Introduction to Java

James Brucker

What is Java?

Java is a language for writing computer programs.

✓ *it runs on almost any "computer".*

- desktop
- mobile phones
- game box
- web server
- embedded device

Why is popular?

Can create many kinds of software...

- mobile apps (Android)
- games
- desktop programs
- web apps & web services

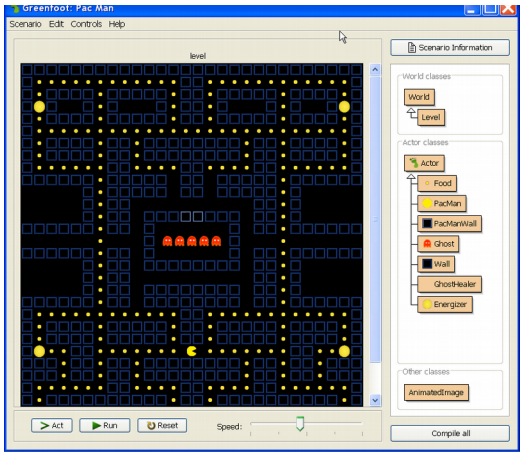
- ✓ *Lots of info, tools, and software*
- ✓ *Runs (almost) anywhere*

What Uses Java?

- OpenOffice (like Microsoft Office)

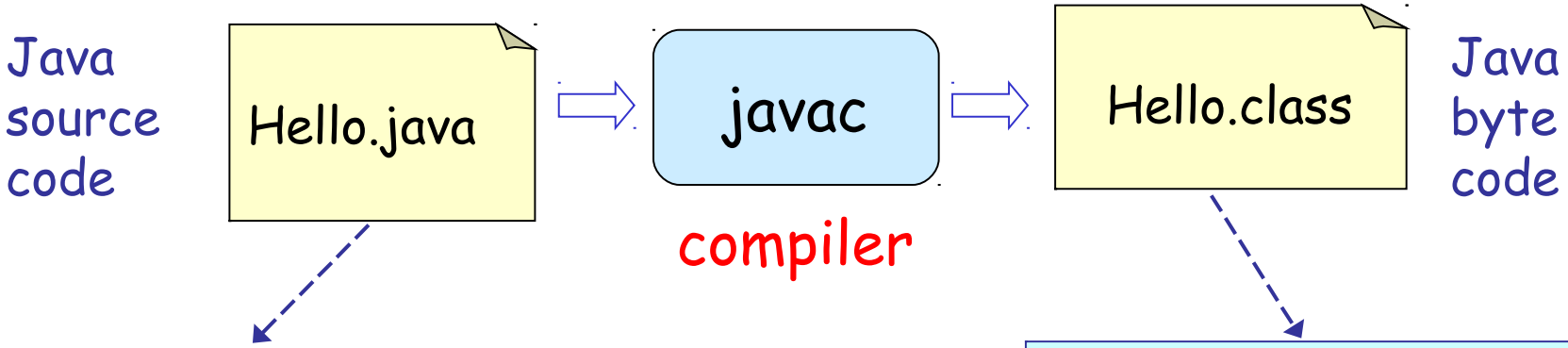
- Firefox
- Google App Engine
- Android

- Minecraft
- Greenfoot



How Java Works: *Compiling*

1. You (programmer) write source code in Java.
2. A compiler checks the code and *translates* it into "byte code" for a "virtual machine".



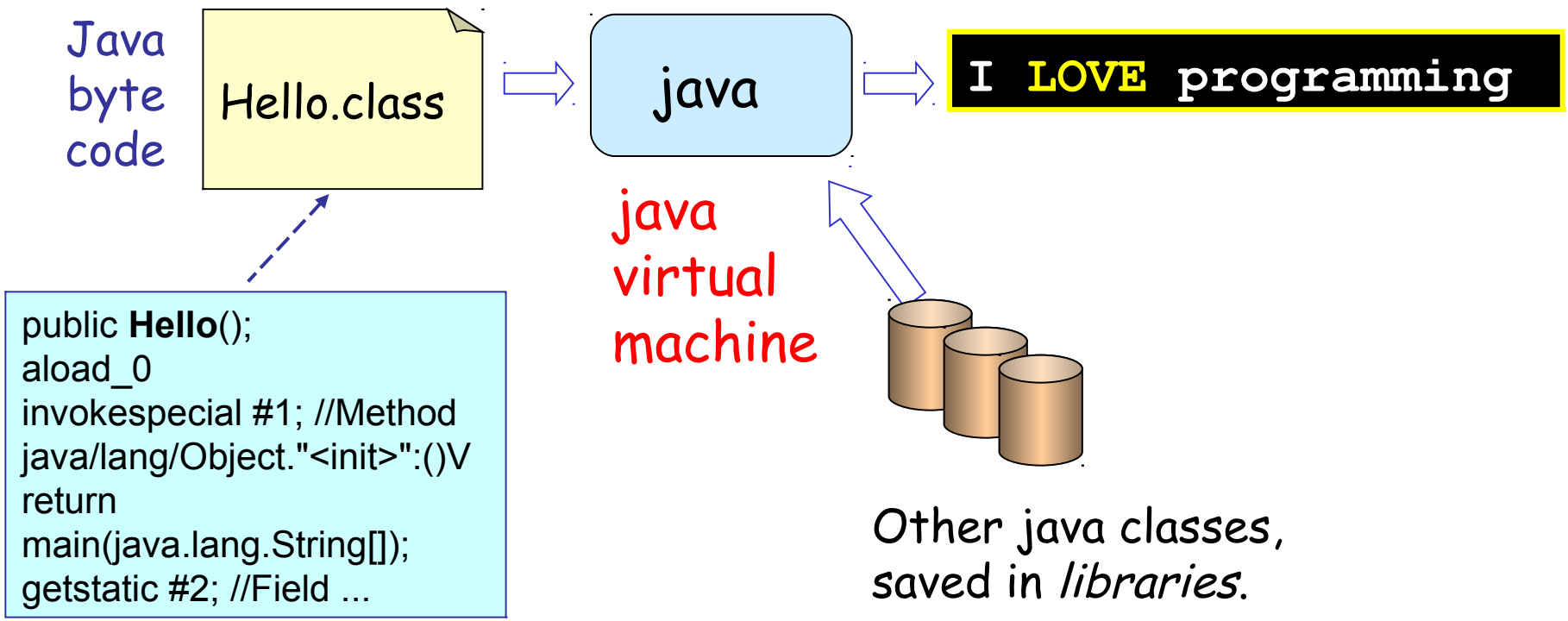

```
public class Hello {
    public static void main( String [ ] args ) {
    System.out.println( "I LOVE programming" );
    }
}
```

```
public Hello();
aload_0
invokespecial #1; //Method
java/lang/Object."<init>":()V
return
main(java.lang.String[]);
getstatic #2; //Field ...
```

How Java Works: *Run the Bytecode*

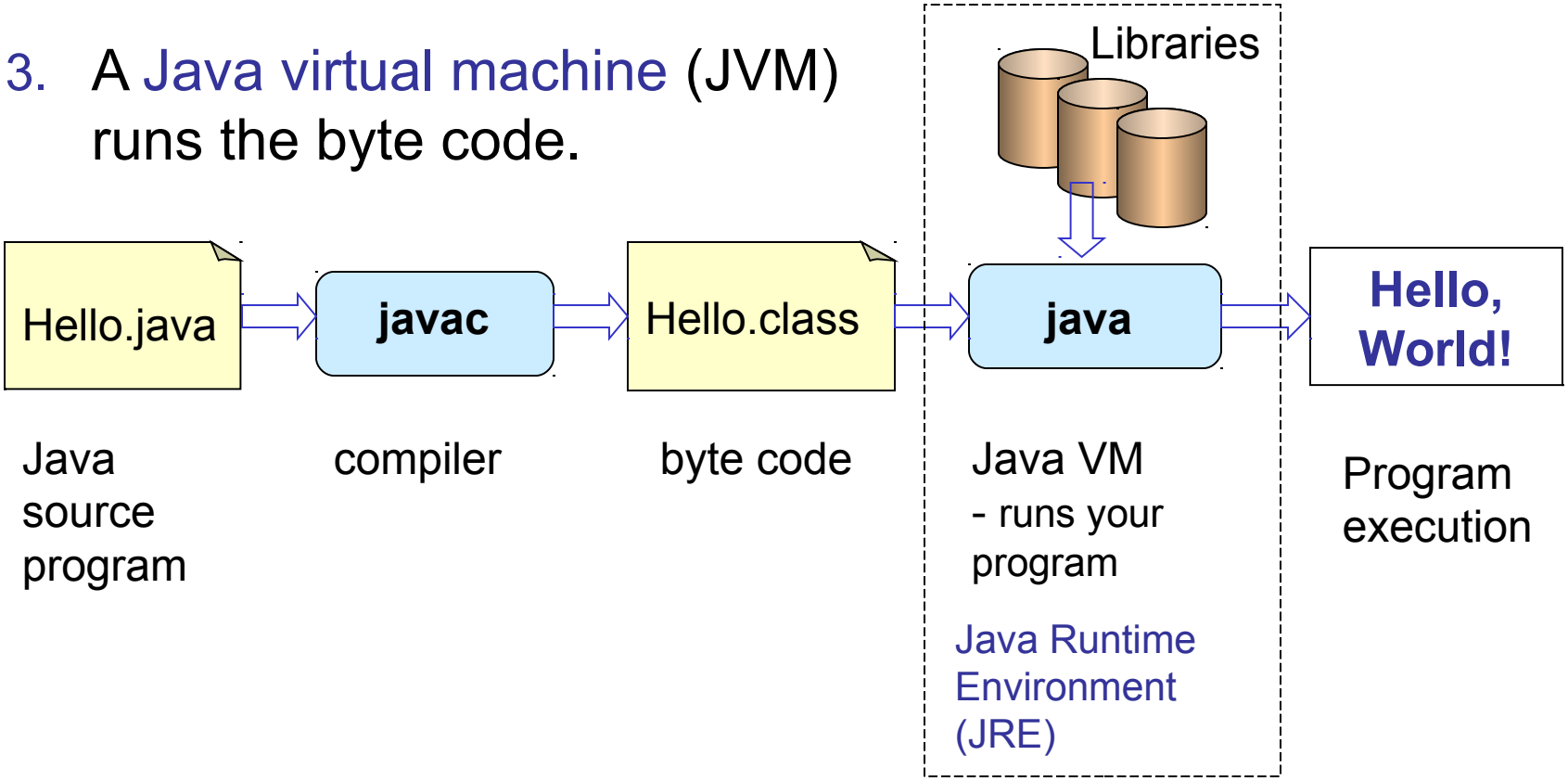
3. *Run* the byte code on a Java Virtual Machine (JVM).

4. The JVM *interprets* the byte code
   and also loads other code from libraries (as needed).



Summary: How Java Works

1. You (programmer) write source code in Java.
2. A Java compiler checks the code and translates it into "byte code".
3. A Java virtual machine (JVM) runs the byte code.



How to Write Source Code?

You can use *any editor* to write the Java code.

- or -

Integrated Development Environment (IDE) such as BlueJ, Eclipse, and Netbeans.

An IDE makes you much more **productive**, but they take some practice...

What you Need

1. install the **Java Development Kit (JDK).**
2. It is helpful to install the **Java documentation**.
3. Integrated Development Environment (IDE) or an editor
   - an IDE makes programming *much* faster
   - BlueJ, Eclipse, Netbeans, IntelliJ

There are several implementations of Java (like OpenJDK) but we will use Oracle's Java, from:

`http://java.oracle.com`

Important: BlueJ *includes* JDK

BlueJ v. 4 for Windows and Mac OSX includes Java JDK

So... if you use BlueJ you **do not need** to download JDK.

Linux: you **do** need to install JDK separately.

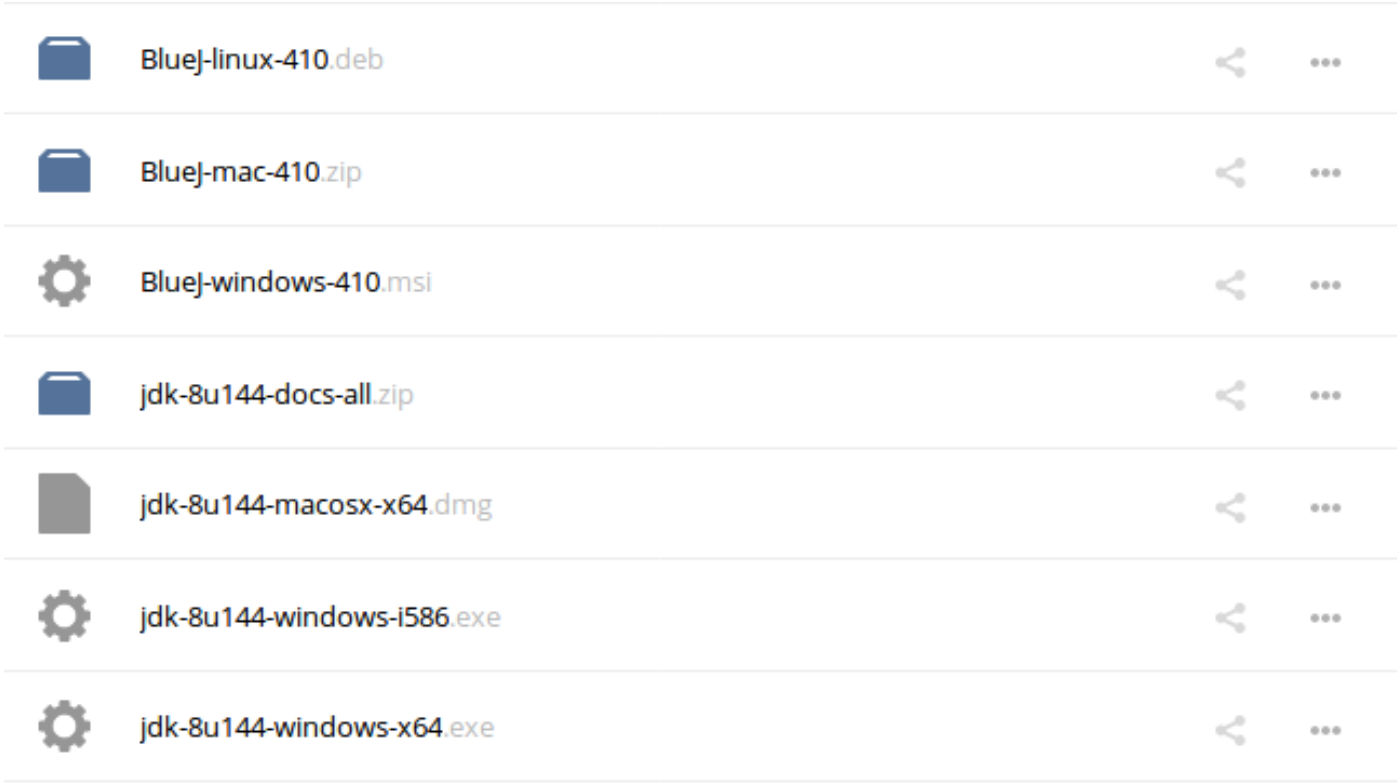
If you use *Eclipse, NetBeans, or IntelliJ*:

install JDK separately.

Download Files at KU

At KU, download everything from **cloubbox**:

https://goo.gl/Ct7nuU



Install Java Development Kit (JDK)

Download "Java SE Development Kit" (JDK) at...

`http://java.oracle.com`

Direct Link:

`http://www.oracle.com/technetwork/java/javase/downloads`

Windows

1. double-click jdk-8u144-windows-x64.exe
2. Install in `C:\java\jdk1.8.0_144`
   (not C:\Program Files)

Ubuntu Linux

1. download debian
2. Install in `C:\java\jdk1.8.0_144`
   (not C:\Program Files)

BlueJ IDE

BlueJ is a simple IDE, but useful for learning Java.

`https://bluej.org`

Note:

BlueJ v.4 for Windows and Mac OSX includes Java JDK.

So... if you use BlueJ you do not need to download JDK.

Installation Notes

- There are some suggestions at the end of these slides
- You can also find videos on YouTube for help installing Java and writing your first program.

What Are We Going to Write?

First version: program will print

```
Hello, human.
```

Second version: program will ask for your name, save it as a String, and print a personal greeting. Example:

```
What is your name?  Cat

Hello, Cat.
```

Third version: we will also get the current time and print it along with greeting like in second version.

Write this Program

1. Use a text editor (WordPad, EditPlus, *not* MS Word).
2. Save this code as Hello.java

Name of the class must be same as name of file

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

Compile and Run the Program

3. *Compile the program using "*javac*".* This translates the source code into byte code.

```
C:> javac  Hello.java
```

4. *Run it.* "java" runs the virtual machine.

```
C:> java Hello

Hello, human.
```

Errors?

javac: Command not found.

This means Java isn't on your PATH environment variable. Fix it. :-)

Hello.java:1 public Class Hello {

^class, interface, or enum expected

Message like this are syntax errors.
Check spelling. Java is case-sensitive.
For example, "`main`" is not "`Main`"

In the above error, the source contains "`Class`" instead of "`class`".

2nd Version: input

In this version we'll see how to read input and how to use a local variable to store the person's name.

The easiest way to read input in Java is with a **Scanner** object. A Scanner *parses* input into strings, numbers, etc

```
import java.util.Scanner;
public class Hello {

    public static void main(String [] args) {
        Scanner console = new Scanner( System.in );
```

import tells the compiler where to find the Scanner class

this declares a variable named "**console**" of type Scanner

What is System.in ?

`System` is a class. It provides access to resources of the operating system.

`System.in` is an *input stream* for reading from the console. But it only reads 1 byte at a time.

`Scanner` is a class. It reads an input and converts the input to numbers, Strings, and more.

```
// create a Scanner object (named console)
Scanner console = new Scanner( System.in );
// read one line of input and save as String
String who = console.nextLine( );
```

2nd Version: main method

Scanner has a *method* named `nextLine( )`. It reads the rest of the input line and converts it to a String.

`System.out.print("string")` does not print a newline after the output.

```
    public static void main(String [] args) {
        System.out.print("What is your name? ");
        String who = console.nextLine( );
        System.out.println("Hello, " + who );
    }
}
```

+ joins two strings together.

Scanner

Scanner methods:

next( ) - read one "word" as a String from console

nextLine( ) - read entire line from console

nextInt( ) - read a number (int) from console

dot notation for object methods

To invoke an object's method, you write the object reference (variable) + "." + the method name:

```
"hello world".length( )      // length of string (11)

// read one line from console (Scanner object)

String s = console.nextLine( ) ;

// read an integer number from console

int n = console.nextInt( );
```

dot notation for object methods

`console` is the name of a variable (an *object reference*) that *refers* to a Scanner object.

To invoke an object's method, you write the object reference (variable) + "." + the method name:

```
String who = console.nextLine( );
```

nextLine method of console object

Compile and Run 2nd Version

Compile (javac) and run (java) the 2nd version:

```
C:> javac  Hello.java
```

```
C:> java  Hello

What is your name? Nerd

Hello, Nerd.
```

3nd Version: decisions

Most programs contain *logic* for *decision making*.

We'll write a program that greets and show the time.

The logic is:

```
get the current time
if time is before 12:00
    print "Good Morning, " + user's name
else
    print "Good Afternoon, " + user's name
print "It is now hh:mm:ss"  (say the actual time)
```

Creating a Date Object

Java has a Date class located in java.util package.

Date has *lots* of methods. getHours( ) returns the hour.

To create a Date *object* with the current date and time, use:

```
Date now = new Date( );
```

To create an *object* from a class, write:

new ClassName( );

Some classes allow parameters when creating a new object, for example:

new Double(0.5); // double with value 0.5

3rd version: using a method

```
import java.util.Date;
import java.util.Scanner;
/** Greeting with time of day. */
public class Hello {
   private static Scanner console = ...;
```

we will add **greet** method here

```
   public static void main( String[] args ) {
      // ask user his name and call greet
      System.out.print("What is your name? ");
      String who = console.nextLine( );
      greet( who );
   }
}
```

greet method

This declares a method named greet that doesn't return anything (**void**) and has one parameter (**name**)

```
public static void greet( String name ) {
   Date now = new Date( );
   if ( now.getHours() < 12 )
      Sytem.out.println("Good morning, "+name);
   else
      System.out.println("Good afternoon, "+name);
   System.out.println("The time is "+now);
}
```

Compile and Run

- Compile (javac) and run (java) the 3rd Hello program.

That's It!

- This program was a quick overview of how to program in Java.
- After this, we'll write code in BlueJ. BlueJ makes it much easier to edit, compile, and run your code.
- In BlueJ, you can also run Java commands interactively, without creating a program.

What do you need to use Java?

Programmer needs the JDK to compile Java code.

- JDK contains many useful tools + JRE
- but its very big (150MB).

To run a Java program you need only:

- "Java Runtime Environment" (JRE) - about 10MB
- contains Java Virtual Machine (JVM) and libraries

Layout of the JDK

`C:/java`	Base directory for java stuff
`/jdk1.8.0_111`	JDK 8u111
`/bin`	programs ("binaries")
`/demo`	demo apps with source
`/include`	interface to C language code
`/jre`	Java Runtime for JDK
`/lib`	libraries used by JDK
`/sample`	samples with source
`src.zip`	source code for JRE classes

Executable are in /bin

C:/java	
/jdk1.8.0_26	
/bin	
java	Java Virtual Machine (JVM)
javac	compiler
javadoc	create Javadoc (HTML)
javaw	JVM for GUI applications
jar	manage Java Archive (jar) files
jvisualvm	monitor the Java VM

Demo applications

`C:/java`	"Demo" is optional.
`/jdk1.8.0_26`	You might not have it.
`/demo`	
`/jfc/`	Demos for Java core classes
`/applets/`	Java applets (run in browser)
`/plugins/`	Java plugins
`/netbeans/`	jfc and applets as Netbeans projects

Java Runtime for JDK

/java/jdk1.8.0_26	
/jre	Java Runtime Environment
/bin/	Executables and C-libraries needed by JRE
/lib/	Java classes and utilities
classlist	list of all classes
rt.jar	Archive of runtime classes
plugin.jar	Plugin for web browser
/ext	Java extensions (automatically added to CLASSPATH)

Java Archive (JAR)

A JAR file (`*.jar`) is a ZIP file with special directory structure.

* Used to contain Java class files.

* May also contain other kinds of files (images).

* You can run JAR files! (if they designate a "main" method).

Organize Your Software

You may have *many JDK and JRE*.
Organize them so you can find them.

`C:/java`	Location for java (your choice)
`/jdk1.8.0_26`	JDK 8u26 (you can have many)
`/docs`	Documentation for JDK 8
`/jre1.8.0`	JRE for Java 8
`/jdk1.7.0_xx`	Old Java for a client (example)
`/tutorial`	Java tutorial
`/...`	More Java tools

Java on your PATH

```
JAVA_HOME=C:\java\jdk1.8.0_26

PATH=...;%JAVA_HOME%\bin;...
```

Java should be on your search PATH in order to be able to use Java at the command prompt.

May also affect double-click on executable JAR files.

Can't find javac or java ?

```
C:>  javac  -version

"javac" not found.
```

If "Not Found" then add Java's "**bin**" dir to your PATH.

1) Right-click "My Computer" → choose "Properties"

2) Select "Advanced" tab

3) Click "Environment Variables"

4) Select PATH and click "Edit"

5) Add this to PATH:

...;C:\java\jdk1.6.0_26\bin

MS Windows

Env Variables used by Java

These are not required, but used by many Java tools to find Java. On Windows they are usually set by the setup program, but you might want to check it.

How? open a cmd window and type "set" or "env".

```
JAVA_HOME=C:\java\jdk1.6.0_26

JAVA_HOME=C:\java\jre1.6.0
```

CLASSPATH is another variable used by Java. CLASSPATH tells Java where to look for class files.

Know Your Tools

Craftman, Farmers, Engineers, Scientists, ...

Know Their Tools

Programming Problems

1. LocalTime - Java 8 has a better class for time. It is named LocalTime in package java.time. Use LocalTime instead of Date.

What you need:

```
import java.time.LocalTime;
```

// get the current time:

```
LocalTime now = LocalTime.now( );
```

// get the current hour ("getHour" instead of "getHours")

```
if ( now.getHour( ) < 12 ) ...
```

Programming Problems

2. Modify the greet method:

```
if (hour < 12)
    print "Good morning, [name]"
else if (hour < 18)
    print "Good afternoon, [name]"
else
    print "Good evening, [name]"
```