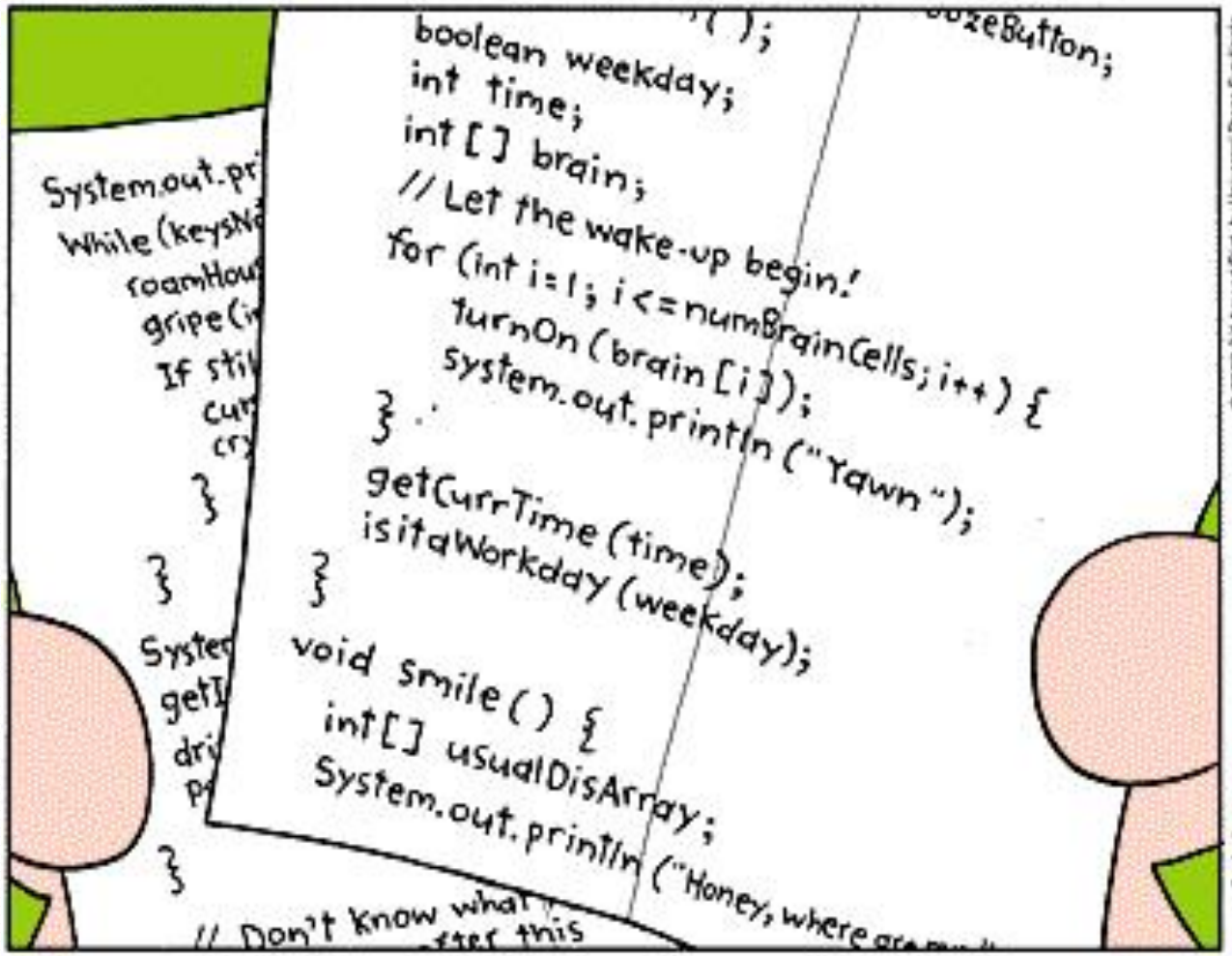
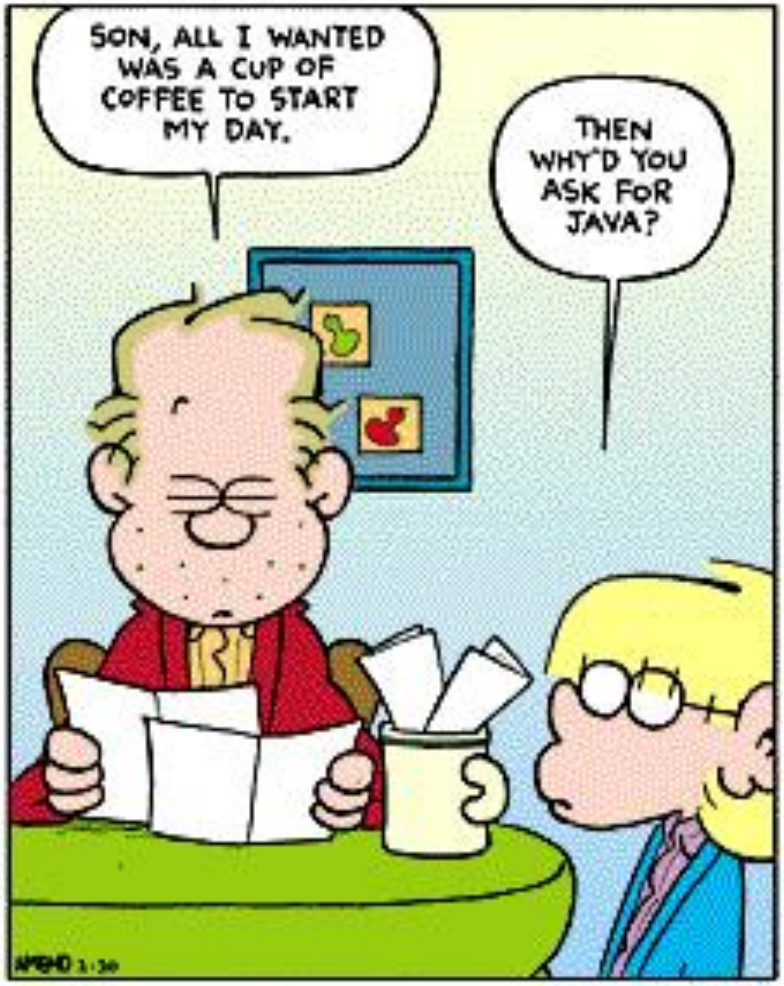
Building Java Programs

Chapter 1

Lecture 1-2: Static Methods

reading: 1.4 - 1.5


boolean weekday;
int time;
int [] brain;
// Let the wake-up begin.'
for (int i=1; i<=numBrainCells; i++) {
turnOn (brain [i]);
system.out.println ("Yawn");
getCurrTime (time);
isitaWorkday (weekday);
void smile () {
int[] usualDisArray;
System.out.println ("Honey, where


SON, ALL I WANTED WAS A CUP OF COFFEE TO START MY DAY.
THEN WHY'D YOU ASK FOR JAVA?
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Recall: structure, syntax

```
public class name {
    public static void main(String[] args) {
        statement;
        statement;
        ...
        statement;
    }
}
```

class: a program

method: a named group of statements

statement: a command to be executed

- Every executable Java program consists of a **class**,
  - that contains a **method** named `main`,
    - that contains the **statements** (commands) to be executed.

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. */
```

Where to place comments

- At the top of each file (a "comment header") to describe the program.

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

- At the start of every method (seen later) to describe what the method does.

```
// Print the chorus
```

- To explain complex pieces of code

```
// Compute the Mercator map projection
```

Comments example

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

public class FraggleRock {
    public static void main(String[] args) {
        // first verse
        System.out.println("Dance your cares away");
        System.out.println("Worry's for another day");
        System.out.println();

        // second verse
        System.out.println("Let the music play");
        System.out.println("Down at Fraggle Rock");
    }
}
```

Why comments?

- Helpful for understanding larger, more complex programs.

- Helps other programmers understand your code.
  - The “other” programmer could be the future you.

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.
  - Mix ingredients for frosting.
  - ...

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 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.

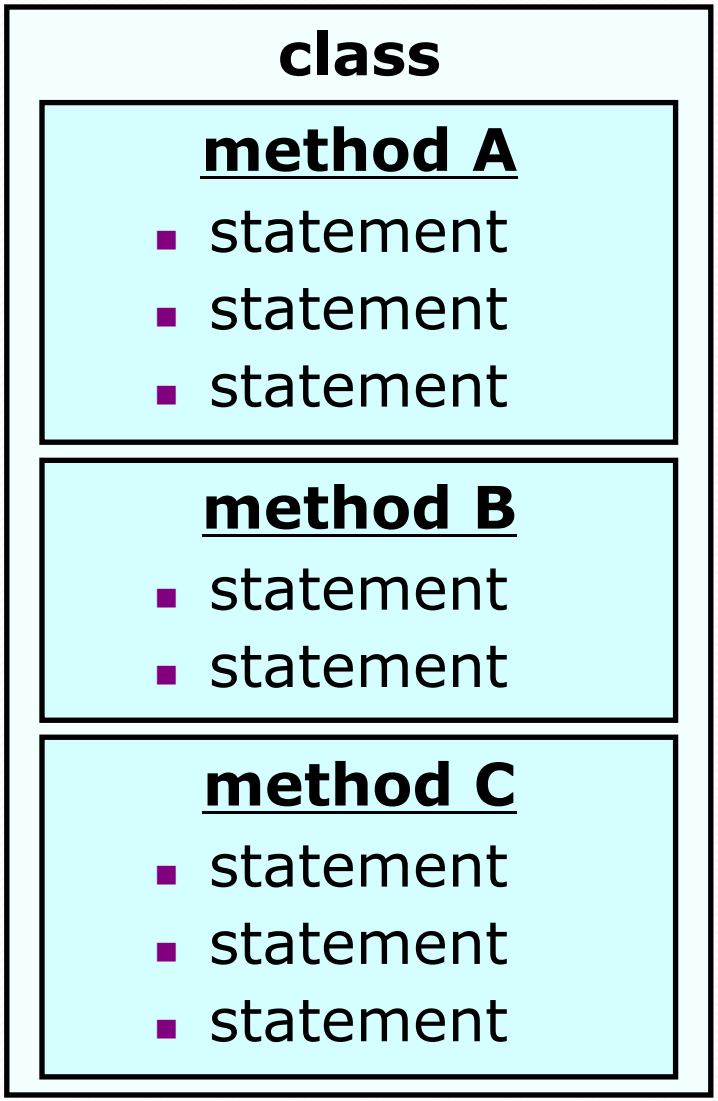
- ...

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 for 10 minutes.");
        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 for 10 minutes.");
        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.");
    }
}
```

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.



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.

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 for 10 minutes.");
        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 for 10 minutes.");
        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.");
    }
}
```

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
```

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 for 10 minutes.");
        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.");
    }
}
```

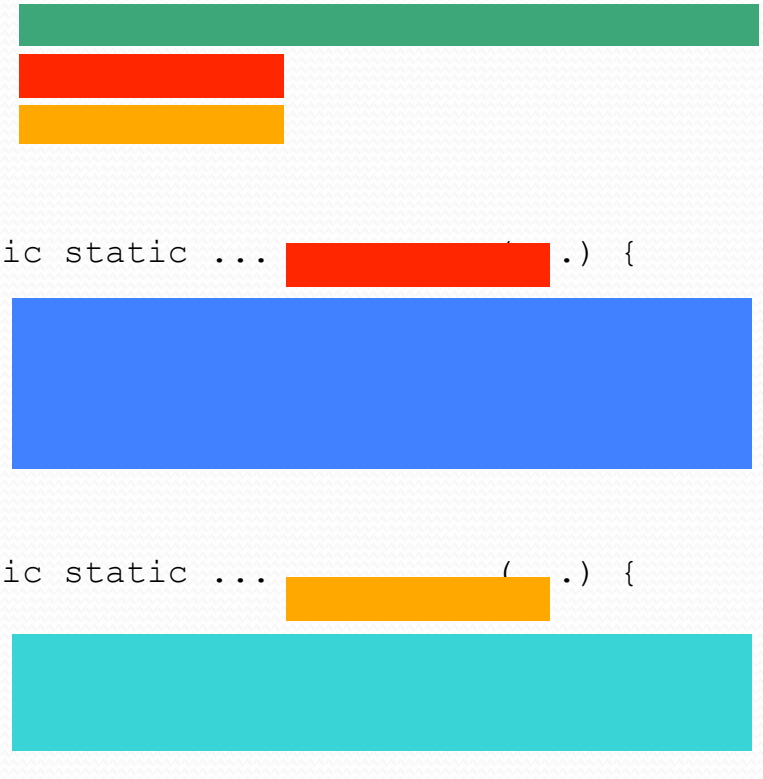
Summary: Why methods?

- 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) {
}
```

Note: Longer code doesn't necessarily mean worse code

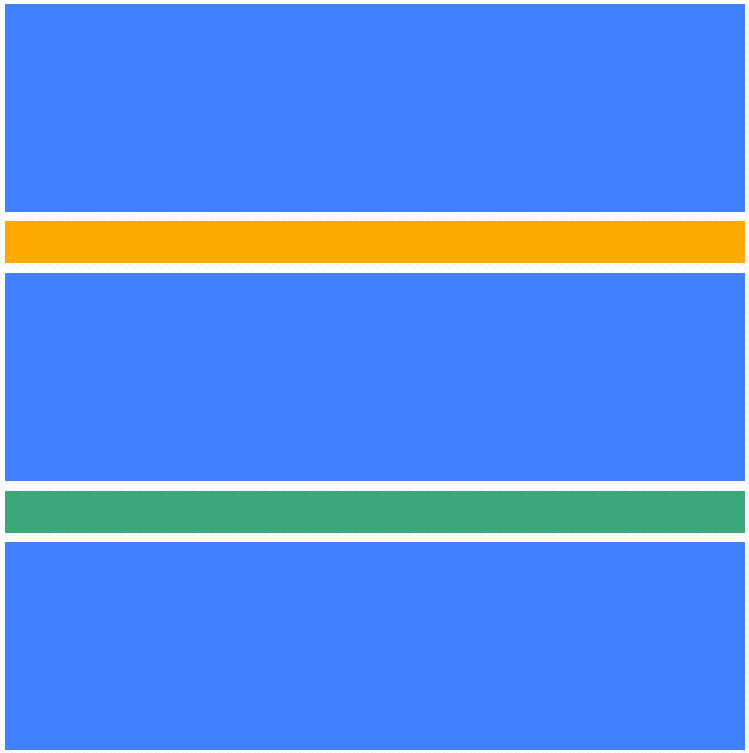
```
public static void main(String[] args) {
}

public static ...                    .) {
}

public static ...                    .) {
}
```



Summary: Why methods?

- Eliminate redundancy

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



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

public static ...  .) {
}
```

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(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.");
}
```

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 that appears once in a program.
  - Only blank lines.
  - Unrelated or weakly related statements.
    (Consider splitting them into two smaller methods.)

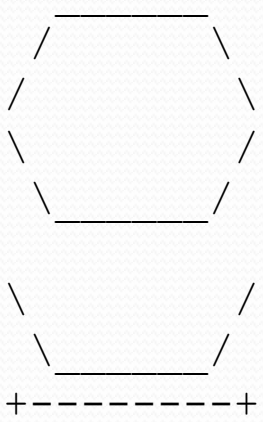
Drawing complex figures with static methods

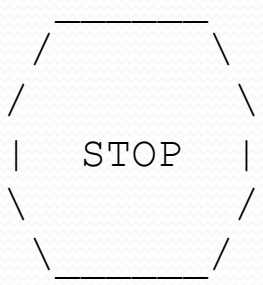
reading: 1.5

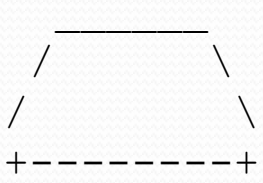
(Ch. 1 Case Study: `DrawFigures`)

Static methods question

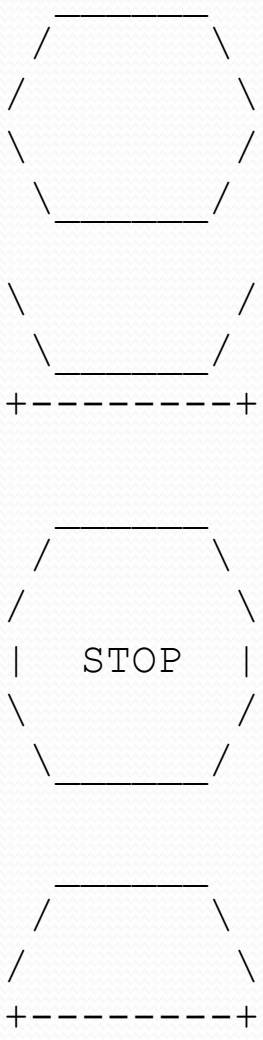
- Write a program to print these figures using methods.







Development strategy



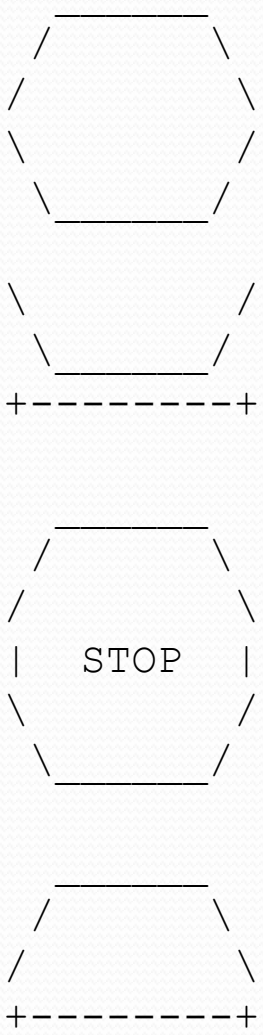
First version (unstructured):

- 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.

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("+--------+");
    }
}
```

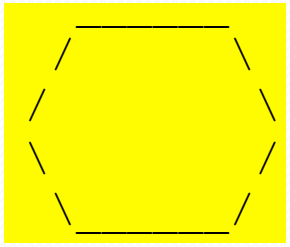
Development strategy 2

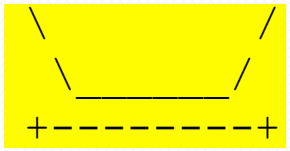


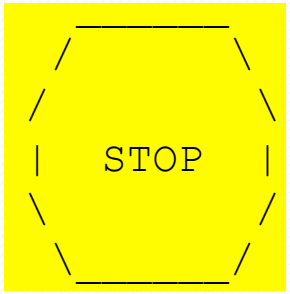
Second version (structured, with redundancy):

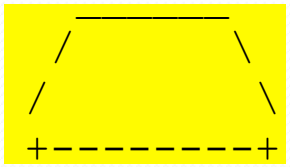
- Identify the structure of the output.
- Divide the `main` method into static methods based on this structure.

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`

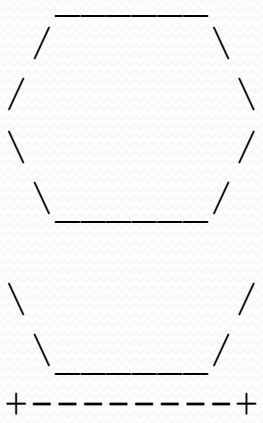
Program version 2

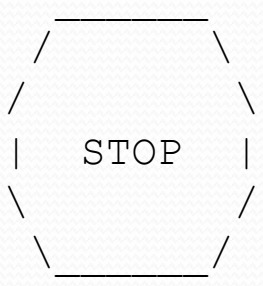
```
public class Figures2 {
    public static void main(String[] args) {
        egg();
        teaCup();
        stopSign();
        hat();
    }

    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();
    }
    ...
```

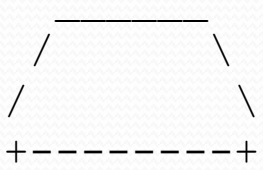
Program version 2, cont'd.

```
    ...

    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("+---------+");
    }
}
```

Development strategy 3



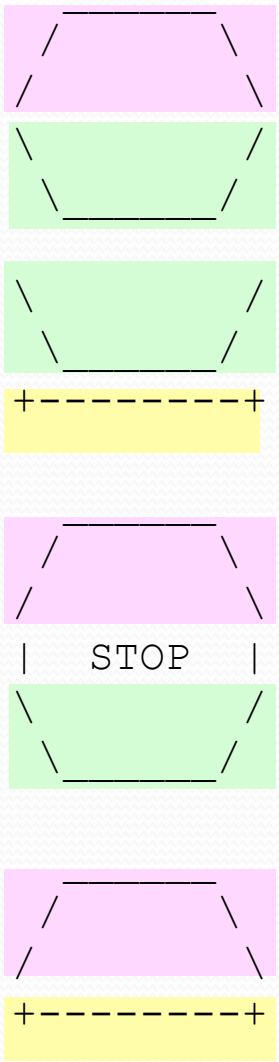




Third version (structured, without redundancy):

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

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`

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();
    }

    ...
```

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("+--------+");
    }
}
```

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

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!