Objectives

- Basics of Java Syntax
- Java fundamentals
  - Primitive data types
  - Static typing
  - Arithmetic operators
  - Relational operators

Review

- What are qualities of good software?
- What is Java?
  - Benefits to using Java?
- How do you compile a Java program?
  - How do you run/execute a Java program?

Purpose of questions?

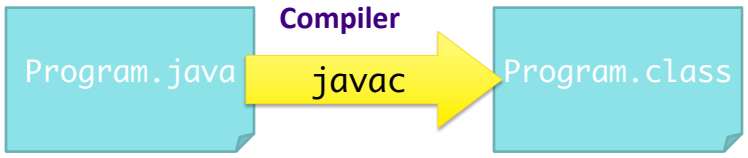
Review: Benefits of Java

- Rapid development of programs
  - Large library of classes, including GUIs, Enterprise-level applications, Web applications
- Portability
  - Run program on multiple platforms without recompiling
- Statically-typed language
  - Compiling - find some errors before execution, performance benefits

Review: Java Programming Language

- Entirely object-oriented
- Similar to Python

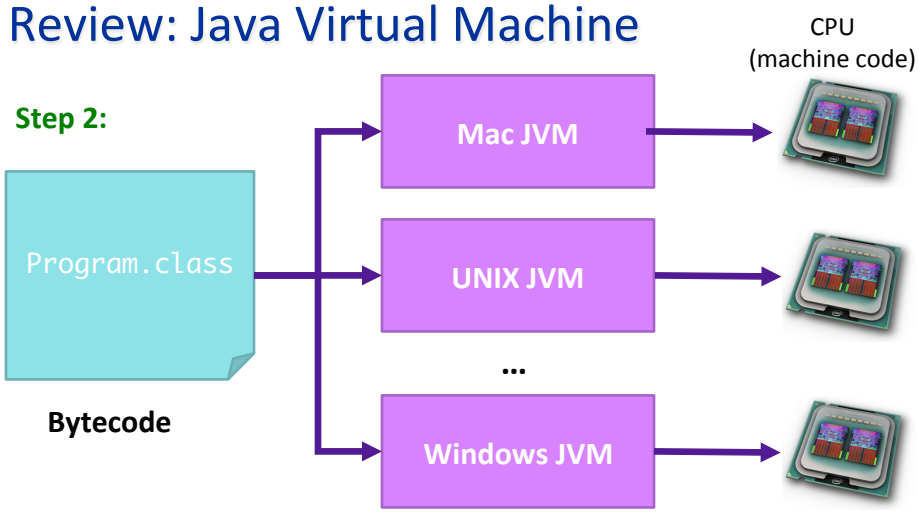
Step 1:



Written in Java Programming Language

Bytecode: machine code for a virtual CPU

Review: Java Virtual Machine



- Same **bytecode** executes on each platform
- Don't need to provide the source code

Java Class Libraries

- Pre-defined classes
  - Included with Java Development Kit (JDK) and Java Runtime Environment (JRE)
  - View the available classes online:
    `http://docs.oracle.com/javase/8/docs/api/`
- Similar in purpose to modules included with Python

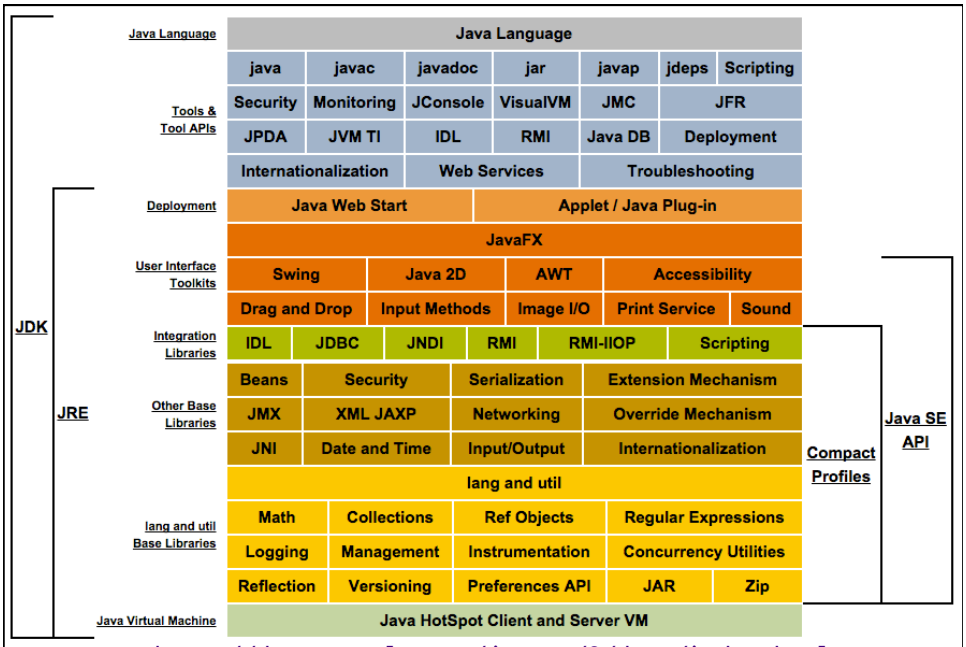


Image from http://docs.oracle.com/javase/8/docs/index.html

Benefits of Java

- Rapid development of programs
  - Large library of classes, including GUIs, Enterprise-level applications, Web applications
- Portability
  - Run program on multiple platforms without recompiling
- Statically-typed language
  - Compiling: find some errors before execution!
  - Can give performance boost by doing optimizations

Which 'Java' is this class about?

- Java programming language
- Java class libraries

- Use the JVM but won't learn about how it works
  - For more information: http://docs.oracle.com/javase/specs/

Aside: JavaScript vs Java

- JavaScript is **not** Java
  - JavaScript is a *scripting* language, primarily embedded in HTML, executed by Web browsers


```
<script type="text/javascript">
function myFunction() {
    return ("Hello, have a nice day!")
}
</script>
</head>
<body>
<script type="text/javascript">
    document.write(myFunction())
</script>
```

Java Development Kit

- JDK: Java Development Kit
- SDK: Software Development Kit
- Free from Oracle
- Contains
  - **javac**: Java compiler
  - **java**: Java Virtual Machine
  - Java class libraries

http://www.oracle.com/technetwork/java/javase/downloads/index.html

Python Review

```
# a Python program
def main():
     print("Hello")

main()
```

What does this program do?

Example Java Program

```
public class Hello {
   public static void main(String[] args) {
      System.out.println("Hello");
   }
}
```

What are your observations about this program?
What can you figure out?

Example Java Program

```
public class Hello {
   public static void main(String[] args) {
      System.out.println("Hello");
   }
}
```

- Everything in Java is inside a **`class`**
  - Java is *entirely* object-oriented*
  - This class is named **`Hello`**

Example Java Program

Blocks of code marked with { }

```
public class Hello {
   public static void main(String[] args) {
      System.out.println("Hello");
   }
}
```

Defines the class "Hello"

- In general, each Java program file contains **one** class definition*
- Name of the class is name of file
  - E.g., `Hello.java`

Example Java Program

```
public class Hello {
   public static void main(String[] args) {
      System.out.println("Hello");
   }
}
```

Access Modifier:
controls if other classes can use code in this class

Example Java Program

```
public class Hello {
   public static void main(String[] args) {
      System.out.println("Hello");
   }                                    method
}
```

- Class contains one *method*: `main`

Example Java Program: `main` Method

```
public class Hello {
   public static void main(String[] args) {
      System.out.println("Hello");
   }
}
```

- Similar to `main` in Python
  - But *must be* associated with a *class*
- Must take one parameter: an *array* of Strings
  - For command-line arguments
- Must be `public static`
- Must be `void`: data type of what method returns (nothing)
- `main` is automatically called when program is executed from command line

Example Java Program

```
public class Hello {
   public static void main(String[] args) {
      System.out.println("Hello");
   }
}
```

- Method contains one line of code
  - What do you think it does?

Example Java Program: Print Statements

```
public class Hello {
   public static void main(String[] args) {
      System.out.println("Hello");
   }
}
```

- Calls the `println` method on the `System.out` object
- `println` takes one parameter, a `String`
- Displays string on terminal, terminates the line with new line (`\n`) character

Example Java Program: Comments

```
/**
 * Our first Java class
 * @author Sara Sprenkle
 */
public class Hello {
   public static void main(String[] args) {
      //print a message
      System.out.println("Hello");
   }
}
```

- Comments: /* */ or //
  - /** */ are special JavaDoc comments

Code Style

```
/**
 * Our first Java class
 * @author Sara Sprenkle
 */
```

- **Comments** at top of program
  - Must include your name
  - High-level description of program
- Proper **indentation**
  - Similar to Python
  - Everything within sets of {} is indented the same

```
public class Hello {
   public static void main(String[] args) {
      System.out.println("Hello");
   }
}
```

What are the Differences?

```
# a Python program
def main():
     print("Hello")

main()
```

```
/**
 * Our first Java class
 * @author Sara Sprenkle
 */
public class Hello {
   public static void main(String[] args) {
      //print a message
      System.out.println("Hello");
   }
}
```


Java vs. Python, so far…

- ***Semantics*** the same, ***syntax*** different
  - Blocks of code
  - End statements
- Access modifiers
- Data type declarations
- Class-based programs
- Compiled

We'll see more differences as we go…

Literal Translation to Python Program?

```
/**
 * Our first Java class
 * @author Sara Sprenkle
 */
public class Hello {
   public static void main(String[] args) {
      //print a message
      System.out.println("Hello");
   }
}
```


Translation to Python Program

```
class Hello:
   """Our first Python class"""

   def __init__(self):
      # fill in later…

   def main(self):
      print ("Hello")
```

Semi-literal translation

JAVA FUNDAMENTALS

Print Statement

- Syntax:

```
System.out.println(<String>);
System.out.print(<String>);
```

No newline

- Similar to Python's `file.write()` method
  - Need to combine parameter into one `String` using +'s
    - Python's `print` used *commas*
  - More on `String` operations later

String Concatenation

- If a string is concatenated with something that is not a string, the other variable is converted to a string.

Note +

```
System.out.println("The answer is " + 78);
```

Automatically converted to a String

Escape Sequences

- Same as Python:

Meaning	Sequence
Newline character (carriage return)	\n
Tab	\t
Quote	\"
Backslash	\\

- In Java, you can print a ' without escaping
- What does the following display?

```
System.out.println("To print a \\, you must
  use \"\\\\\"");
```

First.java

Java keywords/reserved words

- Case-sensitive
- Can't be used for variable or class names
- Reserved words seen so far …
  - `public`
  - `class`
  - `static`
  - `void`
- Exhaustive list
  - `http://docs.oracle.com/javase/tutorial/java/nutsandbolts/_keywords.html`

Data Types

- Java is ***strongly-typed***
  - Every variable must be a **declared type**
- All data in Java is an ***object*** except for the **primitive data types**:

`int`	4 bytes (-2,147,483,648 -> 2,147,483,647)
`short`	2 bytes (-32,768 -> 32,767)
`long`	8 bytes (really big integers)
`byte`	1 byte (-128 -> 127)
`float`	4 bytes (floating point)
`double`	8 bytes (floating point)
`char`	2 bytes (Unicode representation), **single** quotes
`boolean`	`false` or `true`

Variables

- Must be **declared** before used
  - **Syntax**: `<datatype> <name> [= value];`

- Variable names typically start with lowercase letter
  - _ (underscore) also a valid first character
  - Convention: Subsequent words are capitalized
    - Called "Camel Casing"

Variable Examples

- Must be **declared** before used
  - **Syntax**: `<datatype> <name> [= value];`

- Examples:
  - `int x;`
  - `double pi = 3.14;`
  - `char exit = 'q';`
  - `boolean isValid = false;`

Note *must* use single quotes for `chars`

Floats in Java

- Decimal literals are considered *doubles*
- This code won't compile:

```
float f = 3.14;
```

Compiler reads 3.14 as a double

- Compiler error message:

```
Float.java:13: possible loss of precision
found   : double
required: float
        float f = 3.14;
```

- To fix code, add an `f` to specification of number or declare as `double`

Python Transition **Warning**

You cannot **redeclare** a variable name in the same scope

- OK:

```
int x = 3;
x = -3;
```

- Not OK:

```
int x = 3;
int x = -3;
…
boolean x = true;
```

Compiler errors

More Data Type Information

- Default data types
  - Same as Python **2**, **not** Python 3
  - Result of integer division is an `int`
    - Example: `4/3 = ??`
- Casting
  - Similar to Python for primitive types
  - Example: `4/(double) 3`

TestScore.java

Formatted Output

- `printf` or `format`
  - `System.out` is a `PrintStream` object

```
double d1=3.14159, d2=1.45, total=9.43;

// simple formatting...
System.out.printf("%6.5f and %5.2f ", d1, d2);

// %n is platform-specific line separator,
// e.g., \n or \r\n
System.out.printf("%-6s%5.2f%n", "Tax:", total);
```

 Format.java

Constants

- Read-only variables
  - **Cannot** be assigned new values
- Keyword `final` precedes data type
  - Example within a method:

```
final double CM_PER_INCH = 2.540;
```

Why might we want to use constants *within* a method?

Class Constants

- Constant variable for all methods in class or for multiple classes
  - Much more common than constant instance variables
- Requires `static` keyword
  - `static`: "for class"
  - Also used for methods (will see more later)

```
static final double CM_PER_INCH = 2.540;
```

Arithmetic, Relational Operators

- Java has most of the same operators as Python:
  - Arithmetic operators: `+, -, *, /, %`
    - **No power operator:** `**`
  - Relational operators: `==, !=, <, >, <=, >=`
    - Evaluate to a `boolean` value
  - Increment and decrement
    - `+= x, -= y,` etc.
    - Additional shortcut for += 1, -=1: `++ , --`

Unix Output Redirection: >

- We can redirect output to a file
  - For example

```
ls *.java > java_files.out
```

  - Above command saves the output from the `ls` command into the file named `java_files.out`
- This is how you will save output from your Java programs initially
  - For example

```
java Intro > out
```

Please follow instructions on names