# Java Foundations

**What Is a Variable?**

## Objectives

- This lesson covers the following objectives:
  - Understand the benefits of variables
  - Identify four main types of variables:
    - (boolean, int, double, String)
  - Declare and assign values to variables
  - Name variables according to conventions

## Exercise 1

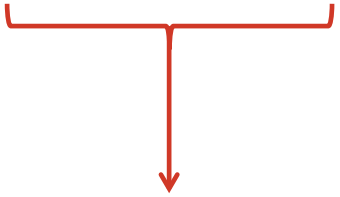
- Run `JavaLibs.jar`
- Consider the types of data this program asks for


**Problem Set 3 is to re-create this program with your own story**
**This section teaches everything you'll need to create this program**

## What Is a Variable in Java?

- Similarly, we can assign values to Java variables

```
String x = "Alex";
System.out.println("My name is " + x);
```



## Disadvantage Without Variables

- Code isn't flexible
- To replace the name "Alex," you must make many changes in many places:
  - Tedious editing
  - Risk of missing an "Alex"

```
System.out.println("My name is Alex");
System.out.println("Alex is so cool!");
System.out.println("Hooray Alex!");
System.out.println("Please enjoy Alex Appreciation "
       + "Day! My name is Alex. I know how excited "
       + "everyone is to start appreciating Alex on Alex"
       + "Appreciation Day! Alex, Alex, Alex! Yay "
       + "Alex!!! That's me! Alex is the best date ever!");
```

## Advantage with Variables

- Code becomes flexible
  - Remember and manipulate values
- To replace the name "Alex," you make one change:
  - Efficient editing
  - No risk of missing an "Alex"

```
String x = "Sam";
System.out.println("My name is " + x );
System.out.println(x + " is so cool!");
System.out.println("Hooray " + x +"!");
System.out.println("Please enjoy " + x + " Appreciation "
       + "Day! My name is " + x + ". I know how excited "
       + "everyone is to start appreciating " + x
       + " on " + x + "Appreciation Day! " + x + "," + x + ","
       + x + "! Yay " + x + "!!! That's me! " + x
       + " is the best date ever!");
```

## More Advantage with Variables

- Manipulate values many times in several ways:
  - Directly change values yourself (shown below)
  - Programmatically change calculated values
  - Change based on user input

```
5     String x = "Alex";
6     x = "Sam";
7     x = "Nicky";
8     x = "Mystery Date";
9
10    "backwards" = x;   //Can't do this
```

## Exercise 2

- Import and open the `Variables02` project
- Follow the steps in the exercise
- Run the program between each step and observe the output
- Your program should produce the following outputs:
  - After Step 1)

```
puppy
puppy
```

  - After Step 2)

```
kitty
kitty
```

  - After Step 3)

```
kitty
bunny
```

## Line-by-Line Nature of Programs

- From line 8 onward, x always equals "kitty" until …
- Line 14 onward where x always equal "bunny“

```
7  public static void main(String[] args) {
8      String x = "kitty";
9      System.out.println(x);          //prints "kitty"
10
11
12     System.out.println(x);          //prints "kitty"
13
14     x = "bunny";
15
16
17     System.out.println(x);          //prints "bunny"
18
19
20     }
21 }
```

## Many Variable Types

- Variables can exist for many different data types in Java
- Here are the variables that you've seen:

| Type | Keyword | Example Values |
|---|---|---|
| Boolean | boolean | true, false |
| Integer | int | 1, -10, 20000, 123_456_789 |
| Double | double | 1.0, -10.0005, 3.141 |
| String | String | "Alex", "I ate too much dinner." |

# Declaring a Variable

- Java is a “strongly typed language”
  - You must declare what type of data your variable will handle by using keywords


```
boolean bool;
int x;
double y;
String z;
```

- After you declare a variable …
  - That variable exists
  - There’s no need to declare it again

# Options for Declaring and Assigning Values

- Declare and assign a variable in a single line


```
boolean bool = true;
```

- Declare a variable in one line and assign a value later

```
boolean bool;
bool = true;
```

## Assigning Bad Values

- Assigned values must be appropriate for the data type you've declared

```
int x = 3;
```

```
int z = "Puppies!";
```

## Exercise 3, Part 1

- Import and open the `Variables03` project
- There are six mistakes in this program
- Can you fix these mistakes so that the program produces the following output?

```
bool = true
intVar1 = 1
intVar2 = 2
intVar3 = 3
doubleVar1 = 1.1
doubleVar2 = 2.1
doubleVar3 = 3.1
doubleVar4 = 4.1
stringVar1 = 11
stringVar2 = 22
```

# Exercise 3, Hints 1

- NetBeans underlines problematic code
  - Hold the cursor over the code or icon in the left margin for details
  - NetBeans may hint at possible solutions
  - Click the icon in the left margin

```
4   public class Variables03 {
5
6       public static void main(String[] args) {
7   incompatible types: boolean cannot be converted to int
8   ----
9   (Alt-Enter shows hints)
10          int intVar1 = true;
11          int intVar2 = 2;
12          intVar3 = 3;
13
14          double doubleVar1, doubleVar2, doubleVar3, doubleVar4;
15          doubleVar1 = 1.1;
16          doublevAr2 = 2.1;
17          double doubleVar3 = 3.1;
```

# Exercise 3, Hints 2

- NetBeans suggested solutions are sometimes bad
  - Don't rely entirely on NetBeans hinted solutions
- Your own problem-solving skills can be a wonderful resource

## Mistakes with Variables

- Assigning inappropriate values for a variable type

```
int intVar1 = true;
```

- Forgetting to declare a variable's type

```
intVar3 = 3;
```

- Misspelling a variable

```
double doubleVar2;
doublevAr2 = 2.1;   //Java is case-sensitive
```

## Mistakes with Variables

- Declaring the same variable twice

```
double doubleVar3;
double doubleVar3 = 3.1;
```

- Forgetting to assign a value before using a variable

```
double doubleVar4;
System.out.println(doubleVar4);
```

Assigning an initial value to a variable is called initialization.

## You May Have Noticed …

- It's possible to declare many variables in a single line

```
double doubleVar1, doubleVar2, doubleVar3;
```

- It's possible to assign values when declaring many variables

```
double doubleVar1, doubleVar2, doubleVar3 = 3.1;
```

- It's a matter of personal preference either to …
  - Declare every variable on separate lines
  - Declare all variables of a given type in a single line

## Bad Variable Naming

- You can name a variable almost anything you want

```
int dsfdsfspoop = 20;   //Ha ha!
```

  - This might be funny, but …
  - Will you or a friend understand what data dsfdsfspoop represents when you read the code?

- Tiny names are usually discouraged

```
int x = 20;
```

  - This is useful for testing …
  - And commonly found in small loops (covered later), but …
  - Will you or a friend understand what data x represents when you read the code?

# Very Bad Variable Naming

- Variables can't share the same name

```
int x = 20;
double x = 22.0;
System.out.println(x);  //Which x?
```

- Variables can't start with numbers

```
boolean 1337Hacker = true;
```

- Keywords can't be used for variables names

```
int continue = 20;
```

  - Keywords turn blue in NetBeans
  - Keywords have special meanings in Java

# Variable Naming Conventions

- Begin each variable with a lowercase letter
- Subsequent words should be capitalized:
  - myVariable
- Choose names that are mnemonic and that indicate the intent of the variable to the casual observer
- Remember that …
  - Names are case-sensitive
  - Names can't include white space

```
int studentAge = 20;
String myCatchPhrase = "Enjoy Alex Appreciation Day!";
```

# Summary

- In this lesson, you should have learned how to:
  - Understand the benefits of variables
  - Identify four main types of variables:
    - (boolean, int, double, String)
  - Declare and assign values to variables
  - Name variables according to conventions