CSCI165 Computer Science II
Lab Assignment
Spring 2020

Objectives:

- Install and configure Java
- Install and configure JavaFX
- Define environment variables
- Write the classic Hello World program
- Push code to a remote git repository

Read the following document closely. Whenever you see a section marked **TASK,** this is something you need to do. When you see the word **SUBMISSION**, this means the following should be added to your final submission. The instructions may ask for screen shots. These screenshots are required to prove that you correctly followed the instructions. **In my opinion the superior screen shot tools are**

- **Windows:** Greenshot
- **Linux:** Flameshot

I expect you to be able to figure out how to perform screen shots. Do not submit screen shots of your entire desktop or take pictures of your computer with a phone or camera. These will not be accepted. Only capture active windows or snippets of active windows.

TASK: Create a document (Word, Libra, OpenOffice, Pages) named **<your last name>_LabOne. Save this file into the module-1 directory inside the cloned repository on your machine.** Anytime a screen shot is required you will paste it into this document and **clearly mark what it represents.**

TASK: Download and Install Java 13

The first step in learning a new language is the installation and configuration of the language, followed by the classic Hello World program. The Hello World program allows us to ensure that all language features are configured correctly and we can write, build and run programs.

Begin by downloading and configuring the latest version of Java SE. This download will include the entire Java SE code base as well as a host of tools to compile, debug, run and deploy Java programs.

There are many tutorials online that will walk you through this installation. I have linked some videos below . . . choose the video that fits your operating system and follow along. If you need additional information on this task an Internet search will turn up ample results. Here are some important things for you to keep in mind while watching these videos

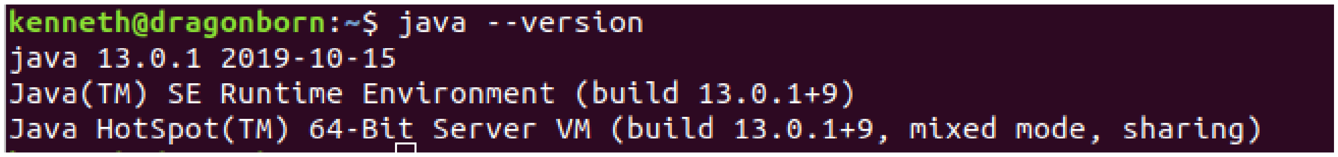
1. All code examples in this course will be compiled and executed with Java 13
2. Some post installation configuration may have to happen. This may include setting the following environment variables: PATH, CLASSPATH and JAVA_HOME

Windows: https://www.youtube.com/watch?v=bIl48gbFiEc

Mac OSX: https://www.youtube.com/watch?v=y6szNJ4rMZ0

Linux: https://www.youtube.com/watch?v=88_a3h2rTk8

When you have completed the installation and configuration you can check your version using the following terminal command: **java --version**



```
kenneth@dragonborn:~$ java --version
java 13.0.1 2019-10-15
Java(TM) SE Runtime Environment (build 13.0.1+9)
Java HotSpot(TM) 64-Bit Server VM (build 13.0.1+9, mixed mode, sharing)
```

If you get output similar to that shown above then all is well.

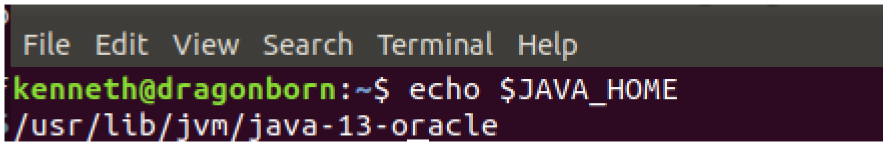
If you get a **Command Not Found** error message after installing the language that means that you need to configure your PATH environment variable. Oracle has some great info on this: https://java.com/en/download/help/path.xml

SUBMISSION: Capture a screen shot similar to the one above showing that you have successfully installed Java 13. Paste this into your submission document.

TASK: Another common configuration is to set a JAVA_HOME variable. Also do this

https://www.baeldung.com/java-home-on-windows-7-8-10-mac-os-x-linux

Make sure you understand this concept as it is common in library configuration. Matter of fact it directly applies to the installation and configuration of JavaFX. You can check your variable using the **echo** command. Windows users will need to place %% around the variable name.



```
kenneth@dragonborn:~$ echo $JAVA_HOME
/usr/lib/jvm/java-13-oracle
```

SUBMISSION: Capture a screen shot similar to the one above showing that you have successfully created the JAVA_HOME variable. Paste this into your submission document.

JavaFX

JavaFX is a software platform for creating and delivering desktop applications, as well as rich Internet applications (RIAs) that can run across a wide variety of devices. JavaFX is intended to replace Swing as the standard GUI library for Java SE, but both will be included for the foreseeable future. JavaFX has support for desktop computers and web browsers on Microsoft Windows, Linux, and macOS. Since the JDK 11 release in 2018, JavaFX is part of the open-source OpenJDK, under the OpenJFX project.

JavaFX 1.1 was based on the concept of a "common profile" that is intended to span across all devices supported by JavaFX. This approach makes it possible for developers to use a common programming model while building an application targeted for both desktop and mobile devices and to share much of the code, graphics assets and content between desktop and mobile versions. To address the need for tuning applications on a specific class of devices, the JavaFX 1.1 platform includes APIs that are desktop or mobile-specific. For example, JavaFX Desktop profile includes Swing and advanced visual effects.

TASK: Download and Install JavaFX here: https://gluonhq.com/products/javafx/

Be sure that you remember where you extracted the archive as we will need this information for the configuration. I extracted to my **home directory**.

Linux:	/home/<username>
Windows:	C:\Users\<username>
Mac OSX:	/Users/<username>

You can put these libraries where you like, **but you need to know where they are.** We also need to inform the JDK tools where these libraries are. We will do that with another environment variable.

JavaFX Configuration
This is the tricky part. JavaFX used to come bundled with the JDK and as such was included in the default build path. This made compiling and executing GUI applications quite easy. Now that JavaFX is being developed as part of the OpenJFX project, the download and configuration is separate from the JDK.

Let’s create a new environment variable to conveniently hold the path to the JavaFX installation location. On my Linux system this path is:

~/javafx-sdk-11.0.2/lib

What is your path? I’ll tell you a secret . . . **I do not know.** Revisit the material on setting environment variables from before and create a new variable called JAVAFX

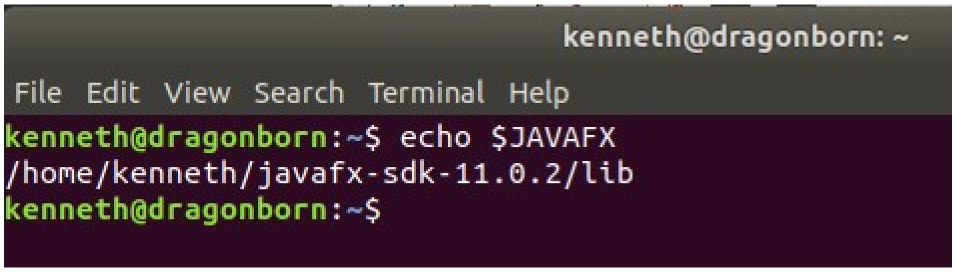
Linux and Mac
Add the following line to the **.bashrc** file found in your home directory or **.profile**:

```
JAVAFX="/home/kenneth/javafx-sdk-11.0.2/lib"
```

IMPORTANT: Obviously you cannot put **/home/kenneth** in this path. Adapt this concept to your machine.

Windows
Click through the labyrinthine menus to find the environment variables window. Add a new variable called JAVAFX and provide the appropriate path.

Check your variable. Linux and Mac



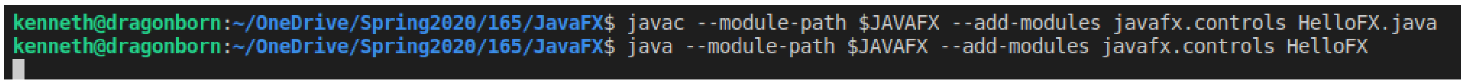
```
kenneth@dragonborn:~$ echo $JAVAFX
/home/kenneth/javafx-sdk-11.0.2/lib
kenneth@dragonborn:~$
```

Windows users execute: **echo %JAVAFX%**

SUBMISSION: Capture a screen shot similar to the one above showing that you have successfully created the JAVAFX variable. Paste this into your submission document.

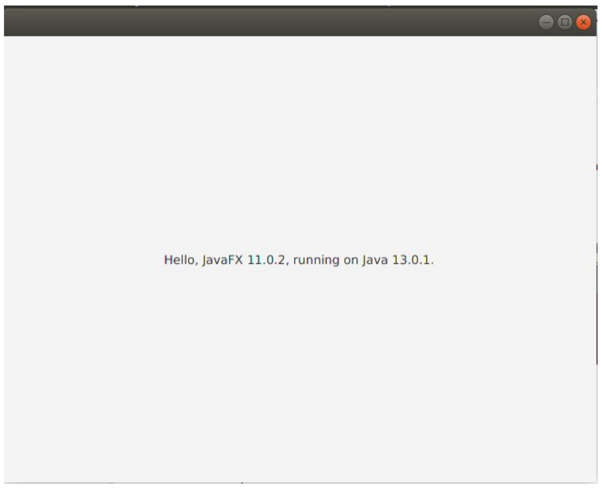
TASK: Test your installation

1. Open a terminal
2. Navigate to the folder containing the file **HelloFX.java** (it came with the repository)
3. Compile and run using the following syntax.



```
kenneth@dragonborn:~/OneDrive/Spring2020/165/JavaFX$ javac --module-path $JAVAFX --add-modules javafx.controls HelloFX.java
kenneth@dragonborn:~/OneDrive/Spring2020/165/JavaFX$ java --module-path $JAVAFX --add-modules javafx.controls HelloFX
```

- The first command compiles the source code to byte code
- The second command launches the application. If all goes well you should see a window resembling the following



```
Hello, JavaFX 11.0.2, running on Java 13.0.1.
```

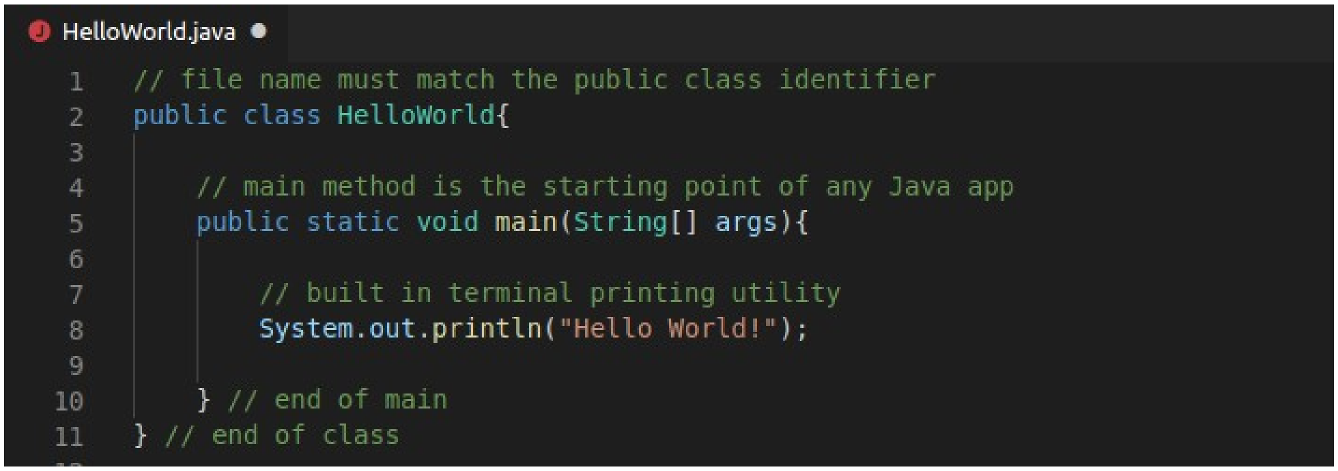
Don't worry . . . I know this is a complicated workflow but we will be making this easier when we switch to Eclipse.

SUBMISSION: Capture a screen shot similar to the one above showing that you can successfully execute a JavaFX application. Paste this into your submission document.

TASK: Hello World

Using the code editor of your choice key in the following code and save the file as **HelloWorld.java** Save the file into the cloned repository in the **module-1** directory. Take care to spell everything correctly and match case. Java is a case-sensitive language.

File Names: A file that defines a public Java class named ClassName must be saved in a text file named ClassName.java. Otherwise an error will result.


HelloWorld.java

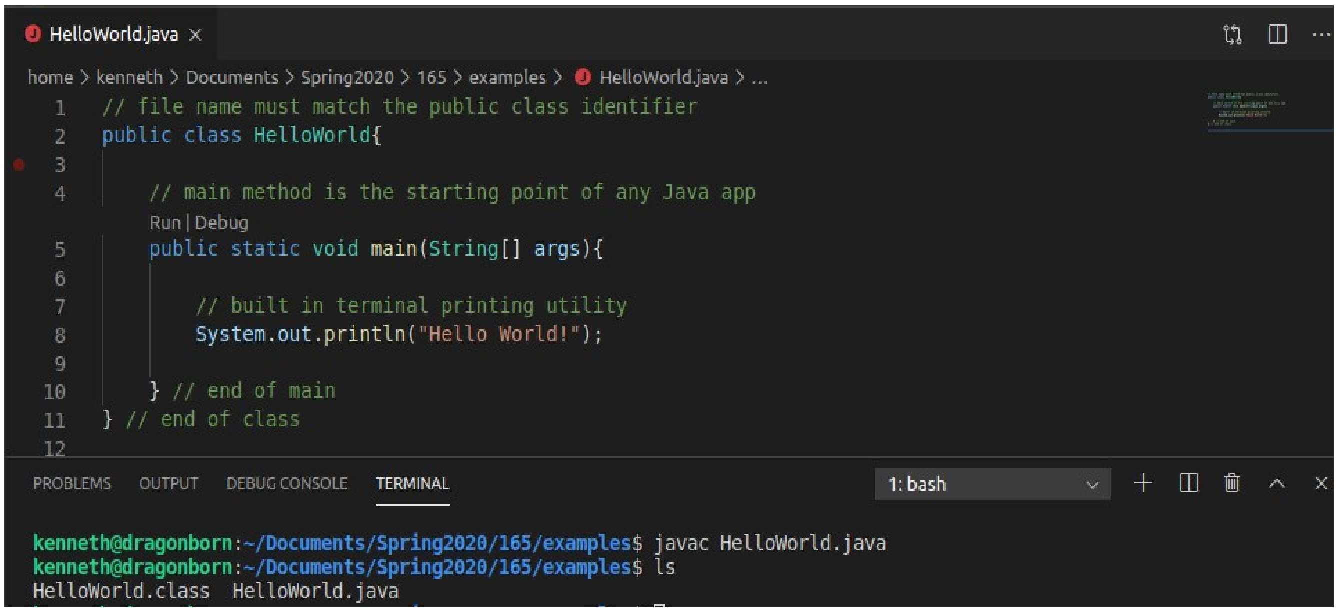
```java
// file name must match the public class identifier
public class HelloWorld{

    // main method is the starting point of any Java app
    public static void main(String[] args){

        // built in terminal printing utility
        System.out.println("Hello World!");

    } // end of main
} // end of class
```

Compile:

Recall that before you can run a Java source program you have to compile it into the Java bytecode, the intermediate code understood by the Java Virtual Machine (JVM). Source code for both applets and applications must be compiled. To run a Java program, the JVM is then used to interpret and execute the bytecode. The Java SE comes in two parts, a runtime program, called the Java Runtime Environment (JRE) and a development package, called the Software Development Kit (SDK). If you are just going to run Java programs, you need only install the JRE on your computer. If you are going to be developing Java programs, you will need to install the SDK as well. The Java compiler is invoked from the terminal using the command **javac.**

Understand that if you did not configure your Java installation successfully, you will receive an error on this step.

1. Make sure you are in the correct directory.
2. Execute **javac HelloWorld.java**


HelloWorld.java
home > kenneth > Documents > Spring2020 > 165 > examples > HelloWorld.java > ...
Run | Debug
PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
1: bash

```java
// file name must match the public class identifier
public class HelloWorld{

    // main method is the starting point of any Java app
    public static void main(String[] args){

        // built in terminal printing utility
        System.out.println("Hello World!");

    } // end of main
} // end of class

```

```
kenneth@dragonborn:~/Documents/Spring2020/165/examples$ javac HelloWorld.java
kenneth@dragonborn:~/Documents/Spring2020/165/examples$ ls
HelloWorld.class  HelloWorld.java
```

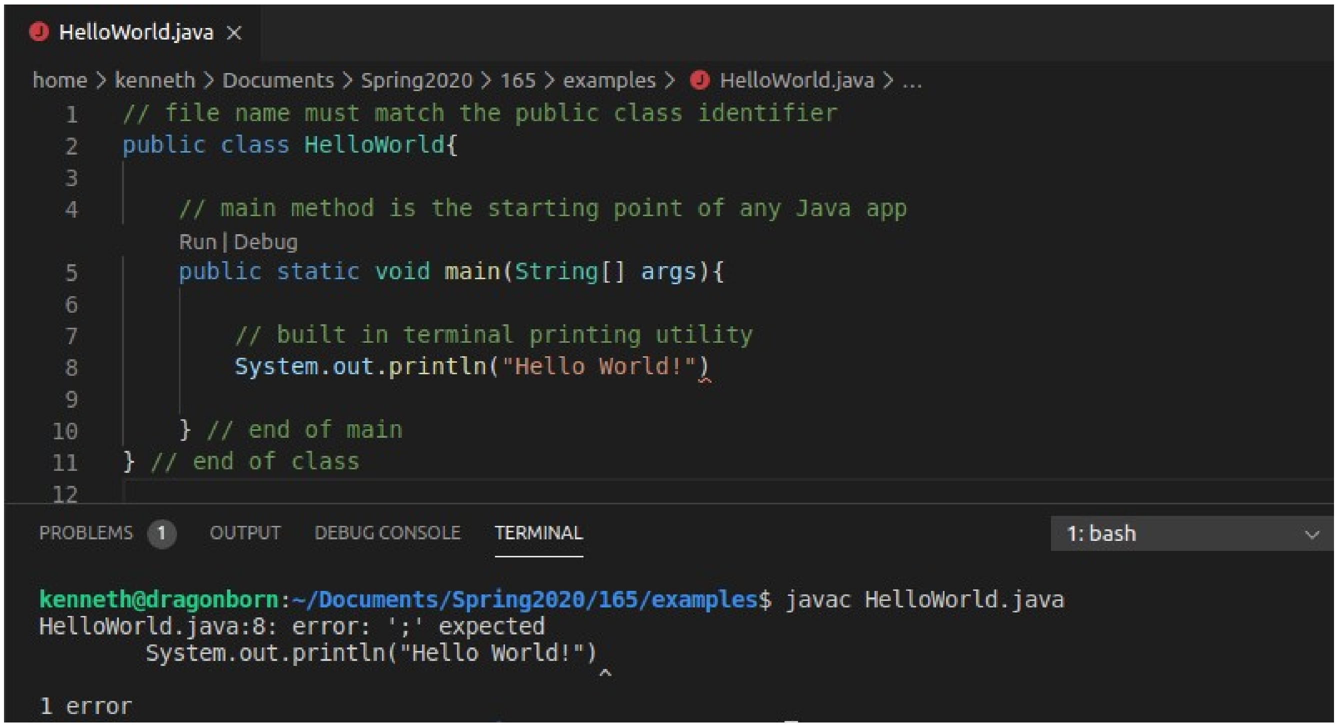
The compilation step is an important one. This is where you will be notified of any syntax errors that may occur. If your code builds with no errors, there will be no messages. You could then do a directory listing and see that a new file was generated. This file will have the same name as the original but it will have a **.class** extension. This class file is the byte-code version of the original source code.

Compilation With a Syntax Error

In this version I have purposefully included a syntax error to show the compiler output. If you receive syntax errors when you build your code you need to

1. Carefully read the error messages. Lots of helpful information here
2. Fix the error(s) by editing the source code file.
3. Save your changes and recompile

This error message is telling me I have an error in **HelloWorld.java on line 8** and that the error is due to a missing semi-colon. This is an easy error for the program to spot, but that is not always the case. Pay very close attention!!


HelloWorld.java
home > kenneth > Documents > Spring2020 > 165 > examples > HelloWorld.java > ...
Run | Debug
PROBLEMS 1
OUTPUT
DEBUG CONSOLE
TERMINAL
1: bash

```java
// file name must match the public class identifier
public class HelloWorld{

    // main method is the starting point of any Java app
    public static void main(String[] args){

        // built in terminal printing utility
        System.out.println("Hello World!")

    } // end of main
} // end of class

```

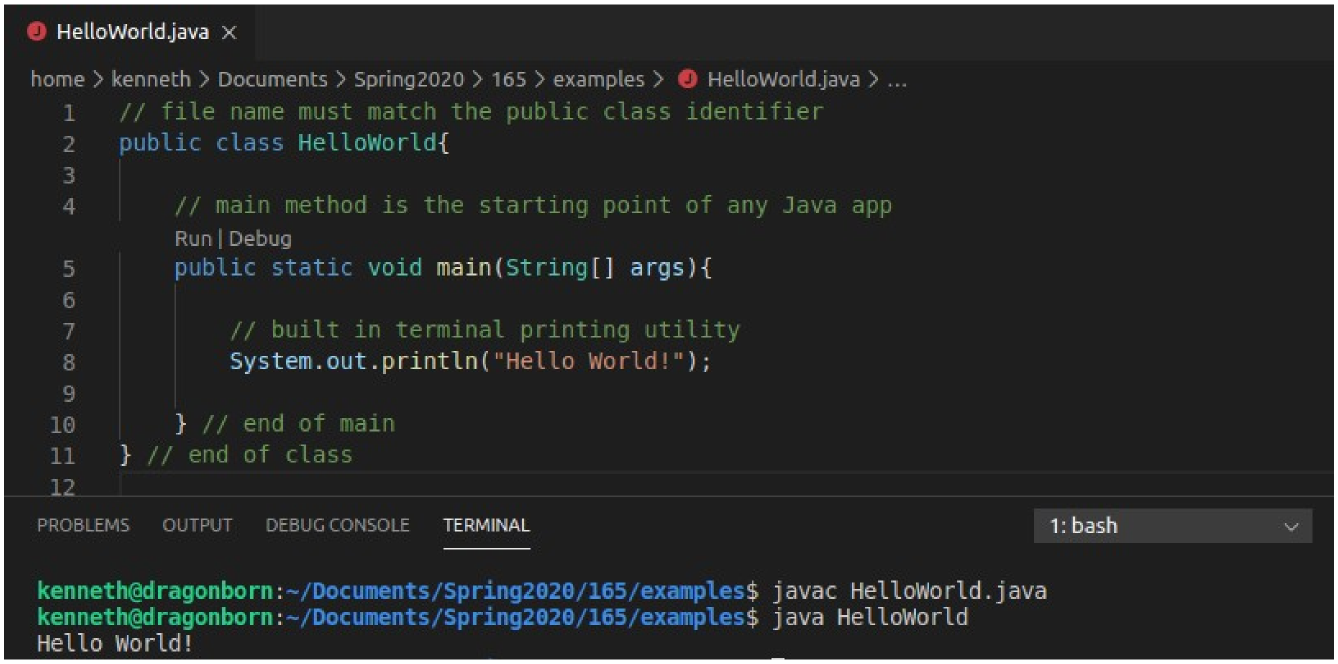
```
kenneth@dragonborn:~/Documents/Spring2020/165/examples$ javac HelloWorld.java
HelloWorld.java:8: error: ';' expected
        System.out.println("Hello World!")
                                          ^
1 error
```

Program Execution:

In order to run (or execute) a program on any computer, the program's executable code must be loaded into the computer's main memory. For Java environments, this means that the program's .class file must be loaded into the computer's memory, where it is then interpreted by the Java Virtual Machine. To run a Java program on Linux systems or at the Windows command prompt, type

java ProgramName

When executing Java code you leave off the **.class** file extension. This command loads the JVM, which will then load and interpret the application's bytecode (HelloWorld.class). The "HelloWorld" string will be displayed on the command line. To run within an IDE, which do not typically have a command line interface, you would select the compile and run commands from a menu. Once the code is compiled, the run command will cause the JVM to be loaded and the bytecode to be interpreted. The "Hello, World!" output would appear in a text-based window that automatically pops up on your computer screen. In any case, regardless of the system you use, running the HelloWorld console application program will cause the "Hello, World!" message to be displayed on some kind of standard output device


HelloWorld.java
home > kenneth > Documents > Spring2020 > 165 > examples > HelloWorld.java > ...
Run | Debug
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
1: bash

```java
// file name must match the public class identifier
public class HelloWorld{

    // main method is the starting point of any Java app
    public static void main(String[] args){

        // built in terminal printing utility
        System.out.println("Hello World!");

    } // end of main
} // end of class

```

```
kenneth@dragonborn:~/Documents/Spring2020/165/examples$ javac HelloWorld.java
kenneth@dragonborn:~/Documents/Spring2020/165/examples$ java HelloWorld
Hello World!
```

SUBMISSION: Take a screen shot of your program being compiled and executed from the terminal. Paste this into your submission document.

Notes on the program structure

Java is known as a verbose language, and it does take a bit of syntax to organize even the simplest of programs into a runnable state; especially compared to a language like Python. Here are some things to focus on understanding at this point. (Understand that some of these items will be discussed in more detail as the course progresses.

1. **Everything is a class:** Well . . . almost everything. As Java is an object-oriented programming language the **class** is the basic structure. We will be spending the remainder of the semester discussing classes, so at this point just understand that you need a class to create a Java program. Source code file names must match the public class name with a **.java** extension.
2. **{} mark scoped blocks of code:** If you have experience with C/C++, JavaScript or C# you are used to curly braces marking the beginning and ending of a block of code. Where Python uses indentation to mark code blocks, Java uses a **{** to mark the beginning of a code block, and **}** to mark the ending of a code block. These items also mark variable scope. Start paying attention to these braces early on because they are the source of countless syntax errors for Java beginners. Also look at the source code and see if you can determine the difference between class scope and method scope. Java also does not require indentation. You could feasibly write an entire Java program on a single line of code but it would be impossible to read and even more impossible to debug and maintain. In this class you are required to use appropriate indentation to enhance readability.
3. **main is the ignition:** While every class does not require a main method, every Java application does. An application can consist of tens or even hundreds of Java classes, but there is only one main method. This method defines the starting point for an application and is the method that is invoked from the Java Virtual Machine when an application is executed. The signature of this

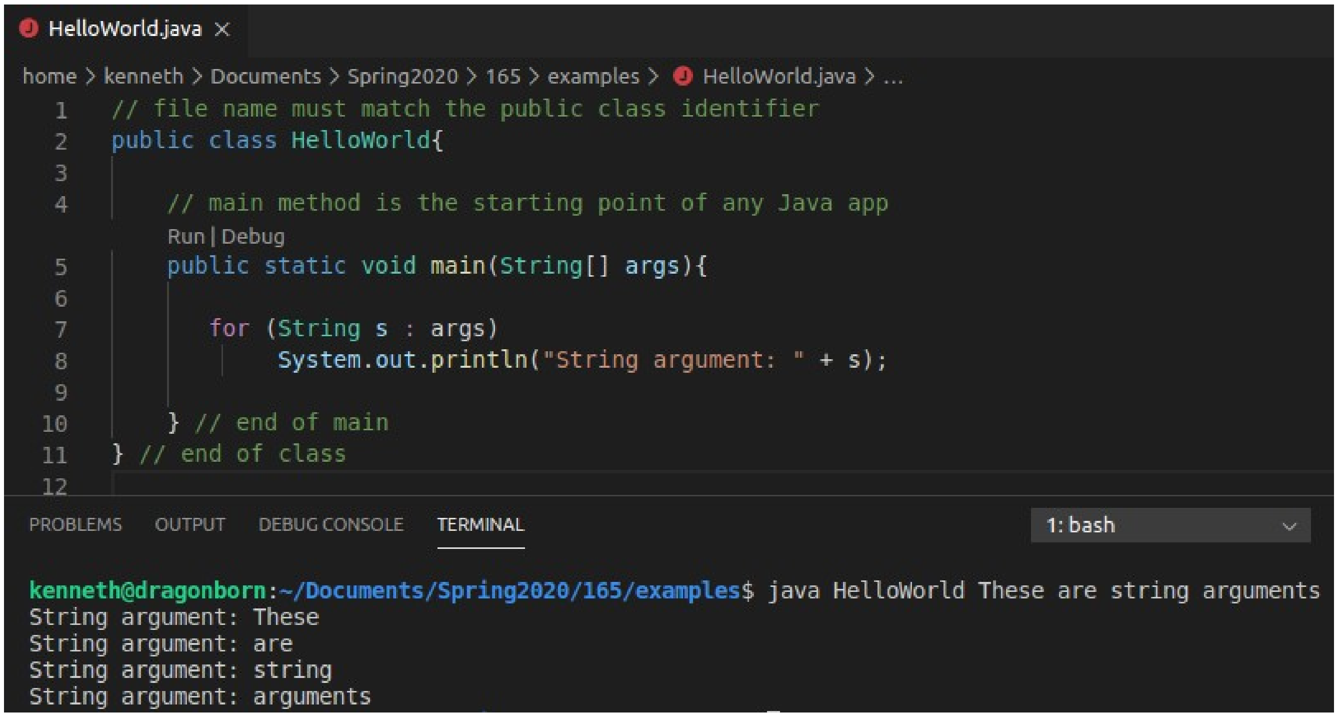
method must be exact or your code will not run. We will be discussing the keywords **public**, **static** and **void** as the course progresses.

4. **Comments are important:** Single line comments in Java are noted with **//.** Internal documentation is important for a well defined program. While I will not expect you to comment obvious things, you are expected to included appropriate documentation. I have found that commenting the ending curly brace of a code block is a helpful reminder. Block comments in Java are denoted with **/*** . . . and ***/**

Command line Arguments:

Java allows programs to accept input from the command line execution of a program. Notice the **String[ ] args** parameter on the main method on line 5 above. This is saying that the main method can accept an array (list) of strings as arguments to the program execution.

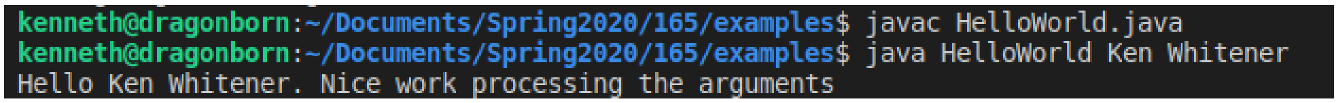
In the example below I have included a simple **for . . . each loop** (more on these later) that iterates through the **args array** printing each command line argument. Pay close attention to the output and the command line syntax I used to run the program.


HelloWorld.java
home > kenneth > Documents > Spring2020 > 165 > examples > HelloWorld.java > ...
Run | Debug
PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
1: bash

```java
// file name must match the public class identifier
public class HelloWorld{

    // main method is the starting point of any Java app
    public static void main(String[] args){

        for (String s : args)
            System.out.println("String argument: " + s);

    } // end of main
} // end of class

```

```
kenneth@dragonborn:~/Documents/Spring2020/165/examples$ java HelloWorld These are string arguments
String argument: These
String argument: are
String argument: string
String argument: arguments
```

TASK: Define a new Java source file called **HelloWorld2.java** This program will utilize command line arguments to achieve the following results.



```
kenneth@dragonborn:~/Documents/Spring2020/165/examples$ javac HelloWorld.java
kenneth@dragonborn:~/Documents/Spring2020/165/examples$ java HelloWorld Ken Whitener
Hello Ken Whitener. Nice work processing the arguments
```

Note: Java arrays can be indexed in the same fashion as Python lists and C/C++ arrays. Use the overloaded **+** operator to perform concatenation.

SUBMISSION: In your module-1 directory you should have the following files

1. **<your last name>_LabOne**
2. **HelloWorld.java**
3. **HelloWorld2.java**

Along with the original files that came with the cloned repository. You don't need to worry about those files as they will not be pushed to the remote repository because they have not changed. Pretty neat.

SUBMISSION REQUIREMENTS: This submission process is part of the course and as such is worth points. Make sure you understand it. Review the material on git or watch some videos. I have described each step in detail. Let's talk about this on Discord.

From the terminal, inside the **tc3-csci165-online** repository, run the following git commands

1. **git status:** This should show you that you have un-staged files in your repository. These will show up in red. These are files that are either new or have changed since the clone.

2. **git add <file>:** Stage the files for committing by running the **git add** command. You will have to either run this ***for each file*** by name or by using the wildcard **git add ***
   The wildcard is fine but you don't always want to stage **every file . . .** for instance, I don't care about your .class files, **so please do not submit those. This means do not stage these files.** If you are interested, research the ***.gitignore*** file and add one to include .class files. Then they will not show up as un-staged changes when you run git status.

3. **git commit -m "lab submission for module 1":** Commits require that you include a message about the commit. That is what the **-m** flag is for. Use messages that are descriptive and understand that I will be able to see these. The push command simply updates your personal repository. The changes are not pushed to the remote repo on GitHub

4. **git push:** This will push your changes to your remote repository on GitHub. You will probably be asked for your GitHub credentials. Enter them. This can become a hassle if you push often (which you shouldn't). Learn how to cache your credentials or use ssh with encryption keys if this bothers you. https://help.github.com/en/github/authenticating-to-github/connecting-to-github-with-ssh

5. You should now be able to see your new files through the GitHub UI

I will grade your work by fetching updates from your personal repository. You do not need to submit anything to Blackboard ***unless explicitly instructed to***.

Rubric

Requirement	**Points**
Correctness: Code functions as required. Output matches example format	10 points
Style: File naming, Indentation and appropriate comments	2 points
Screenshots: Submitted and complete	3 points
Submission: Followed submission requirements	5 points