Building Java Programs

Chapter 3
Lecture 3-1: Parameters

reading: 3.1

Redundant recipes

- Recipe for baking **20** cookies:
  - Mix the following ingredients in a bowl:
    - **4** cups flour
    - **1** cup butter
    - **1** cup sugar
    - **2** eggs
    - **40** pounds chocolate chips ...
  - Place on sheet and bake for 10 minutes.
- Recipe for baking **40** cookies:
  - Mix the following ingredients in a bowl:
    - **8** cups flour
    - **2** cups butter
    - **2** cups sugar
    - **4** eggs
    - **80** pounds chocolate chips ...
  - Place on sheet and bake for 10 minutes.

Parameterized recipe

- Recipe for baking **20** cookies:
  - Mix the following ingredients in a bowl:
    - **4** cups flour
    - **1** cup sugar
    - **2** eggs
    - **...**
- Recipe for baking **N** cookies:
  - Mix the following ingredients in a bowl:
    - **N/5** cups flour
    - **N/20** cups butter
    - **N/20** cups sugar
    - **N/10** eggs
    - **2N** bags chocolate chips ...
  - Place on sheet and Bake for about 10 minutes.
- **parameter**: A value that distinguishes similar tasks.

Redundant figures

- Consider the task of drawing the following lines/boxes:

```
*************

*******

***********************************

**********
*        *
**********

*****
*   *
*   *
*****
```


A redundant solution

```
public class LinesAndBoxes1 {
    public static void main(String[] args) {
        drawLineOf13();
        drawLineOf7();
        drawLineOf35();
        drawBox10x3();
        drawBox5x4();
    }

    public static void drawLineOf13() {
        for (int i = 1; i <= 13; i++) {
            System.out.print("*");
        }
        System.out.println();
    }

    public static void drawLineOf7() {
        for (int i = 1; i <= 7; i++) {
            System.out.print("*");
        }
        System.out.println();
    }

    public static void drawLineOf35() {
        for (int i = 1; i <= 35; i++) {
            System.out.print("*");
        }
        System.out.println();
    }
    ...
```

- This code is redundant.
- Would variables help? Would constants help?
- What is a better solution?

A better solution

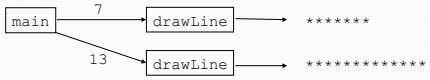
- Generalized tasks:
  - `drawLine` - A method to draw a line of any number of stars
  - `drawBox` - A method to draw a box of any size
- We really want:

```
public static void drawLine() {
    for (int i = 1; i <= N; i++) {
        System.out.print("*");
    }
    System.out.println();
}
```

- Desired properties for `drawLine`:
  - Can call `drawLine` method multiple times, producing differently sized lines
  - Size of line printed is determined by the caller of the command (i.e. "Print me a line of size 7")

Parameterization

- **parameter**: A value passed to a method by its caller.
  - Instead of `drawLineOf7`, `drawLineOf13`, write `drawLine` to draw any length.
    - When *declaring* the method, we will state that it requires a parameter for the number of stars.
    - When *calling* the method, we will specify how many stars to draw.



Declaring a parameter

Stating that a method requires a parameter in order to run

```
public static void name ( type name ) {
    statement(s);
}
```

- Example:

```
public static void sayPassword(int code) {
    System.out.println("The password is: " + code);
}
```

  - When `sayPassword` is called, the caller must specify the integer code to print.

Passing a parameter

Calling a method and specifying values for its parameters

```
name (expression);
```

- Example:

```
public static void main(String[] args) {
    sayPassword(42);
    sayPassword(12345);
}
```

Output:

```
The password is 42
The password is 12345
```


Parameters and loops

- A parameter can guide the number of repetitions of a loop.

```
public static void main(String[] args) {
    chant(3);
}

public static void chant(int times) {
    for (int i = 1; i <= times; i++) {
        System.out.println("Ole ole ole ole");
    }
}
```

Output:

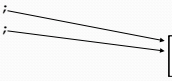
```
Ole ole ole ole
Ole ole ole ole
Ole ole ole ole
```


How parameters are passed

- When the method is called:
  - The value is stored into the parameter variable.
  - The method's code executes using that value.

```
public static void main(String[] args) {
    chant(3);
    chant(7);
}

public static void chant(int times) {
    for (int i = 1; i <= times; i++) {
        System.out.println("Ole ole ole ole");
    }
}
```



Common errors

- If a method accepts a parameter, it is illegal to call it without passing any value for that parameter.

```
chant();      // ERROR: parameter value required
```

- The value passed to a method must be of the correct type.

```
chant(3.7);   // ERROR: must be of type int
```

- Exercise: Change the `LinesAndBoxes` program to use a parameterized method for drawing lines of stars.

LinesAndBoxes solution

```
// Prints several lines of stars.
// Uses a parameterized method to remove redundancy.
public class LinesAndBoxes2 {
    public static void main(String[] args) {
        drawLine(13);
        drawLine(7);
        drawLine(35);
    }

    // Prints the given number of stars plus a line break.
    public static void drawLine(int count) {
        for (int i = 1; i <= count; i++) {
            System.out.print("*");
        }
        System.out.println();
    }
}
```


Multiple parameters

- A method can accept multiple parameters. (separate by ,)
  - When calling it, you must pass values for each parameter.
- Declaration:

```
public static void name (type name, ..., type name) {
    statement(s);
}
```

- Call:

```
methodName (value, value, ..., value);
```


Multiple parameters example

```
public static void main(String[] args) {
    printNumber(4, 9);
    printNumber(17, 6);
    printNumber(8, 0);
    printNumber(0, 8);
}
public static void printNumber(int number, int count) {
    for (int i = 1; i <= count; i++) {
        System.out.print(number);
    }
    System.out.println();
}
```

Output:

```
444444444
171717171717

00000000
```

- Modify the `LinesAndBoxes` program to draw boxes with parameters.

LinesAndBoxes solution

```
// Prints several lines and boxes made of stars.
// Third version with multiple parameterized methods.
public class LinesAndBoxes3 {
    public static void main(String[] args) {
        drawLine(13);
        drawLine(7);
        drawLine(35);
        System.out.println();
        drawBox(10, 3);
        drawBox(5, 4);
        drawBox(20, 7);
    }

    // Prints the given number of stars plus a line break.
    public static void drawLine(int count) {
        for (int i = 1; i <= count; i++) {
            System.out.print("*");
        }
        System.out.println();
    }
    ...
```


LinesAndBoxes solution, cont'd.

```
    ...

    // Prints a box of stars of the given size.
    public static void drawBox(int width, int height) {
        drawLine(width);
        for (int line = 1; line <= height - 2; line++) {
            System.out.print("*");
            for (int space = 1; space <= width - 2; space++) {
                System.out.print(" ");
            }
            System.out.println("*");
        }
        drawLine(width);
    }
}
```


Value semantics

- **value semantics**: When primitive variables (`int`, `double`) are passed as parameters, their values are copied.
  - Modifying the parameter will not affect the variable passed in.

```
public static void strange(int x) {
    x = x + 1;
    System.out.println("1. x = " + x);
}

public static void main(String[] args) {
    int x = 23;
    strange(x);
    System.out.println("2. x = " + x);
    ...
}
```

Output:

```
1. x = 24
2. x = 23
```

A "Parameter Mystery" problem

```
public class ParameterMystery {
    public static void main(String[] args) {
        int x = 9;
        int y = 2;
        int z = 5;

        mystery(z, y, x);

        mystery(y, x, z);
    }

    public static void mystery(int x, int z, int y) {
        System.out.println(z + " and " + (y - x));
    }
}
```

Strings

- **string**: A sequence of text characters.

```
String name = "text";
String name = expression;
```

  - Examples:

```
String name = "Marla Singer";

int x = 3;
int y = 5;
String point = "(" + x + ", " + y + ")";
```


Strings as parameters

```
public class StringParameters {
    public static void main(String[] args) {
        sayHello("Marty");

        String teacher = "Bictolia";
        sayHello(teacher);
    }

    public static void sayHello(String name) {
        System.out.println("Welcome, " + name);
    }
}
```

Output:

```
Welcome, Marty
Welcome, Bictolia
```

- Modify the `LinesAndBoxes` program to use string parameters. Use a method named `repeat` that prints a string many times.

LinesAndBoxes solution

```
// Prints several lines and boxes made of stars.
// Fourth version with String parameters.
public class LinesAndBoxes4 {
    public static void main(String[] args) {
        drawLine(13);
        drawLine(7);
        drawLine(35);
        System.out.println();
        drawBox(10, 3);
        drawBox(5, 4);
        drawBox(20, 7);
    }

    // Prints the given number of stars plus a line break.
    public static void drawLine(int count) {
        repeat("*", count);
        System.out.println();
    }

    ...
```


LinesAndBoxes solution, cont'd.

```
    ...

    // Prints a box of stars of the given size.
    public static void drawBox(int width, int height) {
        drawLine(width);

        for (int line = 1; line <= height - 2; line++) {
            System.out.print("*");
            repeat(" ", width - 2);
            System.out.println("*");
        }

        drawLine(width);
    }
    // Prints the given String the given number of times.
    public static void repeat(String s, int times) {
        for (int i = 1; i <= times; i++) {
            System.out.print(s);
        }
    }
}
```