Tutorial of Enum

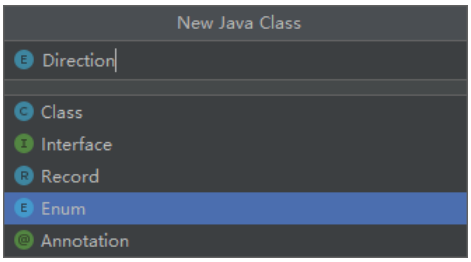
> Based on the tutorial of "2020S-Java-A" designed by teaching group in SUSTech
>
> Modified (only change to markdown file) by ZHU Yueming in 2021. April. 19th
>
> Minor changes by Yida Tao on Nov. 10, 2022

Objective

- Learn to use `enum` types

An `enum` type is a special data type that enables a variable to be a set of predefined constants. The variable must be equal to one of the values that have been predefined for it. For example, a week has seven days (MONDAY to SUNDAY).

A `enum` type is declared using the `enum` keyword. Let's create a new `enum` type `Direction` with four constants named `NORTH`, `SOUTH`, `EAST`, and `WEST`, respectively. In IDEA, creating a new `enum` type is similar to creating a new class. The only difference is to select `Enum` in the dropdown list.



Variables of this `enum` type `Direction` can only receive the values of the four `enum` constants. For example, the following code creates an object of this `enum` type.

```
package lab10;

public enum Direction {
    NORTH, SOUTH, EAST, WEST // semicolon unnecessary
}
```

```
package lab10;

public class DirectionTest {
    public static void main(String[] args) {
        Direction d = Direction.EAST;
        System.out.println(d);
    }
}
```

The above code prints `EAST`. The last statement in the main method is equivalent to `System.out.println(d.toString())`. The `toString()` method returns the name of the`enum` constant EAST.

In the code, we cannot create an object of the `enum` type using the `new` operator with a constructor call. If you compile the following code, you will receive the error message "Enum types cannot be instantiated".

```
Direction d = new Direction();
```

This is because under the hood, every `enum` type is internally implemented using class (the compiler will create a `private` constructor that cannot be called outside the `enum` type).

```
public final class Direction extends Enum {
public static final Direction NORTH = new Direction();
public static final Direction SOUTH = new Direction();
public static final Direction EAST = new Direction();
public static final Direction WEST = new Direction();
} // simplified for illustration
```

From this internal view, we can see that NORTH, SOUTH, EAST, WEST are no more than four class variables pointing to four Direction objects. The `final` modifier makes them constants.

An `enum` type variable can be passed as an argument to a `switch` statement.

```
package lab10;

public class DirectionTest {

  private Direction d;

  public DirectionTest(Direction d) {
    this.d = d;
  }

  public Direction getDirection() {
    return d;
  }

  public static void main(String[] args) {
    DirectionTest test = new DirectionTest(Direction.EAST);
    switch(test.getDirection()) {
      case EAST: // must be unqualified name of the enum constant
        System.out.println("Countries in the east: Japan, Korea");
        break;
      case WEST:
        System.out.println("Countries in the west: US, Germany");
        break;
      case SOUTH:
```

```
            System.out.println("Countries in the south: Australia, New Zealand");
            break;
          case NORTH:
            System.out.println("Countries in the north: Russia, Mongolia");
            break;
        }
      }
    }
```

When declaring an `enum` type, besides the `enum` constants, we can also declare other members such as constructors, fields and methods. A `enum` type constructor can specify any number of parameters and can be overloaded, but it cannot have the access modifier public (must be private or no-modifier, meaning package private).

```
package lab10;

public enum Book {
    JHTP("Java: How to Program", "2012"),
    CHTP("C: How to Program"),
    CPPHTP("C++: How to Program", "2012"),
    VBHTP("Visual Basic: How to Program", "2011"),
    CSHARPHTP("Visual C#: How to Program");

    private final String title;
    private final String year;

    private Book(String title, String year) {
        this.title = title;
        this.year = year;
    }

    private Book(String title) {
        this.title = title;
        this.year = "no info";
    }

    public String getTitle() {
        return title;
    }

    public String getYear() {
        return year;
    }
}
```

In the `enum` type Book, there are two fields: title and year. They are declared to be constants since `enum` type objects only receive predefined constant values (`enum` constants). There are two getter methods. There are two overloaded constructors. The two constructors are used in the declarations of the `enum` constants. For example, when declaring the `enum` constant CHTP, the one-argument constructor is used.

We can further write the following program to test the `enum` type.

```
package lab10;
import java.util.EnumSet;

public class BookTest {
    public static void main(String[] args) {
        System.out.println("All books:");

        for (Book book : Book.values()) {
            System.out.printf("%-10s", book);
            System.out.printf("%-30s", book.getTitle());
            System.out.printf("%s\n", book.getYear());
        }

        System.out.println("\nDisplaying a range of enum constants:");

        for(Book book : EnumSet.range(Book.JHTP, Book.CPPHTP)) {
            System.out.printf("%-10s", book);
            System.out.printf("%-30s", book.getTitle());
            System.out.printf("%s\n", book.getYear());
        }
    }
}
```

The code prints:

```
All books:
JHTP      Java: How to Program          2012
CHTP      C: How to Program             no info
CPPHTP    C++: How to Program           2012
VBHTP     Visual Basic: How to Program  2011
CSHARPHTP Visual C#: How to Program     no info

Displaying a range of enum constants:
JHTP      Java: How to Program          2012
CHTP      C: How to Program             no info
CPPHTP    C++: How to Program           2012
```

In the above example, only five Book objects will be created. The constants such as `Book.JHTP` stores the references to the objects.

The `values()` method is a static method that is automatically generated by the compiler to return an array of the `enum` constants (an array of references to the objects of the `enum` type).

The generic class `EnumSet` has a static method `range()`, which returns a collection of the `enum` constants in the range specified by two endpoints. In the above code, range() takes two `enum` constants as arguments. The first constant should be declared before the second (the ordinal() method of a `enum` constant can return the position of the constant in all declared constants). If this constraint is violated (for example, when

`EnumSet.range(Book.CPPHTP, Book.JHTP)` is used in the code), an `java.lang.IllegalArgumentException` will be thrown.

Exercise

1. Create an `enum` type `PhoneModel`, which contains the following constants: `IPHONE, HUAWEI, PIXEL, SAMSUNG, LG`.
2. Create a field named `price (int type)`. Write a getter method for this field.
3. Create a one-argument constructor `PhoneModel(int price)` that can be used to create the `enum` constants. The prices for the five models are: 9999, 8888,6666, 9399, 5588.
4. Write a test program .It contains a main method that recommends possible phones for a user based on the user's budget.

   Three sample runs:

```
Your budget: 4000
You don't have sufficient money
```

```
Your budget: 8888
HUAWEI          price: 8888
PIXEL           price: 6666
LG              price: 5588
```

```
Your budget: 10000
IPHONE          price: 9999
HUAWEI          price: 8888
PIXEL           price: 6666
SAMSUNG         price: 9399
LG              price: 5588
```