Java Persistence with MyBatis 3

A practical guide to MyBatis, a simple yet powerful Java Persistence Framework!

K. Siva Prasad Reddy
Java Persistence with MyBatis 3

A practical guide to MyBatis, a simple yet powerful Java Persistence Framework!

K. Siva Prasad Reddy
Credits

Author
K. Siva Prasad Reddy

Reviewers
Muhammad Edwin
Eduardo Macarrón

Acquisition Editor
Usha Iyer

Commissioning Editor
Ameya Sawant

Technical Editors
Jeeten Handu
Akshata Patil
Zafeer Rais

Copy Editor
Alfida Paiva
Insiya Morbiwala
Laxmi Subramanian

Project Coordinator
Suraj Bist

Proofreader
Lesley Harrison

Indexer
Monica Ajmera Mehta

Graphics
Abhinash Sahu

Production Coordinator
Melwyn D’sa

Cover Work
Melwyn D’sa
K. Siva Prasad Reddy is a Senior Software Engineer living in Hyderabad, India and has more than six years’ experience in developing enterprise applications with Java and JavaEE technologies. Siva is a Sun Certified Java Programmer and has a lot of experience in server-side technologies such as Java, JavaEE, Spring, Hibernate, MyBatis, JSF (PrimeFaces), and WebServices (SOAP/REST).

Siva normally shares the knowledge he has acquired on his blog www.sivalabs.in. If you want to find out more information about his work, you can follow him on Twitter (@sivalabs) and GitHub (https://github.com/sivaprasadreddy).

I would like to thank my wife Neha, as she supported me in every step of the process and without her, this wouldn’t have been possible. I thank my parents and my sister for their moral support in helping me complete this dream.
About the Reviewers

**Muhammad Edwin** is the founder and Chief Technology Officer for Baculsoft Technology, an Indonesian leading system integrator company, which provides consultancy, support, and services around open source technologies. His primary responsibility is designing and implementing solutions that use cutting-edge enterprise Java technologies to fit his customer’s needs. He has held a number of positions including Software Engineer, Development Team Lead, and also as a Java Trainer. Edwin earned his Bachelor’s and Master’s degree from Budi Luhur University, majoring in Information Technology.

While not working or answering questions on various forums and mailing lists, he can be found traveling around beautiful beaches, scuba diving, and clicking underwater pictures.

---

I would like to thank my parents and my wife, Nunung Astuti, for their unwavering support while I used my personal time to review this book. I would also like to thank my colleagues at Budi Luhur University, my friends at Kaskus Programmer Community, and also people from Java User Group Indonesia. May the Source be with you.

---

**Eduardo Macarrón** has worked as an enterprise integrator and solution architect for 15 years in the electric utility industry, which focused on large projects (with more than 100 developers).

He is an open source enthusiast and has been a member of the MyBatis project since 2010.
# Table of Contents

**Preface** 1

**Chapter 1: Getting Started with MyBatis** 7

**What is MyBatis?** 7

**Why MyBatis?** 8
- Eliminates a lot of JDBC boilerplate code 8
- Low learning curve 12
- Works well with legacy databases 12
- Embraces SQL 12
- Supports integration with Spring and Guice frameworks 13
- Supports integration with third-party cache libraries 13
- Better performance 13

**Installing and configuring MyBatis** 14
- Creating a STUDENTS table and inserting sample data 15
- Creating a Java project and adding mybatis-3.2.2.jar to the classpath 15
- Creating the mybatis-config.xml and StudentMapper.xml configuration files 17
- Creating the MyBatisSqlSessionFactory singleton class 19
- Creating the StudentMapper interface and the StudentService classes 20
- Creating a JUnit test for testing StudentService 22
- How it works 23

**Sample domain model** 24

**Summary** 25

**Chapter 2: Bootstrapping MyBatis** 27

**Configuring MyBatis using XML** 27
- Environment 29
- DataSource 30
- TransactionManager 30
- Properties 31
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MyBatis recipes</strong></td>
<td>72</td>
</tr>
<tr>
<td>Handling enumeration types</td>
<td>73</td>
</tr>
<tr>
<td>Handling the CLOB/BLOB types</td>
<td>74</td>
</tr>
<tr>
<td>Passing multiple input parameters</td>
<td>76</td>
</tr>
<tr>
<td>Multiple results as a map</td>
<td>77</td>
</tr>
<tr>
<td>Paginated ResultSets using RowBounds</td>
<td>77</td>
</tr>
<tr>
<td>Custom ResultSet processing using ResultSetHandler</td>
<td>78</td>
</tr>
<tr>
<td>Cache</td>
<td>79</td>
</tr>
<tr>
<td><strong>Summary</strong></td>
<td>81</td>
</tr>
<tr>
<td><strong>Chapter 4: SQL Mappers using Annotations</strong></td>
<td>83</td>
</tr>
<tr>
<td>Mapper interfaces using annotations</td>
<td>84</td>
</tr>
<tr>
<td><strong>Mapped statements</strong></td>
<td>84</td>
</tr>
<tr>
<td>@Insert</td>
<td>84</td>
</tr>
<tr>
<td>Autogenerated keys</td>
<td>84</td>
</tr>
<tr>
<td>@Update</td>
<td>85</td>
</tr>
<tr>
<td>@Delete</td>
<td>86</td>
</tr>
<tr>
<td>@Select</td>
<td>86</td>
</tr>
<tr>
<td><strong>Result maps</strong></td>
<td>86</td>
</tr>
<tr>
<td>One-to-one mapping</td>
<td>88</td>
</tr>
<tr>
<td>One-to-many mapping</td>
<td>90</td>
</tr>
<tr>
<td><strong>Dynamic SQL</strong></td>
<td>92</td>
</tr>
<tr>
<td>@InsertProvider</td>
<td>96</td>
</tr>
<tr>
<td>@UpdateProvider</td>
<td>97</td>
</tr>
<tr>
<td>@DeleteProvider</td>
<td>97</td>
</tr>
<tr>
<td><strong>Summary</strong></td>
<td>98</td>
</tr>
<tr>
<td><strong>Chapter 5: Integration with Spring</strong></td>
<td>99</td>
</tr>
<tr>
<td>Configuring MyBatis in a Spring application</td>
<td>99</td>
</tr>
<tr>
<td>Installation</td>
<td>100</td>
</tr>
<tr>
<td>Configuring MyBatis beans</td>
<td>101</td>
</tr>
<tr>
<td><strong>Working with SqlSession</strong></td>
<td>103</td>
</tr>
<tr>
<td><strong>Working with mappers</strong></td>
<td>105</td>
</tr>
<tr>
<td><a href="">mybatis:scan/</a></td>
<td>106</td>
</tr>
<tr>
<td>@MapperScan</td>
<td>107</td>
</tr>
<tr>
<td><strong>Transaction management using Spring</strong></td>
<td>108</td>
</tr>
<tr>
<td><strong>Summary</strong></td>
<td>112</td>
</tr>
<tr>
<td><strong>Index</strong></td>
<td>113</td>
</tr>
</tbody>
</table>
Preface

For many software systems, saving and retrieving data from a database is a crucial part of the process. In Java land there are many tools and frameworks for implementing the data persistence layer and each of them follow a different approach. MyBatis, a simple yet powerful Java persistence framework, took the approach of eliminating the boilerplate code and leveraging the power of SQL and Java while still providing powerful features.

This MyBatis book will take you through the process of installing, configuring, and using MyBatis. Concepts in every chapter are explained through simple and practical examples with step-by-step instructions.

By the end of the book, you will not only gain theoretical knowledge but also gain hands-on practical understanding and experience on how to use MyBatis in your real projects.

This book can also be used as a reference or to relearn the concepts that have been discussed in each chapter. It has illustrative examples, wherever necessary, to make sure it is easy to follow.

What this book covers

Chapter 1, Getting Started with MyBatis, introduces MyBatis persistence framework and explains the advantages of using MyBatis instead of plain JDBC. We will also look at how to create a project, install MyBatis framework dependencies with and without the Maven build tool, configure, and use MyBatis.

Chapter 2, Bootstrapping MyBatis, covers how to bootstrap MyBatis using XML and Java API-based configuration. We will also learn various MyBatis configuration options such as type aliases, type handlers, global settings, and so on.
Chapter 3, SQL Mappers Using XML, goes in-depth into writing SQL mapped statements using the Mapper XML files. We will learn how to configure simple statements, statements with one-to-one, one-to-many relationships and mapping results using ResultMaps. We will also learn how to build dynamic queries, paginated results, and custom ResultSet handling.

Chapter 4, SQL Mappers Using Annotations, covers writing SQL mapped statements using annotations. We will learn how to configure simple statements, statements with one-to-one and one-to-many relationships. We will also look into building dynamic queries using SqlProvider annotations.

Chapter 5, Integration with Spring, covers how to integrate MyBatis with Spring framework. We will learn how to install Spring libraries, register MyBatis beans in Spring ApplicationContext, inject SqlSession and Mapper beans, and use Spring’s annotation-based transaction handling mechanism with MyBatis.

What you need for this book
You will need the following software to follow the examples:

- Java JDK 1.5+
- MyBatis latest version (https://code.google.com/p/mybatis/)
- MySQL (http://www.mysql.com/) or any other relational database, which has JDBC driver
- Eclipse (http://www.eclipse.org) or any of your favorite Java IDE
- Apache Maven build tool (http://maven.apache.org/)

Who this book is for
This book is for Java developers who have at least some basic experience with databases and using JDBC. You will need to have a basic familiarity with SQL. We do not assume that you have prior experience with MyBatis.

Conventions
In this book, you will find a number of styles of text that distinguish between different kinds of information. Here are some examples of these styles, and an explanation of their meaning.

Code words in text are shown as follows: "We can include other contexts through the use of the include directive."
A block of code is set as follows:

```java
package com.mybatis3.domain;
import java.util.Date;
public class Student
{
    private Integer studId;
    private String name;
    private String email;
    private Date dob;
    // setters and getters
}
```

When we wish to draw your attention to a particular part of a code block, the relevant lines or items are set in bold:

```java
package com.mybatis3.domain;
import java.util.Date;
public class Student
{
    private Integer studId;
    private String name;
    private String email;
    private Date dob;
    // setters and getters
}
```

**New terms** and **important words** are shown in bold. Words that you see on the screen, in menus or dialog boxes for example, appear in the text like this: "clicking the **Next** button moves you to the next screen".

[![Warnings or important notes appear in a box like this.]](image)

[![Tips and tricks appear like this.]](image)
Reader feedback

Feedback from our readers is always welcome. Let us know what you think about this book—what you liked or may have disliked. Reader feedback is important for us to develop titles that you really get the most out of.

To send us general feedback, simply send an e-mail to feedback@packtpub.com, and mention the book title via the subject of your message.

If there is a topic that you have expertise in and you are interested in either writing or contributing to a book, see our author guide on www.packtpub.com/authors.

Customer support

Now that you are the proud owner of a Packt book, we have a number of things to help you to get the most from your purchase.

Downloading the example code

You can download the example code files for all Packt books you have purchased from your account at http://www.packtpub.com. If you purchased this book elsewhere, you can visit http://www.packtpub.com/support and register to have the files e-mailed directly to you.

Errata

Although we have taken every care to ensure the accuracy of our content, mistakes do happen. If you find a mistake in one of our books—maybe a mistake in the text or the code—we would be grateful if you would report this to us. By doing so, you can save other readers from frustration and help us improve subsequent versions of this book. If you find any errata, please report them by visiting http://www.packtpub.com/submit-errata, selecting your book, clicking on the errata submission form link, and entering the details of your errata. Once your errata are verified, your submission will be accepted and the errata will be uploaded on our website, or added to any list of existing errata, under the Errata section of that title. Any existing errata can be viewed by selecting your title from http://www.packtpub.com/support.
Piracy

Piracy of copyright material on the Internet is an ongoing problem across all media. At Packt, we take the protection of our copyright and licenses very seriously. If you come across any illegal copies of our works, in any form, on the Internet, please provide us with the location address or website name immediately so that we can pursue a remedy.

Please contact us at copyright@packtpub.com with a link to the suspected pirated material.

We appreciate your help in protecting our authors, and our ability to bring you valuable content.

Questions

You can contact us at questions@packtpub.com if you are having a problem with any aspect of the book, and we will do our best to address it.
In this chapter, we will cover the following topics:

- What is MyBatis?
- Why MyBatis?
- Installing and configuring MyBatis
- Sample domain model

**What is MyBatis?**

MyBatis is an open source persistence framework that simplifies the implementation of the persistence layer by abstracting a lot of JDBC boilerplate code and provides a simple and easy-to-use API to interact with the database.

MyBatis was formerly known as iBATIS and was started by Clinton Begin in 2002. MyBatis 3 is a complete redesign of iBATIS, with annotations and Mapper support.

The main reason for the popularity of MyBatis is its simplicity and ease of use. In Java applications, the persistence layer involves populating Java objects with data loaded from the database using SQL queries, and persisting the data in Java objects into the database using SQL.

MyBatis makes using SQL easy by abstracting low-level JDBC code, automating the process of populating the SQL result set into Java objects, and persisting data into tables by extracting the data from Java objects.

Why MyBatis?
There are many Java-based persistence frameworks, however MyBatis became popular because of the following reasons:

- It Eliminates a lot of JDBC boilerplate code
- It has a low learning curve
- It works well with legacy databases
- It embraces SQL
- It provides support for integration with Spring and Guice frameworks
- It provides support for integration with third-party cache libraries
- It induces better performance

Eliminates a lot of JDBC boilerplate code
Java has a Java Database Connectivity (JDBC) API to work with relational databases. But JDBC is a very low-level API, and we need to write a lot of code to perform database operations.

Let us examine how we can implement simple insert and select operations on a STUDENTS table using plain JDBC.

Assume that the STUDENTS table has STUD_ID, NAME, EMAIL, and DOB columns.

The corresponding Student JavaBean is as follows:

```java
package com.mybatis3.domain;
import java.util.Date;
public class Student
{
    private Integer studId;
    private String name;
    private String email;
    private Date dob;
    // setters and getters
}
```
The following `StudentService.java` program implements the `SELECT` and `INSERT` operations on the `STUDENTS` table using JDBC.

```java
public Student findStudentById(int studId) {
    Student student = null;
    Connection conn = null;
    try{
        //obtain connection
        conn = getDatabaseConnection();
        String sql = "SELECT * FROM STUDENTS WHERE STUD_ID=?";
        //create PreparedStatement
        PreparedStatement pstmt = conn.prepareStatement(sql);
        //set input parameters
        pstmt.setInt(1, studId);
        ResultSet rs = pstmt.executeQuery();
        //fetch results from database and populate into Java objects
        if(rs.next()) {
            student = new Student();
            student.setStudId(rs.getInt("stud_id"));
            student.setName(rs.getString("name"));
            student.setEmail(rs.getString("email"));
            student.setDob(rs.getDate("dob"));
        }
    } catch (SQLException e){
        throw new RuntimeException(e);
    }
    return student;
}
```

Downloading the example code
You can download the example code files for all Packt books you have purchased from your account at http://www.packtpub.com. If you purchased this book elsewhere, you can visit http://www.packtpub.com/support and register to have the files e-mailed directly to you.
public void createStudent(Student student) {
    Connection conn = null;
    try{
        //obtain connection
        conn = getDatabaseConnection();
        String sql = "INSERT INTO STUDENTS(STUD_ID,NAME,EMAIL,DOB) VALUES(?,?,?,?)";
        //create a PreparedStatement
        PreparedStatement pstmt = conn.prepareStatement(sql);
        //set input parameters
        pstmt.setInt(1, student.getStudId());
        pstmt.setString(2, student.getName());
        pstmt.setString(3, student.getEmail());
        pstmt.setDate(4, new java.sql.Date(student.getDob().getTime()));
        pstmt.executeUpdate();
    } catch (SQLException e){
        throw new RuntimeException(e);
    }finally{
        //close connection
        if(conn!= null){
            try {
                conn.close();
            } catch (SQLException e){ }
        }
    }
}

protected Connection getDatabaseConnection() throws SQLException {
    try{
        Class.forName("com.mysql.jdbc.Driver");
        return DriverManager.getConnection("jdbc:mysql://localhost:3306/test", "root", "admin");
    } catch (SQLException e){
        throw e;
    } catch (Exception e){
        throw new RuntimeException(e);
    }
}
There is a lot of duplicate code in each of the preceding methods, for creating a connection, creating a statement, setting input parameters, and closing the resources, such as the connection, statement, and result set.

MyBatis abstracts all these common tasks so that the developer can focus on the really important aspects, such as preparing the SQL statement that needs to be executed and passing the input data as Java objects.

In addition to this, MyBatis automates the process of setting the query parameters from the input Java object properties and populates the Java objects with the SQL query results as well.

Now let us see how we can implement the preceding methods using MyBatis:

1. Configure the queries in a SQL Mapper config file, say StudentMapper.xml.

```xml
<select id="findStudentById" parameterType="int" resultType="Student">
    SELECT STUD_ID AS studId, NAME, EMAIL, DOB
    FROM STUDENTS WHERE STUD_ID=#{Id}
</select>

<insert id="insertStudent" parameterType="Student">
    INSERT INTO STUDENTS(STUD_ID,NAME,EMAIL,DOB)
    VALUES(#{studId},#{name},#{email},#{dob})
</insert>
```

2. Create a StudentMapper interface.

```java
public interface StudentMapper {
    Student findStudentById(Integer id);
    void insertStudent(Student student);
}
```

3. In Java code, you can invoke these statements as follows:

```java
SqlSession session = getSqlSessionFactory().openSession();
StudentMapper mapper = session.getMapper(StudentMapper.class);
// Select Student by Id
Student student = mapper.selectStudentById(1);
//To insert a Student record
mapper.insertStudent(student);```
Getting Started with MyBatis

That's it! You don't need to create the `Connection`, `PrepareStatement`, `extract`, and `set` parameters and close the connection by yourself for every database operation. Just configure the database connection properties and SQL statements, and MyBatis will take care of all the ground work.

Don't worry about what `SqlSessionFactory`, `SqlSession`, and Mapper XML files are. These concepts will be explained in detail in the coming chapters.

Along with these, MyBatis provides many other features that simplify the implementation of persistence logic.

- It supports the mapping of complex SQL result set data to nested object graph structures
- It supports the mapping of one-to-one and one-to-many results to Java objects
- It supports building dynamic SQL queries based on the input data

**Low learning curve**
One of the primary reasons for MyBatis' popularity is that it is very simple to learn and use because it depends on your knowledge of Java and SQL. If developers are familiar with Java and SQL, they will find it fairly easy to get started with MyBatis.

**Works well with legacy databases**
Sometimes we may need to work with legacy databases that are not in a normalized form. It is possible, but difficult, to work with these kinds of legacy databases with fully-fledged ORM frameworks such as Hibernate because they attempt to statically map Java objects to database tables.

MyBatis works by mapping query results to Java objects; this makes it easy for MyBatis to work with legacy databases. You can create Java domain objects following the object-oriented model, execute queries against the legacy database, and map the query results to the Java objects.

**Embraces SQL**
Full-fledged ORM frameworks such as Hibernate encourage working with entity objects and generate SQL queries under the hood. Because of this SQL generation, we may not be able to take advantage of database-specific features. Hibernate allows to execute native SQLs, but that might defeat the promise of a database-independent persistence.
The MyBatis framework embraces SQL instead of hiding it from developers. As MyBatis won’t generate any SQLs and developers are responsible for preparing the queries, you can take advantage of database-specific features and prepare optimized SQL queries. Also, working with stored procedures is supported by MyBatis.

**Supports integration with Spring and Guice frameworks**
MyBatis provides out-of-the-box integration support for the popular dependency injection frameworks Spring and Guice; this further simplifies working with MyBatis.

**Supports integration with third-party cache libraries**
MyBatis has inbuilt support for caching `SELECT` query results within the scope of `SqlSession` level ResultSets. In addition to this, MyBatis also provides integration support for various third-party cache libraries, such as EHCache, OSCache, and Hazelcast.

**Better performance**
Performance is one of the key factors for the success of any software application. There are lots of things to consider for better performance, but for many applications, the persistence layer is a key for overall system performance.

- MyBatis supports database connection pooling that eliminates the cost of creating a database connection on demand for every request.
- MyBatis has an in-built cache mechanism which caches the results of SQL queries at the `SqlSession` level. That is, if you invoke the same mapped select query, then MyBatis returns the cached result instead of querying the database again.
- MyBatis doesn't use proxying heavily and hence yields better performance compared to other ORM frameworks that use proxies extensively.
There are no one-size-fits-all solutions in software development. Each application has a different set of requirements, and we should choose our tools and frameworks based on application needs. In the previous section, we have seen various advantages of using MyBatis. But there will be cases where MyBatis may not be the ideal or best solution. If your application is driven by an object model and wants to generate SQL dynamically, MyBatis may not be a good fit for you. Also, if you want to have a transitive persistence mechanism (saving the parent object should persist associated child objects as well) for your application, Hibernate will be better suited for it.

Installing and configuring MyBatis

We are assuming that the JDK 1.6+ and MySQL 5 database servers have been installed on your system. The installation process of JDK and MySQL is outside the scope of this book.

At the time of writing this book, the latest version of MyBatis is MyBatis 3.2.2. Throughout this book, we will use the MyBatis 3.2.2 version.

Even though it is not mandatory to use IDEs, such as Eclipse, NetBeans IDE, or IntelliJ IDEA for coding, they greatly simplify development with features such as handy autocompletion, refactoring, and debugging. You can use any of your favorite IDEs for this purpose.

This section explains how to develop a simple Java project using MyBatis:

- By creating a STUDENTS table and inserting sample data
- By creating a Java project and adding mybatis-3.2.2.jar to the classpath
- By creating the mybatis-config.xml and StudentMapper.xml configuration files
- By creating the MyBatisSqlSessionFactory singleton class
- By creating the StudentMapper interface and the StudentService classes
- By creating a JUnit test for testing StudentService
**Creating a STUDENTS table and inserting sample data**

Create a STUDENTS table and insert sample records in the MySQL database using the following SQL script:

```sql
CREATE TABLE STUDENTS
(
    stud_id int(11) NOT NULL AUTO_INCREMENT,
    name varchar(50) NOT NULL,
    email varchar(50) NOT NULL,
    dob date DEFAULT NULL,
    PRIMARY KEY (stud_id)
) ENGINE=InnoDB AUTO_INCREMENT=1 DEFAULT CHARSET=latin1;

/*Sample Data for the students table */
insert into students(stud_id,name,email,dob)
values (1,'Student1','student1@gmail.com','1983-06-25');

insert into students(stud_id,name,email,dob)
values (2,'Student2','student2@gmail.com','1983-06-25');
```

**Creating a Java project and adding mybatis-3.2.2.jar to the classpath**

Let us create a Java project and configure MyBatis JAR dependencies.

1. Create a Java project named mybatis-demo.
2. If you are not using a build tool, such as Maven or Gradle, with dependency management capabilities, you need to download the JAR files and add them to the classpath manually.
3. You can download the MyBatis distribution mybatis-3.2.2.zip from http://code.google.com/p/mybatis/. This bundle contains the mybatis-3.2.2.jar file and its optional dependent jars such as the slf4j/log4j logging jars.
4. We will use the SLF4J logging framework along with the log4j binding for logging. The mybatis-3.2.2.zip file contains the slf4j dependency jars as well.
5. Extract the ZIP file and add the mybatis-3.2.2.jar, lib/slf4j-api-1.7.5.jar, lib/slf4j-log4j12-1.7.5.jar, and lib/log4j-1.2.17.jar JARS to the classpath.


7. Add junit-4.11.jar and mysql-connector-java-5.1.22.jar to the classpath.

8. If you are using Maven, configuring these jar dependencies is much simpler. In your pom.xml file add the following dependencies:

   `<dependencies>
   <dependency>
     <groupId>org.mybatis</groupId>
     <artifactId>mybatis</artifactId>
     <version>3.2.2</version>
   </dependency>
   <dependency>
     <groupId>mysql</groupId>
     <artifactId>mysql-connector-java</artifactId>
     <version>5.1.22</version>
     <scope>runtime</scope>
   </dependency>
   <dependency>
     <groupId>org.slf4j</groupId>
     <artifactId>slf4j-api</artifactId>
     <version>1.7.5</version>
   </dependency>
   <dependency>
     <groupId>org.slf4j</groupId>
     <artifactId>slf4j-log4j12</artifactId>
     <version>1.7.5</version>
     <scope>runtime</scope>
   </dependency>
   <dependency>
     <groupId>log4j</groupId>
     <artifactId>log4j</artifactId>
     <version>1.2.17</version>
     <scope>runtime</scope>
   </dependency>
   <dependency>
     <groupId>junit</groupId>
     <artifactId>junit</artifactId>
     <version>4.11</version>
   </dependency>
   </dependencies>`
9. Create the `log4j.properties` file and put it in the classpath.

```java
log4j.rootLogger=DEBUG, stdout
log4j.appender.stdout=org.apache.log4j.ConsoleAppender
log4j.appender.stdout.layout=org.apache.log4j.PatternLayout
log4j.appender.stdout.layout.ConversionPattern=%d [%-5p] %c - %m%n
```

### Creating the `mybatis-config.xml` and `StudentMapper.xml` configuration files

Let us create MyBatis' main configuration file `mybatis-config.xml` with database connection properties, type aliases, and so on, and create the `StudentMapper.xml` file containing mapped SQL statements.

1. Create the `mybatis-config.xml` file to configure database connection properties, SQL Mapper files, type aliases, and so on, and put it in the classpath.

```xml
<configuration>
   <typeAliases>
      <typeAlias alias="Student" type="com.mybatis3.domain.Student"/>
   </typeAliases>
   <environments default="development">
      <environment id="development">
         <transactionManager type="JDBC"/>
         <dataSource type="POOLED">
            <property name="driver" value="com.mysql.jdbc.Driver"/>
            <property name="url" value="jdbc:mysql://localhost:3306/test"/>
            <property name="username" value="root"/>
            <property name="password" value="admin"/>
         </dataSource>
      </environment>
   </environments>
   <mappers>
```

[17]
<mapper resource="com/mybatis3/mappers/StudentMapper.xml"/>
</mappers>
</configuration>

2. Create the SQL Mapper XML file `StudentMapper.xml` and put it in the classpath under the `com.mybatis3.mappers` package.

```xml
<?xml version="1.0" encoding="UTF-8" ?>
<!DOCTYPE mapper
    PUBLIC "-//mybatis.org//DTD Mapper 3.0//EN"
    "http://mybatis.org/dtd/mybatis-3-mapper.dtd">
<mapper namespace="com.mybatis3.mappers.StudentMapper">
    <resultMap type="Student" id="StudentResult">
        <id property="studId" column="stud_id"/>
        <result property="name" column="name"/>
        <result property="email" column="email"/>
        <result property="dob" column="dob"/>
    </resultMap>

    <select id="findAllStudents" resultMap="StudentResult">
        SELECT * FROM STUDENTS
    </select>

    <select id="findStudentById" parameterType="int" resultType="Student">
        SELECT STUD_ID AS STUDID, NAME, EMAIL, DOB
        FROM STUDENTS WHERE STUD_ID=#{Id}
    </select>

    <insert id="insertStudent" parameterType="Student">
        INSERT INTO STUDENTS(STUD_ID,NAME,EMAIL,DOB)
        VALUES(#{studId },#{name},#{email},#{dob})
    </insert>
</mapper>
```

The preceding `StudentMapper.xml` file contains the mapped statements that can be invoked using the statement ID along with the namespace.
Creating the MyBatisSqlSessionFactory singleton class

Create the MyBatisSqlSessionFactory.java class to instantiate and hold the SqlSessionFactory singleton object.

```java
package com.mybatis3.util;
import java.io.*;
import org.apache.ibatis.io.Resources;
import org.apache.ibatis.session.*;

public class MyBatisSqlSessionFactory
{
    private static SqlSessionFactory sqlSessionFactory;

    public static SqlSessionFactory getSqlSessionFactory() {
        if (sqlSessionFactory == null) {
            InputStream inputStream;
            try {
                inputStream = Resources.getResourceAsStream("mybatis-config.xml");
                sqlSessionFactory = new SqlSessionFactoryBuilder().build(inputStream);
            } catch (IOException e) {
                throw new RuntimeException(e.getCause());
            }
        }
        return sqlSessionFactory;
    }

    public static SqlSession openSession() {
        return getSqlSessionFactory().openSession();
    }
}
```

In the preceding code snippet, we have created the SqlSessionFactory object that will be used to get SqlSession and execute mapped statements.
Creating the StudentMapper interface and the StudentService classes

Let us create a StudentMapper interface with method signatures similar to mapped SQL statements and a StudentService.java class that contains the implementation of business operations.

1. First, create the JavaBean Student.java.

   ```java
   package com.mybatis3.domain;
   import java.util.Date;
   public class Student {
       private Integer studId;
       private String name;
       private String email;
       private Date dob;
       // setters and getters
   }
   ```

2. Create a Mapper interface StudentMapper.java with the same method signatures as the mapped statements in StudentMapper.xml.

   ```java
   package com.mybatis3.mappers;
   import java.util.List;
   import com.mybatis3.domain.Student;
   public interface StudentMapper {
       List<Student> findAllStudents();
       Student findStudentById(Integer id);
       void insertStudent(Student student);
   }
   ```

3. Now create StudentService.java to implement database operations on the STUDENTS table.

   ```java
   package com.mybatis3.services;
   import java.util.List;
   import org.apache.ibatis.session.SqlSession;
   import org.slf4j.Logger;
   import org.slf4j.LoggerFactory;
   import com.mybatis3.domain.Student;
   import com.mybatis3.mappers.StudentMapper;
   import com.mybatis3.util.MyBatisSqlSessionFactory;
   public class StudentService {
       ```
private Logger logger = LoggerFactory.getLogger(getClass());

public List<Student> findAllStudents()
{
    SqlSession sqlSession = MyBatisSqlSessionFactory.openSession();
    try {
        StudentMapper studentMapper = sqlSession.getMapper(StudentMapper.class);
        return studentMapper.findAllStudents();
    } finally {
        //If sqlsession is not closed
        //then database Connection associated this sqlSession will not be
        //returned to pool
        //and application may run out of connections.
        sqlSession.close();
    }
}

public Student findStudentById(Integer studId)
{
    logger.debug("Select Student By ID : ", studId);
    SqlSession sqlSession = MyBatisSqlSessionFactory.openSession();
    try {
        StudentMapper studentMapper = sqlSession.getMapper(StudentMapper.class);
        return studentMapper.findStudentById(studId);
    } finally {
        sqlSession.close();
    }
}

public void createStudent(Student student)
{
    SqlSession sqlSession = MyBatisSqlSessionFactory.openSession();
    try {
        StudentMapper studentMapper = sqlSession.getMapper(StudentMapper.class);
        studentMapper.insertStudent(student);
        sqlSession.commit();
    } finally {
        sqlSession.close();
    }
You can also execute mapped SQL statements without using Mapper interfaces. An example is as follows:

```java
Student student = (Student)sqlSession.
    selectOne("com.mybatis3.mappers.StudentMapper.findStudentById", studId);
```

However, it is best practice to use Mapper interfaces so that we invoke mapped statements in a type-safe manner.

### Creating a JUnit test for testing StudentService

Create a JUnit test class `StudentServiceTest.java` to test the `StudentService` methods.

```java
package com.mybatis3.services;
import java.util.*;
import org.junit.*;
import com.mybatis3.domain.Student;
public class StudentServiceTest
{
    private static StudentService studentService;

    @BeforeClass
    public static void setup(){
        studentService = new StudentService();
    }

    @AfterClass
    public static void teardown(){
        studentService = null;
    }

    @Test
    public void testFindAllStudents() {
        List<Student> students = studentService.findAllStudents();
        Assert.assertNotNull(students);
        for (Student student : students) {
            System.out.println(student);
        }
    }
```
@Test
public void testFindStudentById() {
    Student student = studentService.findStudentById(1);
    Assert.assertNotNull(student);
    System.out.println(student);
}

@Test
public void testCreateStudent() {
    Student student = new Student();
    int id = 3;
    student.setStudId(id);
    student.setName("student_"+id);
    student.setEmail("student_"+id+"gmail.com");
    student.setDob(new Date());
    studentService.createStudent(student);
    Student newStudent = studentService.findStudentById(id);
    Assert.assertNotNull(newStudent);
}

How it works

First, we have configured the main MyBatis configuration file, `mybatis-config.xml`, with the JDBC connection parameters and configured the Mapper XML files that contain the SQL statement’s mappings.

We have created the `SqlSessionFactory` object using the `mybatis-config.xml` file. There should be only one instance of `SqlSessionFactory` per database environment, so we have used a singleton pattern to have only one instance of `SqlSessionFactory`.

We have created a Mapper interface, `StudentMapper`, with method signatures that are the same as those of the mapped statements in `StudentMapper.xml`. Note that the `StudentMapper.xml` namespace value is set to `com.mybatis3.mappers.StudentMapper`, which is a fully qualified name of the `StudentMapper` interface. This enables us to invoke mapped statements using the Mapper interface.
In StudentService.java, we have created a new SqlSession in each method and closed it after the method completes. Each thread should have its own instance of SqlSession. Instances of SqlSession objects are not thread safe and should not be shared. So the best scope for SqlSession is the method scope. From a web application perspective, SqlSession should have a request scope.

Sample domain model

In this section, we will discuss the sample domain model that represents an e-learning application that will be used throughout the book.

An e-learning system enables students to enroll for courses and take lessons through web-based mediums, such as virtual classes or desktop-sharing systems.

The tutors who are interested in teaching courses through an e-learning system can register with the system and announce the course details that they are going to teach.

The course details include course name, description, and duration. Students from across the globe can register and enroll for the courses that they want to learn.

The e-learning system provides a course search functionality where you can search for the available courses by course name, tutor, start date, or end date.

The following diagram represents the database schema for our e-learning application:
Summary

In this chapter, we discussed about MyBatis and the advantages of using MyBatis instead of plain JDBC for database access. We learned how to create a project, install MyBatis jar dependencies, create a MyBatis configuration file, and configure SQL mapped statements in Mapper XML files. We created a Service class to insert and get data from the database using MyBatis. We created a JUnit test case for testing Service.

In the next chapter, we will discuss bootstrapping MyBatis using XML and Java-API-based approaches in detail.
The key component of MyBatis is SqlSessionFactory from which we get SqlSession and execute the mapped SQL statements. The SqlSessionFactory object can be created using XML-based configuration or Java API.

We will explore various MyBatis configuration elements, such as dataSource, environments, global settings, typeAliases, typeHandlers, and SQL mappers, and instantiate SqlSessionFactory.

In this chapter, we will cover:

- Configuring MyBatis using XML
- Configuring MyBatis using Java API
- Customizing MyBatis logging

Configuring MyBatis using XML

The most commonly used approach for building SqlSessionFactory is XML-based configuration. The following mybatis-config.xml file shows how a typical MyBatis configuration file looks:

```xml
<?xml version="1.0" encoding="UTF-8" ?>
<!DOCTYPE configuration
PUBLIC "-//mybatis.org//DTD Config 3.0//EN"
"http://mybatis.org/dtd/mybatis-3-config.dtd">
<configuration>

<properties resource="application.properties">
    <property name="username" value="db_user"/>
    <property name="password" value="verysecurepwd"/>
</properties>

<settings>
```
Bootstrapping MyBatis

```xml
<setting name="cacheEnabled" value="true"/>
</settings>
<typeAliases>
  <typeAlias alias="Tutor" type="com.mybatis3.domain.Tutor"/>
  <package name="com.mybatis3.domain"/>
</typeAliases>
<typeHandlers>
  <typeHandler handler="com.mybatis3.typehandlers.PhoneTypeHandler"/>
  <package name="com.mybatis3.typehandlers"/>
</typeHandlers>
<environments default="development">
  <environment id="development">
    <transactionManager type="JDBC"/>
    <dataSource type="POOLED">
      <property name="driver" value="${jdbc.driverClassName}"/>
      <property name="url" value="${jdbc.url}"/>
      <property name="username" value="${jdbc.username}"/>
      <property name="password" value="${jdbc.password}"/>
    </dataSource>
  </environment>
  <environment id="production">
    <transactionManager type="MANAGED"/>
    <dataSource type="JNDI">
      <property name="data_source" value="java:comp/jdbc/MyBatisDemoDS"/>
    </dataSource>
  </environment>
</environments>
<mappers>
  <mapper resource="com/mybatis3/mappers/StudentMapper.xml"/>
  <mapper url="file:///D:/mybatisdemo/mappers/TutorMapper.xml"/>
  <mapper class="com.mybatis3.mappers.TutorMapper"/>
</mappers>
</configuration>

Let us discuss each part of the preceding configuration file, starting with the most important part, that is, environments.
Environment

MyBatis supports configuring multiple dataSource environments so that deploying the application in various environments, such as DEV, TEST, QA, UAT, and PRODUCTION, can be easily achieved by changing the default environment value to the desired environment id value. In the preceding configuration, the default environment has been set to development. When deploying the application on to production servers, you don't need to change the configuration much; just set the default environment to the production environment id attribute.

Sometimes, we may need to work with multiple databases within the same application. For example, we may have the SHOPPINGCART database to store all the order details and the REPORTS database to store the aggregates of the order details for reporting purposes.

If your application needs to connect to multiple databases, you'll need to configure each database as a separate environment and create a separate SqlSessionFactory object for each database.

```xml
<environments default="shoppingcart">
  <environment id="shoppingcart">
    <transactionManager type="MANAGED"/>
    <dataSource type="JNDI">
      <property name="data_source" value="java:comp/jdbc/ShoppingcartDS"/>
    </dataSource>
  </environment>
  <environment id="reports">
    <transactionManager type="MANAGED"/>
    <dataSource type="JNDI">
      <property name="data_source" value="java:comp/jdbc/ReportsDS"/>
    </dataSource>
  </environment>
</environments>
```

We can create SqlSessionFactory for a given environment as follows:

```java
inputStream = Resources.getResourceAsStream("mybatis-config.xml");
defaultSqlSessionFactory = new SqlSessionFactoryBuilder().build(inputStream);
cartSqlSessionFactory = new SqlSessionFactoryBuilder().build(inputStream, "shoppingcart");
reportSqlSessionFactory = new SqlSessionFactoryBuilder().build(inputStream, "reports");
```
When we create `SqlSessionFactory` without explicitly defining `environmentId`, `SqlSessionFactory` will be created using the default environment. In the preceding code, `defaultSqlSessionFactory` was created using the `shoppingcart` environment settings.

For each environment, we need to configure the `dataSource` and `transactionManager` elements.

**DataSource**

The `dataSource` element is used to configure the database connection properties.

```xml
<dataSource type="POOLED">
  <property name="driver" value="${jdbc.driverClassName}"/>
  <property name="url" value="${jdbc.url}"/>
  <property name="username" value="${jdbc.username}"/>
  <property name="password" value="${jdbc.password}"/>
</dataSource>
```

The `dataSource` type can be one of the built-in types such as `UNPOOLED`, `POOLED`, or `JNDI`.

- If you set the type to `UNPOOLED`, MyBatis will open a new connection and close that connection for every database operation. This method can be used for simple applications that have a small number of concurrent users.
- If you set the type to `POOLED`, MyBatis will create a pool of database connections, and one of these connections will be used for the database operation. Once this is complete, MyBatis will return the connection to the pool. This is a commonly used method for developing/testing environments.
- If you set the type to `JNDI`, MyBatis will get the connection from the JNDI `dataSource` that has typically been configured in the application server. This is a preferred method in production environments.

**TransactionManager**

MyBatis supports two types of transaction managers: `JDBC` and `MANAGED`.

- The `JDBC` transaction manager is used where the application is responsible for managing the connection life cycle, that is, commit, rollback, and so on. When you set the `TransactionManager` property to `JDBC`, behind the scenes MyBatis uses the `JdbcTransactionFactory` class to create `TransactionManager`. For example, an application deployed on Apache Tomcat should manage the transactions by itself.
• The **MANAGED** transaction manager is used where the application server is responsible for managing the connection life cycle. When you set the `TransactionManager` property to `MANAGED`, behind the scenes MyBatis uses the `ManagedTransactionFactory` class to create `TransactionManager`. For example, a JavaEE application deployed on an application server, such as JBoss, WebLogic, or GlassFish, can leverage the application server’s transaction management capabilities using EJB. In these managed environments, you can use the **MANAGED** transaction manager.

**Properties**

The properties configuration element can be used to externalize the configuration values into a properties file and use the properties’ key names as placeholders. In the preceding configuration, we have externalized the database connection properties into the `application.properties` file and used placeholders for the driver, URL, and so on.

1. Configure the database connection parameters in `application.properties` as follows:
   
   ```
   jdbc.driverClassName=com.mysql.jdbc.Driver
   jdbc.url=jdbc:mysql://localhost:3306/mybatisdemo
   jdbc.username=root
   jdbc.password=admin
   ```

2. In `mybatis-config.xml`, use the placeholders for the properties defined in `application.properties`.
   
   ```
   <datasource type="POOLED">
   <property name="driver" value="${jdbc.driverClassName}"/>
   <property name="url" value="${jdbc.url}"/>
   <property name="username" value="${jdbc.username}"/>
   <property name="password" value="${jdbc.password}"/>
   </datasource>
   ```

   ```
   <properties resource="application.properties">
   <property name="jdbc.username" value="db_user"/>
   <property name="jdbc.password" value="verysecurepwd"/>
   </properties>
   ```
Also, you can configure the default parameter values inside the `<properties>` element; they will be overridden by the values in the properties file if there are properties with the same key name.

```xml
<properties resource="application.properties">
    <property name="jdbc.username" value="db_user"/>
    <property name="jdbc.password" value="verysecurepwd"/>
</properties>
```

Here, the username and password values `db_user` and `verysecurepwd` will be overridden by the values in `application.properties` if the `application.properties` file contains the key names `jdbc.username` and `jdbc.password`.

### typeAliases

In the SQL Mapper configuration file, we need to give the fully qualified name of the JavaBeans for the `resultType` and `parameterType` attributes.

An example is as follows:

```xml
<select id="findStudentById" parameterType="int" resultType="com.mybatis3.domain.Student">
    SELECT STUD_ID AS ID, NAME, EMAIL, DOB
    FROM STUDENTS WHERE STUD_ID=#{Id}
</select>

<update id="updateStudent" parameterType="com.mybatis3.domain.Student">
    UPDATE STUDENTS SET NAME=#{name}, EMAIL=#{email}, DOB=#{dob}
    WHERE STUD_ID=#{id}
</update>
```

Here we are giving the fully qualified name of the `Student` type `com.mybatis3.domain.Student` for the `resultType` and `parameterType` attributes.

Instead of typing the fully qualified names everywhere, we can give the alias names and use these alias names in all the other places where we need to give the fully qualified names.

An example is as follows:

```xml
<typeAliases>
    <typeAlias alias="Student" type="com.mybatis3.domain.Student"/>
    <typeAlias alias="Tutor" type="com.mybatis3.domain.Tutor"/>
    <package name="com.mybatis3.domain"/>
</typeAliases>
```
Now in the SQL Mapper file, we can use the alias name `Student` as follows:

```xml
<select id="findStudentById" parameterType="int" resultType="Student">
  SELECT STUD_ID AS ID, NAME, EMAIL, DOB
  FROM STUDENTS WHERE STUD_ID=#{id}
</select>

<update id="updateStudent" parameterType="Student">
  UPDATE STUDENTS SET NAME=#{name}, EMAIL=#{email}, DOB=#{dob}
  WHERE STUD_ID=#{id}
</update>
```

Instead of giving an alias name for each JavaBeans separately, you can give the package name where MyBatis can scan and register aliases using uncapitalized, nonqualified class names of the Bean.

An example is as follows:

```xml
<typeAliases>
  <package name="com.mybatis3.domain"/>
</typeAliases>

If there are `Student.java` and `Tutor.java` Beans in the `com.mybatis3.domain` package, `com.mybatis3.domain.Student` will be registered as `student` and `com.mybatis3.domain.Tutor` will be registered as `tutor`.

An example is as follows:

```xml
<typeAliases>
  <typeAlias alias="Student" type="com.mybatis3.domain.Student"/>
  <typeAlias alias="Tutor" type="com.mybatis3.domain.Tutor"/>
  <package name="com.mybatis3.domain"/>
  <package name="com.mybatis3.webservices.domain"/>
</typeAliases>
```

There is another way of aliasing JavaBeans, using the `@Alias` annotation.

```java
@Alias("StudentAlias")
public class Student
{
}
```

The `@Alias` annotation overrides the `<typeAliases>` configuration.
Bootstrapping MyBatis

typeHandlers
As discussed in the previous chapter, MyBatis simplifies the persistent logic implementation by abstracting JDBC. MyBatis uses JDBC under the hood and provides simpler ways to implement database operations.

When MyBatis executes an INSERT statement by taking a Java object as an input parameter, it will create PreparedStatement and set the parameter values for the placeholders using the setXXX() methods.

Here xxx can be any one of Int, String, Date, and so on, based on the type of Java property.

An example is as follows:

```xml
<insert id="insertStudent" parameterType="Student">
  INSERT INTO STUDENTS(STUD_ID,NAME,EMAIL,DOB)
  VALUES(#{studId},#{name},#{email},#{dob})
</insert>
```

To execute this statement, MyBatis will perform the following sequence of actions.

1. Create a PreparedStatement interface with placeholders as follows:
   ```java
   PreparedStatement pstmt = connection.prepareStatement
   ("INSERT INTO STUDENTS(STUD_ID,NAME,EMAIL,DOB) VALUES(?,?,?,?)");
   ```

2. Check the property type of studId in the Student object and use the appropriate setXXX method to set the value. Here studId is of the type integer, so it will use the setInt() method.
   ```java
   pstmt.setInt(1, student.getStudId());
   ```

3. Similarly, for the name and email attributes MyBatis will use the setString() methods because they are of the type String.
   ```java
   pstmt.setString(2, student.getName());
   pstmt.setString(3, student.getEmail());
   ```

4. And for the dob property, MyBatis will use the setDate() method for setting the dob placeholder value.

5. MyBatis first converts java.util.Date into java.sql.Timestamp and sets the value.
   ```java
   pstmt.setTimestamp(4, new Timestamp((student.getDob()).getTime()));
   ```
Cool. But how does MyBatis know to use `setInt()` for the Integer and `setString` for the String type properties? MyBatis determines all these things using type handlers.

MyBatis comes with built-in type handlers for all primitive types, primitive wrapper types, `byte[]`, `java.util.Date`, `java.sql.Date`, `java.sql.Time`, `java.sql.Timestamp`, `java enums`, and so on. So when MyBatis finds one of these types of properties, it uses the corresponding type handler to set the value on `PreparedStatement`, while at the same time populating the JavaBeans from the SQL Result Set.

What if we give a custom object type value to store into the database?

An example is as follows:

Assume that the `STUDENTS` table has a `PHONE` column that is of the type `VARCHAR(15)`. The `JavaBeans` `Student` has the `phoneNumber` property of the `PhoneNumber` class.

```java
public class PhoneNumber {
    private String countryCode;
    private String stateCode;
    private String number;

    public PhoneNumber() {
    }

    public PhoneNumber(String countryCode, String stateCode, String number) {
        this.countryCode = countryCode;
        this.stateCode = stateCode;
        this.number = number;
    }

    public PhoneNumber(String string) {
        if(string != null) {
            String[] parts = string.split("-");
            if(parts.length>0) this.countryCode=parts[0];
            if(parts.length>1) this.stateCode=parts[1];
            if(parts.length>2) this.number=parts[2];
        }
    }

    public String getAsString() {
        return countryCode+"-"+stateCode+"-"+number;
    }
```
public class Student {
    private Integer id;
    private String name;
    private String email;
    private PhoneNumber phone;
    // Setters and getters
}

<insert id="insertStudent" parameterType="Student">
    insert into students(name,email,phone)
    values(#{name},#{email},#{phone})
</insert>

Here, for the phone parameter we have given the value #{phone}; this gives the phone object that is of the type PhoneNumber. However, MyBatis doesn't know how to handle this type of object.

To let MyBatis understand how to handle custom Java object types, such as PhoneNumber, we can create a custom type handler as follows:

1. MyBatis provides an abstract class BaseTypeHandler<T> that we can extend to create custom type handlers.

   package com.mybatis3.typehandlers;
   import java.sql.CallableStatement;
   import java.sql.PreparedStatement;
   import java.sql.ResultSet;
   import java.sql.SQLException;
   import org.apache.ibatis.type.BaseTypeHandler;
   import org.apache.ibatis.type.JdbcType;
   import com.mybatis3.domain.PhoneNumber;

   public class PhoneTypeHandler extends BaseTypeHandler<PhoneNumber> {

        @Override
        public void setNonNullParameter(PreparedStatement ps, int i,
               PhoneNumber parameter, JdbcType jdbcType) throws
               SQLException {
               ps.setString(i, parameter.getAsString());

   }
2. We are using the `ps.setString()` and `rs.getString()` methods because the phone number is being stored in a VARCHAR type column.

3. Once the custom type handler is implemented, we need to register it in `mybatis-config.xml`.

```xml
<configuration>
  <typeHandlers>
    <typeHandler handler="com.mybatis3.typehandlers.PhoneTypeHandler"/>
  </typeHandlers>
</configuration>
```

After registering `PhoneTypeHandler`, MyBatis will be able to store the Phone type object value into any VARCHAR type column.
Settings
The default MyBatis global settings, which can be overridden to better suit application-specific needs, are as follows:

```xml
<settings>
  <setting name="cacheEnabled" value="true"/>
  <setting name="lazyLoadingEnabled" value="true"/>
  <setting name="multipleResultSetsEnabled" value="true"/>
  <setting name="useColumnLabel" value="true"/>
  <setting name="useGeneratedKeys" value="false"/>
  <setting name="autoMappingBehavior" value="PARTIAL"/>
  <setting name="defaultExecutorType" value="SIMPLE"/>
  <setting name="defaultStatementTimeout" value="25000"/>
  <setting name="safeRowBoundsEnabled" value="false"/>
  <setting name="mapUnderscoreToCamelCase" value="false"/>
  <setting name="localCacheScope" value="SESSION"/>
  <setting name="jdbcTypeForNull" value="OTHER"/>
  <setting name="lazyLoadTriggerMethods" value="equals, clone, hashCode, toString"/>
</settings>
```

Mappers
Mapper XML files contain the mapped SQL statements that will be executed by the application using statement id. We need to configure the locations of the SQL Mapper files in mybatis-config.xml.

```xml
<mappers>
  <mapper resource="com/mybatis3/mappers/StudentMapper.xml"/>
  <mapper url="file:///D:/mybatisdemo/app/mappers/TutorMapper.xml"/>
  <mapper class="com.mybatis3.mappers.TutorMapper"/>
  <package name="com.mybatis3.mappers"/>
</mappers>
```

Each of the `<mapper>` tag attributes facilitates to load mappers from different kinds of sources:

- The attribute `resource` can be used to point to a mapper file that is in the classpath
- The attribute `url` can be used to point to a mapper file by its fully qualified filesystem path or web URL
• The attribute `class` can be used to point to a Mapper interface
• The `package` element can be used to point to a package name where Mapper interfaces can be found

Configuring MyBatis using Java API

In the previous section, we have discussed various MyBatis configuration elements, such as environments, typeAliases, and typeHandlers, and how to configure them using XML. Even though you want to use the Java-API-based MyBatis configuration, it would be good to go through the previous section to have a better idea about these configuration elements. In this section, we will be referring to some of the classes described in the previous section.

MyBatis' `SqlSessionFactory` interface can be created programmatically using the Java API instead of using the XML-based configuration. Each configuration element used in an XML-based configuration can be created programmatically.

We can create the `SqlSessionFactory` object using the Java API as follows:

```java
public static SqlSessionFactory getSqlSessionFactory()
{
    SqlSessionFactory sqlSessionFactory = null;
    try{
        DataSource dataSource = DataSourceFactory.getDataSource();
        TransactionFactory transactionFactory = new JdbcTransactionFactory();
        Environment environment = new Environment("development",
                                                   transactionFactory, dataSource);
        Configuration configuration = new Configuration(environment);
        configuration.getTypeAliasRegistry().registerAlias("student",
                                                             Student.class);
        configuration.getTypeHandlerRegistry().register(PhoneNumber.
                                                            class,PhoneTypeHandler.class);
        configuration.addMapper(StudentMapper.class);
        sqlSessionFactory = new SqlSessionFactoryBuilder().
                                                   build(configuration);
    }catch (Exception e){
        throw new RuntimeException(e);
    }
    return sqlSessionFactory;
}
```
Environment

We need to create an Environment object for each database that we want to connect to using MyBatis. To work with multiple databases, we'll need to create a SqlSessionFactory object for each environment. To create an instance of Environment, we'll need the javax.sql.DataSource and TransactionFactory instances. Let us see how to create the DataSource and TransactionFactory objects.

DataSource

MyBatis supports three built-in DataSource types: UNPOOLED, POOLED, and JNDI.

- The UNPOOLED dataSource creates a new database connection every time for each user request and is not advisable for concurrent multiuser applications.
- The POOLED dataSource creates a pool of Connection objects, and for every user request, it will use one of the Connection objects readily available in the pool, thereby increasing performance. MyBatis provides org.apache.ibatis.datasource.pooled.PooledDataSource that implements javax.sql.DataSource to create a Connection pool.
- The JNDI dataSource uses the Connection pool configured in the application server and obtains a connection using a JNDI lookup.

Let us see how we can get a DataSource object using MyBatis' PooledDataSource interface:

```java
public class DataSourceFactory
{
    public static DataSource getDataSource()
    {
        String driver = "com.mysql.jdbc.Driver";
        String url = "jdbc:mysql://localhost:3306/mybatisdemo";
        String username = "root";
        String password = "admin";
        PooledDataSource dataSource = new PooledDataSource(driver, url, username, password);
        return dataSource;
    }
}
```

Generally in production environments, DataSource will be configured in the application server and get the DataSource object using JNDI as follows:

```java
public class DataSourceFactory
{
    public static DataSource getDataSource()
    {
```
Chapter 2

```java
String jndiName = "java:comp/env/jdbc/MyBatisDemoDS";
try {
    InitialContext ctx = new InitialContext();
    DataSource dataSource = (DataSource) ctx.lookup(jndiName);
    return dataSource;
} catch (NamingException e) {
    throw new RuntimeException(e);
}
```

There are many popular third-party libraries, such as commons-dbcp and c3p0, implementing javax.sql.DataSource, and you can use any of these libraries to create a dataSource.

**TransactionFactory**

MyBatis supports the following two types of TransactionFactory implementations:

- JdbcTransactionFactory
- ManagedTransactionFactory

If the application is running in a non-managed environment, you should use JdbcTransactionFactory.

```java
DataSource dataSource = DataSourceFactory.getDataSource();
TransactionFactory txnFactory = new JdbcTransactionFactory();
Environment environment = new Environment("development", txnFactory, dataSource);
```

If the application is running in a managed environment and uses container-supported transaction management services, you should use ManagedTransactionFactory.

```java
DataSource dataSource = DataSourceFactory.getDataSource();
TransactionFactory txnFactory = new ManagedTransactionFactory();
Environment environment = new Environment("development", txnFactory, dataSource);
```
typeAliases
MyBatis provides several ways of registering Type Aliases with the Configuration object.

- To register an alias for a single class with an uncapitalized, nonqualified class name according to the default alias rule, use the following code:
  ```java
  configuration.getTypeAliasRegistry().registerAlias(Student.class);
  ```

- To register a single class alias with a given alias name, use the following code:
  ```java
  configuration.getTypeAliasRegistry().registerAlias("Student", Student.class);
  ```

- To register a single class alias name for the given fully qualified class name, use the following code:
  ```java
  configuration.getTypeAliasRegistry().registerAlias("Student", "com.mybatis3.domain.Student");
  ```

- To register aliases for all the classes in the com.mybatis3.domain package, use the following code:
  ```java
  configuration.getTypeAliasRegistry().registerAliases("com.mybatis3.domain");
  ```

- To register aliases for the classes that extend the Identifiable type in the com.mybatis3.domain package, use the following code:
  ```java
  configuration.getTypeAliasRegistry().registerAliases("com.mybatis3.domain", Identifiable.class);
  ```

typeHandlers
MyBatis provides several ways of registering type handlers with the Configuration object. We can register custom type handlers using the Configuration object as follows:

- To register a type handler for a specific Java class:
  ```java
  configuration.getTypeHandlerRegistry().register(PhoneNumber.class, PhoneTypeHandler.class);
  ```

- To register a type handler:
  ```java
  configuration.getTypeHandlerRegistry().register(PhoneTypeHandler.class);
  ```
• To register all the type handlers in the `com.mybatis3.typehandlers` package:

```java
configuration.getTypeHandlerRegistry().register("com.mybatis3.typehandlers");
```

## Settings

MyBatis comes with a set of default global settings that suit well for most applications. However, you can tweak these settings to better suit your application needs. You can use the following methods to set the values of the global settings to the desired values.

```java
configuration.setCacheEnabled(true);
configuration.setLazyLoadingEnabled(false);
configuration.setMultipleResultSetsEnabled(true);
configuration.setUseColumnLabel(true);
configuration.setUseGeneratedKeys(false);
configuration.setAutoMappingBehavior(AutoMappingBehavior.PARTIAL);
configuration.setDefaultExecutorType(ExecutorType.SIMPLE);
configuration.setDefaultStatementTimeout(25);
configuration.setSafeRowBoundsEnabled(false);
configuration.setMapUnderscoreToCamelCase(false);
configuration.setLocalCacheScope(LocalCacheScope.SESSION);
configuration.setAggressiveLazyLoading(true);
configuration.setJdbcTypeForNull(JdbcType.OTHER);
Set<String> lazyLoadTriggerMethods = new HashSet<String>();
lazyLoadTriggerMethods.add("equals");
lazyLoadTriggerMethods.add("clone");
lazyLoadTriggerMethods.add("hashCode");
lazyLoadTriggerMethods.add("toString");
configuration.setLazyLoadTriggerMethods(lazyLoadTriggerMethods);
```

## Mappers

MyBatis provides several ways of registering Mapper XML files and Mapper interfaces with the `Configuration` object.

• To add a single Mapper interface, use the following code:

```java
configuration.addMapper(StudentMapper.class);
```

• To add all the Mapper XML files or interfaces in the `com.mybatis3.mappers` package, use the following code:

```java
configuration.addMappers("com.mybatis3.mappers");
```
Bootstrapping MyBatis

- To add all the Mapper interfaces that extend an interface, say `BaseMapper`, in the `com.mybatis3.mappers` package, use the following code:

  ```java
  configuration.addMappers("com.mybatis3.mappers", BaseMapper.class);
  ```

Mappers should be added to the configuration only after registering `typeAliases` and `typeHandlers` if they have been used.

Customizing MyBatis logging

MyBatis uses its internal `LoggerFactory` as a facade to actual logging libraries. The internal `LoggerFactory` will delegate the logging task to one of the following actual logger implementations, with the priority decreasing from top to bottom in the given order:

- SLF4J
- Apache Commons Logging
- Log4j 2
- Log4j
- JDK logging

If MyBatis finds none of the previous implementations, logging will be disabled.

If your application is running in an environment where multiple logging libraries are available in its classpath and you want MyBatis to use a specific logging implementation, you can do this by calling one of the following methods:

- `org.apache.ibatis.logging.LogFactory.useSlf4jLogging();`
- `org.apache.ibatis.logging.LogFactory.useLog4jLogging();`
- `org.apache.ibatis.logging.LogFactory.useLog4j2Logging();`
- `org.apache.ibatis.logging.LogFactory.useJdkLogging();`
- `org.apache.ibatis.logging.LogFactory.useCommonsLogging();`
- `org.apache.ibatis.logging.LogFactory.useStdOutLogging();`
If you want to customize MyBatis logging, you should call one of these methods before calling any other MyBatis methods. If the logging library that you want to switch is not available at runtime, MyBatis will ignore the request.

**Summary**

In this chapter, we learned how to bootstrap MyBatis using XML and Java-API-based configuration. We also learned about various configuration options, such as type aliases, type handlers, and global settings. In the next chapter, we will discuss SQL Mappers; they are the key elements of MyBatis.
Relational databases and SQL are time-tested and proven data storage mechanisms. Unlike other ORM frameworks such as Hibernate, MyBatis encourages the use of SQL instead of hiding it from developers, thereby utilizing the full power of SQL provided by the database server. At the same time, MyBatis eliminates the pain of writing boilerplate code and makes using SQL easy.

Embedding SQL queries directly inside the code is a bad practice and hard to maintain. MyBatis configures SQL statements using Mapper XML files or annotations. In this chapter, we will see how to configure mapped statements in Mapper XML files in detail; we will cover the following topics:

- Mapper XMLs and Mapper interfaces
- Mapped statements
  - Configuring INSERT, UPDATE, DELETE, and SELECT statements
- ResultMaps
  - Simple ResultMaps
  - One-to-one mapping using a nested Select query
  - One-to-one mapping using nested results mapping
  - One-to-many mapping using a nested Select query
  - One-to-many mapping using nested results mapping
- Dynamic SQL
  - The if condition
  - The choose (when, otherwise) condition
  - The trim (where, set) condition
  - The foreach loop
- MyBatis recipes
Mapper XMLs and Mapper interfaces

In the previous chapters, we have seen some basic examples of how to configure mapped statements in Mapper XML files and how to invoke them using the SqlSession object.

Let us now see how the `findStudentById` mapped statement can be configured in `StudentMapper.xml`, which is in the `com.mybatis3.mappers` package, using the following code:

```xml
<?xml version="1.0" encoding="UTF-8" ?>
<!DOCTYPE mapper
    PUBLIC "-//mybatis.org//DTD Mapper 3.0//EN"
    "http://mybatis.org/dtd/mybatis-3-mapper.dtd">

<mapper namespace="com.mybatis3.mappers.StudentMapper">
    <select id="findStudentById" parameterType="int"
            resultType="Student">
        select stud_id as studId, name, email, dob from Students where stud_id=#{studId}
    </select>
</mapper>
```

We can invoke the mapped statement as follows:

```java
public Student findStudentById(Integer studId) {
    SqlSession sqlSession = MyBatisUtil.getSqlSession();
    try {
        Student student = sqlSession.selectOne("com.mybatis3.mappers.StudentMapper.findStudentById", studId);
        return student;
    } finally {
        sqlSession.close();
    }
}
```

We can invoke mapped statements such as the previous one using string literals (namespace and statement id), but this exercise is error prone. You need to make sure to pass the valid input type parameter and assign the result to a valid return type variable by checking it in the Mapper XML file.
MyBatis provides a better way of invoking mapped statements by using Mapper interfaces. Once we have configured the mapped statements in the Mapper XML file, we can create a Mapper interface with a fully qualified name that is the same as the namespace and add the method signatures with matching statement IDs, input parameters, and return types.

For the preceding `StudentMapper.xml` file, we can create a Mapper interface `StudentMapper.java` as follows:

```java
package com.mybatis3.mappers;
public interface StudentMapper {
    Student findStudentById(Integer id);
}
```

In the `StudentMapper.xml` file, the namespace should be the same as the fully qualified name of the `StudentMapper` interface that is `com.mybatis3.mappers.StudentMapper`. Also, the statement id, parameterType, and returnType values in `StudentMapper.xml` should be the same as the method name, argument type, and return type in the `StudentMapper` interface respectively.

Using Mapper interfaces, you can invoke mapped statements in a type safe manner as follows:

```java
public Student findStudentById(Integer studId) {
    SqlSession sqlSession = MyBatisUtil.getSqlSession();
    try {
        StudentMapper studentMapper = sqlSession.getMapper(StudentMapper.class);
        return studentMapper.findStudentById(studId);
    } finally {
        sqlSession.close();
    }
}
```
Even though Mapper interfaces are enabled to invoke mapped statements in a type safe manner, it is our responsibility to write Mapper interfaces with correct, matching method names, argument types, and return types. If the Mapper interface methods do not match the mapped statements in XML, you will get exceptions at runtime. Actually, specifying `parameterType` is optional; MyBatis can determine `parameterType` by using Reflection API. But from a readability perspective, it would be better to specify the `parameterType` attribute. If the `parameterType` attribute has not been mentioned, the developer will have to switch between Mapper XML and Java code to know what type of input parameter is being passed to that statement.

**Mapped statements**

MyBatis provides various elements to configure different types of statements, such as `SELECT`, `INSERT`, `UPDATE`, and `DELETE`. Let us see how to configure mapped statements in detail.

**The INSERT statement**

An `INSERT` query can be configured in a Mapper XML file using the `<insert>` element as follows:

```
<insert id="insertStudent" parameterType="Student">
    INSERT INTO STUDENTS(STUD_ID, NAME, EMAIL, PHONE)
    VALUES(#{studId}, #{name}, #{email}, #{phone})
</insert>
```

Here, we are giving an ID `insertStudent` that can be uniquely identified along with the namespace `com.mybatis3.mappers.StudentMapper.insertStudent`. The `parameterType` attribute value should be a fully qualified class name or type alias name.

We can invoke this statement as follows:

```
int count = 
    sqlSession.insert("com.mybatis3.mappers.StudentMapper.insertStudent", student);
```

The `sqlSession.insert()` method returns the number of rows affected by the `INSERT` statement.
Instead of invoking the mapped statement using namespace and the statement id, you can create a Mapper interface and invoke the method in a type safe manner as follows:

```java
package com.mybatis3.mappers;
public interface StudentMapper {
    int insertStudent(Student student);
}
```

You can invoke the `insertStudent` mapped statement as follows:

```java
StudentMapper mapper = sqlSession.getMapper(StudentMapper.class);
int count = mapper.insertStudent(student);
```

### Autogenerated keys

In the preceding `INSERT` statement, we are inserting the value for the `STUD_ID` column that is an `auto_generated` primary key column. We can use the `useGeneratedKeys` and `keyProperty` attributes to let the database generate the `auto_increment` column value and set that generated value into one of the input object properties as follows:

```xml
<insert id="insertStudent" parameterType="Student"
    useGeneratedKeys="true" keyProperty="studId">
    INSERT INTO STUDENTS(NAME, EMAIL, PHONE)
    VALUES(#{name},#{email},#{phone})
</insert>
```

Here the `STUD_ID` column value will be autogenerated by MySQL database, and the generated value will be set to the `studId` property of the `student` object.

```java
StudentMapper mapper = sqlSession.getMapper(StudentMapper.class);
mapper.insertStudent(student);
```

Now you can obtain the `STUD_ID` value of the inserted `STUDENT` record as follows:

```java
int studentId = student.getStudId();
```

Some databases such as Oracle don’t support `AUTO_INCREMENT` columns and use `SEQUENCE` to generate the primary key values.

Assume we have a `SEQUENCE` called `STUD_ID_SEQ` to generate the `STUD_ID` primary key values. Use the following code to generate the primary key:

```xml
<insert id="insertStudent" parameterType="Student">
    <selectKey keyProperty="studId" resultType="int" order="BEFORE">
        SELECT ELEARNING.STUD_ID_SEQ.NEXTVAL FROM DUAL
    </selectKey>
</insert>
```
Here we used the `<selectKey>` subelement to generate the primary key value and store it in the `studId` property of the `Student` object. The attribute `order="BEFORE"` indicates that MyBatis will get the primary key value, that is, the next value from the sequence and store it in the `studId` property before executing the `INSERT` query.

We can also set the primary key value using a trigger where we will obtain the next value from the sequence and set it as the primary key column value before executing the `INSERT` query.

If you are using this approach, the `INSERT` mapped statement will be as follows:

```xml
<insert id="insertStudent" parameterType="Student">
  INSERT INTO STUDENTS(NAME, EMAIL, PHONE)
  VALUES(#{name}, #{email}, #{phone})
  <selectKey keyProperty="studId" resultType="int" order="AFTER">
    SELECT ELEARNING.STUD_ID_SEQ.CURRVAL FROM DUAL
  </selectKey>
</insert>
```

### The UPDATE statement

An `UPDATE` statement can be configured in the Mapper XML file using the `<update>` element as follows:

```xml
<update id="updateStudent" parameterType="Student">
  UPDATE STUDENTS SET NAME=#{name}, EMAIL=#{email}, PHONE=#{phone}
  WHERE STUD_ID=#{studId}
</update>
```

We can invoke this statement as follows:

```java
int noOfRowsUpdated =
sqlSession.update("com.mybatis3.mappers.StudentMapper.updateStudent",
                 student);
```

The `sqlSession.update()` method returns the number of rows affected by this `UPDATE` statement.
Instead of invoking the mapped statement using namespace and the statement id, you can create a Mapper interface and invoke the method in a type safe way as follows:

```java
package com.mybatis3.mappers;
public interface StudentMapper {
    int updateStudent(Student student);
}
```

You can invoke the `updateStudent` statement using the Mapper interface as follows:

```java
StudentMapper mapper = sqlSession.getMapper(StudentMapper.class);
int noOfRowsUpdated = mapper.updateStudent(student);
```

### The DELETE statement

A DELETE statement can be configured in the Mapper XML file using the `<delete>` element as follows:

```xml
<delete id="deleteStudent" parameterType="int">
    DELETE FROM STUDENTS WHERE STUD_ID=#{studId}
</delete>
```

We can invoke this statement as follows:

```java
int studId =1;
int noOfRowsDeleted =
    sqlSession.delete("com.mybatis3.mappers.StudentMapper.deleteStudent", studId);
```

The `sqlSession.delete()` method returns the number of rows affected by this delete statement.

Instead of invoking the mapped statement using namespace and the statement id, you can create a Mapper interface and invoke the method in a type safe way as follows:

```java
package com.mybatis3.mappers;
public interface StudentMapper {
    int deleteStudent(int studId);
}
```

You can invoke the `deleteStudent` statement using the Mapper interface as follows:

```java
StudentMapper mapper = sqlSession.getMapper(StudentMapper.class);
int noOfRowsDeleted = mapper.deleteStudent(studId);
```
**The SELECT statement**

The true power of MyBatis will be known only by finding out how flexible MyBatis is for mapping SELECT query results to JavaBeans.

Let us see how a simple select query can be configured, using the following code:

```xml
<select id="findStudentById" parameterType="int" resultType="Student">
  SELECT STUD_ID, NAME, EMAIL, PHONE
  FROM STUDENTS
  WHERE STUD_ID=#{studId}
</select>
```

We can invoke this statement as follows:

```java
int studId = 1;
Student student = sqlSession.selectOne("com.mybatis3.mappers.StudentMapper.findStudentById", studId);
```

The `sqlSession.selectOne()` method returns the object of the type configured for the `resultType` attribute. If the query returns multiple rows for the `sqlSession.selectOne()` method, `TooManyResultsException` will be thrown.

Instead of invoking the mapped statement using namespace and the statement id, you can create a Mapper interface and invoke the method in a type safe manner as follows:

```java
package com.mybatis3.mappers;
public interface StudentMapper {
  Student findStudentById(Integer studId);
}
```

You can invoke the `findStudentById` statement using the Mapper interface as follows:

```java
StudentMapper mapper = sqlSession.getMapper(StudentMapper.class);
Student student = mapper.findStudentById(studId);
```

If you check the property values of the `Student` object, you will observe that the `studId` property value is not populated with the `stud_id` column value. This is because MyBatis automatically populates the JavaBeans properties with the column values that have a matching column name. That is why, the properties `name`, `email`, and `phone` get populated but the `studId` property does not get populated.
To resolve this, we can give alias names for the columns to match with the Java Beans property names as follows:

```xml
<select id="findStudentById" parameterType="int" resultType="Student">
    SELECT STUD_ID AS studId, NAME, EMAIL, PHONE
    FROM STUDENTS
    WHERE STUD_ID=#{studId}
</select>
```

Now the `Student` bean will get populated with all the `stud_id`, `name`, `email`, and `phone` columns properly.

Now let us see how to execute a `SELECT` query that returns multiple rows as shown in the following code:

```xml
<select id="findAllStudents" resultType="Student">
    SELECT STUD_ID AS studId, NAME, EMAIL, PHONE
    FROM STUDENTS
</select>
```

```java
List<Student> students = 
    sqlSession.selectList("com.mybatis3.mappers.StudentMapper.findAllStudents");
```

The Mapper interface `StudentMapper` can also be used as follows:

```java
package com.mybatis3.mappers;
public interface StudentMapper
{
    List<Student> findAllStudents();
}
```

Using the previous code, you can invoke the `findAllStudents` statement with the Mapper interface as follows:

```java
StudentMapper mapper = sqlSession.getMapper(StudentMapper.class);
List<Student> students = mapper.findAllStudents();
```

If you observe the preceding `SELECT` query mappings, we are giving the alias name for `stud_id` in all the mapped statements.

Instead of repeating the alias names everywhere, we can use `ResultMaps`, which we are going to discuss in a moment.
Instead of `java.util.List`, you can also use other types of collections, such as `Set`, `Map`, and `SortedSet`. Based on the type of the collection, MyBatis will use an appropriate collection implementation as follows:

- For the `List`, `Collection`, or `Iterable` types, `java.util.ArrayList` will be returned
- For the `Map` type, `java.util.HashMap` will be returned
- For the `Set` type, `java.util.HashSet` will be returned
- For the `SortedSet` type, `java.util.TreeSet` will be returned

**ResultMaps**

ResultMaps are used to map the SQL SELECT statement's results to JavaBeans properties. We can define ResultMaps and reference this `resultMap` query from several SELECT statements. The MyBatis ResultMaps feature is so powerful that you can use it for mapping simple SELECT statements to complex SELECT statements with one-to-one and one-to-many associations.

**Simple ResultMaps**

A simple `resultMap` query that maps query results to the `Student` JavaBeans is as follows:

```xml
<resultMap id="StudentResult" type="com.mybatis3.domain.Student">
    <id property="studId" column="stud_id"/>
    <result property="name" column="name"/>
    <result property="email" column="email"/>
    <result property="phone" column="phone"/>
</resultMap>

<select id="findAllStudents" resultMap="StudentResult" >
    SELECT * FROM STUDENTS
</select>

<select id="findStudentById" parameterType="int" resultMap="StudentResult">
    SELECT * FROM STUDENTS WHERE STUD_ID=#{studId}
</select>
```

The `id` attribute of `resultMap StudentResult` should be unique within the namespace, and the type should be a fully qualified name or alias name of the return type.
The `<result>` sub-elements are used to map a resultset column to a JavaBeans property.

The `<id>` element is similar to `<result>` but is used to map the identifier property that is used for comparing objects.

In the `<select>` statement, we have used the `resultMap` attribute instead of `resultType` to refer the `StudentResult` mapping. When a `resultMap` attribute is configured for a `<select>` statement, MyBatis uses the column for property mappings in order to populate the JavaBeans properties.

```
We can use either resultType or resultMap for a SELECT mapped statement, but not both.
```

Let us see another example of a `<select>` mapped statement showing how to populate query results into `HashMap` as follows:

```
<select id="findStudentById" parameterType="int" resultType="map">
    SELECT * FROM STUDENTS WHERE STUD_ID=#{studId}
</select>
```

In the preceding `<select>` statement, we configured `resultType` to be `map`, that is, the alias name for `java.util.HashMap`. In this case, the column names will be the key and the column value will be the value.

```
HashMap<String, Object> studentMap = sqlSession.selectOne("com.mybatis3.mappers.StudentMapper.findStudentById", studId);
System.out.println("stud_id :"+studentMap.get("stud_id"));
System.out.println("name ":"+studentMap.get("name"));
System.out.println("email ":"+studentMap.get("email"));
System.out.println("phone ":"+studentMap.get("phone"));
```

Let us see another example using `resultType="map"` that returns multiple rows.

```
<select id="findAllStudents" resultType="map">
    SELECT STUD_ID, NAME, EMAIL, PHONE FROM STUDENTS
</select>
```

As `resultType="map"` and the statement return multiple rows, the final return type would be `List< HashMap<String, Object>>` as shown in the following code:

```
List< HashMap<String, Object>> studentMapList = 
sqlSession.selectList("com.mybatis3.mappers.StudentMapper.findAllStudents");

for (HashMap<String, Object> studentMap : studentMapList)
```
### Extending ResultMaps

We can extend one `<resultMap>` query from another `<resultMap>` query, thereby inheriting the column to do property mappings from the one that is being extended.

```xml
<resultMap type="Student" id="StudentResult">
  <id property="studId" column="stud_id"/>
  <result property="name" column="name"/>
  <result property="email" column="email"/>
  <result property="phone" column="phone"/>
</resultMap>

<resultMap type="Student" id="StudentWithAddressResult" extends="StudentResult">
  <result property="address.addrId" column="addr_id"/>
  <result property="address.street" column="street"/>
  <result property="address.city" column="city"/>
  <result property="address.state" column="state"/>
  <result property="address.zip" column="zip"/>
  <result property="address.country" column="country"/>
</resultMap>
```

The `resultMap` query with the ID `StudentWithAddressResult` extends the `resultMap` with the ID `StudentResult`.

Now you can use `StudentResult` resultMap if you want to map only the `Student` data as shown in the following code:

```xml
<select id="findStudentById" parameterType="int" resultMap="StudentResult">
  SELECT * FROM STUDENTS WHERE STUD_ID=#{studId}
</select>
```

If you want to map the query results with `Student` along with the `Address` data, you can use `resultMap` with the ID `StudentWithAddressResult` as follows:

```xml
<select id="selectStudentWithAddress" parameterType="int" resultMap="StudentWithAddressResult">
  SELECT STUD_ID, NAME, EMAIL, PHONE, A.ADDR_ID, STREET, CITY,
```
One-to-one mapping

In our sample domain model, each student has an associated address. The STUDENTS table has an ADDR_ID column that is a foreign key to the ADDRESSES table.

The STUDENTS table's sample data is as follows:

<table>
<thead>
<tr>
<th>STUD_ID</th>
<th>NAME</th>
<th>E-MAIL</th>
<th>PHONE</th>
<th>ADDR_ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>John</td>
<td><a href="mailto:john@gmail.com">john@gmail.com</a></td>
<td>123-456-7890</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Paul</td>
<td><a href="mailto:paul@gmail.com">paul@gmail.com</a></td>
<td>111-222-3333</td>
<td>2</td>
</tr>
</tbody>
</table>

The ADDRESSES table's sample data is as follows:

<table>
<thead>
<tr>
<th>ADDR_ID</th>
<th>STREET</th>
<th>CITY</th>
<th>STATE</th>
<th>ZIP</th>
<th>COUNTRY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Naperville</td>
<td>CHICAGO</td>
<td>IL</td>
<td>60515</td>
<td>USA</td>
</tr>
<tr>
<td>2</td>
<td>Elgin</td>
<td>CHICAGO</td>
<td>IL</td>
<td>60515</td>
<td>USA</td>
</tr>
</tbody>
</table>

Let us see how to fetch Student details along with Address details.

The Student and Address JavaBeans are created as follows:

```java
public class Address {
    private Integer addrId;
    private String street;
    private String city;
    private String state;
    private String zip;
    private String country;
    // setters & getters
}

public class Student {
    private Integer studId;
    private String name;
```
private String email;
private PhoneNumber phone;
private Address address;
//setters & getters
}

<resultMap type="Student" id="StudentWithAddressResult">
    <id property="studId" column="stud_id"/>
    <result property="name" column="name"/>
    <result property="email" column="email"/>
    <result property="phone" column="phone"/>
    <result property="address.addrId" column="addr_id"/>
    <result property="address.street" column="street"/>
    <result property="address.city" column="city"/>
    <result property="address.state" column="state"/>
    <result property="address.zip" column="zip"/>
    <result property="address.country" column="country"/>
</resultMap>

<select id="selectStudentWithAddress" parameterType="int" resultMap="StudentWithAddressResult">
    SELECT STUD_ID, NAME, EMAIL, A.ADDR_ID, STREET, CITY, STATE, ZIP, COUNTRY
    FROM STUDENTS S LEFT OUTER JOIN ADDRESSES A ON S.ADDR_ID=A.ADDR_ID
    WHERE STUD_ID=#{studId}
</select>

We can set the properties of a nested object using the dot notation. In the preceding resultMap, Student's address property values are set by address column values using dot notation. Likewise, we can refer the properties of nested objects to any depth. We can access the nested object properties as follows:

    public interface StudentMapper
    {
        Student selectStudentWithAddress(int studId);
    }

    int studId = 1;
    StudentMapper studentMapper = sqlSession.getMapper(StudentMapper.class);
    Student student = studentMapper.selectStudentWithAddress(studId);
    System.out.println("Student :"+student);
    System.out.println("Address :"+student.getAddress());
The preceding example shows one way of mapping a one-to-one association. However with this approach, if the address results need to be mapped to the Address object values in other Select mapped statements, we'll need to repeat the mappings for each statement.

MyBatis provides better approaches for mapping one-to-one associations using the Nested ResultMap and Nested Select statements, which is what we are going to discuss next.

**One-to-one mapping using nested ResultMap**

We can get Student along with the Address details using a nested ResultMap as follows:

```xml
<resultMap type="Address" id="AddressResult">
    <id property="addrId" column="addr_id"/>
    <result property="street" column="street"/>
    <result property="city" column="city"/>
    <result property="state" column="state"/>
    <result property="zip" column="zip"/>
    <result property="country" column="country"/>
</resultMap>

<resultMap type="Student" id="StudentWithAddressResult">
    <id property="studId" column="stud_id"/>
    <result property="name" column="name"/>
    <result property="email" column="email"/>
    <association property="address" resultMap="AddressResult"/>
</resultMap>

<select id="findStudentWithAddress" parameterType="int" resultMap="StudentWithAddressResult">
    SELECT STUD_ID, NAME, EMAIL, A.ADDR_ID, STREET, CITY, STATE, ZIP, COUNTRY
    FROM STUDENTS S LEFT OUTER JOIN ADDRESSES A ON S.ADDR_ID=A.ADDR_ID
    WHERE STUD_ID=#{studId}
</select>
```

The `<association>` element can be used to load the has-one type of associations. In the preceding example, we used the `<association>` element, referencing another `<resultMap>` that is declared in the same XML file.
We can also use `<association>` with an inline `resultMap` query as follows:

```xml
<resultMap type="Student" id="StudentWithAddressResult">
  <id property="studId" column="stud_id"/>
  <result property="name" column="name"/>
  <result property="email" column="email"/>
  <association property="address" javaType="Address">
    <id property="addrId" column="addr_id"/>
    <result property="street" column="street"/>
    <result property="city" column="city"/>
    <result property="state" column="state"/>
    <result property="zip" column="zip"/>
    <result property="country" column="country"/>
  </association>
</resultMap>
```

Using the nested ResultMap approach, the association data will be loaded using a single query (along with `joins` if required).

**One-to-one mapping using nested Select**

We can get `Student` along with the `Address` details using a nested `Select` query as follows:

```xml
<resultMap type="Address" id="AddressResult">
  <id property="addrId" column="addr_id"/>
  <result property="street" column="street"/>
  <result property="city" column="city"/>
  <result property="state" column="state"/>
  <result property="zip" column="zip"/>
  <result property="country" column="country"/>
</resultMap>

<select id="findAddressById" parameterType="int" resultMap="AddressResult">
  SELECT * FROM ADDRESSES WHERE ADDR_ID=#{id}
</select>

<resultMap type="Student" id="StudentWithAddressResult">
  <id property="studId" column="stud_id"/>
  <result property="name" column="name"/>
  <result property="email" column="email"/>
  <association property="address" column="addr_id"
    select="findAddressById"/>
</resultMap>
```
In this approach, the `<association>` element's `select` attribute is set to the statement id `findAddressById`. Here, two separate SQL statements will be executed against the database, the first one called `findStudentById` to load student details and the second one called `findAddressById` to load its address details.

The `addr_id` column value will be passed as input to the `selectAddressById` statement.

We can invoke the `findStudentWithAddress` mapped statement as follows:

```java
StudentMapper mapper = sqlSession.getMapper(StudentMapper.class);
Student student = mapper.selectStudentWithAddress(studId);
System.out.println(student);
System.out.println(student.getAddress());
```

### One-to-many mapping

In our sample domain model, a tutor can teach one or more courses. This means that there is a one-to-many relationship between the tutor and course.

We can map one-to-many types of results to a collection of objects using the `<collection>` element.

The `TUTORS` table's sample data is as follows:

<table>
<thead>
<tr>
<th>TUTOR_ID</th>
<th>NAME</th>
<th>EMAIL</th>
<th>PHONE</th>
<th>ADDR_ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>John</td>
<td><a href="mailto:john@gmail.com">john@gmail.com</a></td>
<td>123-456-7890</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Ying</td>
<td><a href="mailto:ying@gmail.com">ying@gmail.com</a></td>
<td>111-222-3333</td>
<td>2</td>
</tr>
</tbody>
</table>

The `COURSES` table's sample data is as follows:

<table>
<thead>
<tr>
<th>COURSE_ID</th>
<th>NAME</th>
<th>DESCRIPTION</th>
<th>START_DATE</th>
<th>END_DATE</th>
<th>TUTOR_ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>JavaSE</td>
<td>Java SE</td>
<td>2013-01-10</td>
<td>2013-02-10</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>JavaEE</td>
<td>JavaEE6</td>
<td>2013-01-10</td>
<td>2013-03-10</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>MyBatis</td>
<td>MyBatis</td>
<td>2013-01-10</td>
<td>2013-02-20</td>
<td>2</td>
</tr>
</tbody>
</table>
In the preceding table data, the tutor John teaches one course whereas the tutor Ying teaches two courses.

The JavaBeans for Course and Tutor are as follows:

```java
public class Course
{
 private Integer courseId;
 private String name;
 private String description;
 private Date startDate;
 private Date endDate;
 private Integer tutorId;

 //setters & getters
}

public class Tutor
{
 private Integer tutorId;
 private String name;
 private String email;
 private Address address;
 private List<Course> courses;
 //setters & getters
}
```

Now let us see how we can get the tutor's details along with the list of courses he/she teaches.

The `<collection>` element can be used to map multiple course rows to a list of course objects. Similar to one-to-one mapping, we can map one-to-many relationships using a nested ResultMap and nested `Select` approaches.

### One-to-many mapping with nested ResultMap

We can get the tutor along with the courses' details using a nested ResultMap as follows:

```xml
<resultMap type="Course" id="CourseResult">  
  <id column="course_id" property="courseId"/>  
  <result column="name" property="name"/>  
  <result column="description" property="description"/>  
  <result column="start_date" property="startDate"/>  
  <result column="end_date" property="endDate"/>
</resultMap>
```
Here we are fetching the tutor along with the courses' details using a single Select query with JOINS. The <collection> element's resultMap is set to the resultMap ID CourseResult that contains the mapping for the Course object's properties.

One-to-many mapping with nested select
We can get the tutor along with the courses' details using a nested select query as follows:

```java
<resultMap type="Course" id="CourseResult">
  <id column="course_id" property="courseId"/>
  <result column="name" property="name"/>
  <result column="description" property="description"/>
  <result column="start_date" property="startDate"/>
  <result column="end_date" property="endDate"/>
</resultMap>

<resultMap type="Tutor" id="TutorResult">
  <id column="tutor_id" property="tutorId"/>
  <result column="tutor_name" property="name"/>
  <result column="email" property="email"/>
  <association property="address" resultMap="AddressResult"/>
  <collection property="courses" column="tutor_id" select="findCoursesByTutor"/>
</resultMap>

<select id="findTutorById" parameterType="int"
resultMap="TutorResult">
  SELECT T.TUTOR_ID, T.NAME AS TUTOR_NAME, EMAIL, C.COURSE_ID,
  C.NAME, DESCRIPTION, START_DATE, END_DATE
  FROM TUTORS T LEFT OUTER JOIN ADDRESSES A ON T.ADDR_ID=A.ADDR_ID
  LEFT OUTER JOIN COURSES C ON T.TUTOR_ID=C.TUTOR_ID
  WHERE T.TUTOR_ID=#{tutorId}
</select>
```
In this approach, the `<association>` element's `select` attribute is set to the statement ID `findCoursesByTutor` that triggers a separate SQL query to load the courses' details. The `tutor_id` column value will be passed as input to the `findCoursesByTutor` statement.

```java
public interface TutorMapper
{
    Tutor findTutorById(int tutorId);
}
TutorMapper mapper = sqlSession.getMapper(TutorMapper.class);
Tutor tutor = mapper.findTutorById(tutorId);
System.out.println(tutor);
List<Course> courses = tutor.getCourses();
for (Course course : courses)
{
    System.out.println(course);
}
```

A nested select approach may result in N+1 select problems. First, the main query will be executed (1), and for every row returned by the first query, another select query will be executed (N queries for N rows). For large datasets, this could result in poor performance.

**Dynamic SQL**

Sometimes, static SQL queries may not be sufficient for application requirements. We may have to build queries dynamically, based on some criteria.

For example, in web applications there could be search screens that provide one or more input options and perform searches based on the chosen criteria. While implementing this kind of search functionality, we may need to build a dynamic query based on the selected options. If the user provides any value for input criteria, we'll need to add that field in the `WHERE` clause of the query.
MyBatis provides first-class support for building dynamic SQL queries using elements such as `<if>`, `<choose>`, `<where>`, `<foreach>`, and `<trim>.

### The If condition

The `<if>` element can be used to conditionally embed SQL snippets. If the test condition is evaluated to true, then only the SQL snippet will be appended to the query.

Assume we have a Search Courses Screen that has a Tutor dropdown, the CourseName text field, and the StartDate and End Date input fields as the search criteria.

Assume that Tutor is a mandatory field and that the rest of the fields are optional.

When the user clicks on the search button, we need to display a list of courses that meet the following criteria:

- Courses by the selected Tutor
- Courses whose name contain the entered course name; if nothing has been provided, fetch all the courses
- Courses whose start date and end date are in between the provided StartDate and EndDate input fields

We can create the mapped statement for searching the courses as follows:

```xml
<resultMap type="Course" id="CourseResult">
  <id column="course_id" property="courseId"/>
  <result column="name" property="name"/>
  <result column="description" property="description"/>
  <result column="start_date" property="startDate"/>
  <result column="end_date" property="endDate"/>
</resultMap>

<select id="searchCourses" parameterType="hashmap" resultMap="CourseResult">
  <![CDATA[
    SELECT * FROM COURSES
    WHERE TUTOR_ID= #{tutorId}
    <if test="courseName != null">
      AND NAME LIKE #{courseName}
    </if>
    <if test="startDate != null">
      AND START_DATE >= #{startDate}
    </if>
  ]]>[CDATA[
</select>
```
SQL Mappers Using XML

```xml
<if test="endDate != null">
    AND END_DATE <= #{endDate}
</if>
</select>

public interface CourseMapper
{
    List<Course> searchCourses(Map<String, Object> map);
}

public void searchCourses()
{
    Map<String, Object> map = new HashMap<String, Object>();
    map.put("tutorId", 1);
    map.put("courseName", "%java%"mutable
    map.put("startDate", new Date());
    CourseMapper mapper = sqlSession.getMapper(CourseMapper.class);
    List<Course> courses = mapper.searchCourses(map);
    for (Course course : courses) {
        System.out.println(course);
    }
}
```

This will generate the query `SELECT * FROM COURSES WHERE TUTOR_ID= ? AND NAME like ? AND START_DATE >= ?`. This will come in handy while preparing a dynamic SQL query based on the given criteria.

MyBatis uses OGNL (Object Graph Navigation Language) expressions for building dynamic queries.

The choose, when, and otherwise conditions

Sometimes, search functionality could be based on the search type. First, the user needs to choose whether he wants to search by Tutor or Course Name or Start Dates and End Dates, and then based on the selected search type, the input field will appear. In such scenarios, we should apply only one of the conditions.

MyBatis provides the `<choose>` element to support this kind of dynamic SQL preparation.
Now let us write a SQL mapped statement to get the courses by applying the search criteria. If no search criteria is selected, the courses starting from today onwards should be fetched as follows:

```sql
<select id="searchCourses" parameterType="hashmap" resultMap="CourseResult">
    SELECT * FROM COURSES
    <choose>
        <when test="searchBy == 'Tutor'"> WHERE TUTOR_ID= #{tutorId} </when>
        <when test="searchBy == 'CourseName'"> WHERE name like #{courseName} </when>
        <otherwise> WHERE TUTOR start_date &gt;= now() </otherwise>
    </choose>
</select>
```

MyBatis evaluates the `<choose>` test conditions and uses the clause with the first condition that evaluates to `TRUE`. If none of the conditions are true, the `<otherwise>` clause will be used.

### The where condition

At times, all the search criteria might be optional. In cases where at least one of the search conditions needs to be applied, then only the `WHERE` clause should be appended. Also, we need to append `AND` or `OR` to the conditions only if there are multiple conditions. MyBatis provides the `<where>` element to support building these kinds of dynamic SQL statements.

In our example Search Courses screen, we assume that all the search criteria is optional. So, the `WHERE` clause should be there only if any of the search criteria has been provided.

```sql
<select id="searchCourses" parameterType="hashmap" resultMap="CourseResult">
    SELECT * FROM COURSES
    <where>
        <if test="tutorId != null ">
            TUTOR_ID= #{tutorId}
        </if>
        <if test="courseName != null">
            AND name like #{courseName}
        </if>
    </where>
</select>
```
The `<where>` element inserts `WHERE` only if any content is returned by the inner conditional tags. Also, it removes the `AND` or `OR` prefixes if the `WHERE` clause begins with `AND` or `OR`.

In the preceding example, if none of the `<if>` conditions are `true`, `<where>` won’t insert the `WHERE` clause. If at least one of the `<if>` conditions is `true`, `<where>` will insert the `WHERE` clause followed by the content returned by the `<if>` tags.

If the `tutor_id` parameter is `null` and the `courseName` parameter is not `null`, `<where>` will take care of stripping out the `AND` prefix and adding `NAME like #{courseName}`.

### The trim condition

The `<trim>` element works similar to `<where>` but provides additional flexibility on what prefix/suffix needs to be prefixed/suffixed and what prefix/suffix needs to be stripped off.

```xml
<select id="searchCourses" parameterType="hashmap" resultMap="CourseResult"/>
    SELECT * FROM COURSES
    <trim prefix="WHERE" prefixOverrides="AND | OR">
        <if test="tutorId != null ">
            TUTOR_ID= #{tutorId}
        </if>
        <if test="courseName != null">
            AND name like #{courseName}
        </if>
    </trim>
</select>
```

Here `<trim>` will insert `WHERE` if any of the `<if>` conditions are `true` and remove the `AND` or `OR` prefixes just after `WHERE`.  

---

[70]
The foreach loop

Another powerful dynamic SQL builder tag is `<foreach>`. It is a very common requirement for iterating through an array or list and for building AND/OR conditions or an IN clause.

Suppose we want to find out all the courses taught by the tutors whose tutor_id IDs are 1, 3, and 6. We can pass a list of tutor_id IDs to the mapped statement and build a dynamic query by iterating through the list using `<foreach>`.

```
<select id="searchCoursesByTutors" parameterType="map" resultMap="CourseResult">
    SELECT * FROM COURSES
    <if test="tutorIds != null">
        <where>
            <foreach item="tutorId" collection="tutorIds">
                OR tutor_id=#{tutorId}
            </foreach>
        </where>
    </if>
</select>
```

```java
public interface CourseMapper {
    List<Course> searchCoursesByTutors(Map<String, Object> map);
}
```

```java
public void searchCoursesByTutors() {
    Map<String, Object> map = new HashMap<String, Object>();
    List<Integer> tutorIds = new ArrayList<Integer>();
    tutorIds.add(1);
    tutorIds.add(3);
    tutorIds.add(6);
    map.put("tutorIds", tutorIds);
    CourseMapper mapper = sqlSession.getMapper(CourseMapper.class);
    List<Course> courses = mapper.searchCoursesByTutors(map);
    for (Course course : courses) {
        System.out.println(course);
    }
}
```
Let us see how to use `<foreach>` to generate the `IN` clause:

```xml
<select id="searchCoursesByTutors" parameterType="map" resultMap="CourseResult">
    SELECT * FROM COURSES
    <if test="tutorIds != null">
        <where>
            tutor_id IN
            <foreach item="tutorId" collection="tutorIds" open="(" separator="," close=")">
                #{tutorId}
            </foreach>
        </where>
    </if>
</select>
```

The set condition
The `<set>` element is similar to the `<where>` element and will insert `SET` if any content is returned by the inner conditions.

```xml
<update id="updateStudent" parameterType="Student">
    update students
    <set>
        <if test="name != null">name=#{name},</if>
        <if test="email != null">email=#{email},</if>
        <if test="phone != null">phone=#{phone},</if>
    </set>
    where stud_id=#{id}
</update>
```

Here, `<set>` inserts the `SET` keyword if any of the `<if>` conditions return text and also strips out the tailing commas at the end.

In the preceding example, if `phone != null`, `<set>` will take care of removing the comma after `phone=#{phone}`.

MyBatis recipes
In addition to simplifying the database programming, MyBatis provides various features that are very useful for implementing some common tasks, such as loading the table rows page by page, storing and retrieving `CLOB/BLOB` type data, and handling enumerated type values, among others. Let us have a look at a few of these features.
Handling enumeration types

MyBatis supports persisting enum type properties out of the box. Assume that the STUDENTS table has a column gender of the type varchar to store either MALE or FEMALE as the value. And, the Student object has a gender property that is of the type enum as shown in the following code:

```java
public enum Gender
{
    FEMALE,
    MALE
}
```

By default, MyBatis uses EnumTypeHandler to handle enum type Java properties and stores the name of the enum value. You don't need any extra configuration to do this. You can use enum type properties just like primitive type properties as shown in the following code:

```java
public class Student
{
    private Integer id;
    private String name;
    private String email;
    private PhoneNumber phone;
    private Address address;
    private Gender gender;
    //setters and getters
}
```

```xml
<insert id="insertStudent" parameterType="Student" useGeneratedKeys="true" keyProperty="id">
    insert into students(name,email,addr_id, phone,gender)
    values(#{name},#{email},#{address.addrId},#{phone},#{gender})
</insert>
```

When you execute the `insertStudent` statement, MyBatis takes the name of the Gender enum (FEMALE/MALE) and stores it in the GENDER column.

If you want to store the ordinal position of the enum instead of the enum name, you will need to explicitly configure it.
So if you want to store 0 for FEMALE and 1 for MALE in the gender column, you'll need to register `EnumOrdinalTypeHandler` in the `mybatis-config.xml` file.

```xml
<typeHandler
    handler="org.apache.ibatis.type.EnumOrdinalTypeHandler"
    javaType="com.mybatis3.domain.Gender"/>
```

Be careful to use ordinal values to store in the DB. Ordinal values are assigned to enum values based on their order of declaration. If you change the declaration order in `Gender` enum, the data in the database and ordinal values will be mismatched.

### Handling the CLOB/BLOB types

MyBatis provides built-in support for mapping CLOB/BLOB type columns.

Assume we have the following table to store the `Students` and `Tutors` photographs and their biodata:

```sql
CREATE TABLE USER_PICS
(
    ID INT(11) NOT NULL AUTO_INCREMENT,
    NAME VARCHAR(50) DEFAULT NULL,
    PIC BLOB,
    BIO LONGTEXT,
    PRIMARY KEY (ID)
) ENGINE=INNODB AUTO_INCREMENT=1 DEFAULT CHARSET=LATIN1;
```

Here, the photograph can be an image of type PNG, JPG, and so on, and the biodata can be a lengthy history about the student/tutor.

By default, MyBatis maps CLOB type columns to the `java.lang.String` type and BLOB type columns to the `byte[]` type.

```java
public class UserPic
{
    private int id;
    private String name;
    private byte[] pic;
    private String bio;
    //setters & getters
}
```
Create the UserPicMapper.xml file and configure the mapped statements as follows:

```xml
<insert id="insertUserPic" parameterType="UserPic">
    INSERT INTO USER_PICS(NAME, PIC,BIO)
    VALUES(#{name},#{pic},#{bio})
</insert>

<select id="getUserPic" parameterType="int" resultType="UserPic">
    SELECT * FROM USER_PICS WHERE ID=#{id}
</select>
```

The following method `insertUserPic()` shows how to insert data into CLOB/BLOB type columns:

```java
public void insertUserPic()
{
    byte[] pic = null;
    try {
        File file = new File("C:\Images\UserImg.jpg");
        InputStream is = new FileInputStream(file);
        pic = new byte[is.available()];
        is.read(pic);
        is.close();
    } catch (FileNotFoundException e) {
        e.printStackTrace();
    } catch (IOException e) {
        e.printStackTrace();
    }
    String name = "UserName";
    String bio = "put some lengthy bio here";
    UserPic userPic = new UserPic(0, name, pic , bio);

    SqlSession sqlSession = MyBatisUtil.openSession();
    try {
        UserPicMapper mapper =
            sqlSession.getMapper(UserPicMapper.class);
        mapper.insertUserPic(userPic);
        sqlSession.commit();
    }
    finally {
        sqlSession.close();
    }
}
```
The following method getUserPic() shows how to read CLOB type data into String and BLOB type data into byte[] properties:

```java
public void getUserPic()
{
    UserPic userPic = null;
    SqlSession sqlSession = MyBatisUtil.openSession();
    try {
        UserPicMapper mapper =
            sqlSession.getMapper(UserPicMapper.class);
        userPic = mapper.getUserPic(1);
    }
    finally {
        sqlSession.close();
    }
    byte[] pic = userPic.getPic();
    try {
        OutputStream os = new FileOutputStream(new File("C:\Images\UserImage_FromDB.jpg"));
        os.write(pic);
        os.close();
    } catch (FileNotFoundException e) {
        e.printStackTrace();
    } catch (IOException e) {
        e.printStackTrace();
    }
}
```

**Passing multiple input parameters**

MyBatis's mapped statements have the parameterType attribute to specify the type of input parameter. If we want to pass multiple input parameters to a mapped statement, we can put all the input parameters in a HashMap and pass it to that mapped statement.

MyBatis provides another way of passing multiple input parameters to a mapped statement. Suppose we want to find students with the given name and email.

```java
Public interface StudentMapper
{
    List<Student> findAllStudentsByNameEmail(String name, String email);
}
```
MyBatis supports passing multiple input parameters to a mapped statement and referencing them using the #{param} syntax.

```xml
<select id="findAllStudentsByNameEmail" resultMap="StudentResult">
    select stud_id, name, email, phone from Students
    where name=#{param1} and email=#{param2}
</select>
```

Here #{param1} refers to the first parameter name and #{param2} refers to the second parameter email.

```java
StudentMapper studentMapper = sqlSession.getMapper(StudentMapper.class);
studentMapper.findAllStudentsByNameEmail(name, email);
```

**Multiple results as a map**

If we have a mapped statement that returns multiple rows and we want the results in a HashMap with some property value as the key and the resulting object as the value, we can use sqlSession.selectMap() as follows:

```xml
<select id="findAllStudents" resultMap="StudentResult">
    select * from Students
</select>
```

```java
Map<Integer, Student> studentMap =
    sqlSession.selectMap("com.mybatis3.mappers.StudentMapper.
    findAllStudents", "studId");
```

Here studentMap will contain studId values as keys and Student objects as values.

**Paginated ResultSets using RowBounds**

Sometimes, we may need to work with huge volumes of data, such as with tables with millions of records. Loading all these records may not be possible due to memory constraints, or we may need only a fragment of data. Typically in web applications, pagination is used to display large volumes of data in a page-by-page style.

MyBatis can load table data page by page using RowBounds. The RowBounds object can be constructed using the offset and limit parameters. The parameter offset refers to the starting position and limit refers to the number of records.
Suppose if you want to load and display 25 student records per page, you can use the following query:

```xml
<select id="findAllStudents" resultMap="StudentResult">
    select * from Students
</select>
```

Then, you can load the first page (first 25 records) as follows:

```java
int offset = 0, limit = 25;
RowBounds rowBounds = new RowBounds(offset, limit);
List<Student> students = studentMapper.getStudents(rowBounds);
```

To display the second page, use `offset=25` and `limit=25`; for the third page, use `offset=50` and `limit=25`.

**Custom ResultSet processing using ResultSetHandler**

MyBatis provides great support with plenty of options for mapping the query results to JavaBeans. But sometimes, we may come across scenarios where we need to process the SQL query results by ourselves for special purposes. MyBatis provides a `ResultHandler` plugin that enables the processing of the ResultSet in whatever way we like.

Suppose that we want to get the student details in a `HashMap` where `stud_id` is used as a key and name is used as a value.

```java
As of mybatis-3.2.2, MyBatis doesn't have support for getting the result as `HashMap`, with one property value as the key and another property value as the value, using the `resultMap` element. `sqlSession.selectMap()` returns a map with the given property value as the key and the result object as the value. We can't configure it to use one property as the key and another property as the value.
```

For `sqlSession.select()` methods, we can pass an implementation of `ResultHandler` that will be invoked for each record in the ResultSet.

```java
public interface ResultHandler {
    void handleResult(ResultContext context);
}
```
Now let us see how we can use ResultHandler to process the ResultSet and return customized results.

```java
public Map<Integer, String> getStudentIdNameMap()
{
    final Map<Integer, String> map = new HashMap<Integer, String>();
    SqlSession sqlSession = MyBatisUtil.openSession();
    try {
        sqlSession.select("com.mybatis3.mappers.StudentMapper.findAllStudents",
                              new ResultHandler() {
            @Override
            public void handleResult(ResultContext context) {
                Student student = (Student) context.getResultObject();
                map.put(student.getStudId(), student.getName());
            }
        });
    } finally {
        sqlSession.close();
    }
    return map;
}
```

In the preceding code, we are providing an inline implementation of ResultHandler. Inside the handleResult() method, we are getting the current result object using context.getResultObject() that is a Student object because we configured resultMap="StudentResult" for the findAllStudents mapped statement. As the handleResult() method will be called for every row returned by the query, we are extracting the studId and name values from the Student object and populating the map.

**Cache**

Caching data that is loaded from the database is a common requirement for many applications to improve their performance. MyBatis provides in-built support for caching the query results loaded by mapped SELECT statements. By default, the first-level cache is enabled; this means that if you'll invoke the same SELECT statement within the same SqlSession interface, results will be fetched from the cache instead of the database.

We can add global second-level caches by adding the `<cache/>` element in SQL Mapper XML files.
When you'll add the `<cache/>` element the following will occur:

- All results from the `<select>` statements in the mapped statement file will be cached
- All the `<insert>`, `<update>`, and `<delete>` statements in the mapped statement file will flush the cache
- The cache will use a Least Recently Used (LRU) algorithm for eviction
- The cache will not flush on any sort of time-based schedule (no Flush Interval)
- The cache will store 1024 references to lists or objects (whatever the query method returns)
- The cache will be treated as a read/write cache; this means that the objects retrieved will not be shared and can safely be modified by the caller without it interfering with other potential modifications by other callers or threads

You can also customize this behavior by overriding the default attribute values as follows:

```xml
<cache eviction="FIFO" flushInterval="60000" size="512"
readOnly="true"/>
```

A description for each of the attributes is as follows:

- **eviction**: This is the cache eviction policy to be used. The default value is LRU. The possible values are LRU (least recently used), FIFO (first in first out), SOFT (soft reference), WEAK (weak reference).
- **flushInterval**: This is the cache flush interval in milliseconds. The default is not set. So, no flush interval is used and the cache is only flushed by calls to the statements.
- **size**: This represents the maximum number of elements that can be held in the cache. The default is 1024, and you can set it to any positive integer.
- **readOnly**: A read-only cache will return the same instance of the cached object to all the callers. A read-write cache will return a copy (via serialization) of the cached object. The default is false and the possible values are true and false.
A cache configuration and cache instance are bound to the namespace of the SQL Mapper file, so all the statements in the same namespace table as the cache are bound by it.

The default cache configuration for a mapped statement is:

```xml
<select ... flushCache="false" useCache="true"/>
<insert ... flushCache="true"/>
<update ... flushCache="true"/>
<delete ... flushCache="true"/>
```

You can override this default behavior for any specific mapped statements; for example, by not using a cache for a select statement by setting the useCache="false" attribute.

In addition to in-built Cache support, MyBatis provides support for integration with popular third-party Cache libraries, such as Ehcache, OSCache, and Hazelcast. You can find more information on integrating third-party Cache libraries on the official MyBatis website https://code.google.com/p/mybatis/wiki/Caches.

**Summary**

In this chapter, we learned how to write SQL mapped statements using the Mapper XML files. We discussed how to configure simple statements, statements with one-to-one and one-to-many relationships, and how to map the results using ResultMap. We also looked into building dynamic queries, paginated results, and custom ResultSet handling. In the next chapter, we will discuss how to write mapped statements using annotations.
In the previous chapter, we had seen how we can configure mapped statements in XML Mapper files. MyBatis supports configuring mapped statements using annotations also. When using annotation-based Mapper interfaces you don't need to configure SQL queries in XML files. If you want, you can use XML and annotation-based mapped statements together.

In this chapter we will cover the following topics:

- Mapper interfaces using annotations
- Mapped statements
  - @Insert, @Update, @Delete, and @SelectStatements
- Resultmaps
  - Simple resultmaps
  - One-to-one mapping
  - One-to-many mapping
- Dynamic SQL
  - @SelectProvider
  - @InsertProvider
  - @UpdateProvider
  - @DeleteProvider
Mapper interfaces using annotations
MyBatis provides annotation-based configuration options for most of the XML-based mapper elements, including `<select>` and `<update>`. However, there are few cases where there are no annotation-based equivalents for some of the XML-based elements.

Mapped statements
MyBatis provides various annotations to configure different types of statements such as `SELECT`, `INSERT`, `UPDATE`, and `DELETE`. Let us see how to configure mapped statements in detail.

@Insert
We can define an `INSERT` mapped statement using the `@Insert` annotation.

```java
class com.mybatis3.mappers;
public interface StudentMapper
{
    @Insert("INSERT INTO STUDENTS(STUD_ID, NAME, EMAIL, ADDR_ID, PHONE)
    VALUES(#{studId},#{name},#{email},#{address.addrId},#{phone})")
    int insertStudent(Student student);
}
```

The `insertStudent()` method with the `@Insert` annotation returns the number of rows affected by this `insert` statement.

Autogenerated keys
As discussed in the previous chapter, there can be autogenerated primary key columns. We can use the `useGeneratedKeys` and `keyProperty` attributes of the `@Options` annotation to let the database server generate the auto_increment column value and set that generated value as one of the input object properties.

```java
@Insert("INSERT INTO STUDENTS(NAME, EMAIL, ADDR_ID, PHONE)
VALUES(#{name},#{email},#{address.addrId},#{phone})")
@Options(useGeneratedKeys=true, keyProperty="studId")
int insertStudent(Student student);
```

Here the `STUD_ID` column value will be autogenerated by MySQL database and the generated value will be set to the `studId` property of the `student` object.

```java
StudentMapper mapper = sqlSession.getMapper(StudentMapper.class);
mapper.insertStudent(student);
int studentId = student.getStudId();
```
Some of the databases, such as Oracle, don't support the AUTO_INCREMENT columns and generally we use SEQUENCE to generate the primary key values.

We can use the @SelectKey annotation to specify any SQL statement that will give the primary key value, which can be used as the primary key column value.

Assume we have a sequence called STUD_ID_SEQ to generate the STUD_ID primary key values.

```java
@Insert("INSERT INTO STUDENTS(STUD_ID,NAME,EMAIL,ADDR_ID, PHONE)
VALUES(#{studId},#{name},#{email},#{address.addrId},#{phone})")
@SelectKey(statement="SELECT STUD_ID_SEQ.NEXTVAL FROM DUAL",
keyProperty="studId", resultType=int.class, before=true)
int insertStudent(Student student);
```

Here we have used @SelectKey to generate the primary key value and stored it in the studId property of the Student object using the keyProperty attribute. This gets executed before executing the INSERT statement, because we specified it via the before=true attribute.

If you are setting the primary key value through triggers using SEQUENCE, we can obtain the database-generated primary key value from sequence_name.currval after the INSERT statement is executed.

```java
@Insert("INSERT INTO STUDENTS(NAME,EMAIL,ADDR_ID, PHONE)
VALUES(#{name},#{email},#{address.addrId},#{phone})")
@SelectKey(statement="SELECT STUD_ID_SEQ.CURRVAL FROM DUAL",
keyProperty="studId", resultType=int.class, before=false)
int insertStudent(Student student);
```

@Update

We can define an UPDATE mapped statement using the @Update annotation as follows:

```java
@Update("UPDATE STUDENTS SET NAME=#{name}, EMAIL=#{email},
PHONE=#{phone} WHERE STUD_ID=#{studId}"
int updateStudent(Student student);
```

The updateStudent() method with @Update returns the number of rows affected by this update statement.

```java
StudentMapper mapper = sqlSession.getMapper(StudentMapper.class);
int noOfRowsUpdated = mapper.updateStudent(student);
```
SQL Mappers Using Annotations

**@Delete**

We can define a `DELETE` mapped statement using the `@Delete` annotation as follows:

```java
@Delete("DELETE FROM STUDENTS WHERE STUD_ID=#{studId}"
int deleteStudent(int studId);
```

The `deleteStudent()` method with `@Delete` returns the number of rows affected by this delete statement.

**@Select**

We can define the `SELECT` mapped statements using the `@Select` annotation.

Let us see how a simple select query can be configured.

```java
package com.mybatis3.mappers;
public interface StudentMapper
{
    @Select("SELECT STUD_ID AS STUDID, NAME, EMAIL, PHONE FROM STUDENTS WHERE STUD_ID=#{studId}"
    Student findStudentById(Integer studId);
}
```

To match the column names with the `Student` bean property names, we gave an alias name for `stud_id` as `studId`. If the query returns multiple rows, `TooManyResultsException` will be thrown.

**Result maps**

We can map query results to JavaBean properties using inline aliases or using an explicit `@Results` annotation.

Now let us see how to execute a `SELECT` query with explicit column to property mappings using the `@Results` annotation.

```java
package com.mybatis3.mappers;
public interface StudentMapper
{
    @Select("SELECT * FROM STUDENTS")
    @Results(
        @Result(id=true, column="stud_id", property="studId"),
        @Result(column="name", property="name"),
        @Result(column="email", property="email"),
        @Result(column="addr_id", property="address.addrId"
```
The @Results annotation is a counterpart of the Mapper XML element <resultMap>. However, as of MyBatis 3.2.2 we can't give an ID for the @Results annotation. So unlike the <resultMap> XML element, we can't reuse the @Results declaration across different mapped statements. What this means is that you need to duplicate the @Results configuration even though it is the same.

For example, see the following findStudentBy() and findAllStudents() methods:

```java
@Select("SELECT * FROM STUDENTS WHERE STUD_ID=#{studId}")
@Results(
    @Result(id=true, column="stud_id", property="studId"),
    @Result(column="name", property="name"),
    @Result(column="email", property="email"),
    @Result(column="addr_id", property="address.addrId")
)
Student findStudentById(int studId);

@Select("SELECT * FROM STUDENTS")
@Results(
    @Result(id=true, column="stud_id", property="studId"),
    @Result(column="name", property="name"),
    @Result(column="email", property="email"),
    @Result(column="addr_id", property="address.addrId")
)
List<Student> findAllStudents();
```

Here the @Results configuration is same for both the statements, but we need to duplicate it. There is also a work around for this problem. We can create a Mapper XML file and configure the <resultMap> element and reference that resultMap using the @ResultMap annotation.

Define <resultMap> with ID StudentResult in StudentMapper.xml.

```xml
<mapper namespace="com.mybatis3.mappers.StudentMapper">
<resultMap type="Student" id="StudentResult">
    <id property="studId" column="stud_id"/>
    <result property="name" column="name"/>
    <result property="email" column="email"/>
    <result property="phone" column="phone"/>
</resultMap>
```
In `StudentMapper.java`, reference the `resultMap` attribute `StudentResult` using `@ResultMap`.

```java
public interface StudentMapper {
    @Select("SELECT * FROM STUDENTS WHERE STUD_ID=#{studId}"")
    @ResultMap("com.mybatis3.mappers.StudentMapper.StudentResult")
    Student findStudentById(int studId);

    @Select("SELECT * FROM STUDENTS")
    @ResultMap("com.mybatis3.mappers.StudentMapper.StudentResult")
    List<Student> findAllStudents();
}
```

**One-to-one mapping**

MyBatis provides the `@One` annotation to load a one-to-one association using a `Nested-Select` statement.

Let us see how we can get student details along with their address details using the `@One` annotation.

```java
public interface StudentMapper {
    @Select("SELECT ADDR_ID AS ADDRID, STREET, CITY, STATE, ZIP, COUNTRY FROM ADDRESSES WHERE ADDR_ID=#{id}")
    Address findAddressById(int id);

    @Select("SELECT * FROM STUDENTS WHERE STUD_ID=#{studId} ")
    @Results({
        @Result(id=true, column="stud_id", property="studId"),
        @Result(column="name", property="name"),
        @Result(column="email", property="email"),
        @Result(property="address", column="addr_id",
        one=@One(select="com.mybatis3.mappers.StudentMapper.
        findAddressById"))
    })
    Student selectStudentWithAddress(int studId);
}
```

Here we have used the `@One` annotation's `select` attribute to point to fully qualified method names, which return an `Address` object. With the attribute `column="addr_id"`, the column value `addr_id` from the table row `STUDENTS` will be passed as an input to the `findAddressById()` method. If the query `@One` `SELECT` returns multiple rows, a `TooManyResultsException` will be thrown.
int studId = 1;
StudentMapper studentMapper = 
sqlSession.getMapper(StudentMapper.class);
Student student = studentMapper.selectStudentWithAddress(studId);
System.out.println("Student :"+student);
System.out.println("Address :"+student.getAddress());

As discussed in Chapter 3, SQL Mappers using XML, we can load a one-to-one
association using nested ResultMap using XML-based Mapper configuration. But as
of MyBatis-3.2.2, there is no annotation-based counterpart for this kind of mapping.
However, we can define <resultMap> in Mapper XML file and reference it using the
@ResultMap annotation.

Configure <resultMap> in StudentMapper.xml as follows:

```xml
<mapper namespace="com.mybatis3.mappers.StudentMapper">
  <resultMap type="Address" id="AddressResult">
    <id property="addrId" column=" addr_id"/>
    <result property="street" column="street" />
    <result property="city" column="city" />
    <result property="state" column="state" />
    <result property="zip" column="zip" />
    <result property="country" column="country" />
  </resultMap>
  <resultMap type="Student" id="StudentWithAddressResult">
    <id property="studId" column="stud_id" />
    <result property="name" column="name" />
    <result property="email" column="email" />
    <association property="address" resultMap="AddressResult"/>
  </resultMap>
</mapper>
```

```java
public interface StudentMapper
{
@Select("select stud_id, name, email, a.addr_id, street, city,
state, zip, country"; FROM students s left outer join addresses a
on s.addr_id=a.addr_id"; where stud_id=#{studId} ")
@ResultMap("com.mybatis3.mappers.StudentMapper.
StudentWithAddressResult")
Student selectStudentWithAddress(int id);
}
```
One-to-many mapping

MyBatis provides the `@Many` annotation to load a one-to-many association using a Nested-Select statement.

Now let us see how we can get a Tutor with a list of courses he/she teaches using the `@Many` annotation.

```java
public interface TutorMapper {
    @Select("select addr_id as addrId, street, city, state, zip, country from addresses where addr_id=#{id}"")
    Address findAddressById(int id);

    @Select("select * from courses where tutor_id=#{tutorId}"")
    @Results({
        @Result(id=true, column="course_id", property="courseId"),
        @Result(column="name", property="name"),
        @Result(column="description", property="description"),
        @Result(column="start_date" property="startDate"),
        @Result(column="end_date" property="endDate")
    })
    List<Course> findCoursesByTutorId(int tutorId);

    @Select("SELECT tutor_id, name as tutor_name, email, addr_id FROM tutors where tutor_id=#{tutorId}"")
    @Results({
        @Result(id=true, column="tutor_id", property="tutorId"),
        @Result(column="tutor_name", property="name"),
        @Result(column="email", property="email"),
        @Result(property="address", column="addr_id",
                one=@One(select=" com.mybatis3.mappers.TutorMapper.findAddressById")),
        @Result(property="courses", column="tutor_id",
                 many=@Many(select="com.mybatis3.mappers.TutorMapper.
                               findCoursesByTutorId"))
    })
    Tutor findTutorById(int tutorId);
}
```

Here we have used the `@Many` annotation's select attribute to point to a fully qualified method name, which returns the `List<Course>` objects. With the attribute column="tutor_id", the tutor_id column value from the TUTORS table row will be passed as an input to the `findCoursesByTutorId()` method.
Using an XML-based Mapper configuration, we can load a one-to-many association using a nested ResultMap as discussed in Chapter 3, SQL Mappers Using XML. As of MyBatis 3.2.2, there is no annotation-based counterpart for this kind of mapping. But we can define the <resultMap> in the Mapper XML file and reference it using the @ResultMap annotation.

Configure <resultMap> in TutorMapper.xml as follows:

```xml
<mapper namespace="com.mybatis3.mappers.TutorMapper">
  <resultMap type="Address" id="AddressResult">
    <id property="addrId" column="addr_id"/>
    <result property="street" column="street"/>
    <result property="city" column="city"/>
    <result property="state" column="state"/>
    <result property="zip" column="zip"/>
    <result property="country" column="country"/>
  </resultMap>

  <resultMap type="Course" id="CourseResult">
    <id column="course_id" property="courseId"/>
    <result column="name" property="name"/>
    <result column="description" property="description"/>
    <result column="start_date" property="startDate"/>
    <result column="end_date" property="endDate"/>
  </resultMap>

  <resultMap type="Tutor" id="TutorResult">
    <id column="tutor_id" property="tutorId"/>
    <result column="tutor_name" property="name"/>
    <result column="email" property="email"/>
    <association property="address" resultMap="AddressResult"/>
    <collection property="courses" resultMap="CourseResult"/>
  </resultMap>
</mapper>
```

```java
public interface TutorMapper {
    @Select("SELECT T.TUTOR_ID, T.NAME AS TUTOR_NAME, EMAIL,
             A.ADDR_ID, STREET, CITY, STATE, ZIP, COUNTRY, COURSE_ID, C.NAME,
             DESCRIPTION, START_DATE, END_DATE FROM TUTORS T LEFT OUTER
             JOIN ADDRESSES A ON T.ADDR_ID=A.ADDR_ID LEFT OUTER JOIN COURSES
             C ON T.TUTOR_ID=C.TUTOR_ID WHERE T.TUTOR_ID=#{tutorId}"")
    @ResultMap("com.mybatis3.mappers.TutorMapper.TutorResult")
    Tutor selectTutorById(int tutorId);
}
```
Dynamic SQL

Sometimes we may need to build queries dynamically based on input criteria. MyBatis provides various annotations such as @InsertProvider, @UpdateProvider, @DeleteProvider, and @SelectProvider, which facilitates building dynamic queries and lets MyBatis execute those queries.

Now let us look at an example of how to create a simple SELECT mapped statement using @SelectProvider.

Create the TutorDynaSqlProvider.java class with the findTutorByIdSql() method as follows:

```java
package com.mybatis3.sqlproviders;
import org.apache.ibatis.jdbc.SQL;

public class TutorDynaSqlProvider
{
    public String findTutorByIdSql(int tutorId)
    {
        return "SELECT TUTOR_ID AS tutorId, NAME, EMAIL FROM TUTORS WHERE TUTOR_ID=\"+tutorId;"
    }
}
```

Create a mapped statement in the TutorMapper.java interface as follows:

```java
@SelectProvider(type=TutorDynaSqlProvider.class,
method="findTutorByIdSql")
Tutor findTutorById(int tutorId);
```

Here we have used @SelectProvider to specify the class and method name, which provide the SQL statement to be executed.

But constructing SQL queries using string concatenation is difficult and error-prone. So MyBatis provides an SQL utility which simplifies building dynamic SQL queries without the need of string concatenations.

Now let us see how we can prepare the same query using the org.apache.ibatis.jdbc.SQL utility.

```java
package com.mybatis3.sqlproviders;
import org.apache.ibatis.jdbc.SQL;

public class TutorDynaSqlProvider
{
    public String findTutorByIdSql(final int tutorId)
```
{ 
return new SQL() {{
SELECT("tutor_id as tutorId, name, email");
FROM("tutors");
WHERE("tutor_id = #{tutorId}");
}}.toString();
}

The SQL utility will take care of constructing the query with proper space prefix and suffixes if required.

The dynamic SQL provider methods can have one of the following parameters:

- No parameter
- A single parameter with same type of Mapper interface method
- java.util.Map

If the SQL query preparation doesn't depend on an input argument, you can use the no-argument SQL provider method.

For example:

```java
public String findTutorByIdSql()
{
return new SQL() {{
SELECT("tutor_id as tutorId, name, email");
FROM("tutors");
WHERE("tutor_id = #{tutorId}");
}}.toString();
}
```

Here we are not using any input parameter to construct the query, so it can be a no-argument method.

If the Mapper interface method has only one parameter, we can use a method that has only one parameter of the same type as the SQL provider method.

```java
Tutor findTutorById(int tutorId);
```
Here the `findTutorById(int)` method has only one input parameter of type `int`. We can have the `findTutorByIdSql(int)` method as an SQL provider method as follows:

```java
public String findTutorByIdSql(final int tutorId)
{
    return new SQL() {{
        SELECT("tutor_id as tutorId, name, email");
        FROM("tutors");
        WHERE("tutor_id"=tutorId);
    }}.toString();
}
```

If the Mapper interface has multiple input parameters, we can use a method with the `java.util.Map` parameter type as the SQL provider method. Then all the input argument values will be placed in `map` with `param1`, `param2`, and so on as keys, and the input arguments as values. You can also get those input argument values using 0, 1, 2, and so on as keys.

```java
@SelectProvider(type=TutorDynaSqlProvider.class,
method="findTutorByNameAndEmailSql")
Tutor findTutorByNameAndEmail(String name, String email);

public String findTutorByNameAndEmailSql(Map<String, Object> map)
{
    String name = (String) map.get("param1");
    String email = (String) map.get("param2");
    //you can also get those values using 0,1 keys
    //String name = (String) map.get("0");
    //String email = (String) map.get("1");
    return new SQL() {{
        SELECT("tutor_id as tutorId, name, email");
        FROM("tutors");
        WHERE("name=#{name} AND email=#{email}");
    }}.toString();
}
```

The SQL utility also provides various other methods to perform `JOINS`, `ORDER_BY`, `GROUP_BY`, and so on.

Let us look at an example of using `LEFT_OUTER_JOIN`:

```java
public class TutorDynaSqlProvider
{
    public String selectTutorById()
```
{ 
return new SQL() {
SELECT("t.tutor_id, t.name as tutor_name, email");
SELECT("a.addr_id, street, city, state, zip, country");
SELECT("course_id, c.name as course_name, description, start_date, end_date");
FROM("TUTORS t");
LEFT_OUTER_JOIN("addresses a on t.addr_id=a.addr_id");
LEFT_OUTER_JOIN("courses c on t.tutor_id=c.tutor_id");
WHERE("t.TUTOR_ID = #{id} ");
}.toString();
}

public interface TutorMapper
{
@SelectProvider(type=TutorDynaSqlProvider.class,
method="selectTutorById")
@ResultMap("com.mybatis3.mappers.TutorMapper.TutorResult")
Tutor selectTutorById(int tutorId);
}

As there is no annotation support for mapping one-to-many results using nestedResultMap, we can use the XML-based <resultMap> configuration and map with @ResultMap.

<mapper namespace="com.mybatis3.mappers.TutorMapper">

<resultMap type="Address" id="AddressResult">
<id property="id" column="addr_id"/>
<result property="street" column="street"/>
<result property="city" column="city"/>
<result property="state" column="state"/>
<result property="zip" column="zip"/>
<result property="country" column="country"/>
</resultMap>

<resultMap type="Course" id="CourseResult">
<id column="course_id" property="id"/>
<result column="course_name" property="name"/>
<result column="description" property="description"/>
<result column="start_date" property="startDate"/>
<result column="end_date" property="endDate"/>
</resultMap>

[95]
<resultMap type="Tutor" id="TutorResult">
  <id column="tutor_id" property="id"/>
  <result column="tutor_name" property="name"/>
  <result column="email" property="email"/>
  <association property="address" resultMap="AddressResult"/>
  <collection property="courses" resultMap="CourseResult"/>
</resultMap>
</mapper>

With this dynamic SQL provider we can fetch Tutor details along with Address and Courses details.

@InsertProvider
We can create dynamic INSERT queries using @InsertProvider as follows:

```java
public class TutorDynaSqlProvider
{
  public String insertTutor(final Tutor tutor)
  {

    return new SQL() {{
      INSERT INTO("TUTORS");

      if (tutor.getName() != null) {
        VALUES("NAME", ":\{name\}"");
      }

      if (tutor.getEmail() != null) {
        VALUES("EMAIL", ":\{email\}"");
      }
    }}.toString();
  }
}
```

```java
public interface TutorMapper
{
  @InsertProvider(type=TutorDynaSqlProvider.class,
                  method="insertTutor")
  @Options(useGeneratedKeys=true, keyProperty="tutorId")
  int insertTutor(Tutor tutor);
}
```
@UpdateProvider
We can create dynamic UPDATE queries using @UpdateProvider as follows:

```java
public class TutorDynaSqlProvider {
    public String updateTutor(final Tutor tutor) {
        return new SQL() {{
            UPDATE("TUTORS");
            if (tutor.getName() != null) {
                SET("NAME = #{name}");
            }
            if (tutor.getEmail() != null) {
                SET("EMAIL = #{email}");
            }
            WHERE("TUTOR_ID = #{tutorId}");
        }}.toString();
    }
}

public interface TutorMapper {
    @UpdateProvider(type=TutorDynaSqlProvider.class,
                    method="updateTutor")
    int updateTutor(Tutor tutor);
}
```

@DeleteProvider
We can create dynamic DELETE queries using @DeleteProvider as follows:

```java
public class TutorDynaSqlProvider {
    public String deleteTutor(int tutorId) {
        return new SQL() {{
            DELETE_FROM("TUTORS");
            WHERE("TUTOR_ID = #{tutorId}");
        }}.toString();
    }
}
```
public interface TutorMapper
{
    @DeleteProvider(type=TutorDynaSqlProvider.class,
    method="deleteTutor")
    int deleteTutor(int tutorId);
}

Summary
In this chapter, we learned how to write SQL mapped statements using annotations. We discussed how to configure simple statements, statements with one-to-one and one-to-many relationships. We also looked into building dynamic queries using SqlProvider annotations. In the next chapter, we will discuss how to integrate MyBatis with the Spring framework.
Integration with Spring

MyBatis-Spring is a submodule of the MyBatis framework, which provides seamless integration with the popular dependency injection framework, Spring.

The Spring framework is a **Dependency Injection** and **Aspect Oriented Programming (AOP)** based Java application framework which encourages POJO-based programming model. Also, Spring provides declarative and programmatic transaction management capabilities, which greatly simplify the implementation of the **data access layer** of the application. In this chapter, we will see how to use MyBatis in a Spring-based application and use Spring's annotation-based transaction management strategy.

In this chapter we will cover the following topics:

- Configuring MyBatis in a Spring application
  - Installation
  - Configuring MyBatis beans
- Working with SqlSession
- Working with mappers
- Transaction management using Spring

**Configuring MyBatis in a Spring application**

This section describes how to install and configure MyBatis in a Spring-based application.
Integration with Spring

Installation
If you are using the Maven build tool, you can configure Mybatis' spring dependency as follows:

```xml
<dependency>
  <groupId>org.mybatis</groupId>
  <artifactId>mybatis-spring</artifactId>
  <version>1.2.0</version>
</dependency>

<dependency>
  <groupId>org.springframework</groupId>
  <artifactId>spring-context-support</artifactId>
  <version>3.1.3.RELEASE</version>
  <exclusions>
    <exclusion>
      <groupId>commons-logging</groupId>
      <artifactId>commons-logging</artifactId>
    </exclusion>
  </exclusions>
</dependency>

<dependency>
  <groupId>org.springframework</groupId>
  <artifactId>spring-jdbc</artifactId>
  <version>3.1.3.RELEASE</version>
</dependency>

<dependency>
  <groupId>org.springframework</groupId>
  <artifactId>spring-test</artifactId>
  <version>3.1.3.RELEASE</version>
  <scope>test</scope>
</dependency>

<dependency>
  <groupId>org.aspectj</groupId>
  <artifactId>aspectjrt</artifactId>
  <version>1.6.8</version>
</dependency>

<dependency>
  <groupId>org.aspectj</groupId>
  <artifactId>aspectjweaver</artifactId>
  <version>1.6.8</version>
</dependency>
```
If you are not using Maven, you can download mybatis-spring-1.2.0-bundle.zip from http://code.google.com/p/mybatis/. Extract and add mybatis-spring-1.2.0.jar to the classpath.

You can download the Spring framework bundle spring-framework-3.1.3.RELEASE.zip from http://www.springframework.org/download/community/ and add Spring and its dependent JAR files to the classpath.

If we are using MyBatis without Spring then we need to create the SqlSessionFactory object by ourselves and need to create a SqlSession object from SqlSessionFactory in every method. Also, we are responsible for committing or rolling back the transaction and closing the SqlSession object.

By using the MyBatis-Spring module, we can configure the MyBatis beans in Spring ApplicationContext, and Spring will take care of instantiating the SqlSessionFactory object and create a SqlSession object and inject it into the DAO or Service classes. Also, you can use Spring's annotation-based transaction management capabilities, without writing transaction-handling code inside the data access logic.

**Configuring MyBatis beans**

To let Spring instantiate MyBatis components such as SqlSessionFactory, SqlSession, and the Mapper objects, we need to configure them in the Spring bean definition file, say applicationContext.xml, as follows:

```xml
<beans>
  <bean id="dataSource" class="org.springframework.jdbc.datasource.DriverManagerDataSource">
    <property name="driverClassName" value="com.mysql.jdbc.Driver"/>
    <property name="url"/>
    <property name="username" value="root"/>
    <property name="password" value="root"/>
  </bean>
  <bean id="sqlSessionFactory" class="org.mybatis.spring.SqlSessionFactoryBean">
    <property name="dataSource" ref="dataSource"/>
    <property name="sqlMapLocation" value="classpath:mybatis-mapping.xml"/>
    <property name="typeAliasesPackage" value="com.example.models"/>
    <property name="sqlSessionFactoryIntercepts"/>
  </bean>
  <bean id="sqlSessionTemplate" class="org.mybatis.spring.SqlSessionTemplate">
    <constructor-arg ref="sqlSessionFactory"/>
    <constructor-arg ref="sqlSessionFactory"/>
  </bean>
</beans>
```
Integration with Spring

```xml
<bean id="sqlSessionFactory"
    class="org.mybatis.spring.SqlSessionFactoryBean">
<property name="dataSource" ref="dataSource" />
<property name="typeAliases" value="com.mybatis3.domain.Student,
                              com.mybatis3.domain.Tutor"/>
<property name="typeAliasesPackage" value="com.mybatis3.domain"/>
<property name="typeHandlers" value="com.mybatis3.typehandlers.PhoneTypeHandler"/>
<property name="typeHandlersPackage" value="com.mybatis3.typehandlers"/>
<property name="mapperLocations" value="classpath*:com/mybatis3/**/*.xml" />
<property name="configLocation" value="WEB-INF/mybatis-config.xml"/>
</bean>
</beans>
```

With the preceding bean definitions, Spring will create a SqlSessionFactory object using the configured properties as follows:

- **dataSource**: It refers to the dataSource bean
- **typeAliases**: It specifies the comma-separated list of fully qualified class names for which aliases should be created using the default aliasing rule
- **typeAliasesPackage**: It specifies the comma-separated list of package names that needs to be scanned and creates aliases for JavaBeans
- **typeHandlers**: It specifies the comma-separated list of fully qualified class names of the type handler classes
- **typeHandlersPackage**: It specifies the comma-separated list of package names, which needs to be scanned for the type handler classes
- **mapperLocations**: It specifies the location of the SQL Mapper XML files
- **configLocation**: It specifies the location of the MyBatis SqlSessionFactory config file
Working with SqlSession

Once the SqlSessionFactory bean is configured, we need to configure the SqlSessionTemplate bean, which is a thread-safe Spring bean from which we can obtain the thread-safe SqlSession objects. Because SqlSessionTemplate provides the thread-safe SqlSession objects, you can share the same SqlSessionTemplate instance with multiple Spring beans. Conceptually SqlSessionTemplate is similar to JdbcTemplate of the Spring DAO module.

    <bean id="sqlSession" class="org.mybatis.spring.SqlSessionTemplate">
        <constructor-arg index="0" ref="sqlSessionFactory" />
    </bean>

Now we can inject the SqlSession bean into any Spring bean and use the SqlSession object to invoke the mapped SQL statements.

    public class StudentDaoImpl implements StudentDao {
        private SqlSession sqlSession;
        public void setSqlSession(SqlSession session) {
            this.sqlSession = session;
        }
        public void createStudent(Student student) {
            StudentMapper mapper = this.sqlSession.getMapper(StudentMapper.class);
            mapper.insertStudent(student);
        }
    }

If you are using an XML-based configuration for configuring the Spring beans, you can inject the SqlSession bean into the StudentDaoImpl beans as follows:

    <bean id="studentDao" class="com.mybatis3.dao.StudentDaoImpl">
        <property name="sqlSession" ref="sqlSession" />
    </bean>

If you are using the annotation-based configuration for wiring the Spring beans, you can inject the SqlSession bean into the StudentDaoImpl beans as follows:

    @Repository
    public class StudentDaoImpl implements StudentDao {
        private SqlSession sqlSession;
        @Autowired
        public void setSqlSession(SqlSession session) {
            this.sqlSession = session;
        }
        public void createStudent(Student student) {
            StudentMapper mapper = this.sqlSession.getMapper(StudentMapper.class);
            mapper.insertStudent(student);
        }
    }
Integration with Spring

```java
public void setSqlSession(SqlSession session) {
    this.sqlSession = session;
}

public void createStudent(Student student) {
    StudentMapper mapper =
    this.sqlSession.getMapper(StudentMapper.class);
    mapper.insertStudent(student);
}
```

There is another way to inject the SqlSession object, that is, by extendingSqlSessionDaoSupport. This approach enables us to perform any custom logic in addition to executing the mapped statements.

```java
public class StudentMapperImpl extends SqlSessionDaoSupport implements StudentMapper {
    public void createStudent(Student student) {
        StudentMapper mapper =
        getSqlSession().getMapper(StudentMapper.class);
        mapper.insertAddress(student.getAddress());
        //Custom logic
        mapper.insertStudent(student);
    }
}
```

```xml
<bean id="studentMapper" class="com.mybatis3.dao.StudentMapperImpl">
    <property name="sqlSessionFactory" ref="sqlSessionFactory" />
</bean>
```

In these approaches we are injecting the SqlSession object, getting the Mapper instance, and executing the mapped statements. Here, Spring will take care of providing a thread-safe SqlSession object and close SqlSession once the method is complete.

However, the MyBatis-Spring module provides a better approach, which we will discuss in the next section, where you can inject the Sql Mapper beans directly instead of getting the mappers from SqlSession.
Working with mappers

We can configure the Mapper interface as a Spring bean using `MapperFactoryBean` as follows:

```java
public interface StudentMapper
{
    @Select("select stud_id as studId, name, email, phone from students where stud_id=#{id}"
    Student findStudentById(Integer id);
}

<bean id="studentMapper" class="org.mybatis.spring.mapper.
MapperFactoryBean">
    <property name="mapperInterface" value="com.mybatis3.mappers.
StudentMapper" />
    <property name="sqlSessionFactory" ref="sqlSessionFactory" />
</bean>

Now the StudentMapper bean can be injected into any Spring bean and can invoke the mapped statement methods as follows:

```java
public class StudentService
{
    private StudentMapper studentMapper;
    public void setStudentMapper (StudentMapper studentMapper)
    {
        this.studentMapper = studentMapper;
    }
    public void createStudent(Student student)
    {
        this.studentMapper.insertStudent(student);
    }
}
```

```xml
<bean id="studentService" class="com.mybatis3.services.
StudentService">
    <property name="studentMapper" ref="studentMapper" />
</bean>
```
Integration with Spring

Configuring each Mapper interface individually is a tedious process. Instead of configuring each mapper separately, we can use `MapperScannerConfigurer` to scan packages for the Mapper interfaces and register them automatically.

```xml
<bean class="org.mybatis.spring.mapper.MapperScannerConfigurer">
    <property name="basePackage" value="com.mybatis3.mappers" />
</bean>
```

If the Mapper interfaces are in different packages, you can specify a comma-separated list of package names for the `basePackage` attribute.

MyBatis-Spring-1.2.0 introduced two new ways for scanning the Mapper interfaces:

- Using the `<mybatis:scan/>` element
- Using the `@MapperScan` annotation (requires Spring 3.1+)

`<mybatis:scan/>`

The `<mybatis:scan>` element will search for Mapper interfaces in the specified comma-separated list of package names. To use this new MyBatis-Spring namespace you need to add the following schema declarations:

```xml
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:mybatis="http://mybatis.org/schema/mybatis-spring"
       xsi:schemaLocation="http://www.springframework.org/schema/beans
                           http://www.springframework.org/schema/beans/spring-beans.xsd
                           http://mybatis.org/schema/mybatis-spring
                           http://mybatis.org/schema/mybatis-spring.xsd">
    <mybatis:scan base-package="com.mybatis3.mappers" />
</beans>
```

The `<mybatis:scan>` element provides the following attributes, which can be used to customize the scanning process:

- `annotation`: The scanner will register all the interfaces in the base package that also have the specified interface class as a parent.
- `factory-ref`: Specifies which `SqlSessionFactory` to use in case there is more than one in the spring context. Usually this is only needed when you have more than one datasource.
- `marker-interface`: The scanner will register all the interfaces in the base package that also have the specified annotation.
• template-ref: Specifies which SqlSessionTemplate to use in case there is more than one in the spring context. Usually this is only needed when you have more than one datasource.

• name-generator: It is the fully-qualified class name of BeanNameGenerator to be used for naming the detected components.

@MapperScan
The Spring framework 3.x+ provides Java-based configurations using the @Configuration and @Bean annotations. If you prefer a Java-based configuration then you can use the @MapperScan annotation to scan for Mapper interfaces. @MapperScan works in the same way as <mybatis:scan/> and also provides all of its customization options as annotation attributes.

```java
@Configuration
@MapperScan("com.mybatis3.mappers")
public class AppConfig {

    @Bean
    public DataSource dataSource() { 
        return new PooledDataSource("com.mysql.jdbc.Driver", 
            "jdbc:mysql://localhost:3306/elearning", "root", "admin");
    }

    @Bean
    public SqlSessionFactory sqlSessionFactory() throws Exception { 
        SqlSessionFactoryBean sessionFactory = new SqlSessionFactoryBean(); 
        sessionFactory.setDataSource(dataSource()); 
        return sessionFactory.getObject();
    }
}
```

The @MapperScan annotation has the following attributes for customizing the scanning process:

• annotationClass: The scanner will register all the interfaces in the base package that also have the specified annotation.

• markerInterface: The scanner will register all the interfaces in the base package that also have the specified interface class as a parent.

• sqlSessionFactoryRef: Specifies which SqlSessionFactory to use in case there is more than one in the spring context.
Integration with Spring

- **sqlSessionTemplateRef**: Specifies which SqlSessionTemplate to use in case there is more than one in the spring context.
- **nameGenerator**: The BeanNameGenerator class is to be used for naming the detected components within the Spring container.
- **basePackageClasses**: A type-safe alternative to basePackages() for specifying the packages to scan for annotated components. The package of each class specified will be scanned.
- **basePackages**: Base packages to scan for MyBatis interfaces. Note that only interfaces with at least one method will be registered; concrete classes will be ignored.

Injecting mappers is a preferred approach for injecting SqlSession beans because it removes the dependency on MyBatis API from the Java code.

Transaction management using Spring

Using plain MyBatis, you need to write the code for transaction handling, such as committing or rolling back the database operations.

```java
public Student createStudent(Student student) {
    SqlSession sqlSession = MyBatisUtil.getSqlSessionFactory().openSession();
    try {
        StudentMapper mapper = sqlSession.getMapper(StudentMapper.class);
        mapper.insertAddress(student.getAddress());
        mapper.insertStudent(student);
        sqlSession.commit();
        return student;
    } catch (Exception e) {
        sqlSession.rollback();
        throw new RuntimeException(e);
    } finally {
        sqlSession.close();
    }
}
```
Instead of writing this boiler plate for each method, we can use the Spring's annotation-based transaction-handling mechanism.

To be able to utilize the Spring's transaction management capabilities, we should configure the `TransactionManager` bean in Spring application context.

```xml
<bean id="transactionManager" class="org.springframework.jdbc.datasource.DataSourceTransactionManager">
    <property name="dataSource" ref="dataSource" />
</bean>
```

The `dataSource` reference for the transaction manager should be the same `dataSource`, which is used for the `SqlSessionFactory` bean.

Enable the annotation-based transaction management feature in Spring as follows:

```xml
<tx:annotation-driven transaction-manager="transactionManager"/>
```

Now you can annotate the Spring service beans with the `@Transactional` annotation, indicating that each method in this service should run within a transaction. Spring will commit the operation if the method is completed successfully and will rollback if any runtime exception occurs. Also, Spring will take care of converting MyBatis Exceptions into appropriate `DataAccessExceptions`, thereby providing additional details on specific error conditions.

```java
@Service
@Transactional
public class StudentService
{
    @Autowired
    private StudentMapper studentMapper;

    public Student createStudent(Student student)
    {
        studentMapper.insertAddress(student.getAddress());
        if(student.getName().equalsIgnoreCase(""))
        {
            throw new RuntimeException("Student name should not be empty.");
        }
        studentMapper.insertStudent(student);

        return student;
    }
}
```
The following is the complete configuration of Spring's `applicationContext.xml`:

```
<beans>

    <context:annotation-config />

    <context:component-scan base-package="com.mybatis3" />

    <context:property-placeholder
    location="classpath:application.properties" />

    <tx:annotation-driven transaction-manager="transactionManager"/>

    <bean id="transactionManager" class="org.springframework.jdbc.datasource.
    DataSourceTransactionManager">
        <property name="dataSource" ref="dataSource" />
    </bean>

    <bean class="org.mybatis.spring.mapper.MapperScannerConfigurer">
        <property name="basePackage" value="com.mybatis3.mappers" />
    </bean>

    <bean id="sqlSession" class="org.mybatis.spring.SqlSessionTemplate">
        <constructor-arg index="0" ref="sqlSessionFactory" />
    </bean>

    <bean id="sqlSessionFactory" class="org.mybatis.spring.SqlSessionFactoryBean">
        <property name="dataSource" ref="dataSource" />
        <property name="typeAliases" value="com.mybatis3.domain.Student,
            com.mybatis3.domain.Tutor"/>
        <property name="typeAliasesPackage" value="com.mybatis3.domain"/>
        <property name="typeHandlers" value="com.mybatis3.typehandlers.PhoneTypeHandler"/>
        <property name="typeHandlersPackage" value="com.mybatis3.typehandlers"/>
        <property name="mapperLocations" value="classpath*:com/mybatis3/**/*.xml" />
    </bean>

    <bean id="dataSource" class="org.springframework.jdbc.datasource.
    JdbcObjectFactory">
```


Now let us write a standalone test client for testing StudentService as follows:

```java
@RunWith(SpringJUnit4ClassRunner.class)
@ContextConfiguration(locations="classpath:applicationContext.xml")
public class StudentServiceTest {

    @Autowired
    private StudentService studentService;

    @Test
    public void testCreateStudent() {
        Address address = new Address(0, "Quaker Ridge Rd.", "Bethel", "Brooklyn", "06801", "USA");

        Student stud = new Student();
        long ts = System.currentTimeMillis();
        stud.setName("stud_"+ts);
        stud.setEmail("stud_"+ts+"@gmail.com");
        stud.setAddress(address);
        Student student = studentService.createStudent(stud);
        assertNotNull(student);
        assertEquals("stud_"+ts, student.getName());
        assertEquals("stud_"+ts+"@gmail.com", student.getEmail());
        System.err.println("CreatedStudent: "+student);
    }

    @Test(expected=DataAccessException.class)
    public void testCreateStudentForException() {
        Address address = new Address(0, "Quaker Ridge Rd.", "Bethel", "Brooklyn", "06801", "USA");

        Student stud = new Student();
        long ts = System.currentTimeMillis();
        stud.setName("Timothy");
        stud.setEmail("timothy@gmail.com");
        stud.setAddress(address);
        Student student = studentService.createStudent(stud);
        assertNotNull(student);
        assertEquals("timothy", student.getName());
        assertEquals("timothy@gmail.com", student.getEmail());
        System.err.println("CreatedStudent: "+student);
    }
}
```
Integration with Spring

    stud.setEmail("stud_"+ts+"@gmail.com");
    stud.setAddress(address);
    studentService.createStudent(stud);
    fail("You should not reach here");
}
}

Here in the testCreateStudent() method, we are giving proper data, so both the Address and Student records should be inserted into the ADDRESSES and STUDENTS tables. In the testCreateStudentForException() method we are setting Name to Timothy, which is already in the database. So when you try to insert this student record into the database, MySQL throws an exception as there is a UNIQUE KEY constraint on the NAME column. Spring will convert that exception into DataAccessException and the record inserted into the ADDRESSES table will also be rolled back.

Summary

In this chapter we learned how to integrate MyBatis with the Spring framework. We also learned how to install the Spring libraries and register the MyBatis beans in Spring ApplicationContext. We saw how to configure and inject the SqlSession and Mapper beans and invoke the mapped statements. We also learned how to utilize Spring’s annotation-based transaction-handling mechanism with MyBatis.

You have finished reading this book, congratulations! By now, you should know how to use MyBatis effectively to work with databases. You learned how to be more productive with MyBatis by leveraging your Java and SQL skills. You know how to write database persistence code using MyBatis in a much cleaner way, leaving all the low-level details to be handled by the MyBatis framework. In addition, you learned how to use MyBatis with the most popular dependency injection framework, Spring.

The MyBatis framework is very easy to work with, yet it provides powerful features, thereby making it a good database persistence solution for the Java-based projects. MyBatis also provides tools such as MyBatis Generator (http://www.mybatis.org/generator/), which can be used to generate the persistence code artifacts such as database entities, Mapper interfaces, and Mapper XML files, from an existing database schema, which comes in very handy to start with MyBatis. Also, MyBatis has sister projects such as MyBatis.NET and MyBatis-Scala, providing the same powerful features for the .NET and Scala programming languages.

MyBatis is getting better and better with each release, with lots of new features. To learn more about these new features, you can visit the official MyBatis website at https://code.google.com/p/mybatis/. It is a good idea to subscribe to the MyBatis user mailing list. We wish you all the best, and happy coding!
Symbols

@Alias annotation 33
<association> element 61
<collection> element 64
@Delete annotation 86
@DeleteProvider 97
<foreach> element 71
@Insert annotation 84
@Insert mapped statement 84
@InsertProvider 96
@Many annotation 90, 91
@MapperScan annotation about 106, 107
annotationClass 108
basePackageClasses 108
basePackages 108
markerInterface 107
nameGenerator 108
sqlSessionFactoryRef 107
sqlSessionTemplateRef 108

<mapper> tag attribute
class attribute 39
package element 39
resource attribute 38
url attribute 38

<mybatis$scan> element
annotation 106
factory-ref 106
marker-interface 106
name-generator 107
template-ref 107

@Options annotation 84
<resultMap> element 87
@Results annotation 86, 87
<result> subelement 57

@Select annotation 86
@SelectKey annotation 85
<selectKey> subelement 52
@SelectProvider used, for creating SELECT mapped statement 92
<select> statement 57
<trim> element 70
@Update annotation 85
@UpdateProvider 97
<where> element 70

A

annotationClass 108
annotation 106
annotation-based configuration options 84
Aspect Oriented Programming (AOP) 99
autogenerated keys 51, 84, 85
auto_increment column value 84

B

basePackage attribute 106
basePackageClasses 108
before=true attribute 85
BLOB types handling 74, 75

cache

eviction attribute 80
flushInterval attribute 80
global second-level caches, adding 79
readOnly attribute 80
size attribute 80
choose condition 68
class attribute 39
CLOB types
   handling 74, 75
configLocation 102

data
   caching 79
data access layer 99
dataSource reference 102, 109
DataSource, types
   JNDI DataSource 40
   POOLED DataSource 30, 40
   UNPOOLED DataSource 30, 40
DELETE mapped statement
   about 53, 86
   sqlSession.delete() method 53
DELETE queries
   creating, @DeleteProvider used 97
delete statement 53
deleteStudent() method 86
dependency injection 99
Domain Model
   sample 24
Dynamic SQL
   about 92
      choose condition 68
      foreach loop 71, 72
      If condition 67, 68
      otherwise condition 68
      parameters 93
      set condition 72
      trim condition 70
      when condition 68
      where condition 69

e-mail attribute 34
enumeration types
   handling 73
environment 29, 30
environment object 40
eviction attribute 80

example code
   URL, downloading 9

F

factory-ref 106
findAllStudents() method 87
findCoursesByTutorId() method 90
findCoursesByTutor statement 66
findStudentById mapped statement 48
findStudentById statement
   invoking 54
findStudentBy() method 87
findTutorById(int) method 94
findTutorByIdSql(int) method 94
findTutorByIdSql() method 92
flushInterval attribute 80
foreach loop 71, 72

H

handleResult() method 79

I

iBATIS
   about 7
   migrating, to MyBatis 7
If condition 67, 68
INSERT mapped statement
   about 50
      autogenerated keys 51
      sqlSession.insert() method 50
INSERT queries
   creating, @InsertProvider used 96
INSERT statement 85
insertStudent mapped statement 51
insertStudent() method 84

J

Java DataBase Connectivity (JDBC) 8
Java project
   creating 15, 17
   developing 15
   mybatis-3.2.2.jar, adding to classpath 15, 17
java.util.Map parameter type 94
JdbcTransactionFactory 41
JDBC transaction manager 30
JNDI DataSource 40
JUnit JAR file
  URL, for downloading 16
JUnit test
creating, to test StudentService 22, 23

K
keyProperty attribute 84, 85

M
ManagedTransactionFactory 41
MANAGED transaction manager 31
mapped interfaces
  annotations used 84
mapped statements
  @Insert mapped statement 84
  about 84
  DELETE mapped statement 53, 86
  INSERT mapped statement 50
  SELECT mapped statement 54, 86
  UPDATE mapped statement 52, 85
mapperLocations 102
mappers
  @MapperScan annotation 107
  <mybatis$scan> element 106
  about 38, 39, 43, 44, 105
  interface 48, 49
  XML 48, 49
marker-interface 106
Maven
  URL, for downloading 101
Maven build tool
  used, for configuring MyBatis 100, 101
multiple input parameters
  passing 77
multiple results
  as map 77
MyBatis
  about 7
  beans, configuring 101, 102
  BLOB types, handling 74, 75
  CLOB types, handling 74, 75
  configuring, in Spring application 99
configuring, Maven build tool used 100, 101
  enumeration types, handling 73, 74
  features 8-13
  Guice frameworks supported 13
  JAR dependencies, configuring 15-17
  Java project, creating 15-17
  JDBC boilerplate code, eliminations 8-11
  JUnit test, creating to test StudentService 22, 23
  learning curve, low 12
  legacy databases 12
  migration from, iBATIS 7
  multiple input parameters, passing 76, 77
  multiple results, as map 77
  mybatis-config.xml configuration file,
    creating 17, 18
  MyBatisSqlSessionFactory singleton class,
    creating 19
  performance 13
  ResultSet processing, ResultSetHandler
    used 78, 79
  ResultSets paginated, RowBounds used 77
  sample data, inserting 15
  Spring integration supported 13
  SQL 12
  StudentMapper interface, creating 20, 22
  StudentMapper.xml configuration file,
    creating 17, 18
  StudentService classes, creating 20-22
  STUDENTS table, creating 15
  third-party cache libraries integration
    supported 13
  used, for developing Java project 14
  used, for implementing preceding methods 11, 12
  website, URL 81, 112
mybatis-3.2.2. jar
  adding, to classpath 15
MyBatis configuration, Java API used
  about 39
  DataSource, types 40
  environment object 40
  mappers 43
  settings 43
  SqlSessionFactory object, creating 39
  TransactionFactory, types 41
typeAliases 42
typeHandlers 42
MyBatis configuration, XML used
about 27, 28
dataSource element 30
dataSource types 30
environment 29, 30
mappers 38
MyBatis global settings 38
properties configuration element 31, 32
transaction managers, types 30, 31
typeAliases 32, 33
typeHandlers 34
mybatis-config.xml configuration file
about 27
creating 17, 18
MyBatis distribution
URL, for downloading 15
MyBatis Generator
URL 112
MyBatis Logging
customizing 44
MyBatisSqlSessionFactory singleton class
creating 19

N
nameGenerator 107, 108
nested ResultMap
used, for one-to-many mapping 64, 65
nested select
used, for one-to-many mapping 65, 66
Nested-Select statement 90

O
OGNL (Object Graph Navigation Language) expressions 68
one-to-many mapping 90, 91
one-to-many mapping, ResultMaps
about 63, 64
nested ResultMap used 64, 65
nested select used 65, 66
one-to-one mapping 88, 89

one-to-one mapping, ResultMaps
about 59, 61
nested ResultMap used 61, 62
nested select used 62, 63
otherwise condition 68

P
package element 39
parameterType attribute 32, 50
phoneNumber property 35
plain old Java object (POJO) 99
POOLED DataSource 30, 40
PreparedStatement interface 34
properties configuration element 31, 32
ps.setString() method 37

R
readOnly attribute 80
resource attribute 38
resultMap attribute 88
result maps
about 86, 87
one-to-many mapping 90, 91
one-to-one mapping 88, 89
ResultMaps
about 56
extending 58
one-to-many mapping 63, 64
one-to-many mapping, nested ResultMap used 64, 65
one-to-many mapping, nested select used 65, 66
one-to-one mapping 59, 61
one-to-one mapping, nested ResultMap used 61, 62
one-to-one mapping, nested Select used 62, 63
simple 56, 57
ResultSets
paginated, RowBounds used 77
processing, ResultSetHandler used 78
resultType attribute 32, 54
rs.getString() method 37
SELECT mapped statement
about 54, 86
creating, @SelectProvider used 92
findAllStudents statement 55
findStudentById statement, invoking 54
resultType attribute 54
select query, configuring 54
sqlSession.selectOne() method 54
studId property 54
set condition 72
setDate() method 34
setInt() method 35
setString() method 34
settings 38
size attribute 80
Spring application
MyBatis, configuring in 99
used, for managing transaction 108-112
SQL 12, 13
SqlSession 103, 104
sqlSession.delete() method 53
SqlSessionFactory interface 39
SqlSessionFactory object
about 23, 27, 102
configLocation 102
dataSource 102
mapperLocations 102
typeAliases 102
typeAliasesPackage 102
typeHandlers 102
typeHandlersPackage 102
sqlSessionFactoryRef 107
sqlSession.insert() method 50
sqlSession.select() method 78
sqlSession.selectOne() method 54
sqlSessionTemplateRef 108
sqlSession.update() method 52
SQL utility 93
StudentMapper bean 105
StudentMapper interface
about 49
creating 20, 22
StudentMapper.xml configuration file
creating 17, 18
Student object 85
StudentService classes
creating 20, 22
testing, by JUnit test creation 22, 23
studId property 54, 84

template-ref 107
testCreateStudentForException() method 112
testCreateStudent() method 112
transaction
managing, Spring used 108-112
TransactionFactory 41
TransactionManager 31
TransactionManager bean 109
trim condition 70
typeAliases 32, 33, 102
typeAliasesPackage 102
typeHandlers 34, 102
typeHandlersPackage 102
UNIQUE KEY constraint 112
UNPOOLED DataSource 30, 40
UPDATE mapped statement
about 52, 85
sqlSession.update() method 52
UPDATE queries
creating, @UpdateProvider used 97
updateStudent() method 85
url attribute 38
when condition 68
where condition 69
Thank you for buying
Java Persistence with MyBatis 3

About Packt Publishing
Packt, pronounced 'packed', published its first book "Mastering phpMyAdmin for Effective MySQL Management" in April 2004 and subsequently continued to specialize in publishing highly focused books on specific technologies and solutions.

Our books and publications share the experiences of your fellow IT professionals in adapting and customizing today's systems, applications, and frameworks. Our solution based books give you the knowledge and power to customize the software and technologies you're using to get the job done. Packt books are more specific and less general than the IT books you have seen in the past. Our unique business model allows us to bring you more focused information, giving you more of what you need to know, and less of what you don't.

Packt is a modern, yet unique publishing company, which focuses on producing quality, cutting-edge books for communities of developers, administrators, and newbies alike. For more information, please visit our website: www.packtpub.com.

About Packt Open Source
In 2010, Packt launched two new brands, Packt Open Source and Packt Enterprise, in order to continue its focus on specialization. This book is part of the Packt Open Source brand, home to books published on software built around Open Source licences, and offering information to anybody from advanced developers to budding web designers. The Open Source brand also runs Packt's Open Source Royalty Scheme, by which Packt gives a royalty to each Open Source project about whose software a book is sold.

Writing for Packt
We welcome all inquiries from people who are interested in authoring. Book proposals should be sent to author@packtpub.com. If your book idea is still at an early stage and you would like to discuss it first before writing a formal book proposal, contact us; one of our commissioning editors will get in touch with you.

We're not just looking for published authors; if you have strong technical skills but no writing experience, our experienced editors can help you develop a writing career, or simply get some additional reward for your expertise.
Spring Persistence with Hibernate
Build robust and reliable persistence solutions for your enterprise Java application

1. Get to grips with Hibernate and its configuration manager, mappings, types, session APIs, queries, and much more
2. Integrate Hibernate and Spring as part of your enterprise Java stack development
3. Work with Spring IoC (Inversion of Control), Spring AOP, transaction management, web development, and unit testing considerations and features

OSWorkflow
ISBN: 978-1-84719-152-6 Paperback: 212 pages
A guide for Java developers and architects to integrating open-source Business Process Management

1. Basics of OSWorkflow
2. Integrating business rules with Drools
3. Task scheduling with Quartz

Please check www_PACKtPub.com for information on our titles
Spring 2.5 Aspect Oriented Programming
Create dynamic, feature-rich, and robust enterprise applications using the Spring framework

1. Master Aspect-Oriented Programming and its solutions to implementation issues in Object-Oriented Programming
2. A practical, hands-on book for Java developers rich with code, clear explanations, and interesting examples
3. Includes Domain-Driven Design and Test-Driven Development of an example online shop using AOP in a three-tier Spring application

Spring Data
Implement JPA repositories and harness the performance of Redis in your applications

1. Implement JPA repositories with lesser code
2. Includes functional sample projects that demonstrate the described concepts in action and help you start experimenting right away
3. Provides step-by-step instructions and a lot of code examples that are easy to follow and help you to get started from page one

Please check www.PacktPub.com for information on our titles