Building Java Programs

Chapter 2

Lecture 2-1: Expressions and Variables

reading: 2.2

Variables

reading: 2.2

Receipt example

What's bad about the following code?

```
public class Receipt {
    public static void main(String[] args) {
        // Calculate total owed, assuming 8% tax / 15% tip
        System.out.println("Subtotal:");
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```

- The subtotal expression `(38 + 40 + 30)` is repeated
- So many `println` statements

Variables

- **variable**: A piece of the computer's memory that is given a name and type, and can store a value.
  - Like preset stations on a car stereo, or cell phone speed dial:

  - Steps for using a variable:
    - *Declare* it - state its name and type
    - *Initialize* it - store a value into it
    - *Use* it - print it or use it as part of an expression

Declaration

- **variable declaration**: Sets aside memory for storing a value.
  - Variables must be declared before they can be used.

- Syntax:

  type name;

  - `int zipcode;`

  - `double myGPA;`

Assignment

- **assignment**: Stores a value into a variable.
  - The value can be an expression; the variable stores its result.

- Syntax:

  name = **expression**;

  - `int zipcode;`
    `zipcode = 90210;`

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zipcode	90210

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    `myGPA = 1.0 + 2.25;`

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zipcode	90210

myGPA	3.25

Using variables

- Once given a value, a variable can be used in expressions:

```
int x;
x = 3;
System.out.println("x is " + x);      // x is 3
System.out.println(5 * x - 1);        // 14
```

- You can assign a value more than once:

```
int x;
x = 3;
System.out.println(x + " here");      // 3 here

x = 4 + 7;
System.out.println("now x is " + x); // now x is 11
```

Declaration/initialization

- A variable can be declared/initialized in one statement.

- Syntax:

  type name = **expression**;

  - `int x = (11 % 3) + 12;`

x	14

  - `double myGPA = 3.95;`

myGPA	3.95

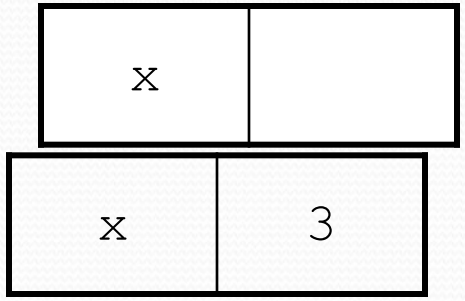
Assignment vs. algebra

- Assignment uses `=` , but it is not an algebraic equation.
  - `=` means, *"store the value at right in variable at left"*
  - `x = 3;` means, *"`x` becomes `3`"* or *"`x` should now store `3`"*

- **ERROR**: `3 = 1 + 2;` is an illegal statement, because `3` is not a variable.

- What happens here?

```
int x = 3;
                    // ???
```



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- What happens here?

```
int x = 3;
x = x + 2;    // ???
```

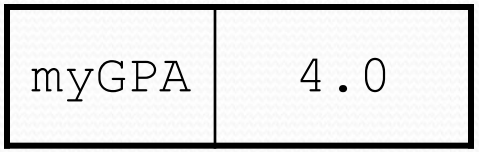
Assignment exercise

- What is the output of the following Java code?

```
int x;
x = 3;
int y = x;
x = 5;
y = y + x;
System.out.println(x);
System.out.println(y);
```

Assignment and types

- A variable can only store a value of its own type.
  - `int x = 2.5;` **`// ERROR: incompatible types`**
- An `int` value can be stored in a `double` variable.
  - The value is converted into the equivalent real number.
  - `double myGPA = 4;`



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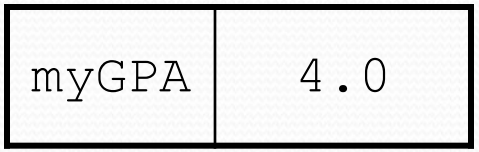

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myGPA	4.0

  - `double avg = 11 / 2;`
    - Why does `avg` store `5.0` and not `5.5` ?

avg	**5.0**

Compiler errors

- A variable can't be used until it is assigned a value.
  - ```
    int x;
    System.out.println(x);    // ERROR: x has no value
    ```
- You may not declare the same variable twice.
  - ```
    int x;
    int x;                    // ERROR: x already exists
    ```
  - ```
    int x = 3;
    int x = 5;                // ERROR: x already exists
    ```
    - How can this code be fixed?
    ```

Printing a variable's value

- Use + to print a string and a variable's value on one line.
  - ```
    double grade = (95.1 + 71.9 + 82.6) / 3.0;
    System.out.println("Your grade was " + grade);

    int students = 11 + 17 + 4 + 19 + 14;
    System.out.println("There are " + students +
                       " students in the course.");
    ```
  - Output:

    ```
    Your grade was 83.2
    There are 65 students in the course.
    ```
    ```

Receipt question

Improve the receipt program using variables.

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public class Receipt {
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}
```

Receipt answer

```
public class Receipt {
    public static void main(String[] args) {
        // Calculate total owed, assuming 8% tax / 15% tip
        int subtotal = 38 + 40 + 30;
        double tax = subtotal * .08;
        double tip = subtotal * .15;
        double total = subtotal + tax + tip;

        System.out.println("Subtotal: " + subtotal);
        System.out.println("Tax: " + tax);
        System.out.println("Tip: " + tip);
        System.out.println("Total: " + total);
    }
}
```