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Java Foundations

3-1
What Is a Variable?

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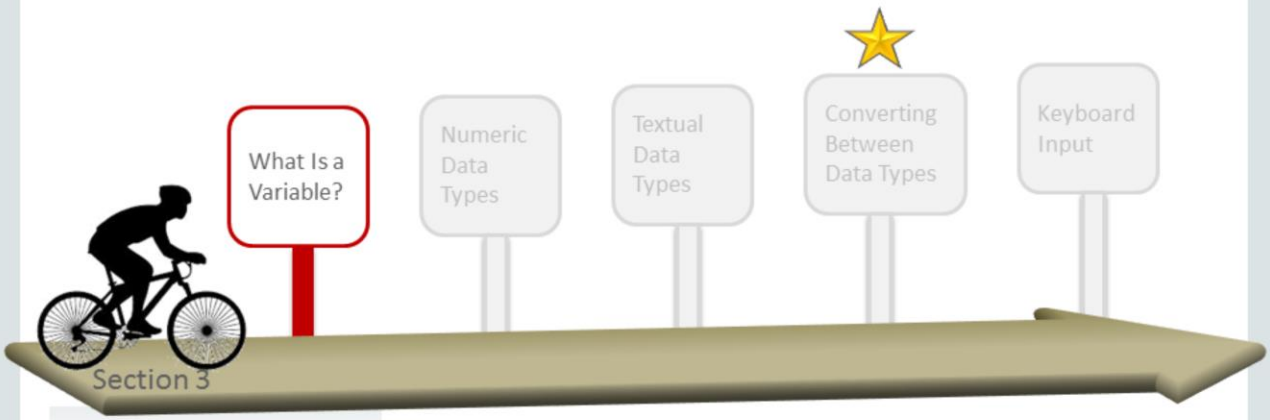
Objectives

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

Topics

- What Is a Variable?
- Types of Data
- Naming Variables



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.

$$y = -2x + 5$$

$x = 0$

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

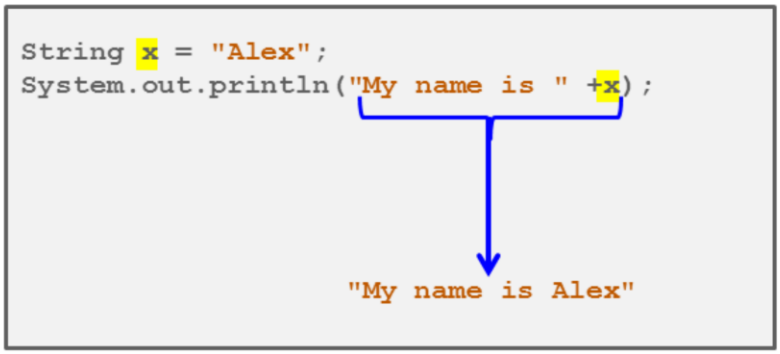
$x = 2$

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

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

- 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 }
```

Topics

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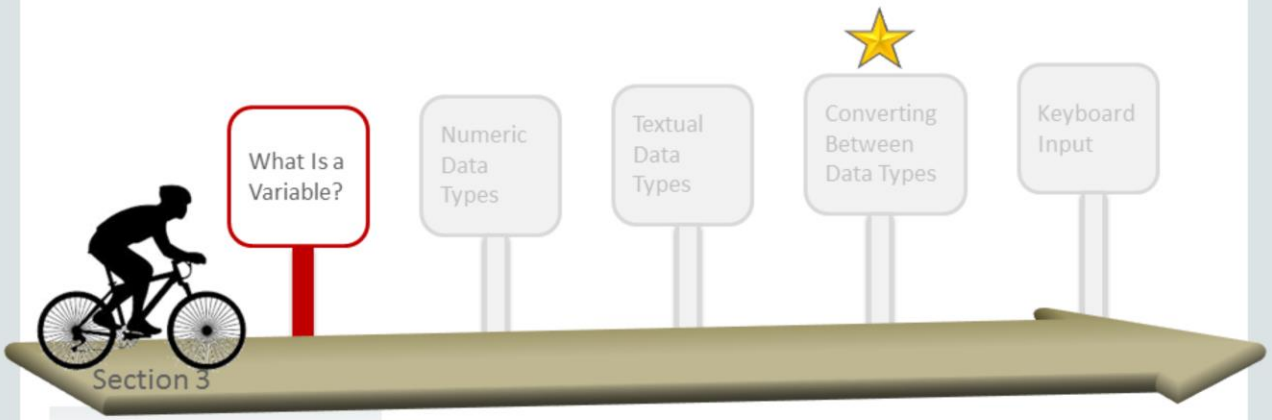
- Types of Data
- Naming Variables



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

A. Declare and assign a variable in a single line.

B. 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!

$$y = -2x + 5$$

$x =$ `"Puppies!"`

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

$$y = ???$$

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

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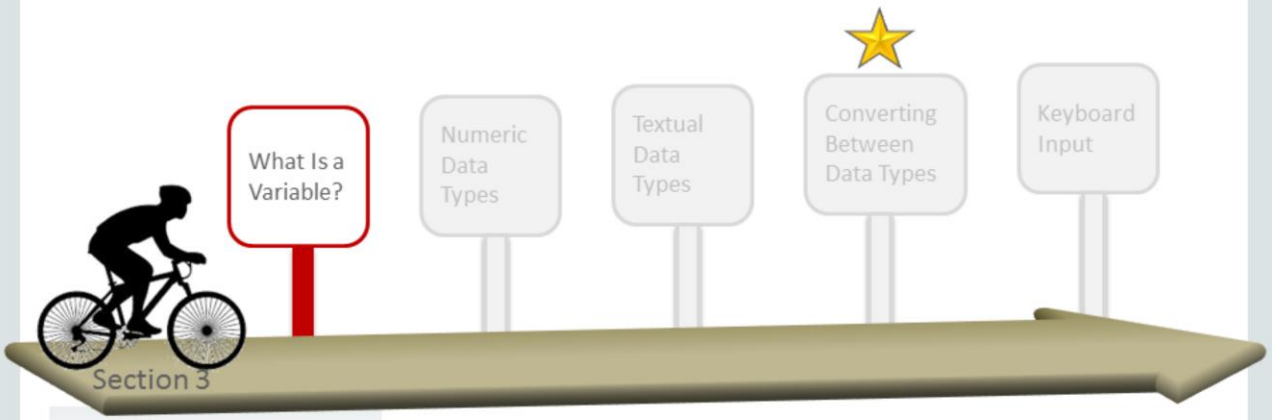

Bad Variable Naming

- 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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