Java Foundations

3-1
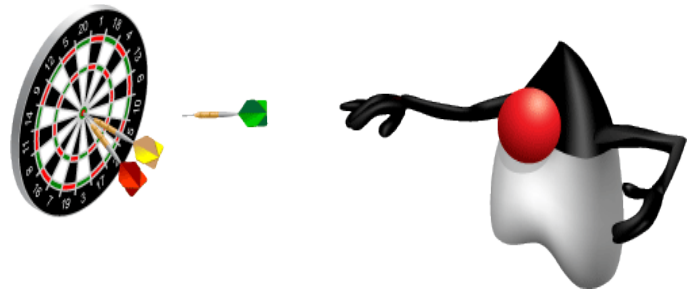**What Is a Variable?**

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Objectives

This lesson covers the following objectives:
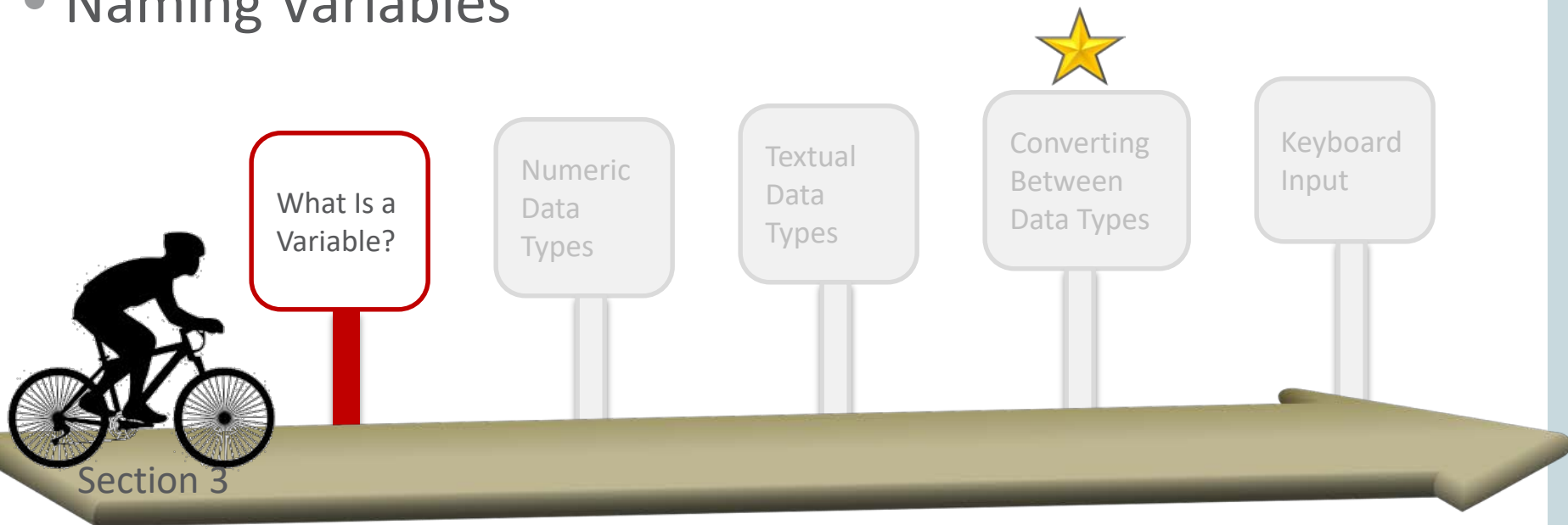
• Understand the benefits of variables.

Identify four main types of variables:
  – (boolean, int, double, String)

• Declare and assign values to variables
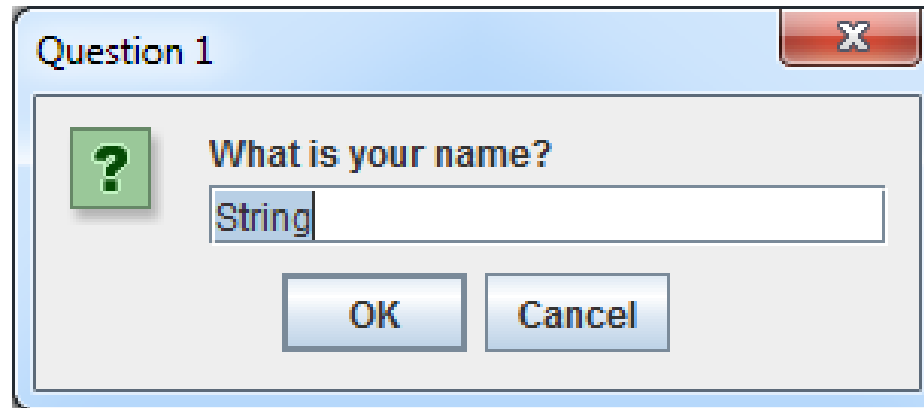
• Name variables according to conventions

Topics

- What Is a Variable?

- Types of Data

- Naming Variables

What Is a Variable?

Numeric Data Types

Textual Data Types

Converting Between Data Types

Keyboard Input

Section 3

4

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.

$$y = -2x + 5$$

$x = 0$

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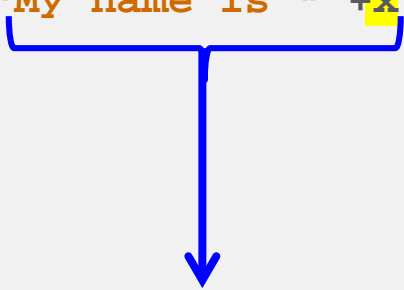
$x = 2$

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

What Is a Variable in Java?

- Similarly, we can assign values to Java variables.

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

"My name is Alex"

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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!");
```

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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
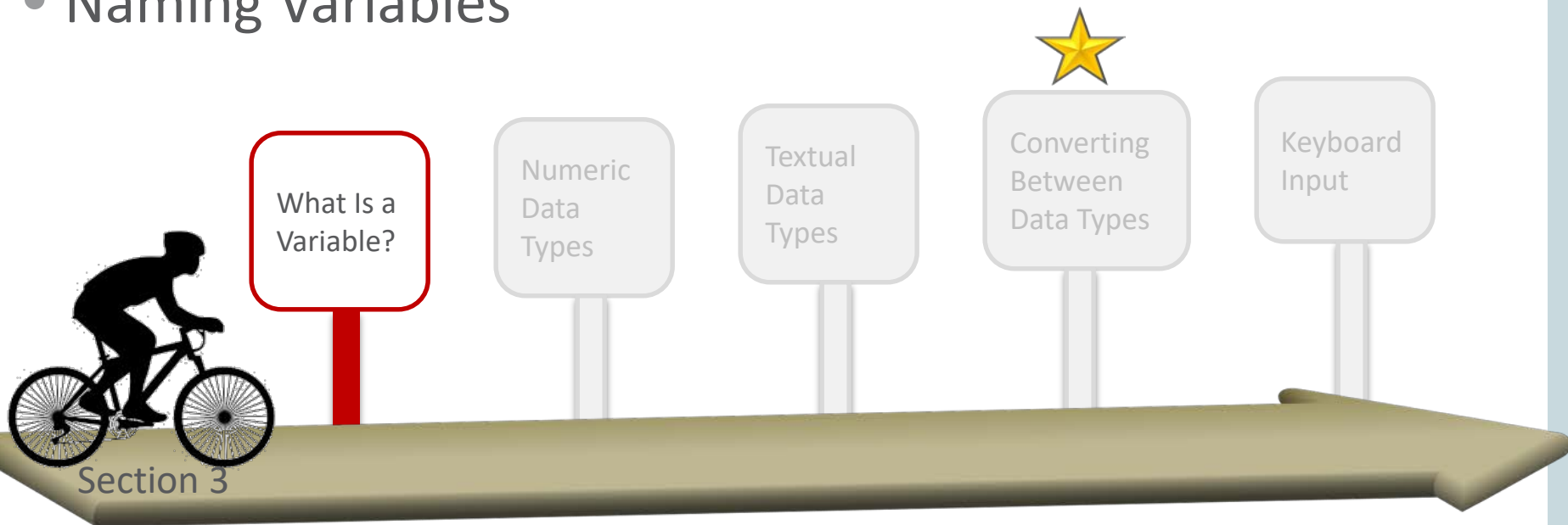    ```

  - After Step 3)
    ```
    kitty
    bunny
    ```

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# 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

- What Is a Variable?

- Types of Data

- Naming Variables

What Is a Variable?

Numeric Data Types

Textual Data Types

Converting Between Data Types

Keyboard Input

Section 3

13

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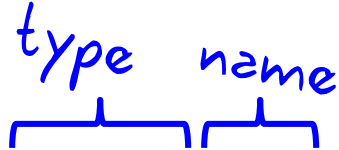
- Variables can exist for many different data types in Java.
- Here are the variables that you've seen:

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."

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Declaring a Variable

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

  type   *name*

  ```
  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.

type   name   value

```
boolean bool = true;
```

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

```
boolean bool;



bool = true;
```

16

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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!"`

$$y = -2("Puppies!") + 5$$

$$y = ???$$

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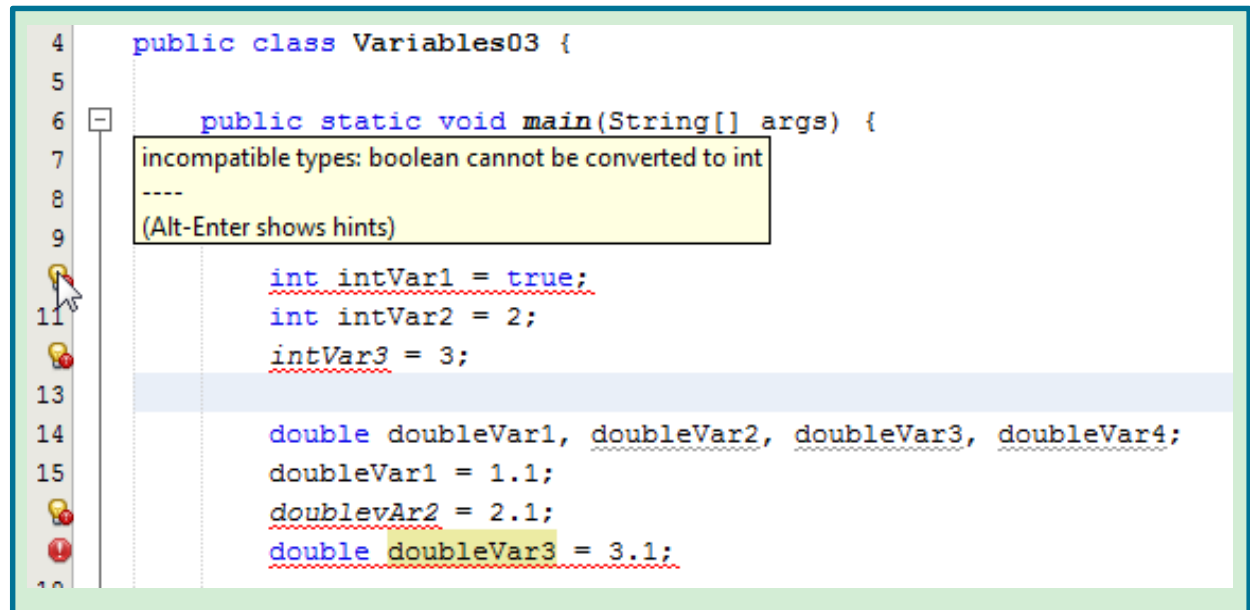Academy

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
```

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19

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)
             int intVar1 = true;
11           int intVar2 = 2;
             intVar3 = 3;
13
14           double doubleVar1, doubleVar2, doubleVar3, doubleVar4;
15           doubleVar1 = 1.1;
             doublevAr2 = 2.1;
             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

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Mistakes with Variables

- Assigning inappropriate values for a variable type

```java
int intVar1 = true;
```

- Forgetting to declare a variable's type

```java
intVar3 = 3;
```

- Misspelling a variable

```java
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.

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You May Have Noticed …

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

```
double doubleVar1, doubleVar2, doubleVar3;
```
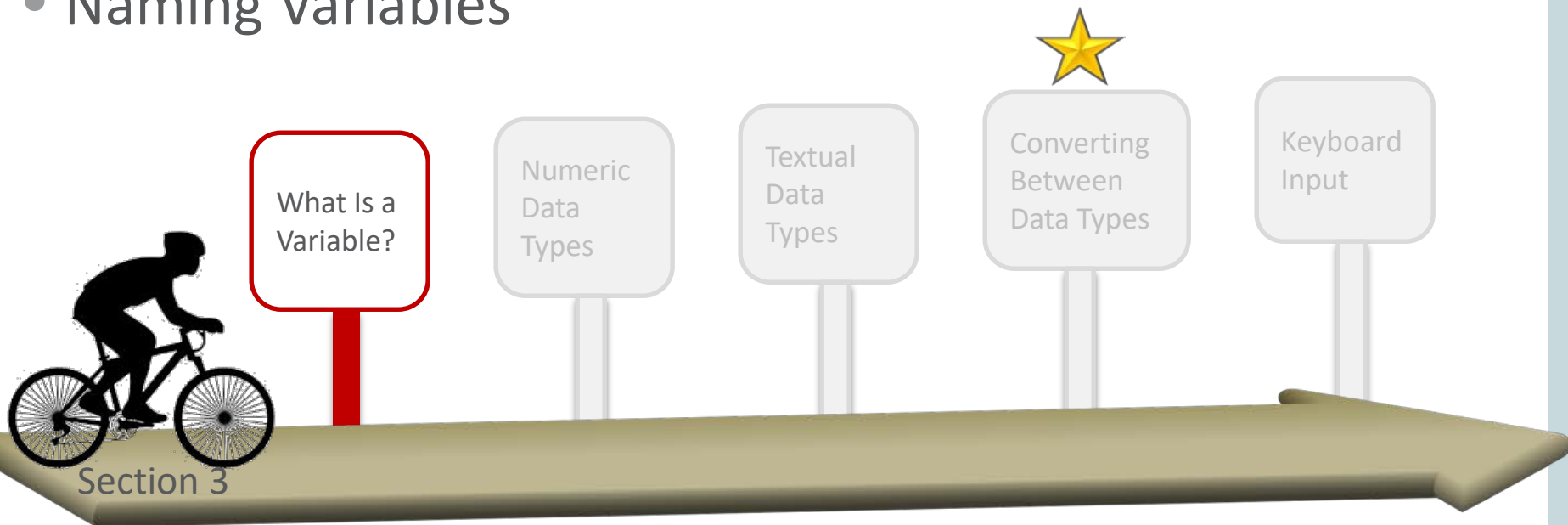
- It's possible to assign values when declaring many variables.

```
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

Topics

- What Is a Variable?
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- Naming Variables

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Section 3

Bad Variable Naming

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- 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?

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Very Bad Variable Naming

- Variables can't share the same name.

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

- Variables can't start with numbers.

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

- Keywords can't be used for variables names.

```java
int continue = 20;
```

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

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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