Java Applications – *FYI* for now

- Always include a class with a `main` method
  e.g., `public static void main(String args[]){ }`
- Huh?
  `public` – can be invoked from another package
  `static` – same for all instances of this class
  `void` – does not return anything
  `main` – the method's name
  `(String args[])` – argument list (an array of Strings)
  `{ }` – block delimiters {method definition is inside}

Comments and white space

- Compiler ignores – but important to human reader
- 3 types of comments:

```
// for single line or end-of-line comment
/* for comment that may
   span lines */
/** Javadoc comment (will discuss later) */
```

- White space:
  - Indent methods, structures, other meaningful units
  - Leave blank lines between meaningful sections
  - Insert spaces before and after operators

Errors – 2 basic types

- Syntax errors – what beginners first see
  - Improperly formed (or typed) source code
    - e.g., `public cass Hello` ← should be `class`
    - e.g., …`println("Hi);` ← missing " (end of string)
    - e.g., `system.out.println("Hi");` ← `System`
  - Compiler won't compile the source code
    - Important to learn to read the error messages – try it
- Logic errors – a.k.a., "bugs"
  - Compiler said it's okay, but results are wrong
  - Often have to fix the algorithm (the step-by-step solution to the problem – program should translate)

Variables and memory

- Every variable has:
  - a name, a type, a size, and a value
- Concept: *name corresponds to a memory location*
- If primitive type (text calls "number type") – the actual value is stored there
- If object type – just a reference to the object stored there (actually it's a memory address)
  - The object is stored somewhere else
  - Or the reference might be `null`

Defining variables

- Must *declare* type for memory locations
  - Compiler must know how big and how to interpret
- Syntax: `typeName variableName;`

```
int x;    // for integers, like 4, -125
double a, b;    // for floating point numbers, like 1.25, -0.9
String s;    // for references to strings, like "dog", "cat"
```

- Also must *assign* value, or compiler won't let you use it

```
x = 2; // use assignment operator – looks like "equals" sign
double y = 7.3; // can initialize when declare – a good idea
```

- And if a reference, must *create an object* to use

```
String name = "Mike";
Rectangle box = new Rectangle();
```

Identifiers

- *Names* of classes, variables, methods
- Rules:
  - Sequence of letters, digits, _, $ ONLY
  - Must not begin with digit; must not contain spaces
  - No Java reserved words
- Unwritten rule: Use meaningful names.
- Conventions:
  - NameOfClass – begin with uppercase
  - other or otherName, unless name of constant, like PI

Assignment

= is the *assignment operator*

- It does not mean "equals" (but we say it like that)
- e.g., `x = 5;` // means "assign 5 to x"
  - Now 5 is stored in the memory location called x
- e.g., `y = x + 2;` // assign (x + 2) to y
  - The value stored in x is retrieved, 2 is added to it, and the result is stored in y
- e.g., `x = x + 2;` // assign (x + 2) to x
  - It's okay! It doesn't *mean* "x equals x+2". Right?

Special characters

- Escape sequences – start with `\` (the "back slash" character)
  - `\n` – newline character
  - `\t` – tab
  - `\"` – double quotes
  - `\'` – single quote
  - `\\` – back slash itself
- Experiment with it – (e.g., change Hello.java)
- Note: `"a string\n"` vs. characters – `'c'`, `'\n'`

Standard Output, and Strings

- System.out – an object of type PrintStream
  - `println(string)` – prints string and newline
  - `print(string)` – prints string, no newline
- String – *literal* is delimited by quotes: `"a string"`
  - Remember: special characters start with "\"
    - e.g., `\n` is a newline character
    - So `println("Hi")` is same as `print("Hi\n")`

  `+` concatenates: e.g., `"a" + 5 + "b"` becomes `"a5b"`
    - Note: first 5 is converted to a String.

Formatted printing

- Java 5: `printf("format", object1, object2, …)`
  - Method of `PrintStream` class – so `System.out` has `System.out.printf("x = %d", x);` // x is an integer
  - Or use `%o` or `%x` to show same value in octal or hexadecimal
- `%f` or `%e` or `%g` for floating point, and `%s` for strings
  - Also control field width, precision, and other formatting …`printf("%-9s%7.2f%n", "Value", v);`
- Complete details in `java.util.Formatter`
  - Format dates, times, …
  - Can use to create formatted `String` objects too:

```
String s = String.format("pt: %d, %d", x, y);
```

Standard input, and more Strings

- Actually have to read keyboard or other input as a String (also requires exception handling)
- So must "parse" string to interpret numbers or other types
  - e.g., `String s1 = "426", s2 = "93.7";`
  - Then s1 can be parsed to find an int or a double, and s2 can be parsed to find a double:

```
int n = Integer.parseInt(s1);
double d = Double.parseDouble(s2);
```

`java.util.Scanner`

- Important Java 5 enhancement greatly simplifies input processing
- First construct a `Scanner` object – pass it `System.in` (or other input stream, or even a string)

```
Scanner in = new Scanner(System.in);
```

- Then get next `string`, `int` or `double` (or others)

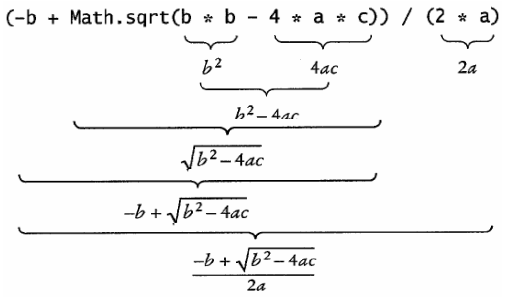
```
String s = in.next();
String wholeLine = in.nextLine();
int x = in.nextInt();
double y = in.nextDouble();
```

- See class Addition (Fig. 2.7, p. 47)

Arithmetic

- Operators:
  - `+`, `-`, `*`, `/` add, subtract, multiply, divide
  - `%` modulus operator – remainder
  - `( )` means whatever is inside is evaluated first
- Use `java.lang.Math` for difficult calculations
  - E.g., `Math.sqrt(x)`, `Math.cos(x)`, … (more later)
- Precedence rules so far (will expand):
  1. `( )`
  2. `*`, `/`, `%`
  3. `+`, `-`
  4. `=`

Analyzing an expression



Simple decisions – using `if`

- Do something or don't do something … depending on the circumstances

```
if (value < 0)
   System.out.print("negative");
```

  - Only prints if value is less than zero
- Formal definition to implement decision:

```
if (boolean expression)
   statement-to-execute;  // only if expression is true
```

Simple `boolean` expressions

- Relational operators: `<`, `>`, `<=`, `>=`, `==`, `!=`
  - e.g., `int x=1, y=2, z=3;`
    - `x > y ?` ⇐ **`false`**
  - Lower precedence than arithmetic
    - `x >= z - y ?` ⇐ **`true`**
    - `x == z + y ?` ⇐ **`false`**
      - Note not same as `x = z + y` // would make x be 5
    - Not equal: `z != x + y ?` ⇐ **`false`**
- See class Comparison (Fig. 2.15, p. 57)