Parameters and Methods

Based on slides by Chand John.
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https://www.cs.utexas.edu/~scottm/cs312/handouts/slides/topic7_parameters.pdf

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** oz. chocolate chips ...
  - Place on sheet and Bake for about 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** oz. chocolate chips ...
  - Place on sheet and Bake for about 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** oz. chocolate chips ...
  - Place on sheet and Bake for about 10 minutes.

- **parameter**: A value that distinguishes similar tasks.

Redundant figures

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

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

*******

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

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

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

A redundant solution

```
public class Stars1 {
    public static void main(String[] args) {
        lineOf13();
        lineOf7();
        lineOf35();
        box10x3();
        box5x4();
    }

    public static void lineOf13() {
        for (int i = 1; i <= 13; i++) {
            System.out.print("*");
        }
        System.out.println();
    }

    public static void lineOf7() {
        for (int i = 1; i <= 7; i++) {
            System.out.print("*");
        }
        System.out.println();
    }

    public static void lineOf35() {
        for (int i = 1; i <= 35; i++) {
            System.out.print("*");
        }
        System.out.println();
    }
    ...
```

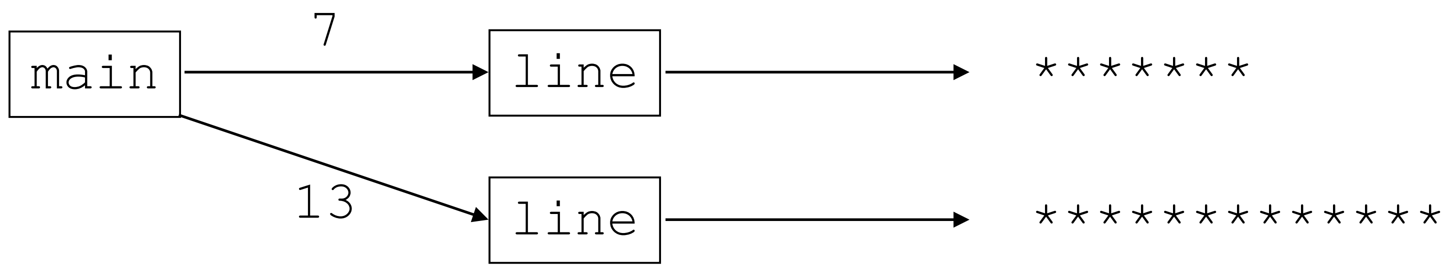
- This code is redundant.

- What is a better solution?

  - `line` - A method to draw a line of any number of stars.
  - `box` - A method to draw a box of any size.

Parameterization

- **parameter**: A value passed to a method by its caller.
  - Instead of `lineOf7`, `lineOf13`, write `line` 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("Just a salad...");
    }
}
```

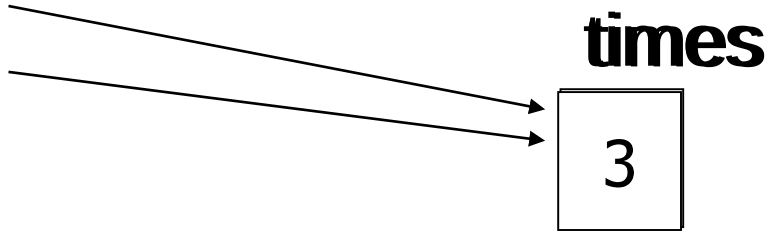
Output:

```
Just a salad...
Just a salad...
Just a salad...
```

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("Just a salad...");
    }
}
```

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 `Stars` program to use a parameterized method for drawing lines of stars.

Stars solution

```
// Prints several lines of stars.
// Uses a parameterized method to remove redundancy.
public class Stars2 {
    public static void main(String[] args) {
        line(13);
        line(7);
        line(35);
    }

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

Multiple parameters

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

- Declaration:

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

- Call:

```
<name>(<exp>, <exp>, ..., <exp>);
```

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 `Stars` program to draw boxes with parameters.

Stars solution

```
// Prints several lines and boxes made of stars.
// Third version with multiple parameterized methods.
public class Stars3 {
    public static void main(String[] args) {
        line(13);
        line(7);
        line(35);
        System.out.println();
        box(10, 3);
        box(5, 4);
        box(20, 7);
    }

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

Stars solution, cont'd.

```
    ...

    // Prints a box of stars of the given size.
    public static void box(int width, int height) {
        line(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("*");
        }

        line(width);
    }
}
```

"Pass by Value" or "Pass by Copy"

- 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
```

Clicker 1 -
Output of "Parameter Mystery"

```
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.print(z + " " + (y - x) + " ");
    }
}
```

A. 5 -7 5 -7 **B.** 9 -3 5 7 **C.** 2 4 9 3

D. 9 -3 5 12 **E.** None of A through D

Clicker 2 - What is output by the following code?

```
int x = 2;
int y = 5;
mystery2(x, y);
System.out.print(x + " " + y + " ");

public static void mystery2(int x, int y) {
    System.out.print(x + " " + y + " ");
    x *= y + 3;
    y--;
    x++;
    System.out.print(x + " " + y + " ");
}
```

A. 2 5 17 4 2 5

B. 2 5 17 4 17 4

C. 17 4 2 5 17 4

D. 2 5 2 5 17 4

E. None of A through D

Stars solution, cont'd.

```
    ...

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

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

        line(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);
        }
    }
}
```