

8.9 enum Types

In Fig. 6.8, we introduced the basic `enum` type, which defines a set of constants represented as unique identifiers. In that program the `enum` constants represented the game's status. In this section we discuss the relationship between `enum` types and classes. Like classes, all `enum` types are *reference* types. An `enum` type is declared with an `enum declaration`, which is a comma-separated list of `enum constants`—the declaration may optionally include other components of traditional classes, such as constructors, fields and methods (as you'll see momentarily). Each `enum` declaration declares an `enum class` with the following restrictions:

1. `enum` constants are *implicitly final*.
2. `enum` constants are *implicitly static*.
3. Any attempt to create an object of an `enum` type with operator `new` results in a compilation error.

The `enum` constants can be used anywhere constants can be used, such as in the `case` labels of `switch` statements and to control enhanced `for` statements.

Declaring Instance Variables, a Constructor and

Methods in an enum Type

Figure 8.10 demonstrates instance variables, a constructor and methods in an `enum` type. The `enum` declaration contains two parts—the `enum` constants and the other members of the `enum` type.

```
1 // Fig. 8.10: Book.java
2 // Declaring an enum type with a constructor and
3 // and accessors for these fields
4
5 public enum Book {
6     // declare constants of enum type
7     JHTP("Java How to Program", "2018"),
8     CHTP("C How to Program", "2016"),
9     IW3HTP("Internet & World Wide Web How to Prog
10    CPPHTP("C++ How to Program", "2017"),
11    VBHTP("Visual Basic How to Program", "2014"),
12    CSHARPHTP("Visual C# How to Program", "2017")
13
14     // instance fields
15    private final String title; // book title
16    private final String copyrightYear; // copyri
17
18     // enum constructor
19    Book(String title, String copyrightYear) {
20        this.title = title;
21        this.copyrightYear = copyrightYear;
22    }
23
24     // accessor for field title
25    public String getTitle() {
26        return title;
27    }
28
29     // accessor for field copyrightYear
30    public String getCopyrightYear() {
```

```
31         return copyrightYear;
32     }
33 }
```

Fig. 8.10

Declaring an `enum` type with a constructor and explicit instance fields and accessors for these fields.

The first part (lines 7–12) declares six constants. Each is optionally followed by arguments that are passed to the `enum constructor` (lines 19–22). Like the constructors in classes, an `enum` constructor can specify any number of parameters and can be overloaded. In this example, the `enum` constructor requires two `String` parameters—one that specifies the book’s title and one that specifies its copyright year. To properly initialize each `enum` constant, we follow it with parentheses containing two `String` arguments.

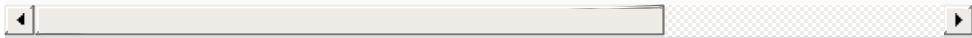
The second part (lines 15–32) declares the `enum` type’s other members—instance variables `title` and `copyrightYear` (lines 15–16), a constructor (lines 19–22) and two methods (lines 25–27 and 30–32) that return the book title and copyright year, respectively. Each `enum` constant in `enum` type `Book` is an object of `enum` type `Book` that has its own copy of instance variables.

Using enum type Book

Figure 8.11 tests the `Book` enum and illustrates how to iterate through a range of its constants. For every enum, the compiler generates the `static` method `values` (called in line 10), which returns an array of the enum's constants in the order they were declared. Lines 10–13 display the constants. Line 12 invokes the enum `Book`'s `getTitle` and `getCopyrightYear` methods to get the title and copyright year associated with the constant. When an enum constant is converted to a `String` (e.g., `book` in line 11), the constant's identifier is used as the `String` representation (e.g., `JHTP` for the first enum constant).

```
1  // Fig. 8.11: EnumTest.java
2  // Testing enum type Book.
3  import java.util.EnumSet;
4
5  public class EnumTest {
6      public static void main(String[] args) {
7          System.out.println("All books:");
8
9          // print all books in enum Book
10         for (Book book : Book.values()) {
11             System.out.printf("%-10s%-45s%s%n", boo
12                 book.getTitle(), book.getCopyrightYe
13                     }
14
15         System.out.printf("\nDisplay a range of en
16
17         // print first four books
18         for (Book book : EnumSet.range(Book.JHTP,
19             System.out.printf("%-10s%-45s%s%n", boo
20                 book.getTitle(), book.getCopyrightYe
```

```
21      }
22      }
23  }
```



All books:



JHTP	Java How to Program	2018
CHTP	C How to Program	2016
IW3HTP	Internet & World Wide Web How to Program	2012
CPPHTP	C++ How to Program	2017
VBHTP	Visual Basic How to Program	2014
CSHARPHTP	Visual C# How to Program	2017

Display a range of enum constants:



JHTP	Java How to Program	2018
CHTP	C How to Program	2016
IW3HTP	Internet & World Wide Web How to Program	2012
CPPHTP	C++ How to Program	2017

Fig. 8.11

Testing `enum` type `Book`.

Lines 18–21 use the `static` method `range` of class `EnumSet` (package `java.util`) to display a range of the `enum Book`'s constants. Method `range` takes two parameters—the first and the last `enum` constants in the range—and returns an `EnumSet` that contains all the constants between these two constants, inclusive. For example, the expression `EnumSet.range(Book.JHTP, Book.CPPHTP)` returns an `EnumSet` containing `Book.JHTP`, `Book.CHTP`, `Book.IW3HTP` and `Book.CPPHTP`. The enhanced `for` statement can be used with an `EnumSet` just as it can with an array, so lines 18–21 use it to display the title and copyright year of every book in the `EnumSet`. Class `EnumSet` provides several other `static` methods for creating sets of `enum` constants from the same `enum` type.



Common Programming Error 8.4

In an `enum` declaration, it's a syntax error to declare `enum` constants after the `enum` type's constructors, fields and methods.