6.092: Introduction to Java

1: Types, Variables, Operators

Types

Kinds of values that can be stored and manipulated.

boolean: Truth value (**true** or **false**).

int: Integer (0, 1, -47).

double: Real number (3.14, 1.0, -2.1).

String: Text (“hello”, “example”).

Variables

Named location that stores a value of one particular type.

Form:

TYPE NAME;

Example:

```
String foo;
```

Assignment

Use = to give variables a value.

Example:

```
String foo;
foo = “IAP 6.092”;
```

Assignment

Can be combined with a variable declaration.

Example:

```
double badPi = 3.14;
boolean isJanuary = true;
```

```java
class Hello3 {
    public static void main(String[] arguments) {
        String foo = "IAP 6.092";
        System.out.println(foo);
        foo = "Something else";
        System.out.println(foo);
    }
}
```

Operators

Symbols that perform simple computations

Assignment: =

Addition: +

Subtraction: -

Multiplication: *

Division: /

Order of Operations

Follows standard math rules:

1. Parentheses
2. Multiplication and division
3. Addition and subtraction

```
class DoMath {
    public static void main(String[] arguments) {
        double score = 1.0 + 2.0 * 3.0;
        System.out.println(score);
        score = score / 2.0;
        System.out.println(score);
    }
}
```

```
class DoMath2 {
    public static void main(String[] arguments) {
        double score = 1.0 + 2.0 * 3.0;
        System.out.println(score);
        double copy = score;
        copy = copy / 2.0;
        System.out.println(copy);
        System.out.println(score);
    }
}
```

String Concatenation (+)

```
String text = "hello" + " world";
text = text + " number " + 5;
// text = "hello world number 5"
```

Assignment: GravityCalculator

Compute the position of a falling object:

$$x(t) = 0.5 \times at^2 + v_i t + x_i$$

```
class GravityCalculator {
 public static void main(String[] args) {
     double gravity = -9.81;
     double initialVelocity = 0.0;
     double fallingTime = 10.0;
     double initialPosition = 0.0;
     double finalPosition = .5 * gravity * fallingTime *
                                         fallingTime;
     finalPosition = finalPosition +
                         initialVelocity * fallingTime;
     finalPosition = finalPosition + initialPosition;
     System.out.println("An object's position after " +
      fallingTime + " seconds is " +
      finalPosition + “ m.");
        }
}
```

```
finalPosition = finalPosition +
                initialVelocity * fallingTime;
finalPosition = finalPosition + initialPosition;
```

OR

```
finalPosition += initialVelocity * fallingTime;
finalPosition += initialPosition;
```

Division

Division (“/”) operates differently on integers and on doubles!

Example:

```
double a = 5.0/2.0; // a = 2.5
int b = 4/2; // b = 2
int c = 5/2; // c = 2
double d = 5/2; // d = 2.0
```

Order of Operations

Precedence like math, left to right

Right hand side of = evaluated first

Parenthesis increase precedence

```
double x = 3 / 2 + 1; // x = 2.0
double y = 3 / (2 + 1); // y = 1.0
```

Mismatched Types

Java verifies that types always match:

```
String five = 5;  // ERROR!
```

```
test.java.2: incompatible types
found: int
required: java.lang.String
String five = 5;
```

Conversion by casting

```
int a = 2;    // a = 2
double a = 2;   // a = 2.0 (Implicit)

int a = 18.7;      // ERROR
int a = (int)18.7;      // a = 18

double a = 2/3;    // a = 0.0
double a = (double)2/3;  // a = 0.6666…
```

Methods

```
public static void main(String[] arguments)
{
        System.out.println(“hi”);
}
```

Adding Methods

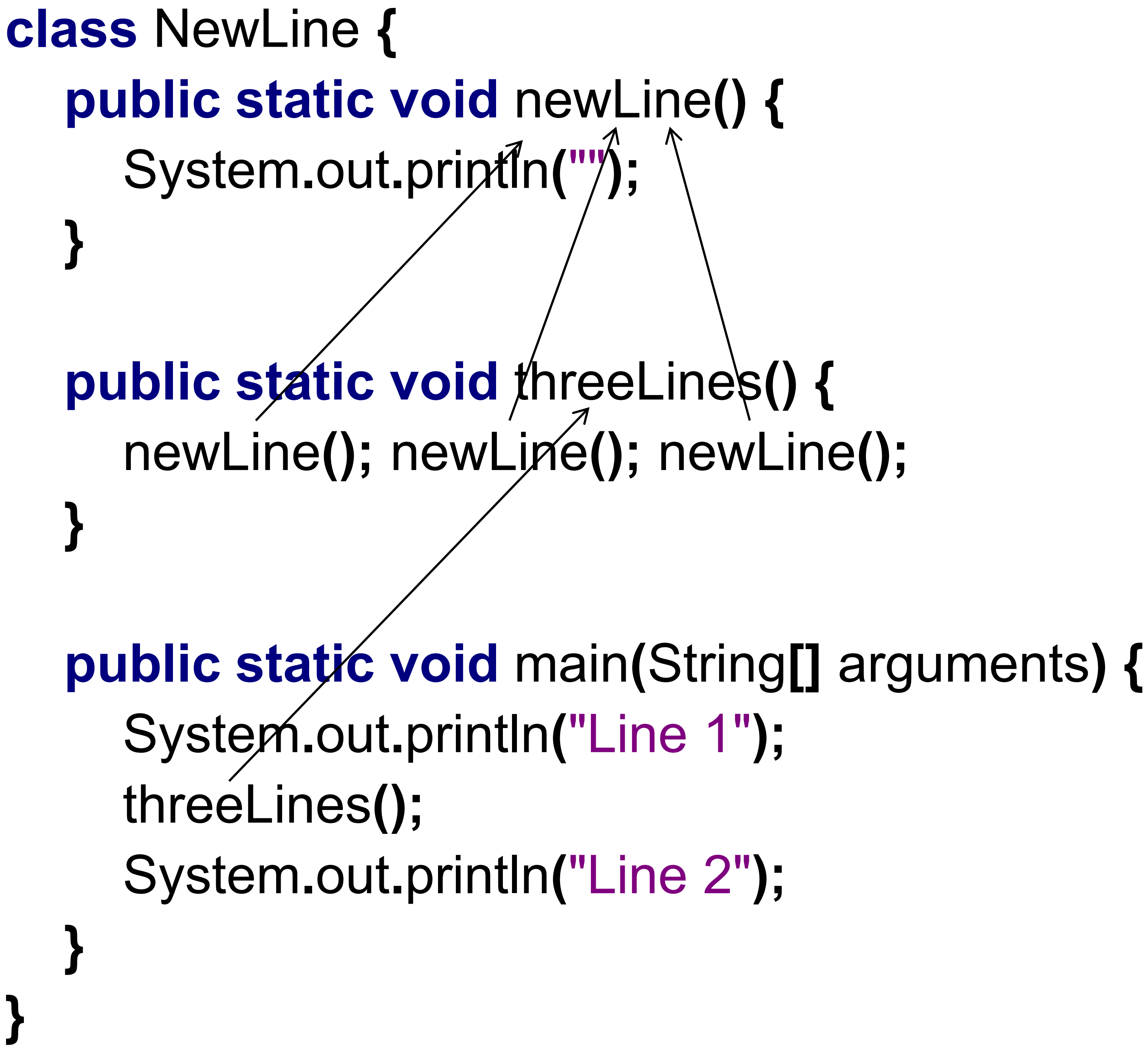
```
public static void NAME() {
    STATEMENTS
}
```

To call a method:

```
NAME();
```

```
class NewLine {
    public static void newLine() {
        System.out.println("");
    }

    public static void threeLines() {
        newLine(); newLine(); newLine();
    }

    public static void main(String[] arguments) {
        System.out.println("Line 1");   ←
        threeLines();
        System.out.println("Line 2");
    }
}
```

```
class NewLine {
    public static void newLine() {
        System.out.println("");
    }

    public static void threeLines() {
        newLine(); newLine(); newLine();
    }

    public static void main(String[] arguments) {
        System.out.println("Line 1");
        threeLines();
        System.out.println("Line 2");
    }
}
```



```
class NewLine {
    public static void newLine() {
        System.out.println("");
    }

    public static void threeLines() {
        newLine(); newLine(); newLine();
    }

    public static void main(String[] arguments) {
        System.out.println("Line 1");
        threeLines();
        System.out.println("Line 2");
    }
}
```

Parameters

public static void ***NAME***(***TYPE NAME***) {

    STATEMENTS

}

To call:

NAME(***EXPRESSION***);

```
class Square {
    public static void printSquare(int x) {
        System.out.println(x*x);
    }

    public static void main(String[] arguments) {
        int value = 2;
        printSquare(value);
        printSquare(3);
        printSquare(value*2);
    }
}
```

```
class Square2 {
    public static void printSquare(int x) {
        System.out.println(x*x);
    }

    public static void main(String[] arguments) {
        printSquare("hello");
        printSquare(5.5);
    }
}
```

What’s wrong here?

```
class Square3 {
    public static void printSquare(double x) {
        System.out.println(x*x);
    }

    public static void main(String[] arguments) {
        printSquare(5);
    }
}
```

What’s wrong here?

Multiple Parameters

```
[…] NAME(TYPE NAME, TYPE NAME) {
    STATEMENTS
}
```

To call:

```
NAME(arg1, arg2);
```

```
class Multiply {
    public static void times (double a, double b) {
        System.out.println(a * b);
    }

    public static void main(String[] arguments) {
        times (2, 2);
        times (3, 4);
    }
}
```

Return Values

```
public static TYPE NAME() {
    STATEMENTS
    return EXPRESSION;
}
```

`void` means “no type”

```
class Square3 {
    public static void printSquare(double x) {
        System.out.println(x*x);
    }

    public static void main(String[] arguments) {
        printSquare(5);
    }
}
```

```
class Square4 {
    public static double square(double x) {
        return x*x;
    }

    public static void main(String[] arguments) {
        System.out.println(square(5));
        System.out.println(square(2));
    }
}
```

Variable Scope

Variables live in the block ({}) where they are defined (**scope**)

Method parameters are like defining a new variable in the method

```java
class SquareChange {
    public static void printSquare(int x) {
        System.out.println("printSquare x = " + x);
        x = x * x;
        System.out.println("printSquare x = " + x);
    }

    public static void main(String[] arguments) {
        int x = 5;
        System.out.println("main x = " + x);
        printSquare(x);
        System.out.println("main x = " + x);
    }
}
```

```java
class Scope {
    public static void main(String[] arguments) {
        int x = 5;
        if (x == 5) {
            int x = 6;
            int y = 72;
            System.out.println("x = " + x + " y = " + y);
        }
        System.out.println("x = " + x + " y = " + y);
    }
}
```

Methods: Building Blocks

- Big programs are built out of small methods
- Methods can be individually developed, tested and reused
- User of method does not need to know how it works
- In Computer Science, this is called "*abstraction*"

Mathematical Functions

```
Math.sin(x)

Math.cos(Math.PI / 2)

Math.pow(2, 3)

Math.log(Math.log(x + y))
```

if statement

```
if (CONDITION) {
    STATEMENTS
}
```

```java
public static void test(int x) {
        if (x > 5) {
            System.out.println(x + " is > 5");
        }
}

public static void main(String[] arguments) {
        test(6);
        test(5);
        test(4);
}
```

Comparison operators

x > y: x is greater than y

x < y: x is less than y

x >= y: x is greater than or equal to x

x <= y: x is less than or equal to y

x == y: x equals y

(equality: ==, assignment: =)

Boolean operators

&&: logical AND

||: logical OR

```
if (x > 6) {
  if (x < 9) {
   …
  }
}
```

→

```
if ( x > 6 && x < 9) {
   …
}
```

else

```
if (CONDITION) {
    STATEMENTS
} else {
    STATEMENTS
}
```

```java
public static void test(int x) {
    if (x > 5) {
        System.out.println(x + " is > 5");
    } else {
        System.out.println(x + " is not > 5");
    }
}

public static void main(String[] arguments) {
    test(6);
    test(5);
    test(4);
}
```

else if

```
if (CONDITION) {
    STATEMENTS
} else if (CONDITION) {
    STATEMENTS
} else if (CONDITION) {
    STATEMENTS
} else {
    STATEMENTS
}
```

```java
public static void test(int x) {
    if (x > 5) {
        System.out.println(x + " is > 5");
    } else if (x == 5) {
        System.out.println(x + " equals 5");
    } else {
        System.out.println(x + " is < 5");
    }
}

public static void main(String[] arguments) {
    test(6);
    test(5);
    test(4);
}
```

Questions?

Assignment: FooCorporation

Method to print pay based on base pay and hours worked

Overtime: More than 40 hours, paid 1.5 times base pay

Minimum Wage: $8.00/hour

Maximum Work: 60 hours a week

Conversion by method

int to String:

```
String five = 5; // ERROR!
String five = Integer.toString (5);
String five = “” + 5;  // five = “5”
```

String to int:

```
int foo = “18”; // ERROR!
int foo = Integer.parseInt (“18”);
```

Comparison operators

- Do NOT call `==` on doubles! EVER.

```
double a = Math.cos (Math.PI / 2);
double b = 0.0;
```

a = 6.123233995736766E-17

`a == b` will return FALSE!