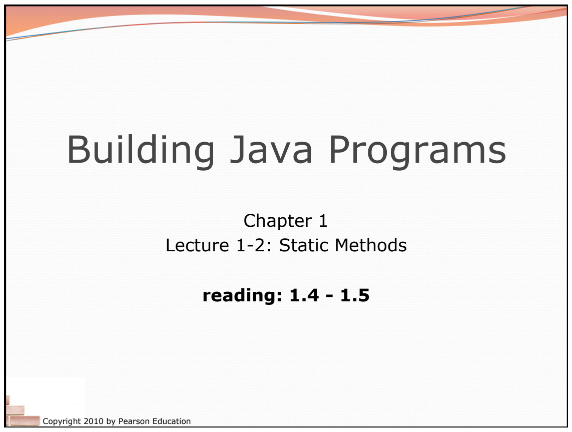
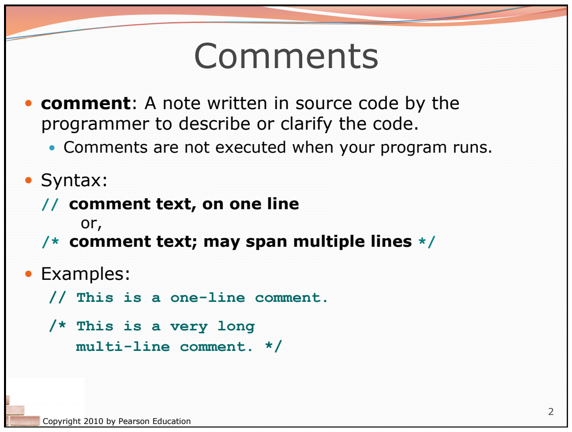


Building Java Programs

Chapter 1
Lecture 1-2: Static Methods

reading: 1.4 - 1.5



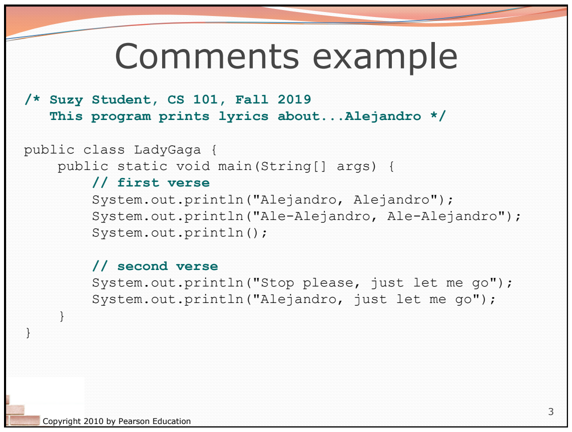
Comments

- **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** `*/`

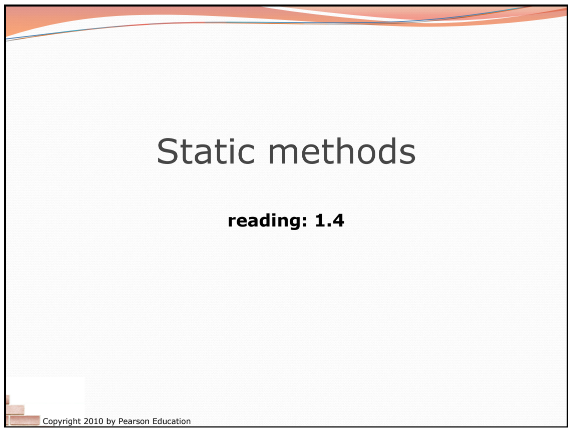
- Examples:

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

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



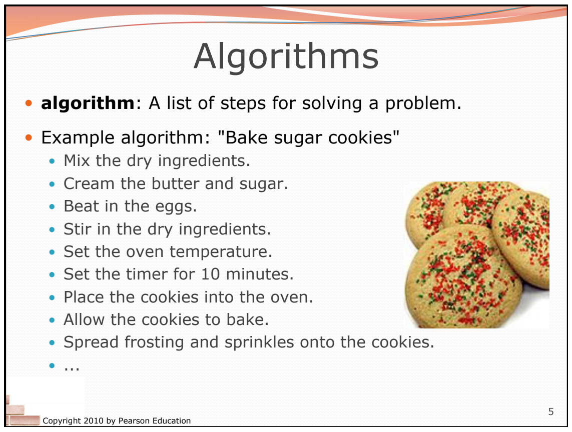
Comments example

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

public class LadyGaga {
    public static void main(String[] args) {
        // first verse
        System.out.println("Alejandro, Alejandro");
        System.out.println("Ale-Alejandro, Ale-Alejandro");
        System.out.println();

        // second verse
        System.out.println("Stop please, just let me go");
        System.out.println("Alejandro, just let me go");
    }
}
```



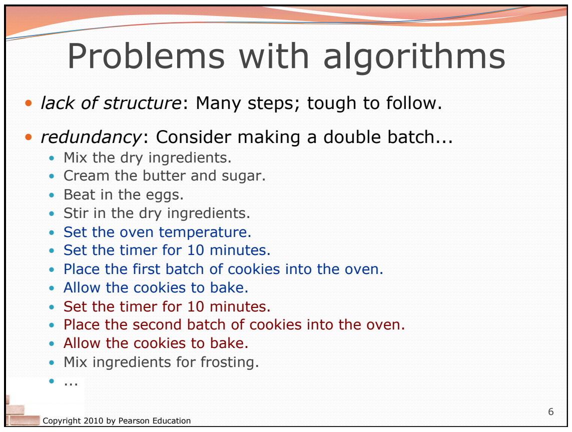
Static methods

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 for 10 minutes.
  - Place the cookies into the oven.
  - Allow the cookies to bake.
  - Spread frosting and sprinkles onto the cookies.
  - ...



Problems with algorithms

- *lack of structure*: Many steps; tough to follow.
- *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 for 10 minutes.
  - Place the first batch of cookies into the oven.
  - Allow the cookies to bake.
  - Set the timer for 10 minutes.
  - Place the second batch of cookies into the oven.
  - Allow the cookies to bake.
  - Mix ingredients for frosting.
  - ...

Structured algorithms

- **structured algorithm**: Split into coherent tasks.

  1 Make the 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 for 10 minutes.
  - Place the cookies into the oven.
  - Allow the cookies to bake.

  3 Decorate the cookies.
  - Mix the ingredients for the frosting.
  - Spread frosting and sprinkles onto the cookies.

  ...

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 for 10 minutes.
  - ...

  2b Bake the cookies (second batch).
  - Repeat Step 2a

  3 Decorate the cookies.
  - ...

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.

class

method A
- statement
- statement
- statement

method B
- statement
- statement

method C
- statement
- statement
- statement

Using static methods

1. **Design** (think about) 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.

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.");
}
```

Calling a method

Executes the method's code

- Syntax:

```
name();
```

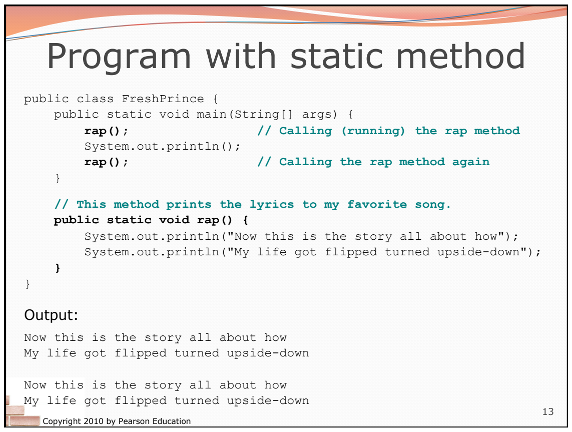
  - You can call the same method many times if you like.

- Example:

```
printWarning();
```

  - Output:

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

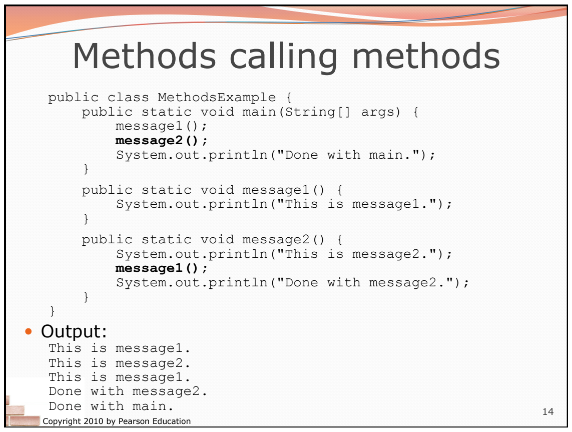


Program with static method

```
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
```

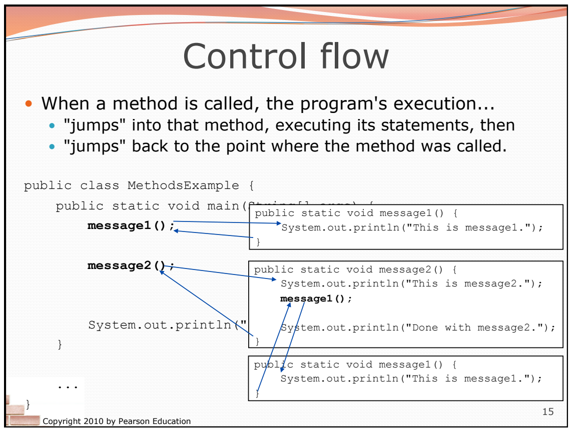


Methods calling methods

```
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.
```



Control flow

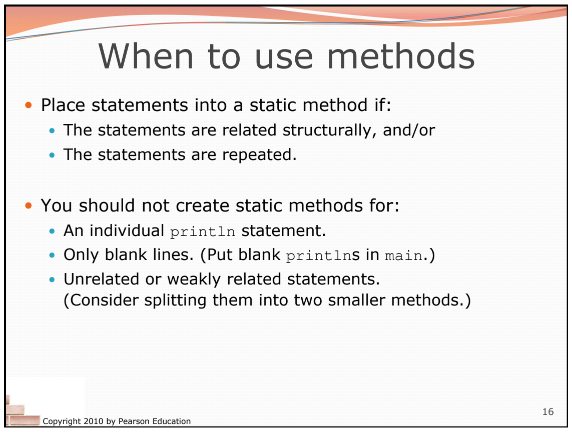
- When a method is called, the program's execution...
  - "jumps" into that method, executing its statements, then
  - "jumps" back to the point where the method was called.

```
public class MethodsExample {
    public static void main(
        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.");
}
```

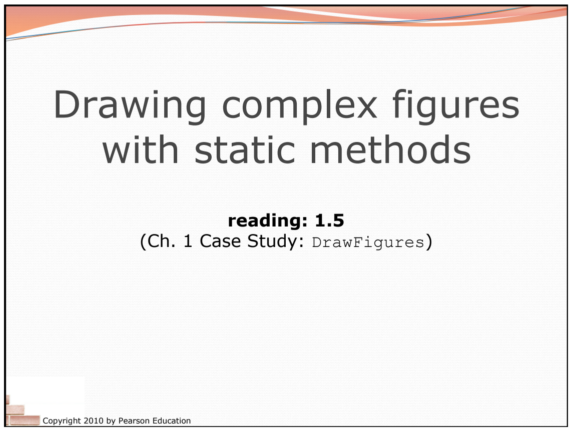
```
public static void message1() {
    System.out.println("This is message1.");
}
```



When to use methods

- Place statements into a static method if:
  - The statements are related structurally, and/or
  - The statements are repeated.

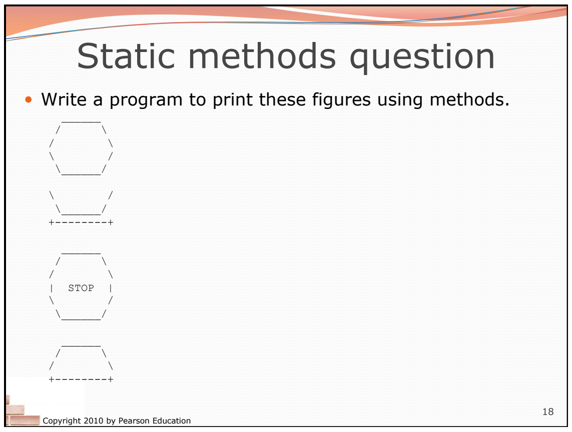
- You should not create static methods for:
  - An individual `println` statement.
  - Only blank lines. (Put blank `println`s in `main`.)
  - Unrelated or weakly related statements.
    (Consider splitting them into two smaller methods.)



Drawing complex figures with static methods

reading: 1.5

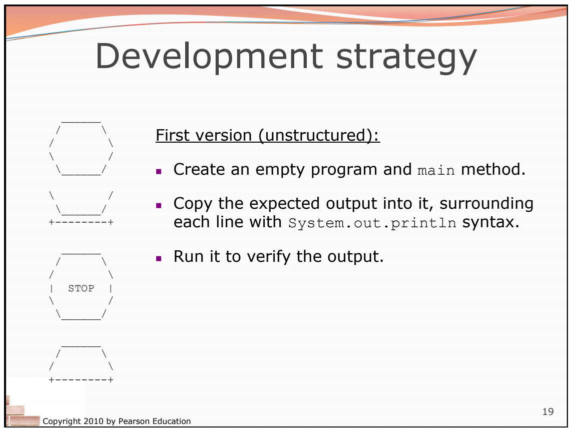
(Ch. 1 Case Study: `DrawFigures`)



Static methods question

- Write a program to print these figures using methods.

```
   ______
  /      \
 /        \
 \        /
  \______/

 \        /
  \______/
 +--------+

   ______
  /      \
 /        \
 |  STOP  |
 \        /
  \______/

   ______
  /      \
 /        \
 +--------+
```



Development strategy

```
  ______
 /      \
/        \
\        /
 \______/

\        /
 \______/
+--------+

  ______
 /      \
/        \
|  STOP  |
\        /
 \______/

  ______
 /      \
/        \
+--------+
```

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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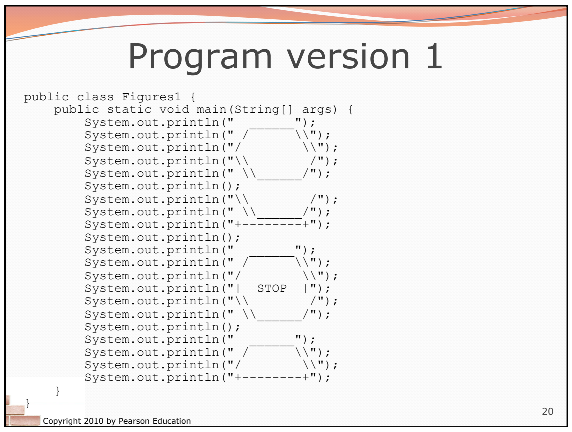

Program version 1

```
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("|  STOP  |");
        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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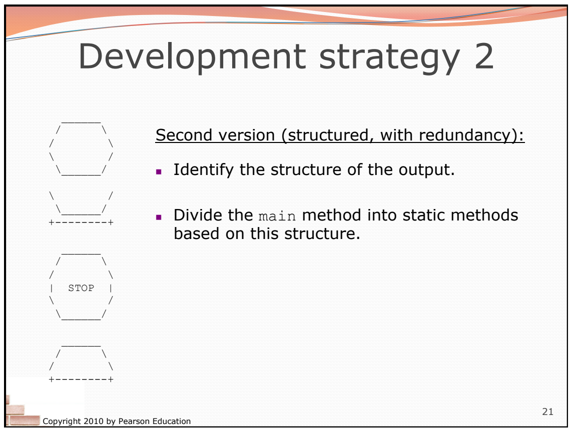

Development strategy 2

```
  ______
 /      \
/        \
\        /
 \______/

\        /
 \______/
+--------+

  ______
 /      \
/        \
|  STOP  |
\        /
 \______/

  ______
 /      \
/        \
+--------+
```

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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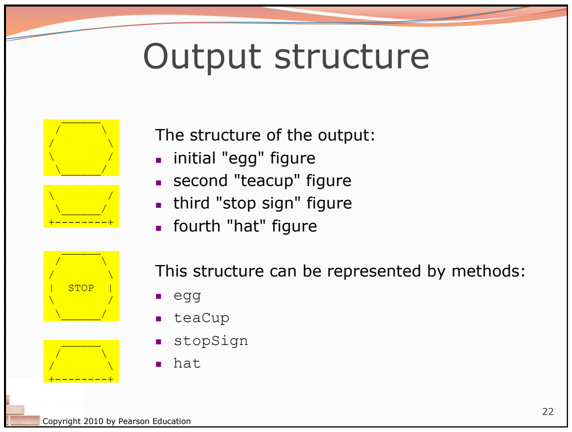

Output structure

```
  ______
 /      \
/        \
\        /
 \______/

\        /
 \______/
+--------+

  ______
 /      \
/        \
|  STOP  |
\        /
 \______/

  ______
 /      \
/        \
+--------+
```

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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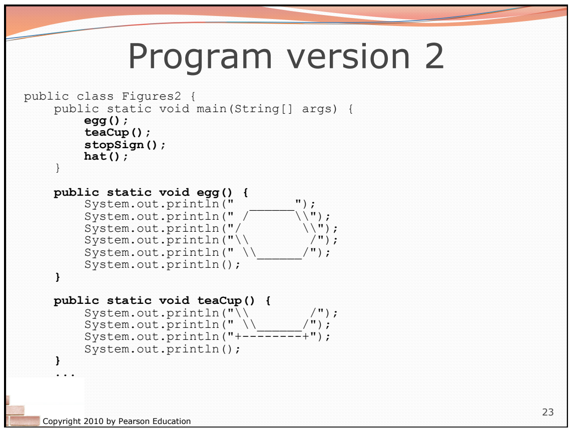

Program version 2

```
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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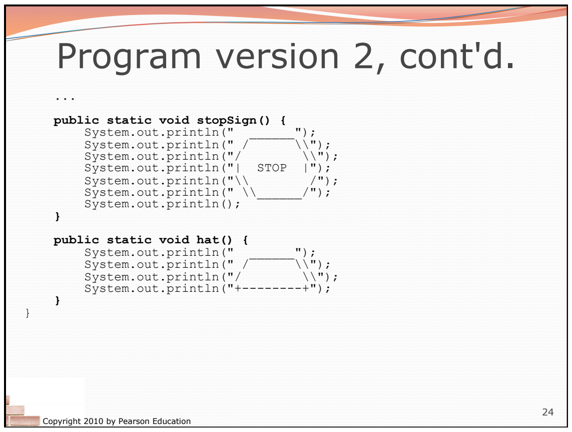

Program version 2, cont'd.

```
    ...
    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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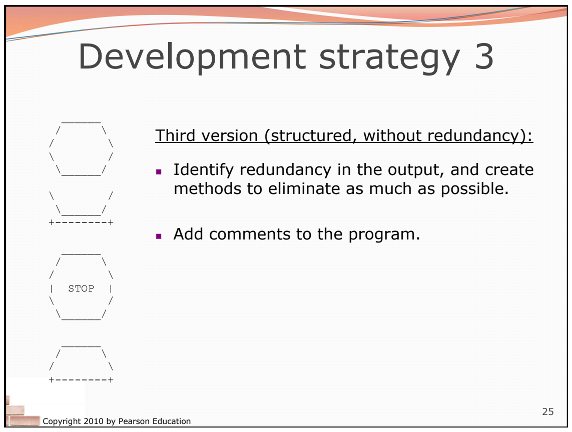
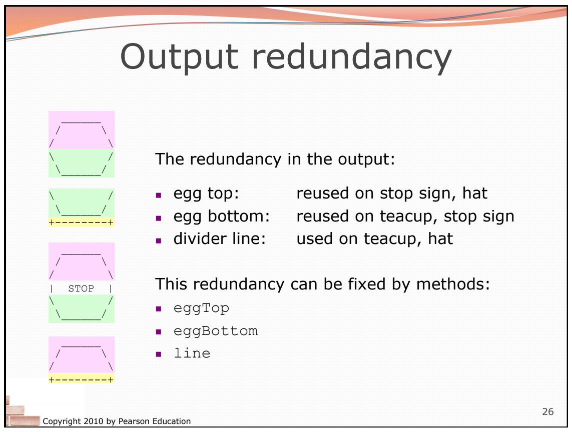


Development strategy 3

```
  ______
 /      \
/        \
\        /
 \______/

\        /
 \______/
+--------+

  ______
 /      \
/        \
|  STOP  |
\        /
 \______/

  ______
 /      \
/        \
+--------+
```

Third version (structured, without redundancy):

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



Output redundancy

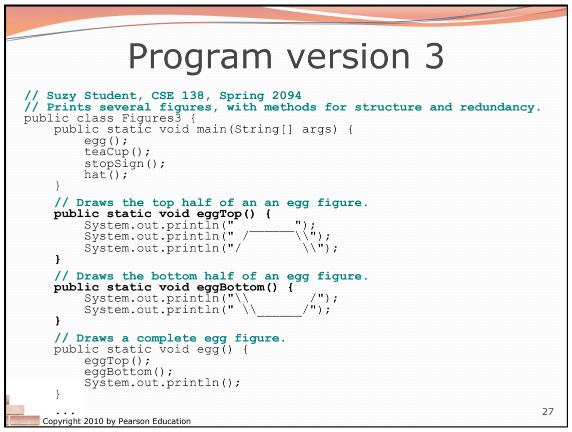
```
  ______
 /      \
/        \
\        /
 \______/

\        /
 \______/
+--------+

  ______
 /      \
/        \
|  STOP  |
\        /
 \______/

  ______
 /      \
/        \
+--------+
```

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

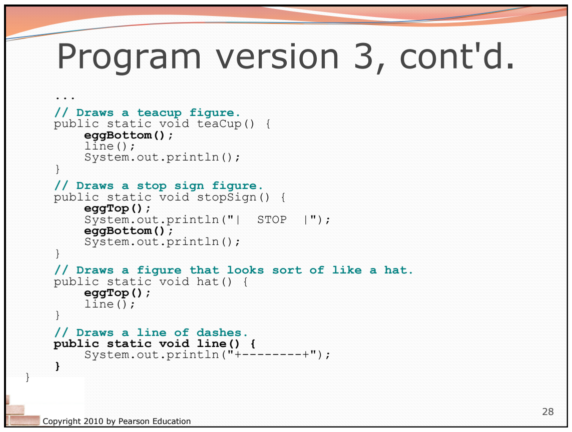
This redundancy can be fixed by methods:

- `eggTop`
- `eggBottom`
- `line`



Program version 3

```java
// 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();
    }

    ...
```



Program version 3, cont'd.

```java
    ...
    // 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("+--------+");
    }
}
```