1.00/1.001
Introduction to Computers and Engineering Problem Solving

Recitation 2
Iteration and Methods

Spring 2012

Quick Exercise: Increment Operator

What is the value of a and b at the end of each code fragment?

```
int a = 1;
int b = a + a++;
```

```
int a = 1;
int b = a + ++a;
```

```
int a = 1;
int b = a++ + a;
```

```
int a = 1;
int b = a*++a;
```

```
int a = 1;
int b = (a++ + 2)*a;
```

```
int a = 1;
int b = a++ + a + a++;
```

Iteration (Loops)

```
while (condition to continue)
{
   // repeat as long as condition = true
}
```

```
do
{
   // run once and repeat as long as condition = true
}
while (condition to continue);
```

```
for (initial statement, condition to continue, increment statement)
{
   // execute initial statement
   // repeat as long as condition = true
   // execute increment statement after each repetition
}
```

while vs. do...while

NO semicolon!

```
double weight = 0;      // Declaration and Initialization
while (weight < 40) {
    String s = JOptionPane.showInputDialog("Enter Weight");
    weight = Double.parseDouble(s);
}
```

```
double weight;          // Declaration only
do {
    String s = JOptionPane.showInputDialog("Enter Weight");
    weight = Double.parseDouble(s);
}
while(weight < 40);
```

semicolon!

`while` vs. `for`

`while` loops and `for` loops are often interchangeable.

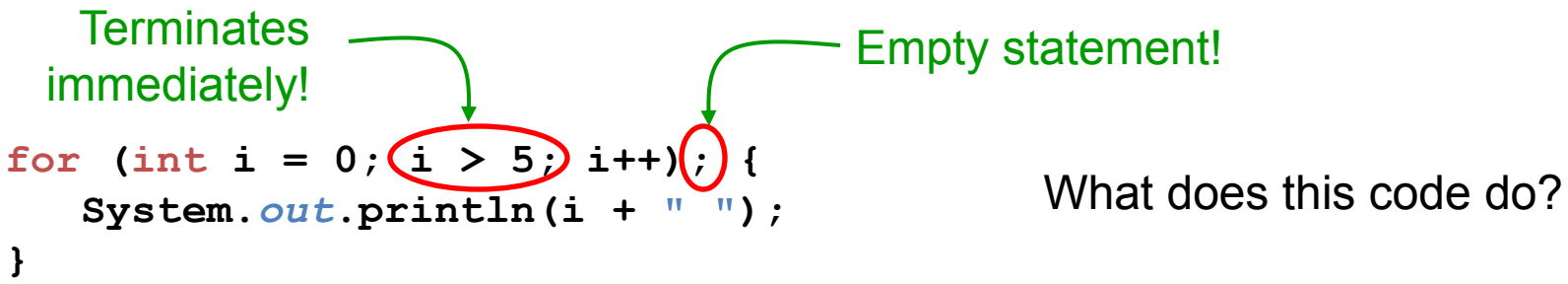
What does the following loop do?

```
int i = 0;
while (i < 5) {
    System.out.print(i + " ");
    i++;
}
```

How would you do the same thing with a `for` loop?

Common for loop errors

(Check these first if you get unexpected results)



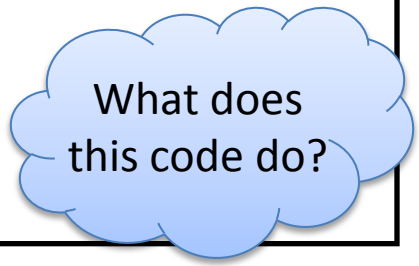
Common errors in declaring **for** loops:

1) Incorrect termination statement
   - Remember, the loop will only run as long as the termination is TRUE
   - Make your termination statement to be true as long as you want the loop to run, not when you want it to stop
2) Semicolon after loop declaration
   - The for loop and all loops exist inside brackets – brackets are a way of grouping bits of code for execution
   - The semicolon terminates a line. Java will move to the next line and won't know to associate the for loop with what is in the brackets

while vs. for

The method uses a **for** loop to raise x to the power of n.

```
public static double power(double x, int n) {
        double result = 1;
        for (int i = 1; i <= n; i++)
            result *= x;
        return result;
}
```



Write a **while** loop version

```
public static double power(double x, int n) {




}
```

Nested Loops

What does the following double loop print?

```
int i = 0;
while (i < 3)
{
    i++;
    for (int j = 0; j <= i; j++)
    {
        System.out.println(10*i + j);
    }
}
```

Can you get rid of the some braces {} and keep the same output?

Methods

What is a method?

Where do you write methods?

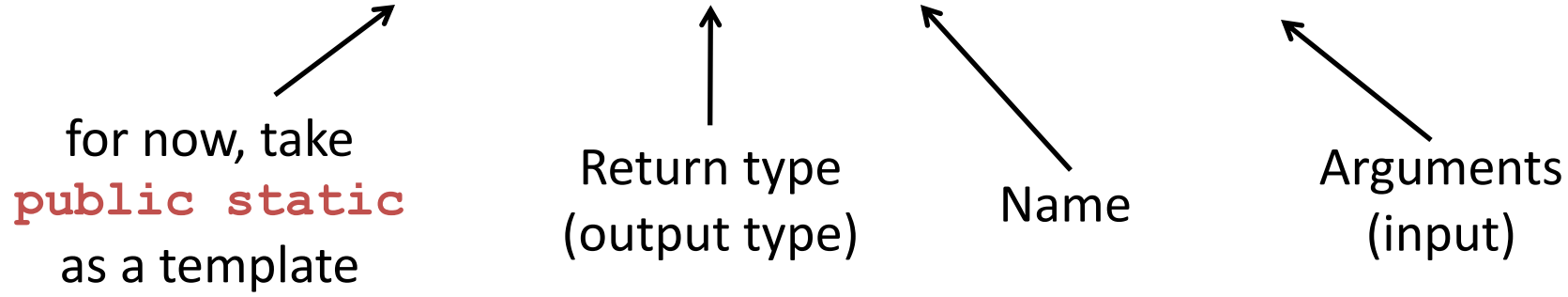
How many methods per class?

How many `main()` method(s) per class?

Method Signature

Example: a **power** method that raises any number **x** to an integer power **n**

```
public static double power(double x, int n)
```



- A method has a single return type: it can only return one "thing."
- If nothing is returned, the return type is **void**.
- The number of arguments is not limited.

Exercise: Income Tax Calculator

Using the following tax brackets, write a method to compute the tax applicable to any income.

Income Bracket	Tax rate (%)
0 – 5,000	0
5,000 –12,500	7
> 12,500	16

For example, if income = 13,000:
tax = 0.07 * (12,500 - 5,000) + 0.16 * (13,000 - 12,500)

Method signature?

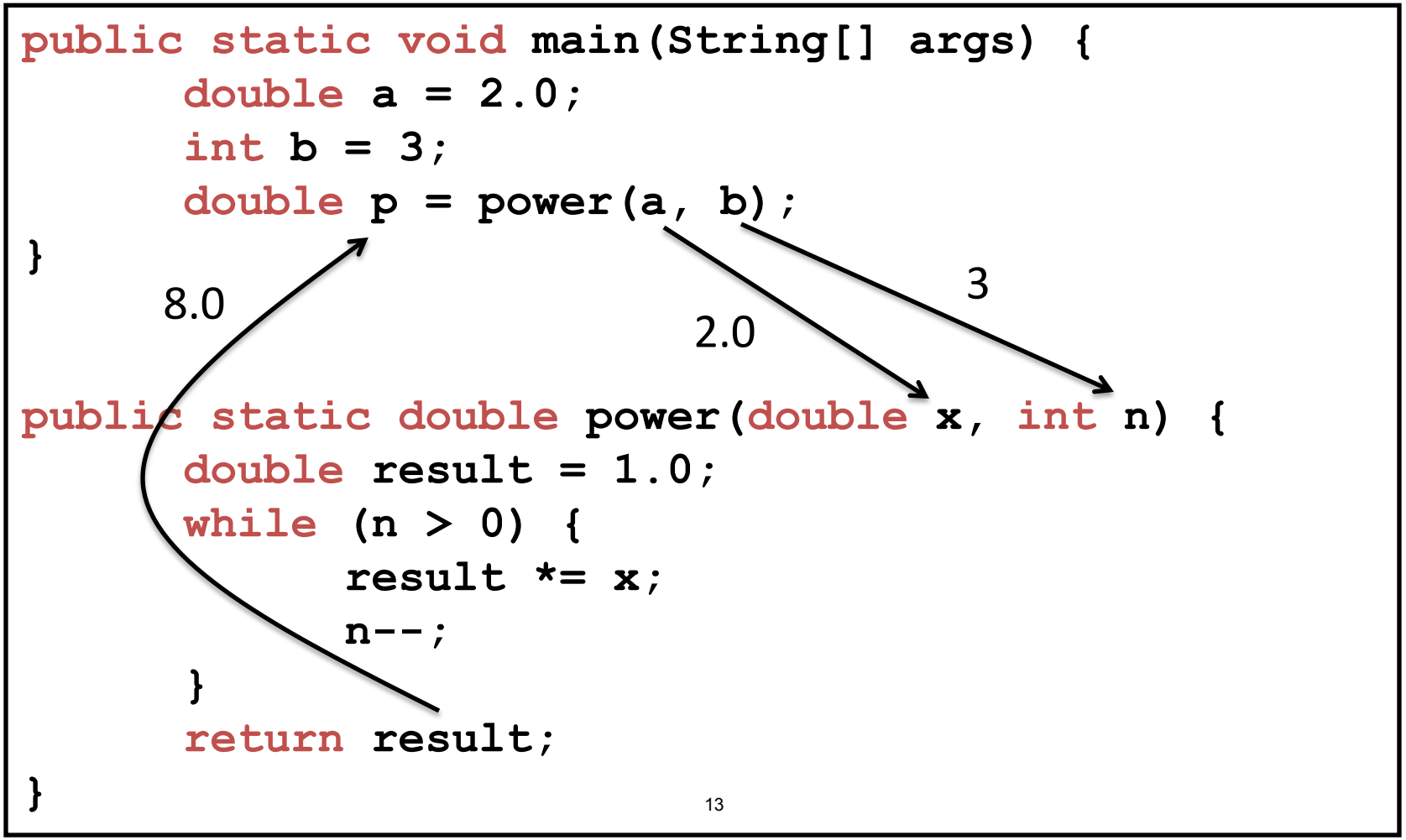
Exercise: Income Tax Calculator

```
public static double calcTax(double inc) {
    if (inc < 5000)
        return 0;
    else if (inc < 12500)
        return 0.07 * (inc - 5000);
    else
        return 0.07 * (12500 - 5000) + 0.16 * (inc - 12500);
}
```

What if you use an `else if` instead of an `else` for the third case?

Passing Arguments to Methods

Primitives are passed "by value".



Exercise: Methods

You will write a method to compute binomial coefficients.

The binomial coefficient $\binom{n}{k}$ can be computed as: $\binom{n}{k} = \frac{n!}{(n-k)!\ k!}$

Where x! is the factorial operator (e.g. 5! = 5 * 4 * 3 * 2 * 1)

Strategy?

Factorial Method

```
// for loop version
```

```
// while loop version
```

Binomial Method

$$\binom{n}{k} = \frac{n!}{(n-k)!\ k!}$$

```
// putting it all together
```

Using methods avoids code repetition!

Homework 2: Throw ball in basket

Main method should:

- Prompt user for input
- Call the following methods:
  - Compute optimal angle
  - Compute smallest angle
  - Compute largest angle
  - Compute max height
  - Determine if ball hits ceiling
  - Adjust velocity incrementally until ball does not hit ceiling anymore
- Print all results to console

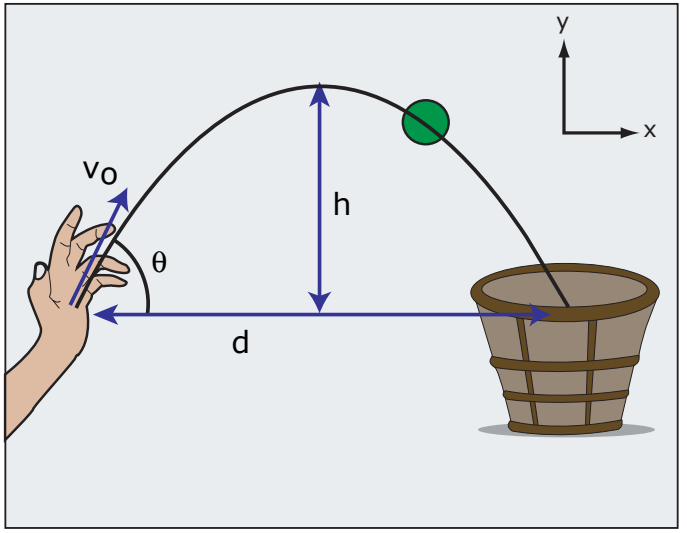


Image by MIT OpenCourseWare.

`Math` is an existing library in Java

Example methods in `Math` class:

```
# = Math.cos(∠)
∠ = Math.asin(#)
```

x^y = `Math.pow(x,y)`

π = `Math.PI`

Math methods are in radians!

1.00 / 1.001 / 1.002 Introduction to Computers and Engineering Problem Solving

Spring 2012