Middlebury

CSCI 201: Data Structures

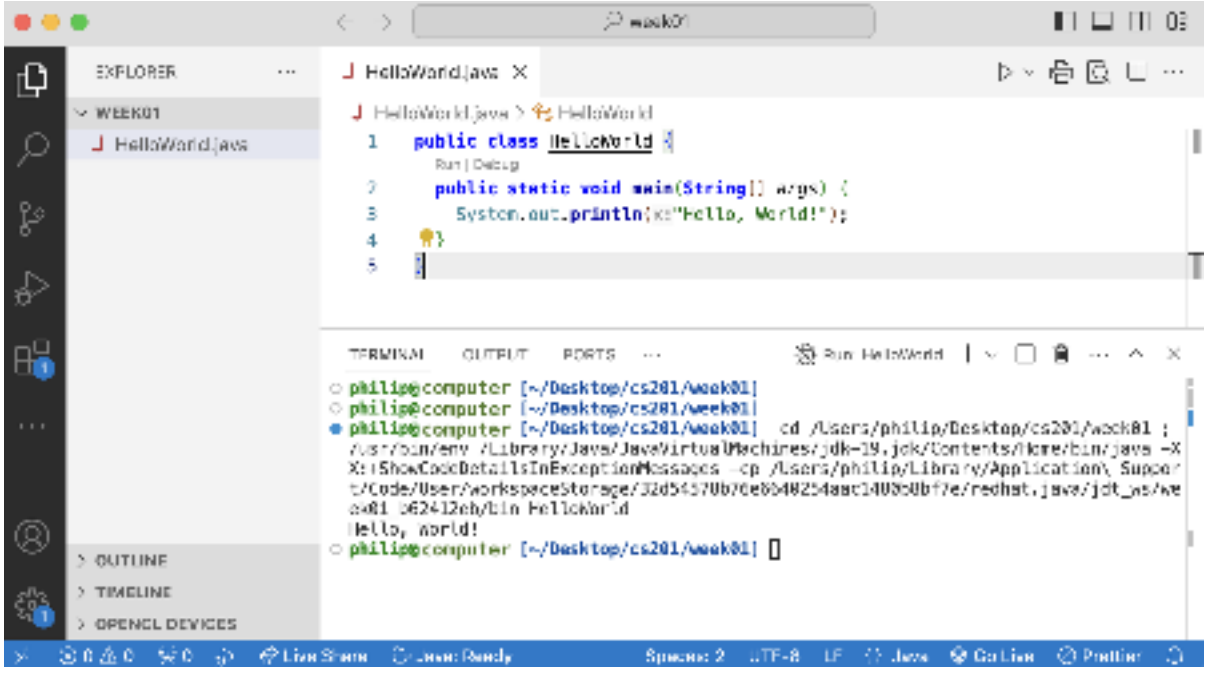
Fall 2024

Lecture 1R: `Java` Control Structures

Goals for today:

- Why do we need a `public static void main`?
- Use a few `String` methods: `length`, `charAt`, `equals`, `replace`, `subtring`.
- Write **functions**.
- Declare and assign `boolean` variables.
- Use comparative operators: `<`, `>`, `<=`, `>=`, `==`, `!=`.
- Use logical operators: `&&` (and), `||` (or), `!` (not).
- Write `if`, `if/else`, `if/else if/else` statements.
- Write `for`-loops and `while`-loops.

How did setting up VS Code and `Java` go?



Respond using the 👍 **reactions** page at go/cs201.

What's with the `public static void main`?

```
1 public class HelloWorld {
2     public static void main(String[] args) {
3         System.out.println("Hi CS 201!");
4     }
5 }
```

- Each `.java` file has a single `public class`.
- Name of the file matches this class name, e.g. `HelloWorld.java` for the `HelloWorld` class.
- Must have a `public static void main` (**PSVM**) method defined in this class if you want to run it.
- Larger projects can have multiple files: only one **PSVM** is needed in one of these files.

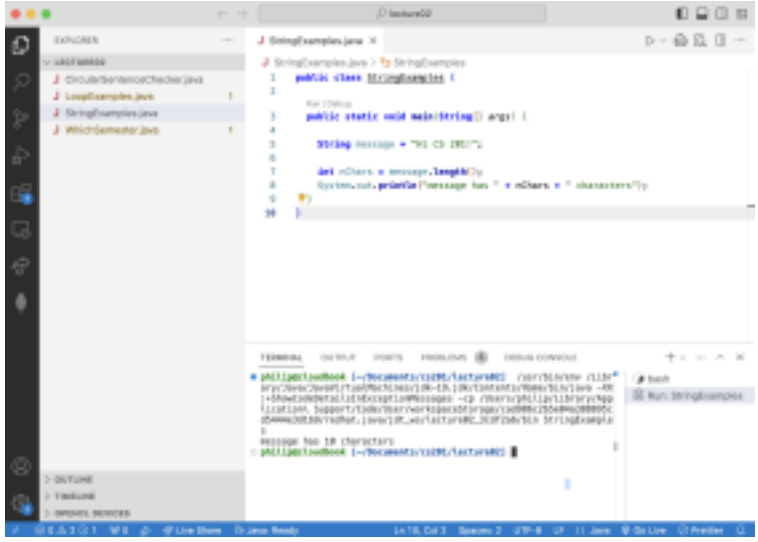
Breaking down `public static void main` (PSVM).

```
1 public class HelloWorld {
2     public static void main(String[] args) {
3         System.out.println("Hi CS 201!");
4     }
5 }
```

- `public`: accessible by other classes,
- `static`: don't need to create an instance of the `class` (i.e. an object), can use the `class` name directly via the dot operator `.` (e.g. we can call `HelloWorld.main`),
- Including `static` is similar to excluding `self` in a `Python` class method.
- `void`: this method returns nothing,
- `main`: starting-point of the program.

Following along with the examples for today.

- Download the file from the `code` link at go/cs201 for today's class.
- Extract the contents (`lecture02`) and then move this folder to your `cs201` folder.
- Open **VS Code**, then `File -> Open Folder`, navigate to the `lecture02` folder and open it.



A note about `Java` primitive types:

Name	Type	Range
`boolean`	Boolean	`true` or `false`
`char`	16-bit Unicode character	`\u0000` (0) to `\uffff` (65,536)
`byte`	8-bit integer	$[-128, 127]$
`short`	16-bit integer	$[-2^{15}, 2^{15} - 1]$
`int`	32-bit integer	$[-2^{31}, 2^{31} - 1]$
`long`	64-bit integer	$[-2^{63}, 2^{63} - 1]$
`float`	32-bit real	$[-3.4028\text{e}38, 3.4028\text{e}38]$
`double`	64-bit real	$[-1.7977\text{e}308, 1.7977\text{e}308]$

Note: `String` is not a primitive type!

Practice with `String`s! Please open `StringExamples.java`

The `String` class has some useful **methods**. We can call them using `.` on an instance of a `String`:

- `length()`: returns the number of characters.
- `charAt(i)`: returns the `char` at (integer) index `i`.
- `toUpperCase()`: returns `String` in which each character is converted to upper-case.
- `toLowerCase()`: returns `String` in which each character is converted to lower-case.
- `replace(oldChar, newChar)`: returns `String` in which each character equal to `oldChar` is replaced with `newChar`.
- `equals(otherStr)`: returns whether all `char`s match those in `otherStr` (in order),
- `substring(start, end)`: returns `String` with `char`s from `start` to `end`.

What were some of the types returned by the `String` methods we used?

A little more about the difference between `static` and dynamic methods.

Here, we have an instance of a `String` (object), `length()` is not `static`.

```
1 public class HelloWorld {
2     public static void main(String[] args) {
3         String message = "Hello, World!";
4         int nChars = message.length();
5     }
6 }
```

Here, we want to call the `speak` method of the `HelloWorld` class, but since it's called from `HelloWorld.main` (which is `static`), that method needs to be declared `static` too. Otherwise we'll get a compiler error: `non-static method speak() cannot be referenced from a static context`.

```
1 public class HelloWorld {
2     public static void speak() {
3       System.out.println("Hello, World!");
4     }
5
6     public static void main(String[] args) {
7         speak(); // can also use HelloWorld.speak()
8     }
9 }
```

But! There's another way: we can create an **instance** of the `HelloWorld` class and then make the `speak` function dynamic (more on this next week).

Use a search engine (e.g. Google) to search for "java PrintStream".

Then look for a function we've used a lot so far... (hint: to print things).
What does this function return?

void	println() Terminates the current line by writing the line separator string
void	println(boolean x) Prints a boolean and then terminate the line
void	println(char x) Prints a character and then terminate the line.
void	println(char[] x) Prints an array of characters and then terminate the line.
void	println(double x) Prints a double and then terminate the line.
void	println(float x) Prints a float and then terminate the line.
void	println(int x) Prints an integer and then terminate the line
void	println(long x) Prints a long and then terminate the line.
void	println(Object x) Prints an Object and then terminate the line.
void	println(String x) Prints a String and then terminate the line.

Writing our own function to see if the message is friendly.

```
1 public static boolean isFriendlyMessage(String s) {
2   return s.contains(":)");
3 }
```

General format of an `if`-statement.

```
1 if (condition1) {
2   // statements executed when condition1 is true
3 } else if (condition2) {
4   // statements executed when condition1 is false but condition2 is true
5 } else if (condition3) {
6   // statements executed when condition1 and condition2 are false but condition3 is true
7 } else {
8   // statements executed when condition1, condition2 and condition3 are false
9 }
```

Technically, we don't need braces for single-line blocks, but I would still suggest using them.

How to put together conditional statements??

Operators in `Java` are mostly the same as `Python`, except the logical operators.

Operator	Type	Notes	(`Python`)
`+`, `-`	arithmetic	add, subtract	`+`, `-`
`*`, `/`	arithmetic	multiply, divide (note `5/4` gives `1`)	`*`, `/`
`%`	arithmetic	modulus (e.g. `5 % 2` gives `1`)	`%`
`<`, `<=`	comparative	less than, less than or equal to	`<`, `<=`
`>`, `>=`	comparative	greater than, greater than or equal to	`>`, `>=`
`==`	comparative	equality (ONLY for primitive types: `boolean`, `byte`, `short`, `int`, `long`, `float`, `double`, `char`)	`==`
`!`	logical	logical NOT	`not`
`&&`	logical	logical AND	`and`
`||`	logical	logical OR	`or`

Example: please open `WhichSemester.java`

```java
public class WhichSemester {

  // x is the month, should be between [1, 12]
  public static String whichSemester(int x) {
    if (x == 1) { // January
      return "Winter";
    } else if (x > 1 && x <= 5) { // February - May
      return "Spring";
    } else if (x > 8 && x <= 12) { // September - December
      return "Fall";
    }
    return ""; // no semester
  }

  public static void main(String[] args) {
    String semester = whichSemester(4);
    if (semester.length() == 0) { // can also use semester.isEmpty()
      System.out.println("We're on break!");
    } else {
      System.out.println("It's the " + semester + " semester");
    }
  }
}
```

General format of a for-loop.

```
1 for (initialization; continue_condition; step_statement) {
2   // statements executed while continue_condition is true
3 }
```

Example:

```
1 for (int i = 0; i < 10; i++) {
2   System.out.println(i);
3 }
```

Please open `LoopExamples.java`

Be careful with the scope of variables.

Variables declared within { } can only be used within the { } or within nested blocks (conditionals, loops).

```
1 for (int k = 0; k < 10; k++) {
2   int kSquared = k * k;
3   System.out.println(kSquared);
4 }
5 System.out.println(kSquared); // compiler error: cannot find symbol
```

We can also write the previous `for`-loops using a `while`-loop.

```
1 int i = 0;
2 while (i < message.length()) {
3   c = message.charAt(i);
4   System.out.println(c);
5   i++;
6 }
```

or:

```
1 int i = 0;
2 while (true) {
3   if (i >= message.length()) break; // one-line if-statement!
4   c = message.charAt(i);
5   System.out.println(c);
6   i++;
7 }
```

Exercise: write a circular sentence checker in `CircularSentenceChecker.java`

A circular sentence is a sentence in which:

- The first letter of the sentence is the same as the last letter of the sentence.
- The last letter of one word is the first letter of the next word.
- Assume there is one space between words.

Examples (not very good ones, I'm sorry):

- you use extra avocado on noodles strangely
- Middlebury yields some extra adventurous students studying gladly yonder researching good data at the ecosystem

Possible Solution to circular sentence checker.

```java
public class CircularSentenceChecker {
    public boolean isCircularSentence(String sentence) {
      sentence = sentence.toLowerCase();
      int n = sentence.length();
      char first = sentence.charAt(0);
      for (int i = 0; i < n; i++) {
          if (sentence.charAt(i) == ' ') {
              if (sentence.charAt(i - 1) != sentence.charAt(i + 1)) return false;
          }
      }
      return (sentence.charAt(n - 1) == first);
    }

    public static void main(String[] args) {
      boolean result = isCircularSentence("you use extra avocado on noodles strangely");
      System.out.println(result); // prints true
    }
}
```

One last note: comments (either single line `//` or multiline `/* */`)

```
1 // this is a single line comment
2
3 /*
4  this is a multiline comment
5  everything here will be ignored by the compiler
6  until it encounters the following symbols (on the next line)
7 */
```

Next week, we'll also look at ways to document our code.

See you tomorrow!

- Please complete Introduction Form if not completed yet (I will use this to determine office hours).
- Submit first exit ticket! (link in the row for today at go/cs201)