogs

SQLQuery2.sql - loca...st.tutorial (sa (62))

SELECT TOP (1000) [id]

,[firstName]

,[lastName]

,[marks]

FROM [tutorial].[dbo].[STUDENTS]

Results

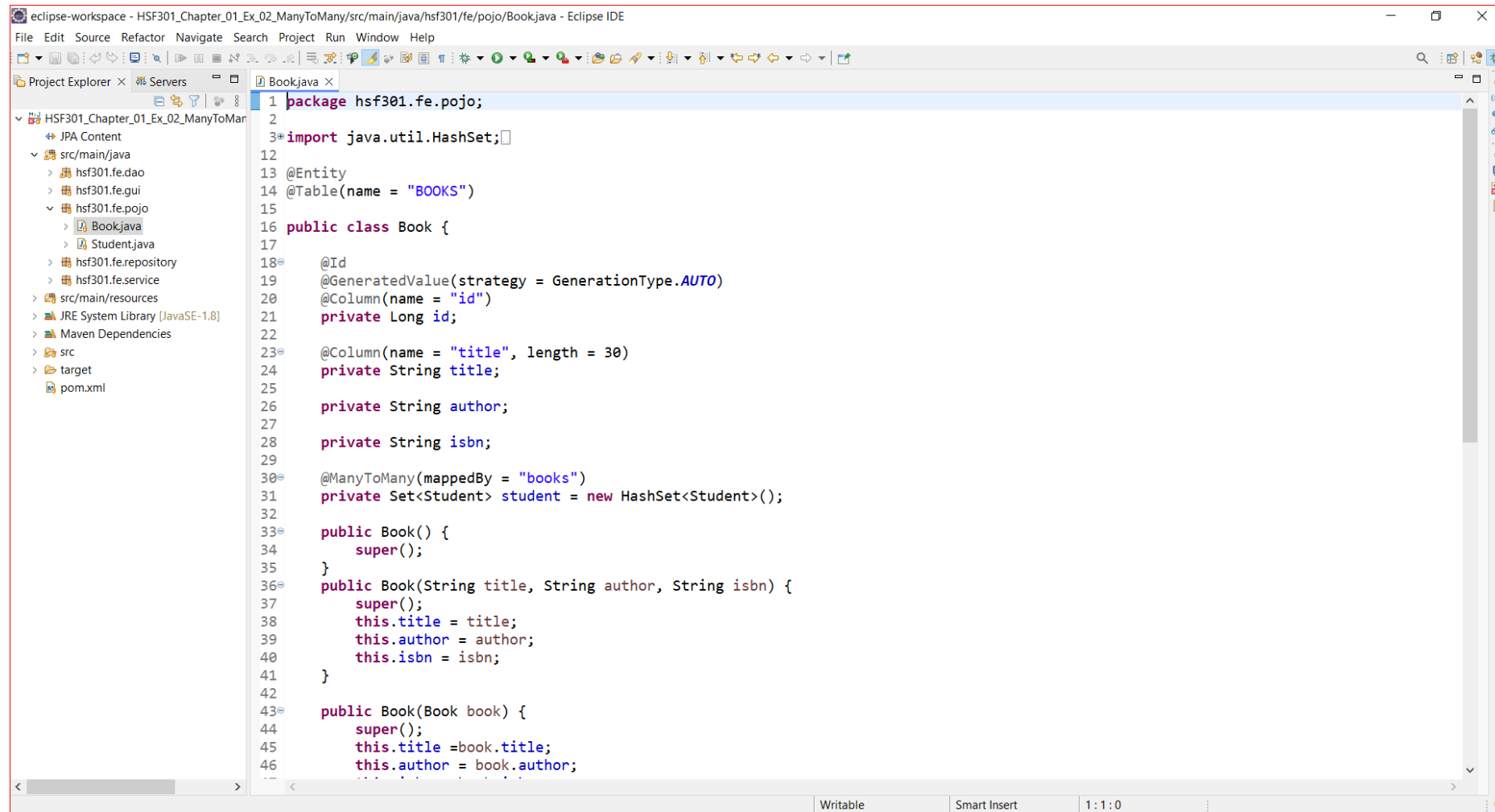
Messages

id	firstName	lastName	marks
1	Lam	Nguyen	9

Query executed successfully.

Demo JPA (Many To Many)

1. Create Books in Pojo's Package



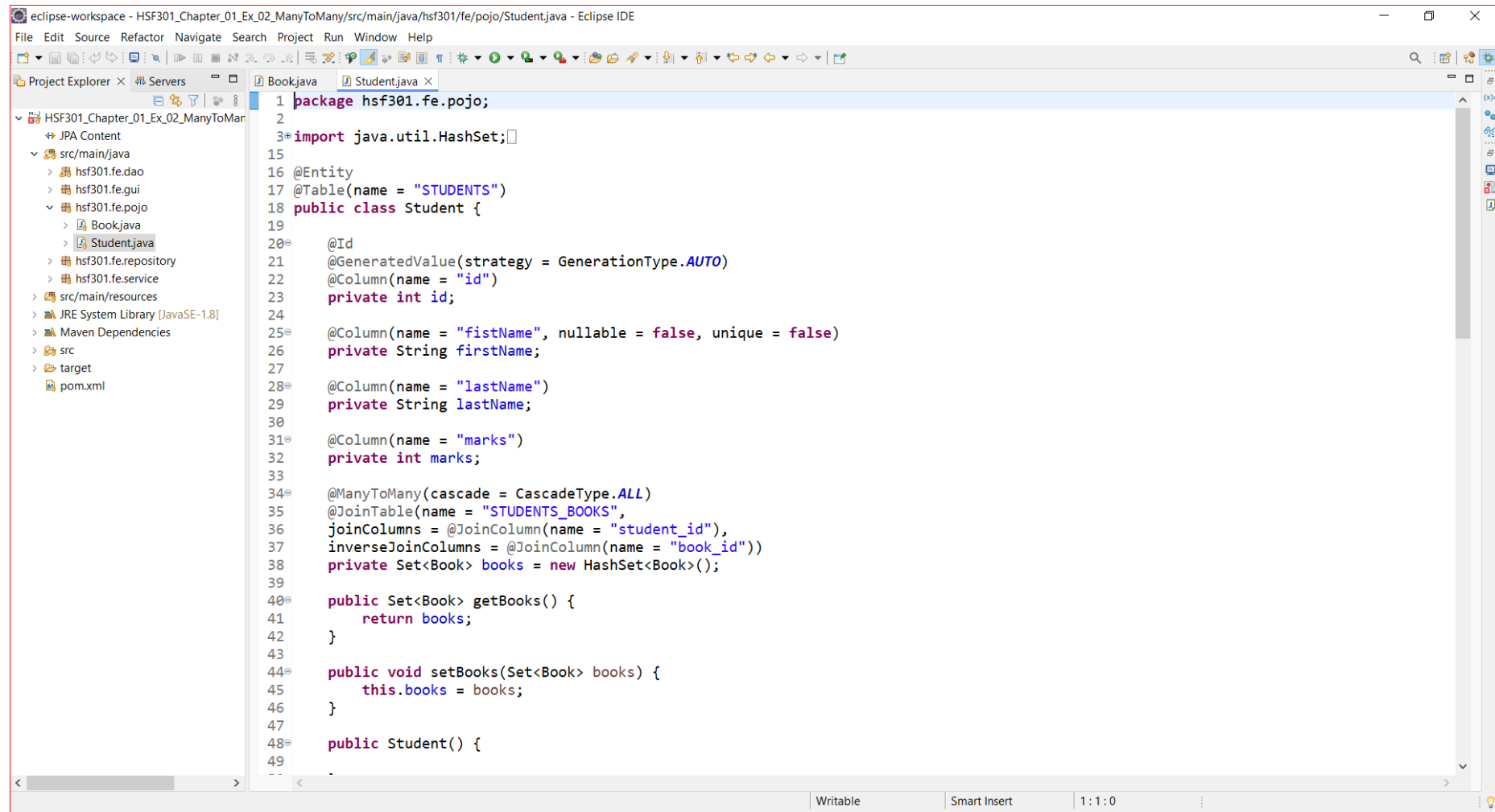
```

eclipse-workspace - HSF301_Chapter_01_Ex_02_ManyToMany/src/main/java/hsf301/fe/pojo/Book.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
Project Explorer Servers Bookjava
HSF301_Chapter_01_Ex_02_ManyToMany
  JPA Content
  src/main/java
    hsf301.fe.dao
    hsf301.fe.gui
    hsf301.fe.pojo
      Bookjava
      Student.java
    hsf301.fe.repository
    hsf301.fe.service
  src/main/resources
  JRE System Library [JavaSE-1.8]
  Maven Dependencies
  src
  target
  pom.xml

1 package hsf301.fe.pojo;
2
3 import java.util.HashSet;
4
12
13 @Entity
14 @Table(name = "BOOKS")
15
16 public class Book {
17
18     @Id
19     @GeneratedValue(strategy = GenerationType.AUTO)
20     @Column(name = "id")
21     private Long id;
22
23     @Column(name = "title", length = 30)
24     private String title;
25
26     private String author;
27
28     private String isbn;
29
30     @ManyToMany(mappedBy = "books")
31     private Set<Student> student = new HashSet<Student>();
32
33     public Book() {
34         super();
35     }
36     public Book(String title, String author, String isbn) {
37         super();
38         this.title = title;
39         this.author = author;
40         this.isbn = isbn;
41     }
42
43     public Book(Book book) {
44         super();
45         this.title = book.title;
46         this.author = book.author;
47     }

```

2. Create Students in Pojo's Package

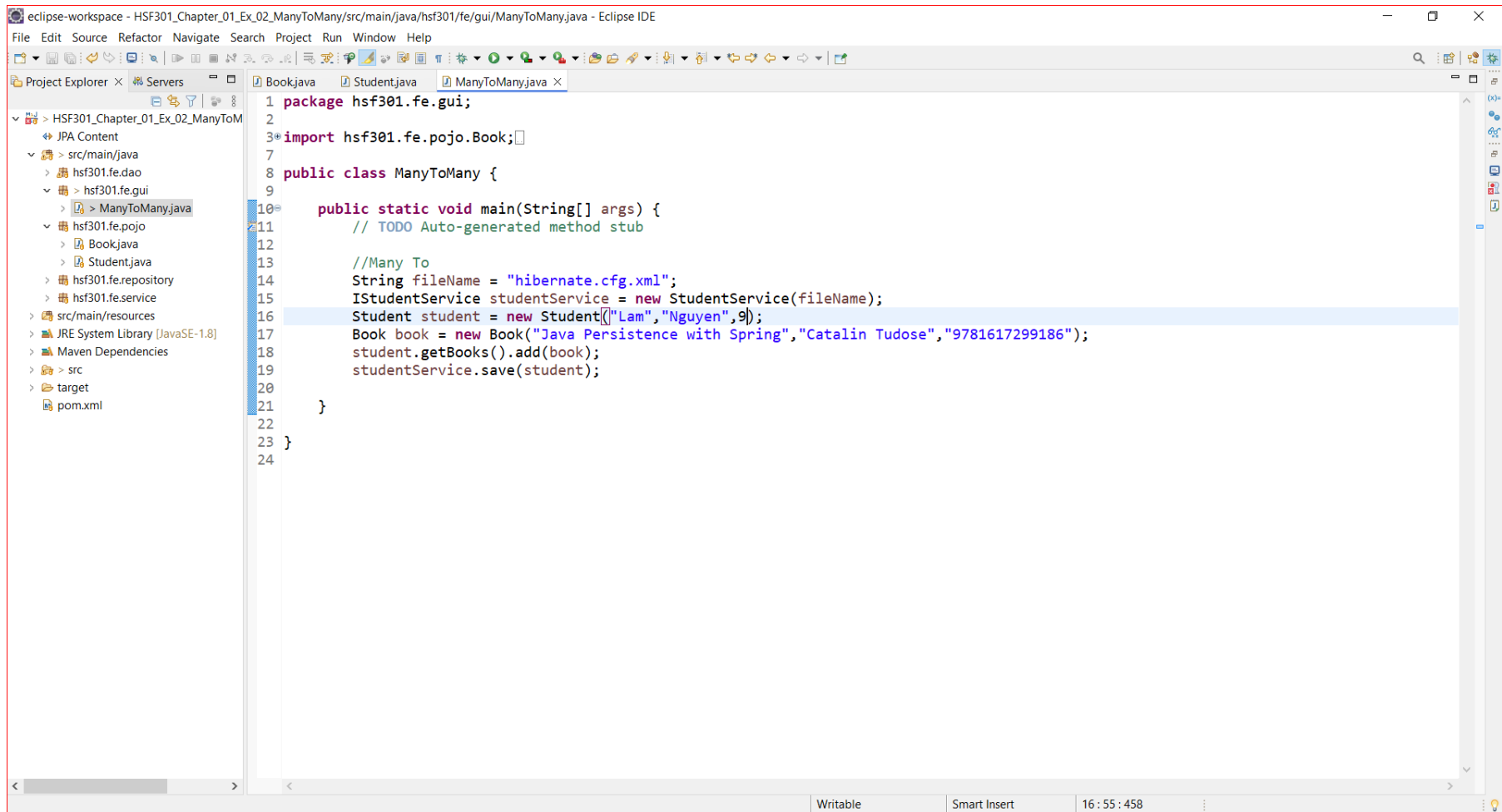


```

1 package hsf301.fe.pojo;
2
3 import java.util.HashSet;
4
5
6
7
8
9
10
11
12
13
14
15 @Entity
16 @Table(name = "STUDENTS")
17 public class Student {
18
19
20     @Id
21     @GeneratedValue(strategy = GenerationType.AUTO)
22     @Column(name = "id")
23     private int id;
24
25     @Column(name = "firstName", nullable = false, unique = false)
26     private String firstName;
27
28     @Column(name = "lastName")
29     private String lastName;
30
31     @Column(name = "marks")
32     private int marks;
33
34     @ManyToMany(cascade = CascadeType.ALL)
35     @JoinTable(name = "STUDENTS_BOOKS",
36               joinColumns = @JoinColumn(name = "student_id"),
37               inverseJoinColumns = @JoinColumn(name = "book_id"))
38     private Set<Book> books = new HashSet<Book>();
39
40     public Set<Book> getBooks() {
41         return books;
42     }
43
44     public void setBooks(Set<Book> books) {
45         this.books = books;
46     }
47
48     public Student() {
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
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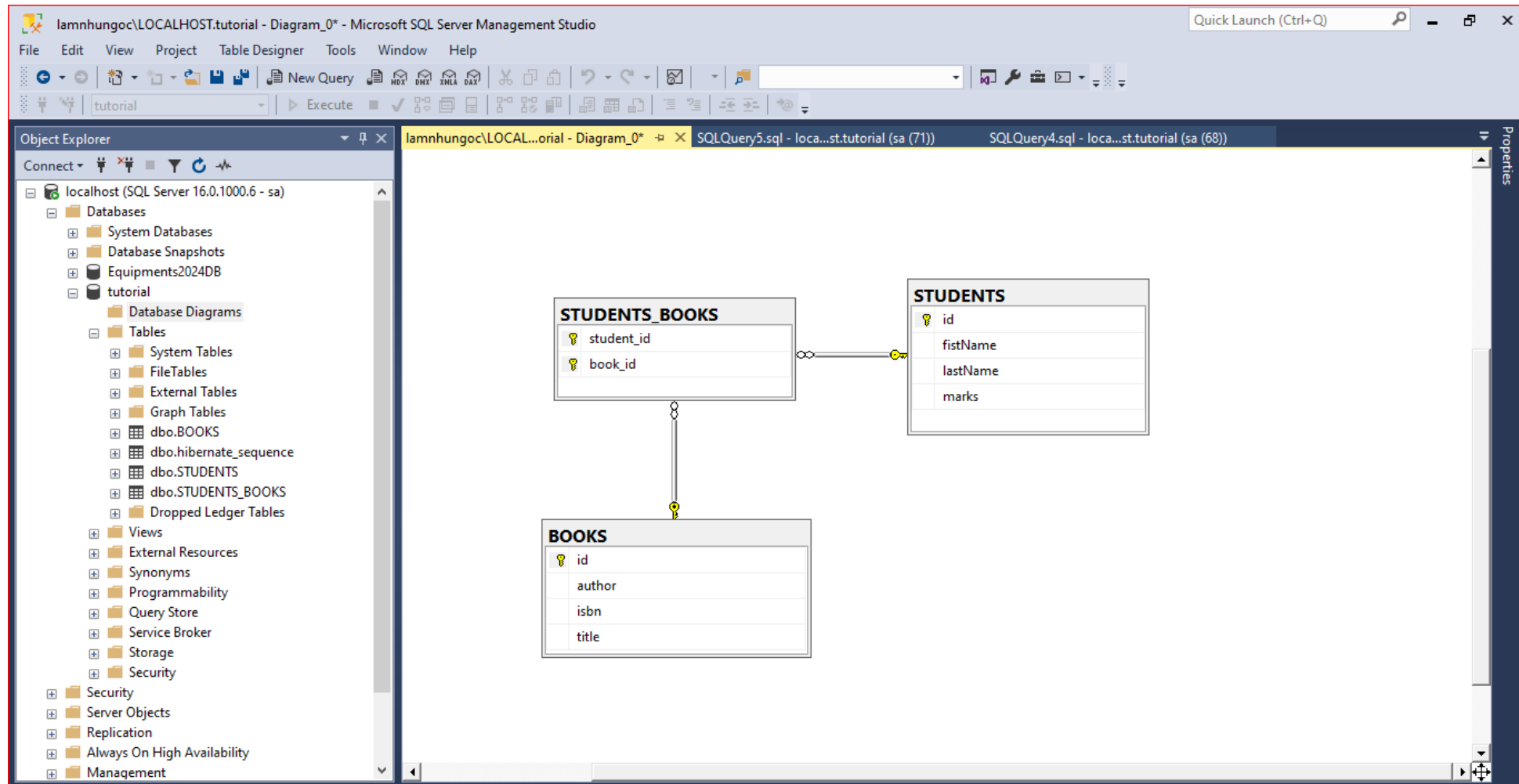
```

3. Run Program



```
1 package hsf301.fe.gui;
2
3 import hsf301.fe.pojo.Book;
4
5
6
7
8 public class ManyToMany {
9
10     public static void main(String[] args) {
11         // TODO Auto-generated method stub
12
13         //Many To
14         String fileName = "hibernate.cfg.xml";
15         IStudentService studentService = new StudentService(fileName);
16         Student student = new Student("Lam", "Nguyen", 9);
17         Book book = new Book("Java Persistence with Spring", "Catalin Tudose", "9781617299186");
18         student.getBooks().add(book);
19         studentService.save(student);
20
21     }
22
23 }
24
```

4. Result



5. Result

SQLQuery1.sql - localhost:tutorial (sa (53)) - Microsoft SQL Server Management Studio

localhost (SQL Server 16.0.1000.6 - sa)

Databases

System Databases

Database Snapshots

Equipments2024DB

tutorial

Database Diagrams

Tables

System Tables

FileTables

External Tables

Graph Tables

dbo.BOOKS

dbo.hibernate_sequence

dbo.STUDENTS

dbo.STUDENTS_BOOKS

Dropped Ledger Tables

Views

External Resources

Synonyms

Programmability

Query Store

Service Broker

Storage

Security

SQLQuery1.sql - localhost:tutorial (sa (53))

```

SELECT TOP (1000) [id]
, [author]
, [isbn]
, [title]
FROM [tutorial].[dbo].[BOOKS]

```

100 %

Results Messages

id	author	isbn	title	student_id
1	Catalin Tudose	9781617299186	Java Persistence with Spring	1

Query executed successfully. localhost (16.0 RTM) | sa (53) | tutorial | 00:00:00 | 1 rows

SQLQuery8.sql - localhost:tutorial (sa (72)) - Microsoft SQL Server Management Studio

localhost (SQL Server 16.0.1000.6 - sa)

Databases

System Databases

Database Snapshots

Equipments2024DB

tutorial

Database Diagrams

Tables

System Tables

FileTables

External Tables

Graph Tables

dbo.BOOKS

dbo.hibernate_sequence

dbo.STUDENTS

dbo.STUDENTS_BOOKS

Dropped Ledger Tables

Views

External Resources

Synonyms

Programmability

Query Store

Service Broker

Storage

Security

SQLQuery8.sql - localhost:tutorial (sa (72))

```

SELECT TOP (1000) [student_id]
, [book_id]
FROM [tutorial].[dbo].[STUDENTS_BOOKS]

```

100 %

Results Messages

student_id	book_id
1	2

Query executed successfully. localhost (16.0 RTM) | sa (72) | tutorial | 00:00:00 | 1 rows

SQLQuery7.sql - localhost:tutorial (sa (64)) - Microsoft SQL Server Management Studio

localhost (SQL Server 16.0.1000.6 - sa)

Databases

System Databases

Database Snapshots

Equipments2024DB

tutorial

Database Diagrams

Tables

System Tables

FileTables

External Tables

Graph Tables

dbo.BOOKS

dbo.hibernate_sequence

dbo.STUDENTS

dbo.STUDENTS_BOOKS

Dropped Ledger Tables

Views

External Resources

Synonyms

Programmability

Query Store

Service Broker

Storage

Security

SQLQuery7.sql - localhost:tutorial (sa (64))

```

SELECT TOP (1000) [id]
, [firstName]
, [lastName]
, [marks]
FROM [tutorial].[dbo].[STUDENTS]

```

100 %

Results Messages

id	firstName	lastName	marks
1	Lam	Nguyen	9

Query executed successfully. localhost (16.0 RTM) | sa (64) | tutorial | 00:00:00 | 1 rows

Summary

- ❖ Concepts were introduced:
 - ❖ Overview about Hibernate
 - ❖ Architecture Overview new features of Hibernate
 - ❖ Explain and demo using Eclipse IDE to create Hibernate Console
 - ❖ Create and Run cross-platform Console application with Java connect to MSSQL with Repository Pattern