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Java Foundations

3-1

What Is a Variable?

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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?

- Consider the variable x in an equation
- We can assign any value to x

$$y = -2x + 5$$

$x = 0$

$$y = -2 \times 0 + 5$$
$$y = 0 + 5$$
$$y = 5$$

$x = 2$

$$y = -2 \times 2 + 5$$
$$y = -4 + 5$$
$$y = 1$$

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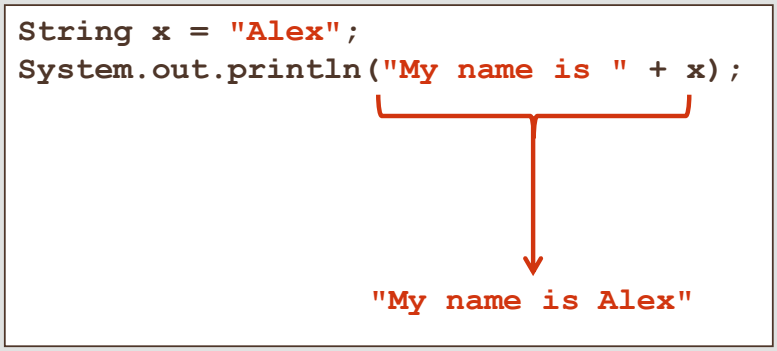
Plug the value of x into the equation.

What Is a Variable in Java?

- Similarly, we can assign values to Java variables
  - Writing the line String x = "Alex" is like we're assigning a variable x a value of "Alex"
  - Writing "My name is " + x is equivalent to writing, “My name is Alex”



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!");
```


This is the Variables01 project.

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

- Create a new project and add the `Variables02.java` file to the 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 }
```

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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."

There are more variable types, but these are the types we'll be using most in this course.

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!";
```

Inappropriate Math Values

- We can assign any number value to x
- We can't assign a String value to x
  - This doesn't make sense!

$$y = -2x + 5$$

$$x = \texttt{"Puppies!"}$$

$$y = -2(\texttt{"Puppies!"}) + 5$$

$$y = ???$$

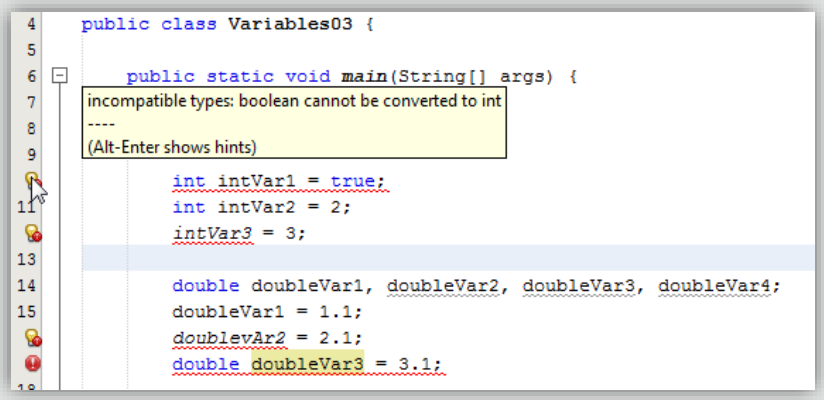
Exercise 3, Part 1

- Create a new project and add the `Variables03.java` file to the 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

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



Exercise 3, Hints 2

- Your IDE's suggested solutions are sometimes bad
  - Don't rely entirely on your IDE's 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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