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# Java Foundations

## 2-2

## What is my Program Doing?

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# Objectives

- This lesson covers the following objectives:
  - Understand how Java is read line by line
  - Set and use breakpoints
  - End statements with semicolons (;)
  - Organize code using whitespace and other conventions
  - Create comments

# Reading a Program Line by Line

- Each line in a program is read one at a time

```
1  System.out.println("Line 1");
2  System.out.println("Line 2");
3  System.out.println("Line 3");
4  System.out.println("Line 4");
5  System.out.println("Line 5");
```

- In the example…
  - Line 1 is read…
  - Then Line 2…
  - Then Line 3…
  - Then Line 4...
  - Then Line 5…

# Reading Line by Line

- Java is mostly read line by line
- But there are a few additional points to consider
- We'll investigate using…
  - A breakpoint
  - Other features of a Java IDE

# Breakpoints

- Set a breakpoint in your code to
  - Pause code execution
  - Check the current state of the program
  - Help debug
- Breakpoints affect code execution …
  - When code is run with the debugger

- Breakpoints can't affect code execution …
  - When code is run normally

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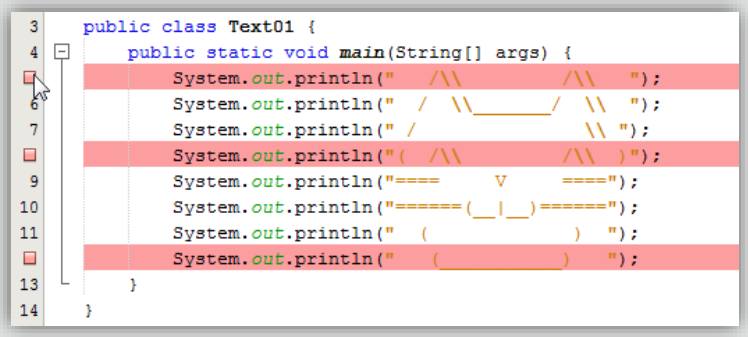
The steps, screenshots and icons in this lesson are from NetBeans. If you are using a different Java IDE, consult the documentation for the steps required to add breakpoints and debug code.

# Setting a Breakpoint Animation

- To set a breakpoint …
  - Place your cursor over a number in the left margin
  - Click … and you have a breakpoint!
  - Click again to remove a breakpoint
  - You can set many breakpoints

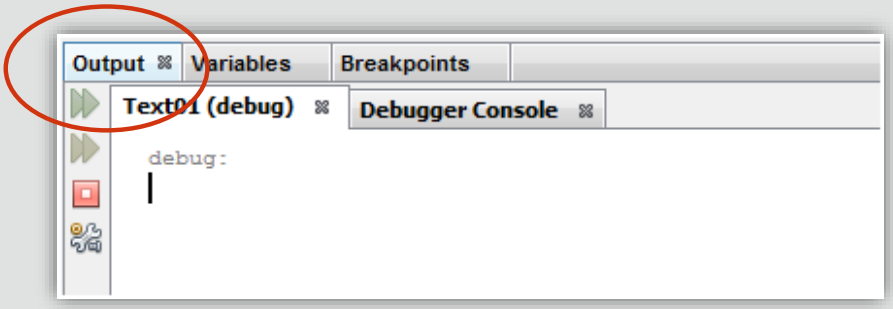


# Exercise 1, Part 1

- Create a new project and add the `Text01.java` file to the project
- Set a breakpoint at Line 5 (the line with the first print statement)
- Run the program normally
  - Breakpoints should have no affect

# Exercise 1, Part 2

- Run the program with the debugger:
  - Make sure the Output window is showing
  - Press Step Over to go to each next line
- Observe the cat appear one line at a time






Select the Output window by clicking the Output button in the lower-left corner of the IDE. Press Step Over repeatedly until you reach the end of the program.

# Exercise 1, Part 3

- Modify the code so that the first three print statements all appear on Line 5 (This is called removing whitespace)
- Run the program with the debugger:
  - Make sure the Output window is showing
  - Press Step Over Expression to go to each next line
  - Ignore the complicated code at the end of debugging
- Observe the cat appear one line at a time
- Try removing a semicolon while debugging the program

Step Over Expression

What if you do it **before** debugging?

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Continue pressing Step Over Expression until the complicated code appears. Step Into Expression is like Step Over, except that it provides for more fine-grained stepping through code. But this level of detail is sometimes unwanted.

# Investigation Results, Part 1

- You could say Java reads code line by line …
- But if multiple statements are on a single line, it's more accurate to say Java reads statement by statement
- A semicolon (;) is required to end a statement
  - Forgetting a semicolon is a common mistake
  - Other languages (Python) may not care about semicolons

```
System.out.println("Meow");
```

- Editing code has no affect while the program is running
- You must recompile for changes to take affect

# Investigation Results, Part 2

- Java isn't precise about whitespace
- Other languages (Python) may be extremely precise
- You could write an entire program in a single line
  - But this is messy and almost impossible to work with
  - Use whitespace to keep code organized

```
3   public class Text01 {
4       public static void main(String[] args) {
5           System.out.println("   /\\          /\\   ");System.out.println("  /  \\_____/  \\  ");
6       System.out.println(" /              \\ ");
7               System.out.println("(  /\\          /\\  )");
8           System.out.println("====     V     ====");
9               System.out.println("======(__|__)======");
10      System.   out.  println("  (             )  ");
11
12              System.out.println("   (___________)   ");
13      }
14  }
```

This code works...
but it's super messy

# Whitespace

- Whitespace is any spacing without code:
  - Space between words
  - Blank lines
  - Indentation before a line of code

```
3   public class Text01 {
4       public static void main(String[] args) {
5           System.out.println("    /\\          /\\    ");
6
7
8           System.out.println("   /  \\_______/  \\   ");
9           System.out.println("  /               \\  ");
10      }
11  }
```





Whitespace doesn't include spaces in print statements. (Strings are covered later.)

# Effects of Whitespace

- Whitespace helps keep code organized
- Whitespace doesn't affect how code runs
- You can use whitespace however you prefer
- But proper indentation is strongly encouraged because it …
  - Prevents readability difficulties
  - Prevents mistakes while programming

# Indentation and Curly Braces

- Indent by an additional tab (4 spaces) following an opening curly brace ( **{** )
- Stop indenting by an additional tab (4 spaces) prior to a closing curly brace ( **}** )
- Code within curly braces is called a block of code
  - When you add an opening curly brace ( **{** ) …
  - You'll eventually need a closing curly brace ( **}** )
  - Mismatching or forgetting a curly brace is a common mistake

# Block Example

```
public class Example
{
    public static void main(String[] args){
        System.out.println("Inner code");
        System.out.println("Inner code");
        {
            System.out.println("Inner-inner code");
        }
    }
}
```

These curly braces also create a block within a block ...

Whose code is indented further.

# IDE Indentation Assistance

- An IDE may…
  - Color-code the scope of a block (Greenfoot, BlueJ)
  - Automatically indent following a curly brace
  - Highlight a matching curly brace (shown below)
- Some Java commands require curly braces, although you can always add more

```
public class Example
{
    public static void main(String[] args){
        System.out.println("Inner code");
        System.out.println("Inner code");
        {
            System.out.println("Inner-inner code");
        }
    }
}
```

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This lesson adds extra curly braces to code for demonstration purposes. Adding extra curly braces isn't a common practice.

# Exercise 2

- Create a new project and add the `Text02.java` file to the project
- Can you fix this program and produce the following output?

```
1
2
3
4
```

- Hints:
  - Your IDE underlines problematic code
  - Your IDE can highlight matching curly braces
  - Your IDE has a shortcut to correct indentation

# Comments

- Neatly spaced programs can grow large and become difficult to read
- You can add comments to code to …
  - Provide an explanation or additional information to the programmer (Commenting code)
  - Disable code and prevent it from executing without erasing it (Commenting out code)

# Adding Comments to Code

- Single-line comments …
  - Start with two slashes //
  - End when the line ends

```
//A single line comment automatically ends when the line ends
   System.out.println("This line prints");
```

# Adding Comments to Code

- Multi-line comments …
  - Start with a slash-star /*
  - End with a star-slash */

```
/* A multi line comment...
 continues for many lines...
 System.out.println("This line does not print");
 until the star-slash appears */

System.out.println("This line prints");
```

# Reading Line by Line

- We can do a little more investigating
- We'll investigate using …
  - Code blocks
  - Comments
  - Breakpoints
  - Other features of your IDE

# Exercise 3

- Create a new project and add the `Text03.java` file to the project
- Set a breakpoint at Line 11
- Run the program with the debugger:
  - Be sure to have the Output window selected
  - Press Step Over to go to each next line


Step Over

- Observe the cat face appear, but the legs don't appear
- Type `drawLegs();` in Line 19 and debug the program
  - Where could you add a breakpoint to see the legs drawn one line at a time?
  - What happens to the output when lines are commented out?

# Investigation Results, Part 3

- When Java reads line by line …
- It starts within the special block of code known as the main method

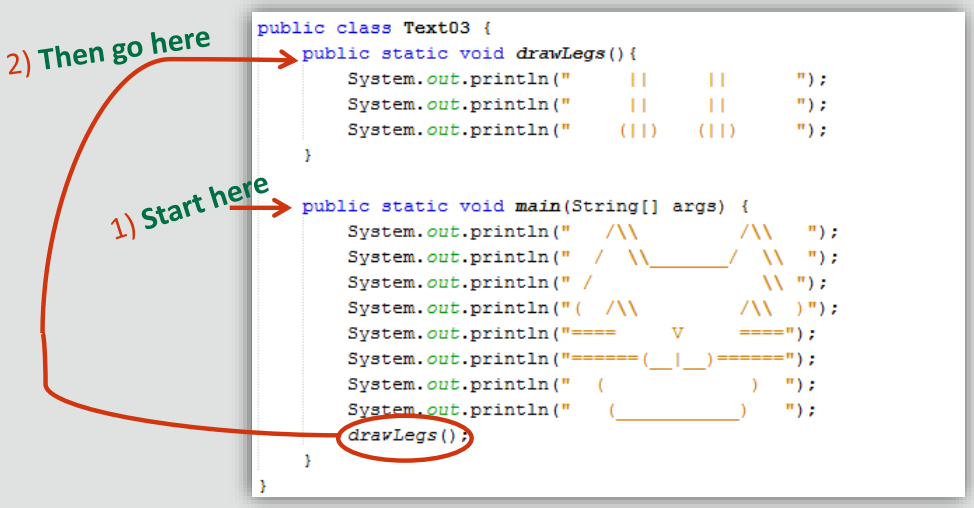
```
public static void main(String[] args){

}//end method main
```

- No other code executes unless it's called
  - In this exercise, the main method must specifically call the block of code that prints legs
- Commented code is ignored
  - Comments are removed in bytecode

# The Program's Flow

1. All Java programs start in the main method
2. No other code executes unless it's called



# The Main Method

- The main method is a special block of code
- All Java programs start in the main method
- Your programs should have only 1 main method
- Methods are discussed more in the next lesson
  - `drawLegs()` is an example of a method

```
public static void main(String[] args){
   //Your program starts here
}//end method main
```

# Summary

- Common mistakes:
  - Missing semicolon (;)

```
System.out.println("Meow")
```

  - Mismatched {curly braces}

```
{
    System.out.println("Meow");
```

- Keep code organized using:
  - Whitespace
  - Curly Braces ( { } )
  - Comments

# Summary

- In this lesson, you should have learned how to:
  - Understand how Java is read line by line
  - Set and use breakpoints
  - End statements with semicolons (;)
  - Organize code using whitespace and other conventions
  - Create comments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