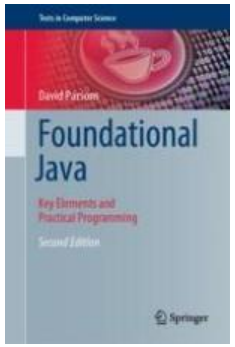


Chapter 2
Compiling and Running Java Programs

Foundational Java

Key Elements and Practical Programming

Objectives

- Gain an understanding of the Java compiler and runtime environment
- Learn how to use packages and the classpath
- Learn to use Java from the command line
- Gain some experience with the Eclipse Java Integrated Development environment (IDE)

Java From the Command Line

- For our first couple of examples we will be compiling and running our Java code from the command line
- Useful to at least get some idea of what is happening in the background when you use a Java IDE
- Understand what happens when
  - code is compiled
  - how it is run
  - how packages and the Java classpath relate to the file system
- Can help to solve problems in development and deployment

Java Environment

- Check that the **path** environment variable includes the JDK's bin folder (not the JRE's bin folder!)
- On Windows systems, the default location is usually something like:

```
C:\Program Files\Java\jdk-14\bin
```

- We have to be aware of the classpath variable too
  - Can be set as an environment variable and/or in a command window

Setting the Windows Path

- The path can be set either permanently as an environment variable or temporarily in a command window using “set path”, for example:

```
set path=C:\Program Files\Java\jdk-14\bin;%path%
```

- Including the reference to %path% is not essential but will append any existing path settings you already have.

A First Java Program

- Here is a simple Java program

```
public class MyJavaProgram
{
  public static void main(String[] args)
  {
    System.out.println("My Java Program Running!");
  }
}
```

- Let's dissect it…

The Class Declaration

- The first line of code (after the comment header) declares the class

```
public class MyJavaProgram
```

  - No Java code can be written that does not belong to one class or another.
- The naming conversion for class names is *Pascal Case*
- The ‘public’ prefix means that the class can be visible to all other classes, even those that are not in the same *package*.
- We are not specifying which package this class is in, so it will be put into the unnamed *default package*

The Java File

- The MyJavaProgram class must be saved in a file called ‘MyJavaProgram.java’
  - Same mix of upper- and lower-case letters.
- Create your Java source code
  - Can use any text editor to write your java code
  - Save the file using the .java suffix

Compiling Java

- Check that javac is available on the system path
- From a command window, compile the source code into byte code, using javac
  - i.e. `javac MyJavaProgram.java`
- You must use the full filename, including the '.java' extension.
- If successful (i.e. no error messages) this will produce the file MyJavaProgram.class in the same folder

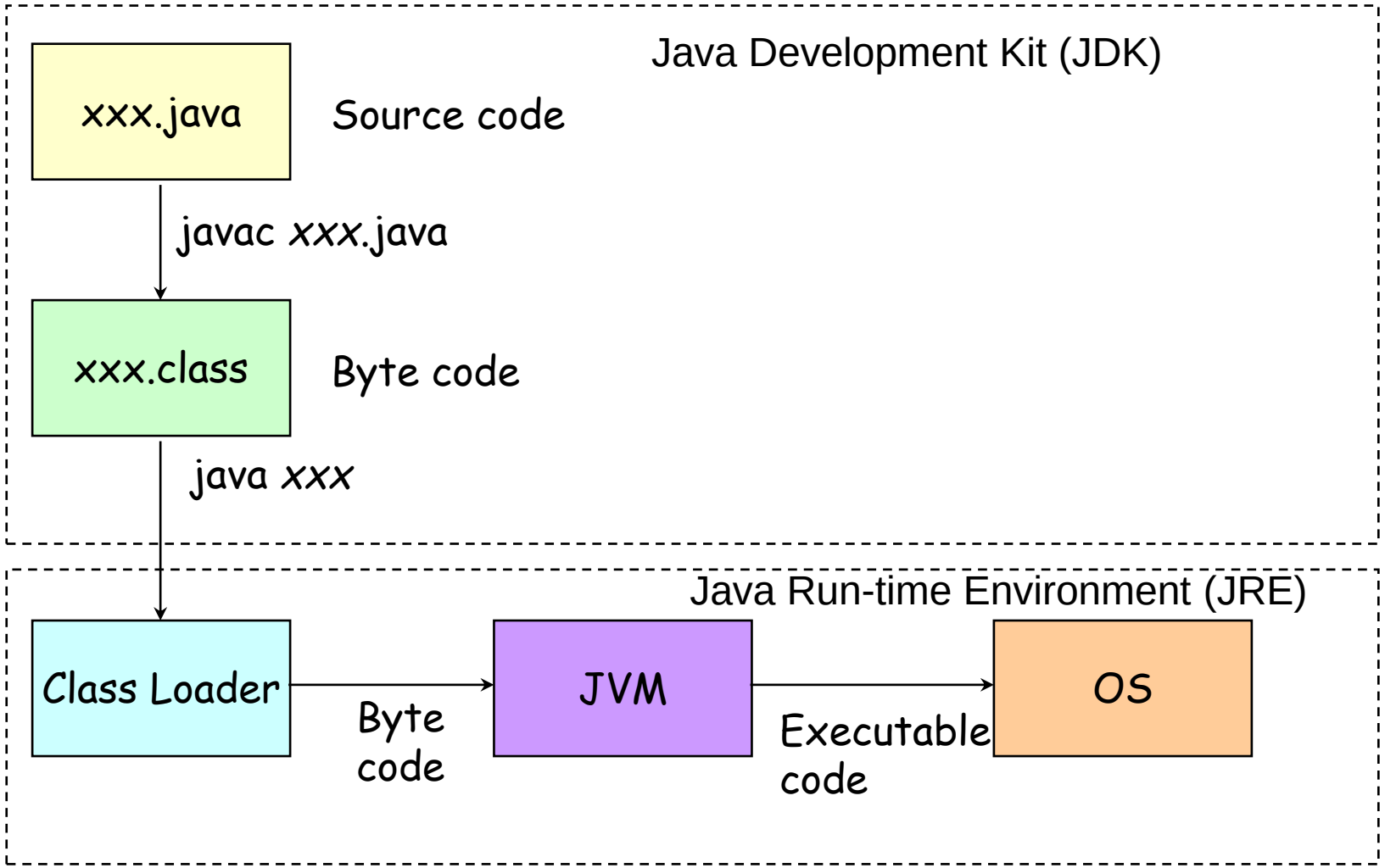
Running Java

- Run the byte code on the JVM (the virtual machine is case sensitive)

```
java MyJavaProgram
```

- The Java Virtual Machine (JVM) runs the class file MyJavaProgram.class
  - But don't use this extension with java.exe
- It must be able to find this file on the classpath
- By default, the classpath is the current directory

Java Build and Run Process



MyJavaProgram Exercise

- Enter the MyJavaProgram class source code into a text editor
- Save it in a file called `MyJavaProgram.java`
- From the source code folder in the command window, type

```
javac MyJavaProgram.java
```

  – This will compile your code
- Fix any errors, and try again
- Run the program by typing

```
java MyJavaProgram
```

The Classpath

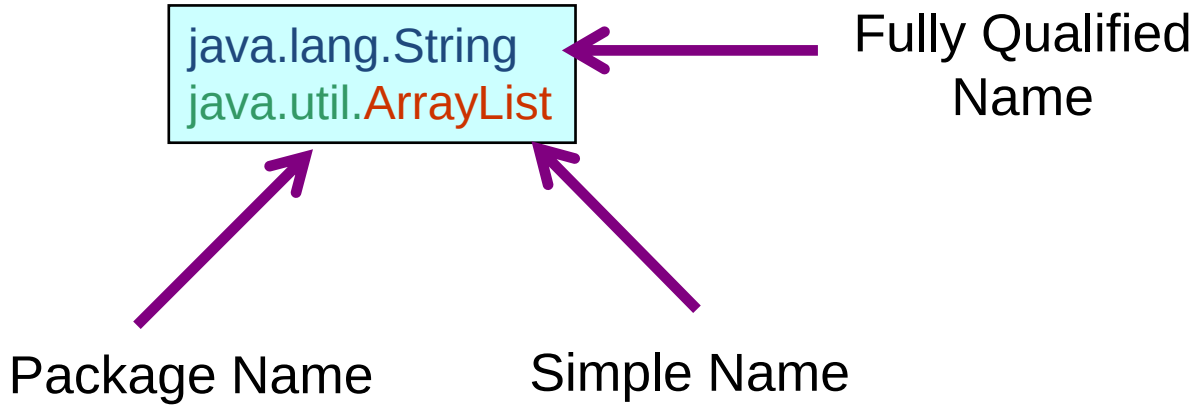
- The Java classpath is what the Java compiler and virtual machine use to find compiled .class files (byte code)
- By default, the classpath is the current directory
  - This is why our example program ran without us being aware of the classpath
  - The JVM found the class file in the current directory
  - However, we can't always work with everything on one directory, so we need to understand how to use packages and the classpath

Packages

- All Java classes are placed in a package, even if it is the default (unnamed) package
- A package is a bundle of classes
  - The classes in a package are typically related by function
- A package is a name space
  - Essential for distinguishing different classes with the same name
- Each class must have a unique name in the package
- Packages are named hierarchically
  - java.lang
  - java.util
  - com.foundjava.examples

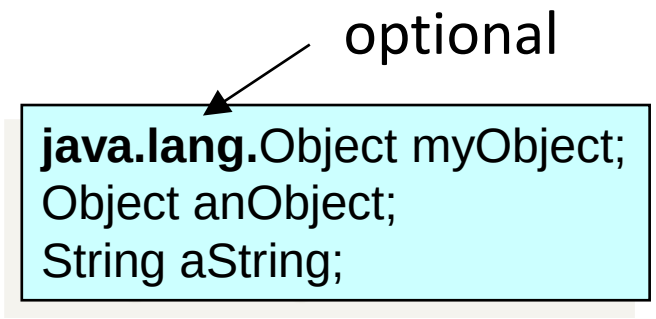
Naming Rules

- Fully qualified class names have two components
  - Package Name
    - all lower case
  - Simple Name
    - Pascal case



java.lang

- Java platform packages begin with ‘java’ or ‘javax’ (Java Extension)
- Core Java types (like Object and String) are found in the java.lang package
  - This package name does not have to be explicitly used



Storing Packages in Directories

- Classes belonging to the same package are stored in the same directory
  - The directory is named after the package
- Periods in the package name are replaced by directory separators
- e.g. a class in com\foundjava\examples would be in the com.foundjava.examples package
- The Java source can be anywhere
  - It's the compiled class files that must be in the folder that matches their package

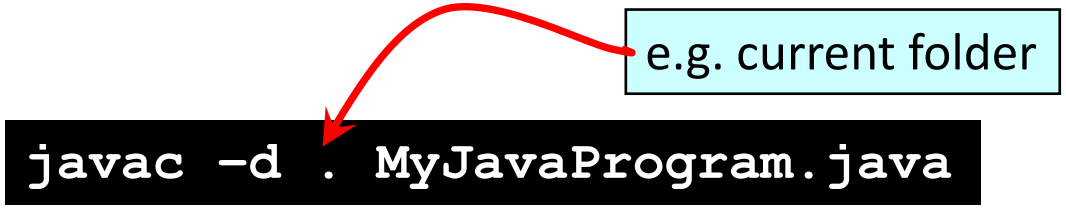
Specifying the Package of a Class

- To specify the package that a class belongs to, use the “package” keyword followed by the name of the package
  - Place this information on the first line of the file
  - Ends with a semicolon
- A class can only belong to one package
  - If no package is specified, the “default” package is used (the current folder)

```
package com.foundjava.examples;
public class MyJavaProgram
{…
```

Compiling into a package

- By default, the Java compiler puts class files in the same folder as the Java source
  - This is only OK if the Java source is in a folder that matches its package name
- Otherwise, use the –d option on the Java compiler



  - This builds the package folder structure from the given directory

Classpath and Directories

- The classpath must start from the root of the package structure
  - This may not be the root of the drive
- For example, if the package is com.foundjava.examples, in this folder structure:
  - C:\javacode\com\foundjava\examples
- Then the classpath must start in the javacode folder:

```
SET CLASSPATH=C:\javacode
```

Running the Class

- The full name of a Java class is its package name followed by the class name, e.g.
  - com.foundjava.examples.MyJavaProgram
- When you run Java programs you must use the full name of a class with a main method, e.g.

```
java com.foundjava.examples.MyJavaProgram
```

Comments

- C style:

```
/*
 * Anything between the
 * slash-star and star-slash
 * is a comment
 */
```

- C++ style

```
//single line comments
```

- Javadoc
  - Use as class headers and method descriptions

```
/**
 * Anything between the
 * slash-star-star and star-slash
 * is a documentation comment
 */
```

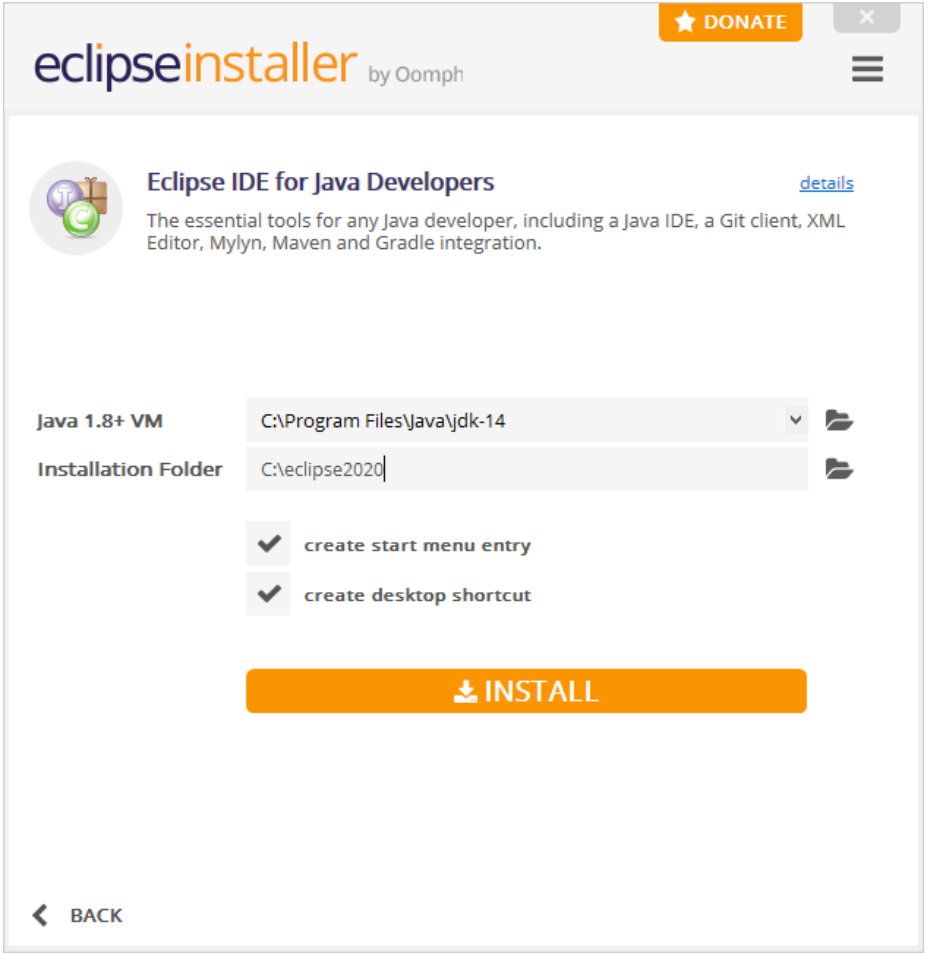
Exercise

- This exercise simply draws together the steps in the previous example:
- Make a copy of your MyJavaProgram class.
- Rename both the class and the file “MySecondProgram.”
- Add an appropriate package statement to the top of the source file (use the reverse URL convention for the package name).
- Add a Javadoc comment block immediately above the class declaration, and a single line comment within the body of the main method.
- Change the message in System.out.println so you can be certain which class you are running.
- Compile the class with the –d option to create the package folder structure.
- Set the classpath on the command line (or as a system variable).
- Run the program (remember you need the fully qualified class name).

Using the Eclipse Integrated Development Environment (IDE)

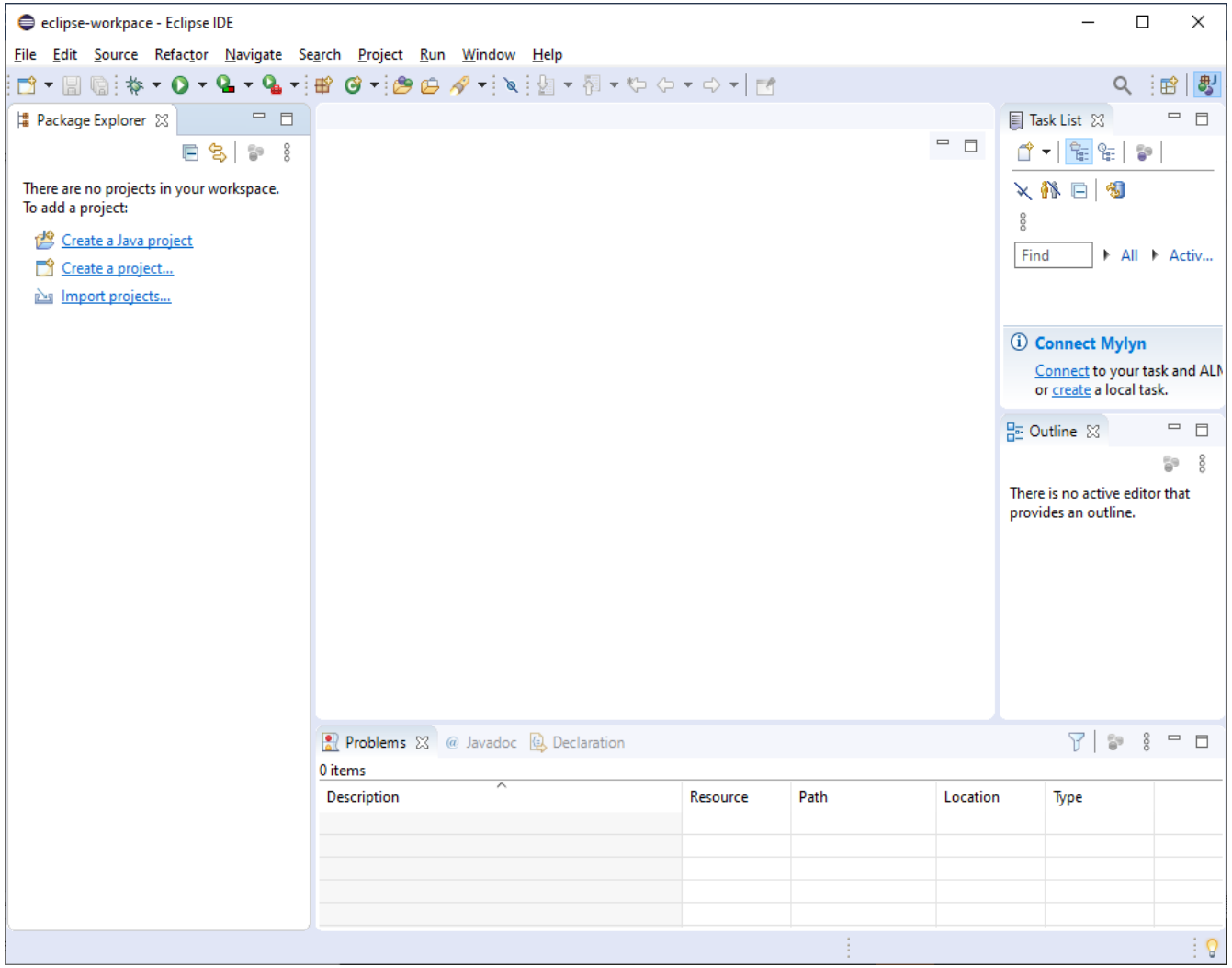
- The Eclipse IDE can be freely downloaded from the “eclipse.org” website
- The version use for the example in this book is the “Eclipse IDE for Java Developers”. Installing Eclipse is very easy. You only need to down-load the installer file and run it
- When the installer starts up it will show a list of language options, so you should choose “Eclipse IDE for Java Developers”

Installing Eclipse



The Java Perspective

If you need to restore this default perspective layout at any point, select “Window” → Perspective” → “Reset Perspective…”



Using Eclipse

- Now we will rewrite the previous example using tools within the Eclipse IDE
  - Create a Java project
  - Add a new package
  - Add the class to the package with a ‘main’ method
  - Add the required code to the main method
  - Save the file (automatically compiles)
  - Run the class