

# Building Java Programs

Chapter 1  
Lecture 1-2: Static Methods

**reading: 1.4 - 1.5**

## Comments

- **comment:** A note written in source code by the programmer to describe or clarify the code.
  - Comments are not executed when your program runs.

- Syntax:

```
// comment text, on one line
```

or,

```
/* comment text; may span multiple lines */
```

- Examples:

```
// This is a one-line comment.
```

```
/* This is a very long  
multi-line comment. */
```

# Using comments

- Where to place comments:
  - at the top of each file (a "comment header")
  - at the start of every method (seen later)
  - to explain complex pieces of code
- Comments are useful for:
  - Understanding larger, more complex programs.
  - Multiple programmers working together, who must understand each other's code.

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# Comments example

```
/* Suzy Student, CS 101, Fall 2019
   This program prints lyrics about ... something. */

public class BaWitDaBa {
    public static void main(String[] args) {
        // first verse
        System.out.println("Bawitdaba");
        System.out.println("da bang a dang diggy diggy");
        System.out.println();

        // second verse
        System.out.println("diggy said the boogy");
        System.out.println("said up jump the boogy");
    }
}
```

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# Static methods

**reading: 1.4**

# Algorithms

- **algorithm:** A list of steps for solving a problem.
- Example algorithm: "Bake sugar cookies"
  - Mix the dry ingredients.
  - Cream the butter and sugar.
  - Beat in the eggs.
  - Stir in the dry ingredients.
  - Set the oven temperature.
  - Set the timer.
  - Place the cookies into the oven.
  - Allow the cookies to bake.
  - Mix ingredients for frosting.
  - ...



## Problems with algorithms

- *lack of structure*: Many tiny steps; tough to remember.
- *redundancy*: Consider making a double batch...
  - Mix the dry ingredients.
  - Cream the butter and sugar.
  - Beat in the eggs.
  - Stir in the dry ingredients.
  - Set the oven temperature.
  - Set the timer.
  - Place the first batch of cookies into the oven.
  - Allow the cookies to bake.
  - Set the timer.
  - Place the second batch of cookies into the oven.
  - Allow the cookies to bake.
  - Mix ingredients for frosting.
  - ...

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## Structured algorithms

- **structured algorithm**: Split into coherent tasks.
  - 1 Make the cookie batter.**
    - Mix the dry ingredients.
    - Cream the butter and sugar.
    - Beat in the eggs.
    - Stir in the dry ingredients.
  - 2 Bake the cookies.**
    - Set the oven temperature.
    - Set the timer.
    - Place the cookies into the oven.
    - Allow the cookies to bake.
  - 3 Add frosting and sprinkles.**
    - Mix the ingredients for the frosting.
    - Spread frosting and sprinkles onto the cookies.
    - ...

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## Removing redundancy

- A well-structured algorithm can describe repeated tasks with less redundancy.

### 1 Make the cookie batter.

- Mix the dry ingredients.
- ...

### 2a Bake the cookies (first batch).

- Set the oven temperature.
- Set the timer.
- ...

### 2b Bake the cookies (second batch).

### 3 Decorate the cookies.

- ...

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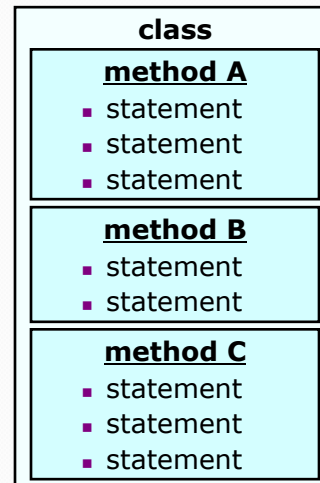
## A program with redundancy

```
// This program displays a delicious recipe for baking cookies.
public class BakeCookies {
    public static void main(String[] args) {
        System.out.println("Mix the dry ingredients.");
        System.out.println("Cream the butter and sugar.");
        System.out.println("Beat in the eggs.");
        System.out.println("Stir in the dry ingredients.");
        System.out.println("Set the oven temperature.");
        System.out.println("Set the timer.");
        System.out.println("Place a batch of cookies into the oven.");
        System.out.println("Allow the cookies to bake.");
        System.out.println("Set the oven temperature.");
        System.out.println("Set the timer.");
        System.out.println("Place a batch of cookies into the oven.");
        System.out.println("Allow the cookies to bake.");
        System.out.println("Mix ingredients for frosting.");
        System.out.println("Spread frosting and sprinkles.");
    }
}
```

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# Static methods

- **static method:** A named group of statements.
  - denotes the *structure* of a program
  - eliminates *redundancy* by code reuse
- **procedural decomposition:** dividing a problem into methods
- Writing a static method is like adding a new command to Java.



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# Using static methods

1. Design the algorithm.
  - Look at the structure, and which commands are repeated.
  - Decide what are the important overall tasks.
2. **Declare** (write down) the methods.
  - Arrange statements into groups and give each group a name.
3. **Call** (run) the methods.
  - The program's `main` method executes the other methods to perform the overall task.

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# Design of an algorithm

```
// This program displays a delicious recipe for baking cookies.
public class BakeCookies2 {
    public static void main(String[] args) {
        // Step 1: Make the cake batter.
        System.out.println("Mix the dry ingredients.");
        System.out.println("Cream the butter and sugar.");
        System.out.println("Beat in the eggs.");
        System.out.println("Stir in the dry ingredients.");

        // Step 2a: Bake cookies (first batch).
        System.out.println("Set the oven temperature.");
        System.out.println("Set the timer.");
        System.out.println("Place a batch of cookies into the oven.");
        System.out.println("Allow the cookies to bake.");

        // Step 2b: Bake cookies (second batch).
        System.out.println("Set the oven temperature.");
        System.out.println("Set the timer.");
        System.out.println("Place a batch of cookies into the oven.");
        System.out.println("Allow the cookies to bake.");

        // Step 3: Decorate the cookies.
        System.out.println("Mix ingredients for frosting.");
        System.out.println("Spread frosting and sprinkles.");
    }
}
```

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# Declaring a method

*Gives your method a name so it can be executed*

- Syntax:

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

- Example:

```
public static void printWarning() {
    System.out.println("This product causes cancer");
    System.out.println("in lab rats and humans.");
}
```

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# Calling a method

*Executes the method's code*

- Syntax:

```
<name> ();
```

- You can call the same method many times if you like.

- Example:

```
printWarning();
```

- Output:

```
This product causes cancer  
in lab rats and humans.
```

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# Program with static method

```
public class FreshPrince {  
    public static void main(String[] args) {  
        rap();                // Calling (running) the rap method  
        System.out.println();  
        rap();                // Calling the rap method again  
    }  
  
    // This method prints the lyrics to my favorite song.  
    public static void rap() {  
        System.out.println("Now this is the story all about how");  
        System.out.println("My life got flipped turned upside-down");  
    }  
}
```

**Output:**

```
Now this is the story all about how  
My life got flipped turned upside-down
```

```
Now this is the story all about how  
My life got flipped turned upside-down
```

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# Final cookie program

```
// This program displays a delicious recipe for baking cookies.
public class BakeCookies3 {
    public static void main(String[] args) {
        makeBatter();
        bake(); // 1st batch
        bake(); // 2nd batch
        decorate();
    }

    // Step 1: Make the cake batter.
    public static void makeBatter() {
        System.out.println("Mix the dry ingredients.");
        System.out.println("Cream the butter and sugar.");
        System.out.println("Beat in the eggs.");
        System.out.println("Stir in the dry ingredients.");
    }

    // Step 2: Bake a batch of cookies.
    public static void bake() {
        System.out.println("Set the oven temperature.");
        System.out.println("Set the timer.");
        System.out.println("Place a batch of cookies into the oven.");
        System.out.println("Allow the cookies to bake.");
    }

    // Step 3: Decorate the cookies.
    public static void decorate() {
        System.out.println("Mix ingredients for frosting.");
        System.out.println("Spread frosting and sprinkles.");
    }
}
```

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## Summary: Why methods?

- Makes code easier to read by capturing the structure of the program
  - `main` should be a good summary of the program

```
public static void main(String[] args) {
    [Red bar]
    [Blue bar]
    [Green bar]
}
```

**Note:** Longer code doesn't necessarily mean worse code

```
public static void main(String[] args) {
    [Red bar]
    [Blue bar]
}

public static ... [Red bar] (...) {
    [Blue bar]
}

public static ... [Green bar] (...) {
    [Green bar]
}
```

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## Summary: Why methods?

- Eliminate redundancy

```
public static void main(String[] args) {  
    [Redundant code block]  
}  
  
public static void main(String[] args) {  
    [Redundant code block]  
}  
  
public static ... [Redundant code block] (...)  
}
```



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## Methods calling methods

```
public class MethodsExample {  
    public static void main(String[] args) {  
        message1();  
        message2();  
        System.out.println("Done with main.");  
    }  
  
    public static void message1() {  
        System.out.println("This is message1.");  
    }  
  
    public static void message2() {  
        System.out.println("This is message2.");  
        message1();  
        System.out.println("Done with message2.");  
    }  
}
```

- Output:

```
This is message1.  
This is message2.  
This is message1.  
Done with message2.  
Done with main.
```

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## Control flow

- When a method is called, the program's execution...
  - "jumps" into that method, executing its statements, then
  - "jumps" back to the point where the method was called.

```
public class MethodsExample {  
    public static void main(String[] args) {  
        message1 () ;  
  
        message2 () ;  
  
        System.out.println("...")  
    }  
    ...  
}
```

```
public static void message1() {  
    System.out.println("This is message1.");  
}
```

```
public static void message2() {  
    System.out.println("This is message2.");  
    message1 () ;  
    System.out.println("Done with message2.");  
}
```

```
public static void message1() {  
    System.out.println("This is message1.");  
}
```

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## When NOT to use methods

- You should not create static methods for:
  - Only blank lines. (Put blank `println`s in main.)
  - Unrelated or weakly related statements.  
(Consider splitting them into two smaller methods.)

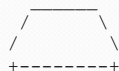
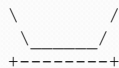
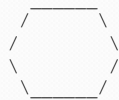
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# Drawing complex figures with static methods

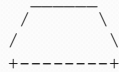
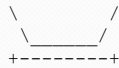
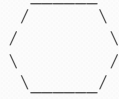
**reading: 1.5**  
(Ch. 1 Case Study: DrawFigures)

## Static methods question

- Write a program to print these figures using methods.



# Development strategy



## First version (unstructured):

- Create an empty program and `main` method.
- Copy the expected output into it, surrounding each line with `System.out.println` syntax.
- Run it to verify the output.

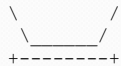
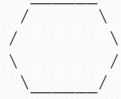
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# Program version 1

```
public class Figures1 {
    public static void main(String[] args) {
        System.out.println(" ");
        System.out.println("/ \ \ \ \ \");
        System.out.println("/ \ \ \ \ \");
        System.out.println("\ \ \ \ \ /");
        System.out.println("\ \ \ \ \ /");
        System.out.println();
        System.out.println("\ \ \ \ \ /");
        System.out.println("\ \ \ \ \ /");
        System.out.println("+-----+");
        System.out.println();
        System.out.println(" ");
        System.out.println("/ \ \ \ \ \");
        System.out.println("/ \ \ \ \ \");
        System.out.println("| \ \ \ \ \ |");
        System.out.println("\ \ \ \ \ /");
        System.out.println("\ \ \ \ \ /");
        System.out.println();
        System.out.println(" ");
        System.out.println("/ \ \ \ \ \");
        System.out.println("/ \ \ \ \ \");
        System.out.println("+-----+");
    }
}
```

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## Development strategy 2

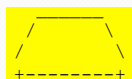
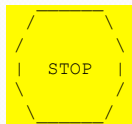


Second version (structured, with redundancy):

- Identify the structure of the output.
- Divide the `main` method into static methods based on this structure.

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## Output structure



The structure of the output:

- initial "egg" figure
- second "teacup" figure
- third "stop sign" figure
- fourth "hat" figure

This structure can be represented by methods:

- `egg`
- `teaCup`
- `stopSign`
- `hat`

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## Program version 2

```
public class Figures2 {
    public static void main(String[] args) {
        egg();
        teaCup();
        stopSign();
        hat();
    }

    public static void egg() {
        System.out.println("      ");
        System.out.println(" /-----\ ");
        System.out.println("/       \ ");
        System.out.println("\      / ");
        System.out.println(" \-----/ ");
        System.out.println();
    }

    public static void teaCup() {
        System.out.println(" \      / ");
        System.out.println("  \    / ");
        System.out.println("+-----+");
        System.out.println();
    }
    ...
}
```

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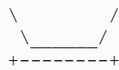
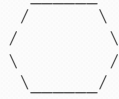
## Program version 2, cont'd.

```
...
public static void stopSign() {
    System.out.println("      ");
    System.out.println(" /-----\ ");
    System.out.println("/       \ ");
    System.out.println("|   STOP   | ");
    System.out.println("\      / ");
    System.out.println(" \-----/ ");
    System.out.println();
}

public static void hat() {
    System.out.println("      ");
    System.out.println(" /-----\ ");
    System.out.println("/       \ ");
    System.out.println("+-----+");
}
}
```

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## Development strategy 3

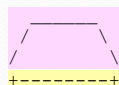
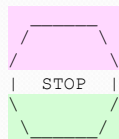
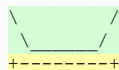
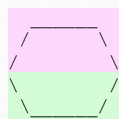


Third version (structured, without redundancy):

- Identify redundancy in the output, and create methods to eliminate as much as possible.
- Add comments to the program.

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## Output redundancy



The redundancy in the output:

- egg top: reused on stop sign, hat
- egg bottom: reused on teacup, stop sign
- divider line: used on teacup, hat

This redundancy can be fixed by methods:

- eggTop
- eggBottom
- line

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## Program version 3

```
// Suzy Student, CSE 138, Spring 2094
// Prints several figures, with methods for structure and redundancy.
public class Figures3 {
    public static void main(String[] args) {
        egg();
        teaCup();
        stopSign();
        hat();
    }

    // Draws the top half of an an egg figure.
    public static void eggTop() {
        System.out.println("      ");
        System.out.println(" /      \");
        System.out.println("/      \");
    }

    // Draws the bottom half of an egg figure.
    public static void eggBottom() {
        System.out.println("\\      /");
        System.out.println(" \\      /");
    }

    // Draws a complete egg figure.
    public static void egg() {
        eggTop();
        eggBottom();
        System.out.println();
    }

    ...
}
```

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## Program version 3, cont'd.

```
...
// Draws a teacup figure.
public static void teaCup() {
    eggBottom();
    line();
    System.out.println();
}

// Draws a stop sign figure.
public static void stopSign() {
    eggTop();
    System.out.println("|  STOP  |");
    eggBottom();
    System.out.println();
}

// Draws a figure that looks sort of like a hat.
public static void hat() {
    eggTop();
    line();
}

// Draws a line of dashes.
public static void line() {
    System.out.println("+-----+");
}
}
```

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## A word about style

- Structure your code properly
- Eliminate redundant code
- Use spaces judiciously and **consistently**
- Indent properly
- Follow the naming conventions
- Use comments to describe code behavior

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## Why style?

- Programmers build on top of other's code all the time.
  - You shouldn't waste time deciphering what a method does.
- You should spend time on thinking or coding. You should **NOT** be wasting time looking for that missing closing brace.
- So code with style!

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