Tony Valderrama, SIPB IAP 2010

PROGRAMMING IN

Overview

- Getting started
- Background
- Syntax

Announcements

Course website: http://sipb.mit.edu/iap/java/

Email: sipb-iap-java@mit.edu

Notes and code samples have been posted on the website.

I need suggestions for advanced topics to cover next Thursday!

Wake up and smell the coffee!

Software

Java Development Kit (JDK) - http://java.sun.com/javase/downloads/index.jsp

Eclipse Platform - http://www.eclipse.org/

Reference

The Java Tutorial - http://java.sun.com/docs/books/tutorial/index.html

Java Language API - http://java.sun.com/javase/reference/api.jsp

Java SE Documentation - http://java.sun.com/javase/downloads/index.jsp

Java SE Source Code - http://java.sun.com/javase/downloads/index.jsp

Not your daddy's cup of Joe…

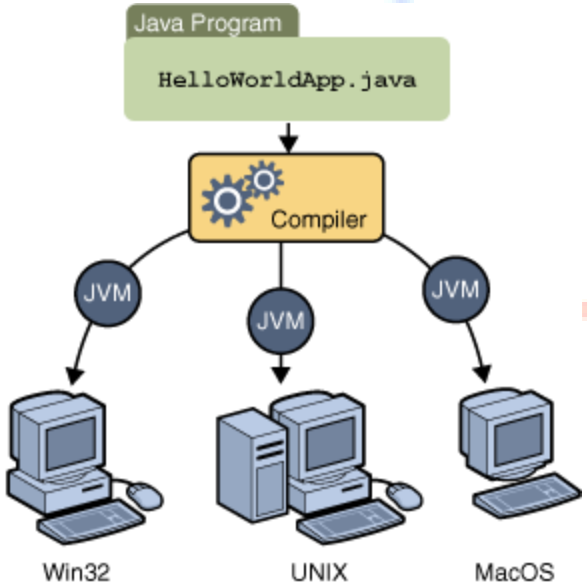
There were five primary goals in the creation of the Java language:

1) It should be "simple, object oriented, and familiar".
2) It should be "robust and secure".
3) It should be "architecture neutral and portable".
4) It should execute with "high performance".
5) It should be "interpreted, threaded, and dynamic".

Java was designed to be **safe**, **simple**, and **powerful**.

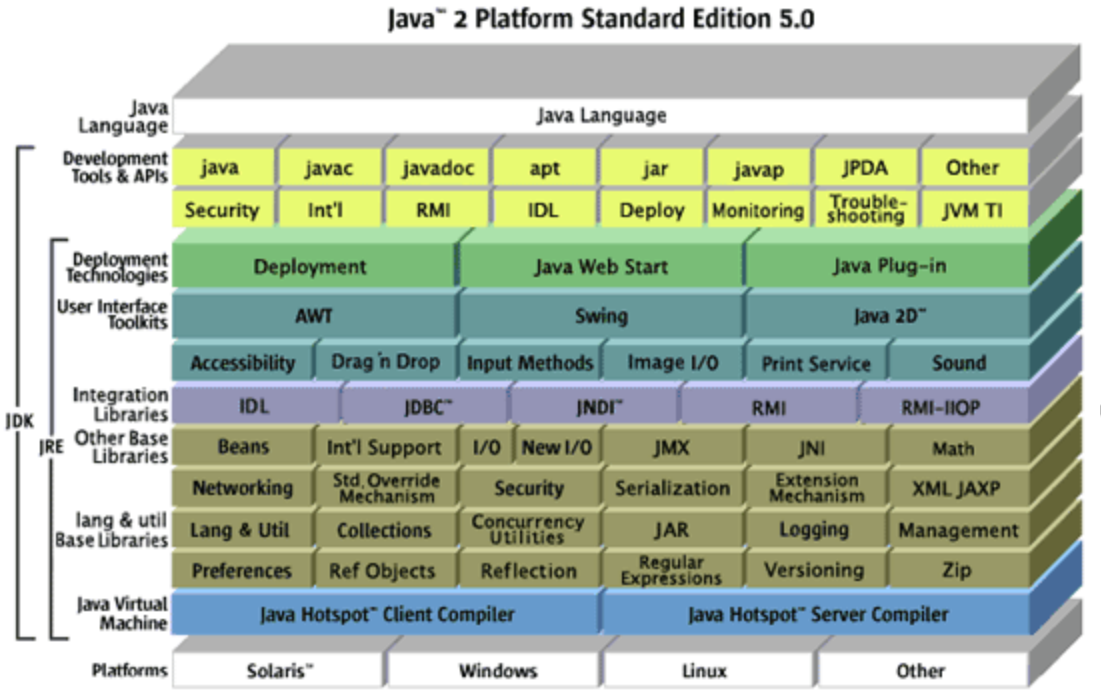
Java whitedocs, as quoted in wikipedia

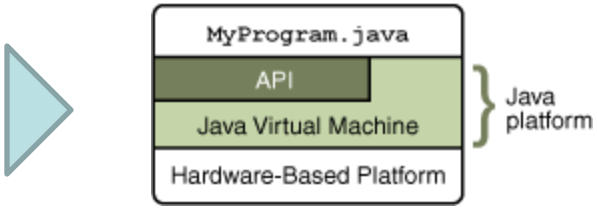
From beans to brew



Images from the Java Tutorial

What's in the cup?





Images from the Java Tutorial

Caf or decaf?

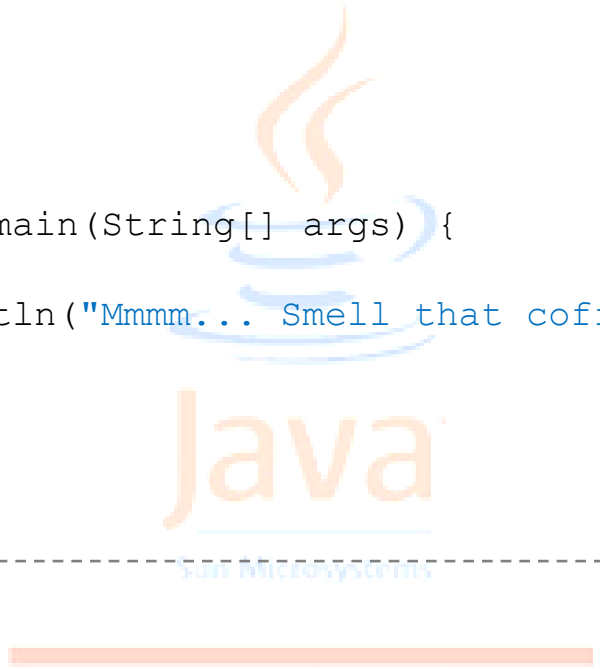
Java is awesome at…

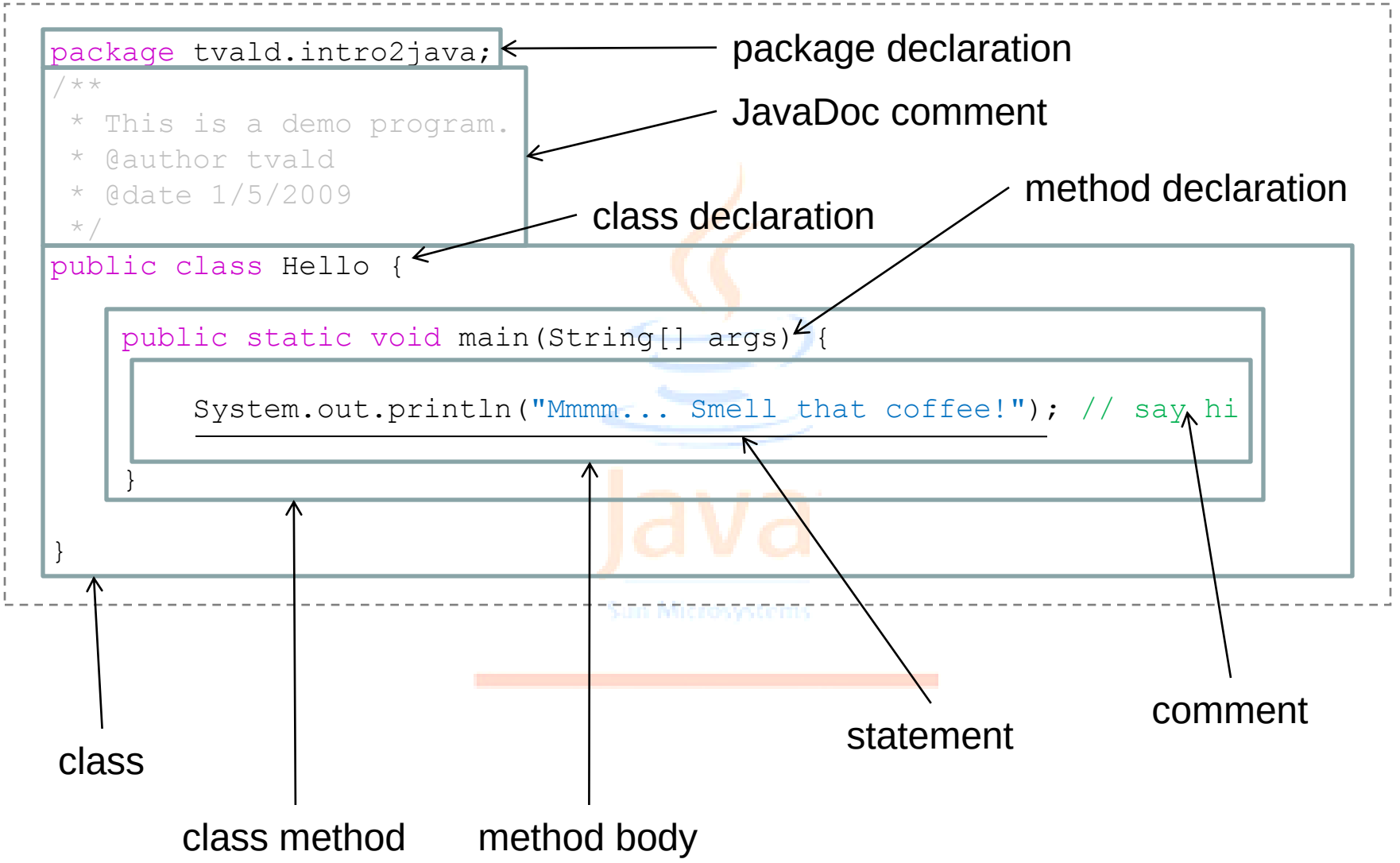
- Cross-platform GUIs
- Large, complex applications
- Embedded systems
- Web-deployment
- Debugging

Java sucks at…

- Short scripts
- Low-level system code
- Malicious code
- Web-deployment
- High-volume data processing

```
package tvald.intro2java;
/**
 * This is a demo program.
 * @author tvald
 * @date 1/5/2009
 */
public class Hello {

    public static void main(String[] args) {

        System.out.println("Mmmm... Smell that coffee!"); // say hi

    }

}
```

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public class Hello {
public static void main(String[] args) {
System.out.println("Mmmm... Smell that coffee!"); // say hi
}
}
package declaration
JavaDoc comment
method declaration
class declaration
class
class method
method body
statement
comment

```
package tvald.intro2java;
/**
 * This is a demo program.
 * @author tvald
 * @date 1/5/2009
 */
public class Hello {

    public static void main(String[] args) {
        System.out.println("Mmmm... Smell that coffee!"); // say hi
    }

}
```

SYNTAX

Keywords

abstract	continue	for	new	switch
assert	default	goto*	package	synchronized
boolean	do	if	private	this
break	double	implements	protected	throw
byte	else	import	public	throws
case	enum	instanceof	return	transient
catch	extends	int	short	try
char	final	interface	static	void
class	finally	long	strictfp	volatile
const*	float	native	super	while

Literals: true false null

* not used

Basics

```
// Single line comment

/*
 * Multi-line
 * comment
 */

/**
 * JavaDocs documentation
 */


{
    // blocks contain statements
    statement;
    another statement;
}
```

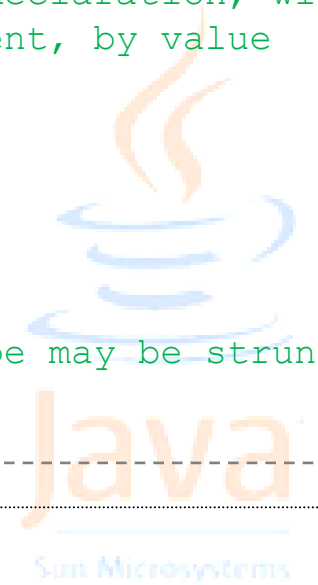

Java is *imperative*

The importance of being consistent…

```
class                                                                    Hello
                  {  public

         static
             void              main
                                 (
         String                                                                [
]                                         args                  )
                                                  {
System
                  .
         out                                                                   .
println                          (                "Mmm… Coffee!"
                                          )
                  ;                                                    }


}
```

Variables

```
<type> name = expression; // declaration, with optional initialization
name = expression; // assignment, by value

char c;
int i = 2;
int j = i+3;
String string;

//Declarations of the same type may be strung together with commas
int a, A = 2, a_ = 3;
```

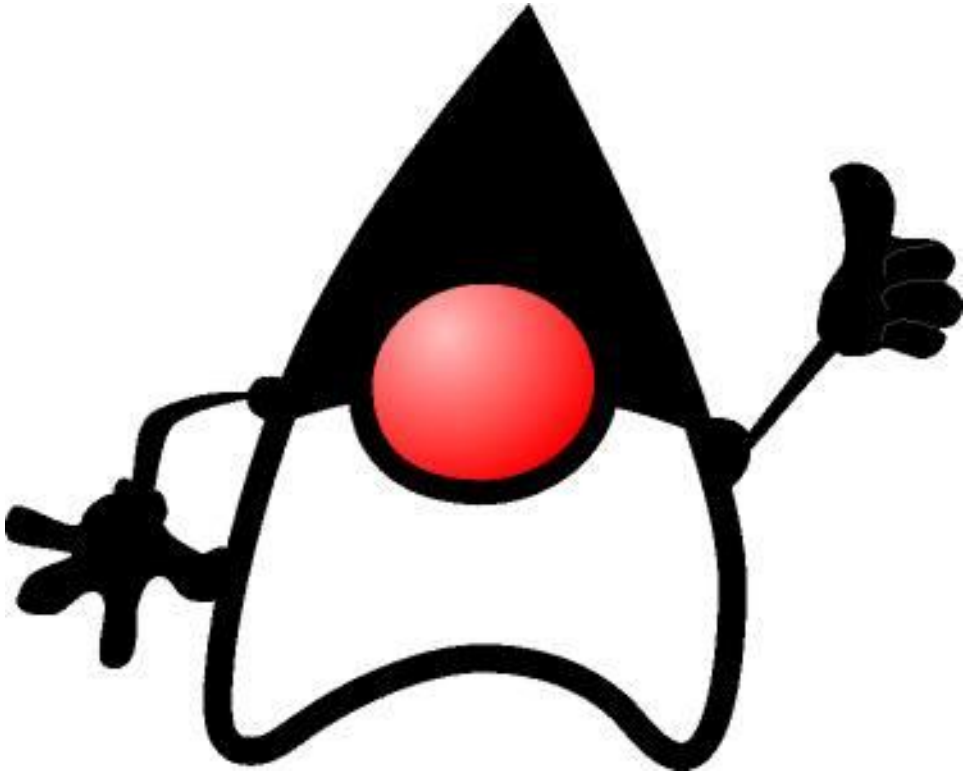


Convention:

All variable names begin with lowercase letter.
Use “camel case” - `firstSecondThird`.
Use only alphanumeric characters, and occasionally underscore.
Use a noun!

Java typing is *static*, *strong*, and *nominative*.

The Java Compiler is Your Friend!



Primitives

```
/* integers */
byte b  = 127; //  8 bits signed; -128 to 127
short s = 127; // 16 bits signed; -32,768 to 32,767
int i   = 127; // 32 bits signed; -2,147,483,648 to 2,147,483,647
long l  = 2000000000000L; // 64 bits signed

int dec = 26, oct = 032, hex = 0x1a, HeX = 0X1Ab0;

/* real numbers */
float f  = 1.0f; // 32 bits signed
double d = 2.0;  // 64 bits signed

double dec = 123.4, sci = 1.234e2;

/* booleans */
boolean t = true, f = false;

/* text */
char c = 'c', unicode = '\u00F1', tab='\t';
String s = "Hello world!\nAnd hello again!";
```

Casting

Variables can be converted to different types by *casting*.
Must be compatible types (applies mainly to objects).
Number conversion is handled by truncation (if converting to integer) then modulus size.

```
int i;
double d = 2.75;

//compiler generates warning if cast is not present:
i = (int)d; // i is 2

i = 2;
d = i; // less exact numbers are automatically promoted
```

Operators

Operators	
postfix	*expr*++ *expr*--
unary	++*expr* --*expr* +*expr* -*expr* ~ !
multiplicative	* / %
additive	+ -
shift	<< >> >>>
relational	< > <= >= instanceof
equality	== !=
bitwise AND	&
bitwise exclusive OR	^
bitwise inclusive OR	|
logical AND	&&
logical OR	||
ternary	? :
assignment	= += -= *= /= %= &= ^= |= <<= >>= >>>=

~ - bitwise NOT
! - logical NOT

"short-circuit" as soon as result is determined

Strings

A String is an Object, NOT an array of characters.
A String is immutable.
Any character is valid between quotes, except a CR / LF

```
String s = "Hello World!";
String longText = " Supercalifragilisticexpialidocious is " +
                  "a very long word."; // concatenation

String numstr = "I can count to " + 3 + '.';
```

Special characters can be escaped

\b (backspace)
\t (tab)
\n (line feed)
\f (form feed)
\r (carriage return)
\" (double quote)
\' (single quote)
\\ (backslash)

Conditionals

```
if (conditional expression) {
        statement;
        ...
} else if (condition2) {
        statement;
        ...
} else {
        statement;
        ...
}

if (condition) statement;

(condition ? expression : elseExpression) // ternary inline conditional
System.out.println("Good " + (Time.isMorning() ?
                        "morning" : "afternoon") + "!");

int i;
if ((i = 1) == 0) statement;
if (i = 1) statement; // invalid, number != boolean
```

Switch

```
switch (month) {
        case 1:  System.out.println("January"); break;
        case 2:  System.out.println("February"); break;
        case 3:  System.out.println("March"); break;
        case 4:  System.out.println("April"); break;
        case 5:  System.out.println("May"); break;
        case 6:  System.out.println("June"); break;
        case 7:  System.out.println("July"); break;
        case 8:  System.out.println("August"); break;
        case 9:  System.out.println("September"); break;
        case 10: System.out.println("October"); break;
        case 11: System.out.println("November"); break;
        case 12: System.out.println("December"); break;
        default: System.out.println("Invalid month.");break;
}
```

Switch

```
switch (month) {
  case 1: case 3: case 5: case 7: case 8: case 10: case 12:
     numDays = 31;
     break;
  case 4: case 6: case 9: case 11:
     numDays = 30;
     break;
  case 2:
     if ( ((year % 4 == 0) && !(year % 100 == 0)) || (year % 400 == 0) )
         numDays = 29;
     else
         numDays = 28;
     break;
  default:
     System.out.println("Invalid month.");
     break;
}
```

Loops

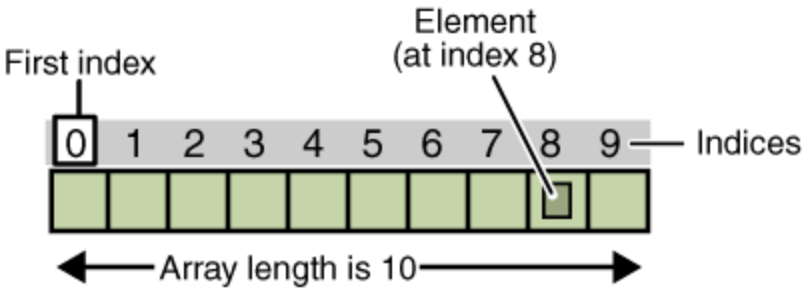
```
while (expression) {
      statement(s)
}

while (true){
    // infinite loop
    if (exitCondition) break;
}

do {
      statement(s)
} while (expression);
```

Scope

Where can I access a variable?
Inside the block where you declare the variable.

```
if (a < 10) {
    int c = 2;
} else {
    int c = 4;
}
System.out.println(c); // ERROR! C isn't in scope!
```

Arrays




```
<type>[] name = new <type>[length];

int[] intArray = new int[10]; // 10 elements, #0 - 9

String[] stringArray = new String[3]; // Objects work too.

// stringArray.length -> 3
// intArray.length    -> 10
```

NOTE: Java Arrays are first-class Objects, so initialized to null.

Images from The Java Tutorial

Arrays

```
int[] intArray = new int[] { 1, 2, 3};
int[][] intArray2 = new int[][] { {1,2,3,4},
                                  {5,6,7,8},
                                  {9,10,11,12} };

intArray2 = new int[3][];  // element arrays are now null
intArray2[0] = new int[1];
intArray2[1] = new int[2]; // element arrays can have different lengths

// intArray2.length    -> 3
// intArray2[0].length -> 1
// intArray2[1].length -> 2
// intArray2[2].length -> NullPointerException


// efficient copying
public static void arraycopy(
        Object src, int srcPos, Object dest, int destPos, int length)

System.arraycopy(intArray, 1, intArray2[1], 0, 2);
// intArray2[1][1] -> 3
```

For Loops

```
for (initialization; termination; increment) {
    statement(s)
}

int[] array = new int[10];
for (int i = 0; i < array.length; i++) {
     statements;
}

for ( ; ; ) {
     // expressions are optional, this is an infinite loop
}

for (<T> element : Iterable<T>) {
     // enhanced for loop
}
```

Branching

```
out: // label any kind of loop
while (condition1) {

     myloop: // nested label
     for ( ; condition2 ; ) {

         while (true) {

             if (condition3) break out;
             else if (condition4) continue myloop;
             else if (condition5) return;

         }
     }
}


// return MUST match method type
boolean foo() { return false; }
```

Method Declaration

```
modifiers <type> name (parameter list) throws exceptionlist {
        // method body
}

public static void main(String[] args) {  ...  }

public double calculateAnswer(double wingSpan, int numberOfEngines,
                              double length, double grossTons) {
        //do the calculation here
        return result;
}
```

Convention:

Method names begin with an lowercase letter
Use “camel case” - `firstSecondThird`.
Use only letters.
Use a verb!

Method Overloading

Method Signature: *name* (*parameters*)

Java compiler will choose the right method based on the supplied name and parameters

```
public void println(String s) {
        ...
}
public void println(int i) {
        ...
}
public void println(double f) {
        ...
}
public void println(boolean b) {
        ...
}
```

Parameters

public void foo (*parameters*) { }

Parameters may be of *any* data type - arrays, primitives, objects, whatever...

Can't pass a method, but you can pass an object and invoke its methods.

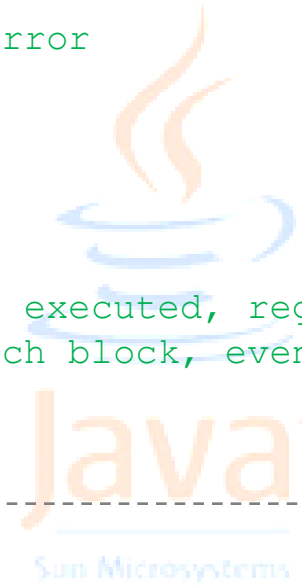
Varargs (shortcut to create an array):

```
public Polygon polygonFrom(Point... corners) {
    for (Point p : corners.length) {
        // more method body code follows that creates
        // and returns a polygon connecting the Points
    }
}
```

Both primitives and object references are passed *by value*.

Error Handling

```
try {
        // this may cause an error
} catch (Exception e) {
        // error recovery
        e.printStackTrace();
        return;
} finally {
        /* this will ALWAYS be executed, regardless of what happens
         * within a try or catch block, even with a return or break.
         */
}
```



Three types of problems:

- **Checked Exceptions**: most expected problems, follow the Catch or Specify requirement.
- **Runtime Exceptions**: unusual cases, usually indicate a logic flaw or misuse of API.
- **Error**: computer unplugged, processor melts, Armageddon, whatever… things you can't really do anything about, but you can try if you want.

Error Handling

```
>java MyClass

java.lang.NullPointerException
        at MyClass.mash(MyClass.java:9)
        at MyClass.crunch(MyClass.java:6)
        at MyClass.main(MyClass.java:3)
```

Method Declaration with Exceptions

```
modifiers type name (parameter list) throws exceptionlist {
        // method body
}

public void readFile(String filename) throws FileNotFoundException,
                                             IOException {

}
```

What is a package?

A package is a namespace for organizing classes and interfaces in a logical manner. Placing your code into packages makes large software projects easier to manage.

```
package edu.mit.sipb.iap;

import java.util.*;                 // wildcard import (load as needed)
import static java.lang.Math.PI;    // import constant (static import)

/* NOTE: only one public class, with the same name as the file,
 * is accessible outside of this source file
 */

public class Test {
    public static void main(String[] args){
        double x = java.lang.Math.E; // fully qualified name
        double rad = 2 * PI;         // PI was statically imported

        java.util.LinkedList list1;  // full class name unnecessary
        ArrayList list2;             // java.util.ArrayList

    }
}
```

Application Programming Interface