COMP 110-003
Introduction to Programming
Branching Statements and Boolean Expressions

January 29, 2013

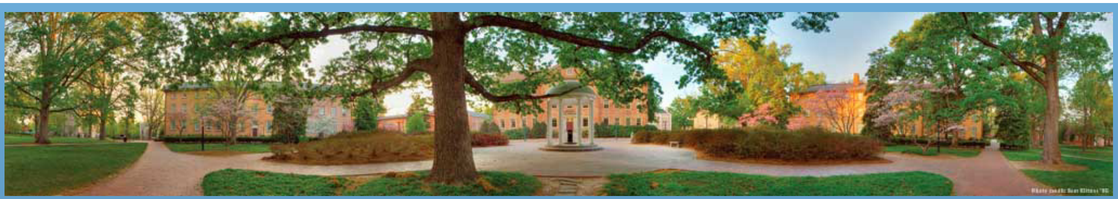
Photo credit: Sam Kittner '85

Haohan Li
TR 11:00 – 12:15, SN 011
Spring 2013

THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

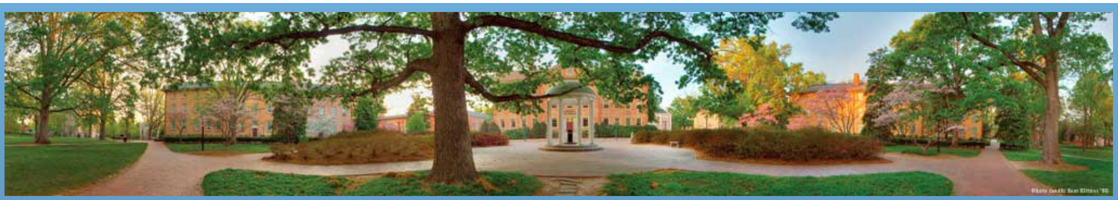
Announcements

- Lab 1 grading and comments on Sakai
- Office hour for Wednesday Jan. 30
  - 1:30PM – 3:30PM



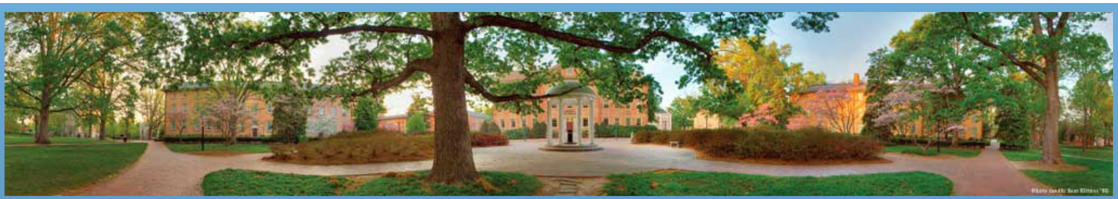
Today

- Review worksheet
- Formatting decimals
- If/Else statements
- Boolean Expressions



Review Worksheets

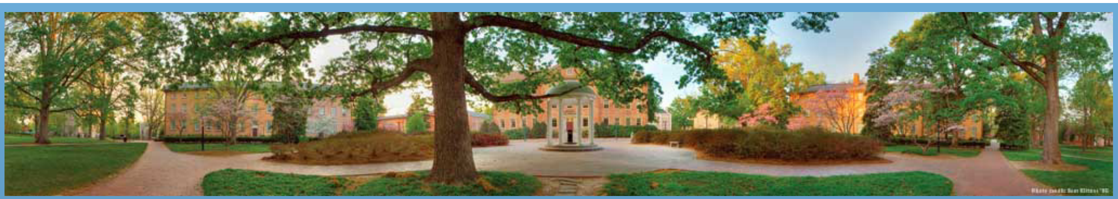
- Print
  - *System.out.println(“COMP110 is my favorite class”);*
- Read input
  - *Scanner keyboard = new Scanner(System.in);*
  - *int myInt = keyboard.nextInt();*



Declare a Variable

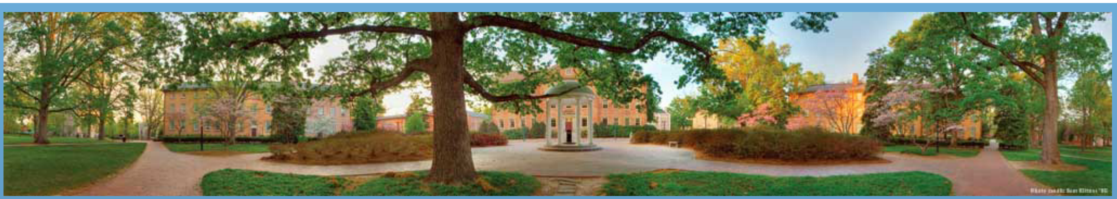
- Declare a variable of type float with the identifier, *myFloat*, and initialize the value to 4.6
  - *float myFloat = 4.6;*

  - *float myFloat;*
  - *myFloat = 4.6;*



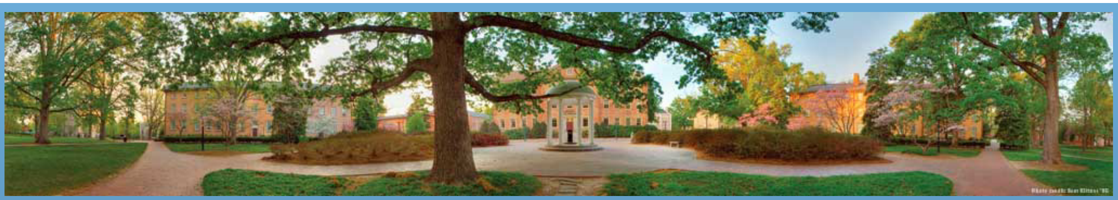
Class, Object, Method, Argument

```
public class MyProgram
{
        public static void main(String[] args)
        {
         String myString = “This is a string”;
         int len = myString.length();
         System.out.print(“the length is “ + len);
         String shortString = myString.substring(10);
        }
}
```



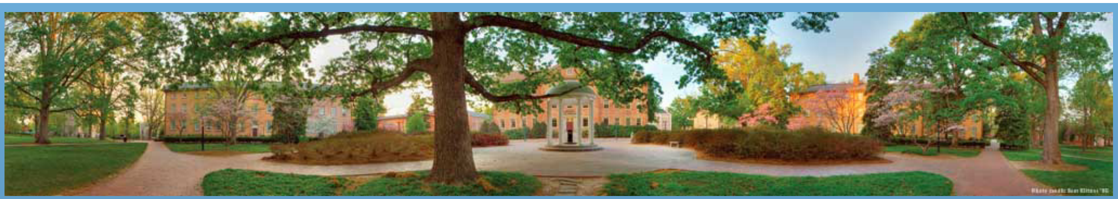
Integer Division

- *double myDouble = (1 / 2) * 5.0;*
- It means:
  - *int temp = (1 / 2);*
    - Because 1 and 2 are both integers, the value type of 1/2 is also an integer
    - Its value should be the integer part of 0.5, which is 0
  - *double myDouble = (double) temp * 5.0;*
    - Because 5.0 is a double, then temp is casted to double
    - However, the result will still be 0.0



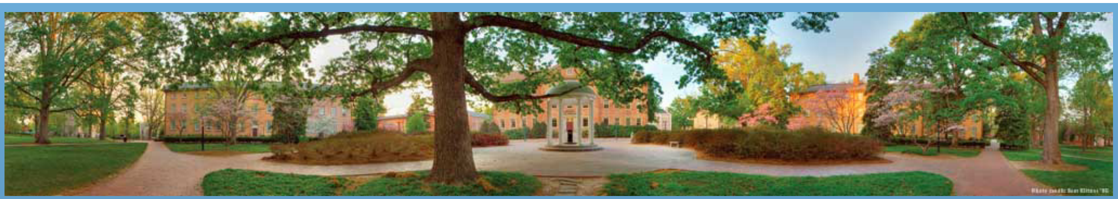
Floating-Point Division

- *double myDouble = (1.0 / 2.0) * 5.0;*
- It means:
  - *double temp = (1.0 / 2.0);*
    - Because 1 and 2 are both floating-points, the return type of 1 / 2 is also a floating-point
    - Its value should be 0.5
  - *double myDouble = temp * 5.0;*
    - The result will still be 2.5



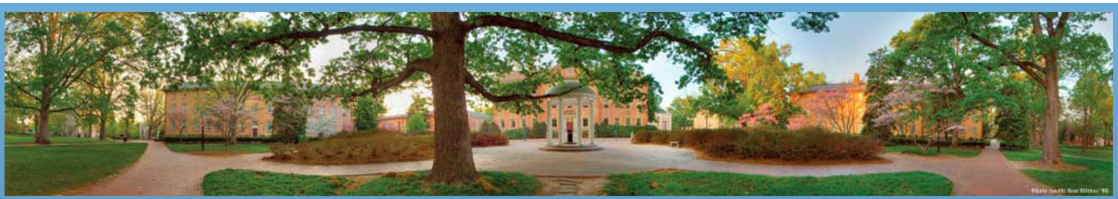
char Type

- ‘x’ represents a character in *char* type
  - char a, b;
  - a = ‘b’; // assign the value ‘b’ to *char* variable *a*
  - System.out.println(a);
  - b = ‘c’; // assign the value ‘c’ to *char* variable *b*
  - System.out.println(b);
  - a = b; // assign the value of *char* variable *b* (which is ‘c’) to
    // the value of *char* variable *a* (which was ‘b’)
  - System.out.println(a); // the value of a is ‘c’ now
  - Output would be: b, c, c



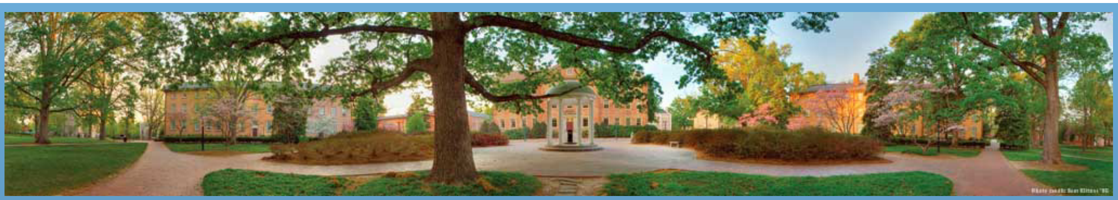
Class, Object and Method

- Suppose that *mary* is an object of class *Person*, and suppose that *increaseAge* is a method of class Person that uses one argument, an integer. Write the invocation of the method *increaseAge* for the object *mary* using the argument 5.
  - Syntax: ***ObjectName.Method(arguments);***
  - *mary.increaseAge(5);*



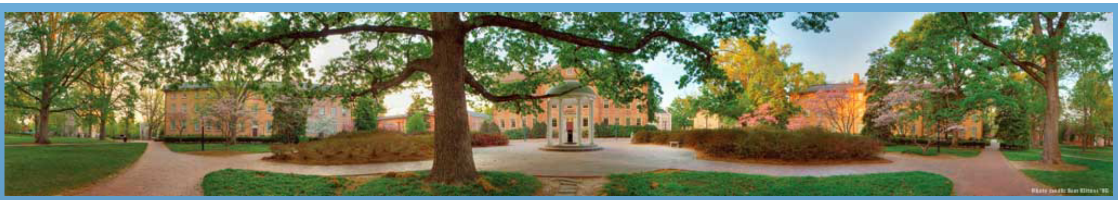
Today

- Review worksheet
- Formatting decimals
- If/Else statements
- Boolean Expressions



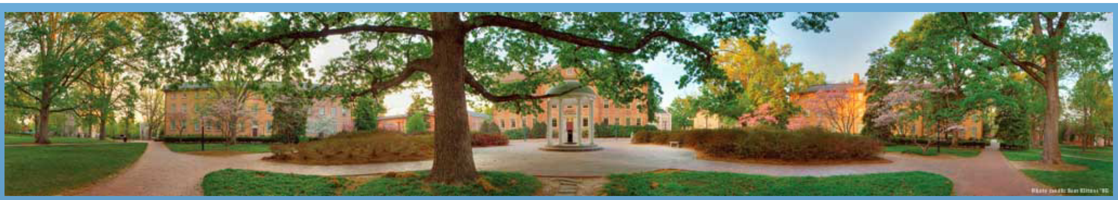
Formatting Decimals

- Use the class *DecimalFormat*
  - *import java.text.DecimalFormat;*
  - *DecimalFormat df = new DecimalFormat("0.00");*
  - *double d = 12.345678;*
  - *System.out.println("my double with two decimal places: " + df.format(d));*
    - The method is called by *df.format(d)*
    - It will output: my double with two decimal places: 12.35

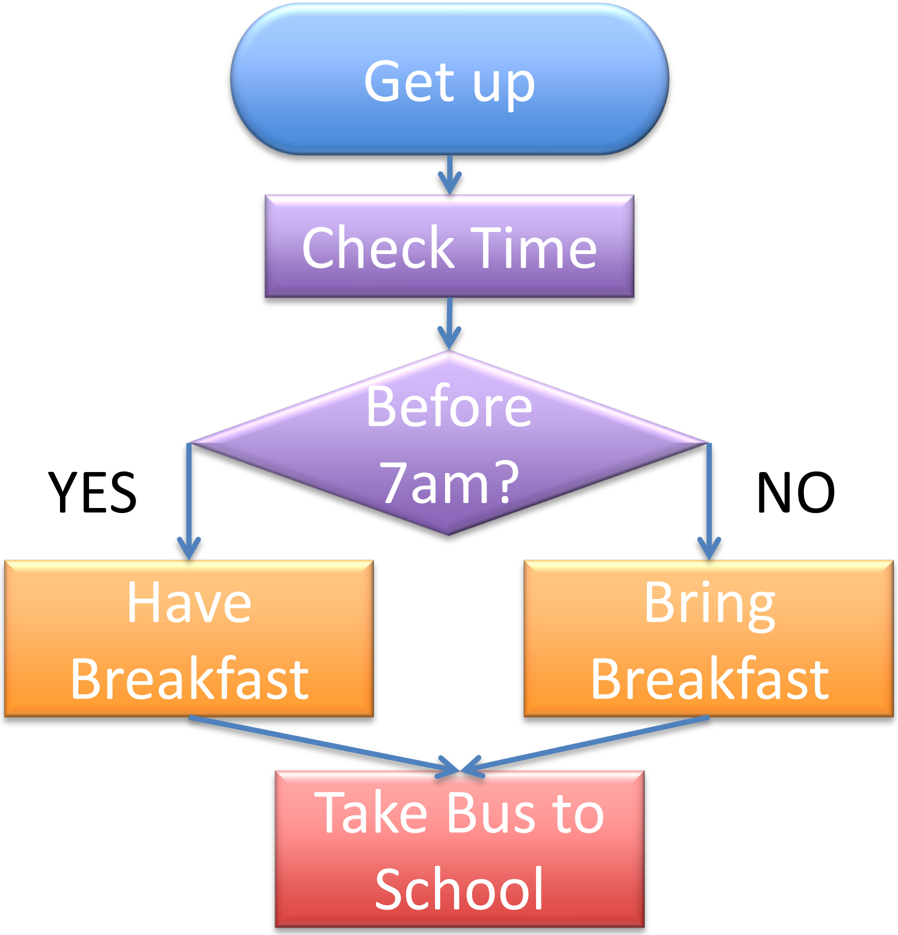


Today

- Review worksheet
- Formatting decimals
- If/Else statements
- Boolean Expressions

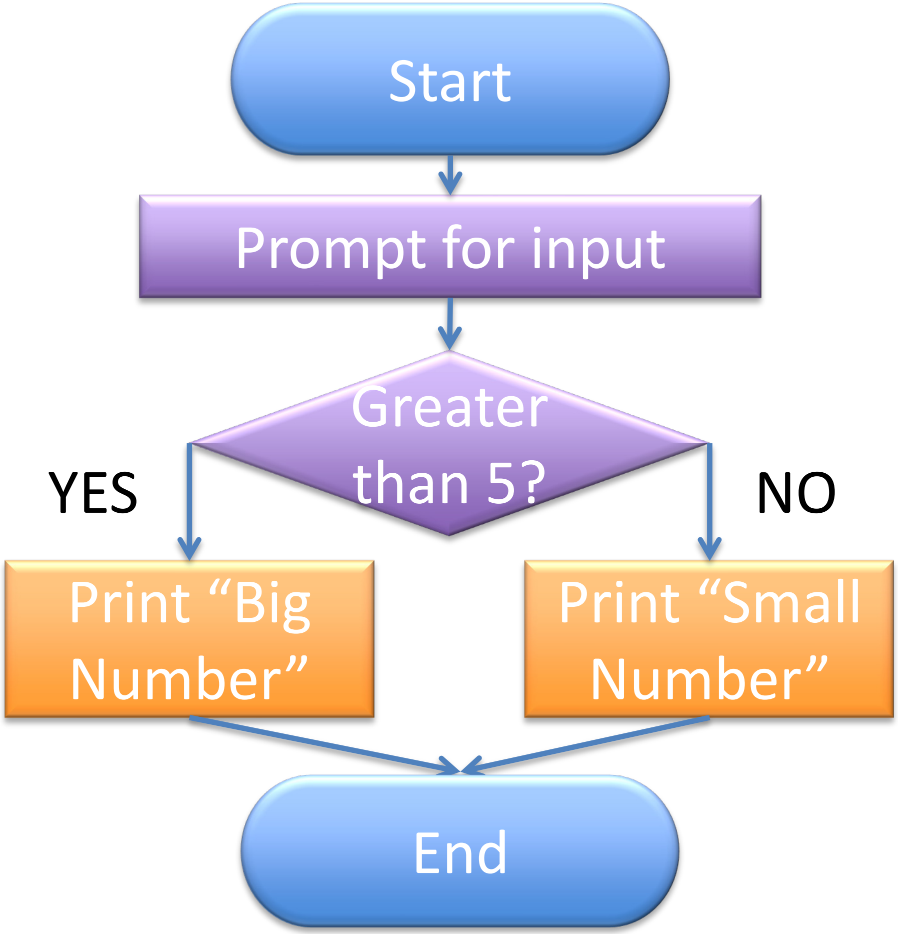


Flow Chart



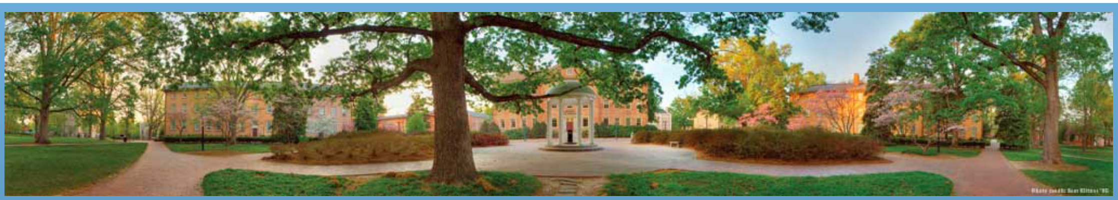
```
Student.getUp();
if (time < 7) {
   Student.haveBreakfast();
}
else {  // time >= 7
  Student.bringBreakfast();
}
Student.takeBus();
```

Full Java Example



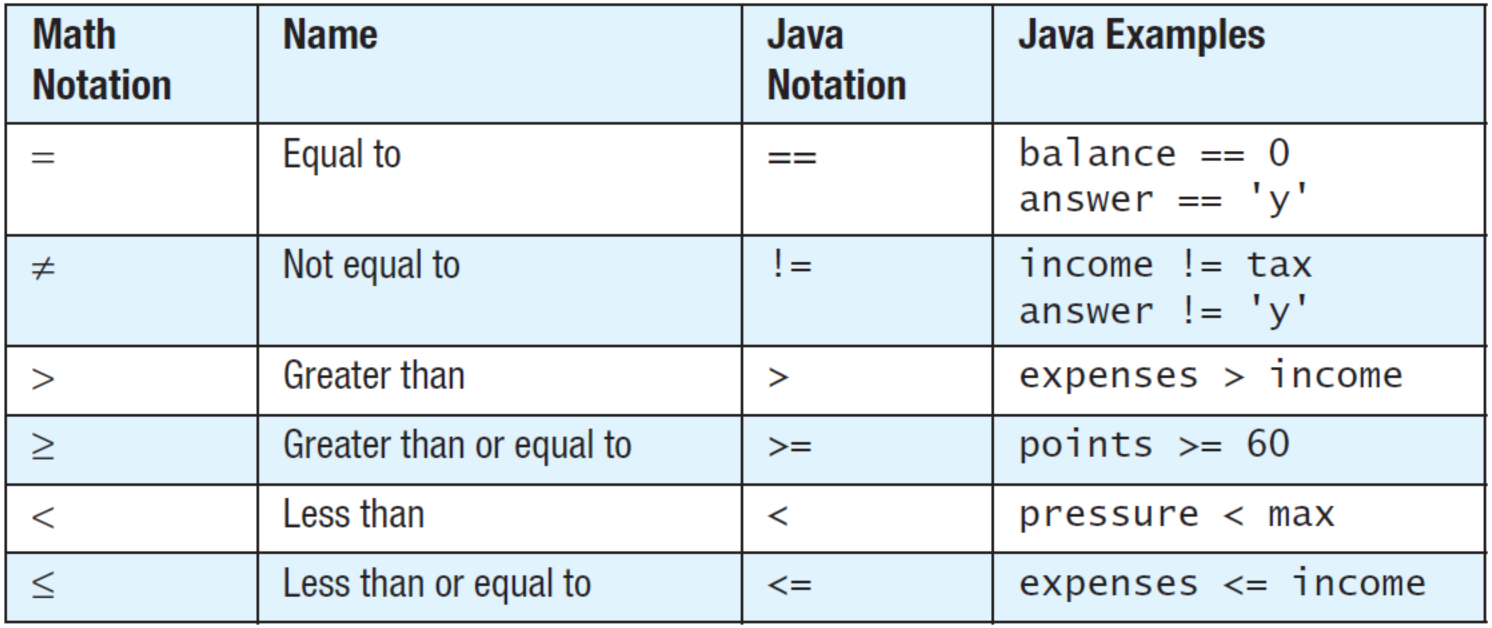
```java
import java.util.*;

public class FlowChart {
  public static void main(String[] args) {
    System.out.println("Give me an integer:");
    Scanner keyboard = new Scanner(System.in);
    int inputInt = keyboard.nextInt();
    if (inputInt > 5)
    {
      System.out.println("Big number");
    }
    else
    {
      System.out.println("Small number");
    }
  }
}
```

What if your input is 5?



Java Comparison Operators

FIGURE 3.4 **Java comparison operators**

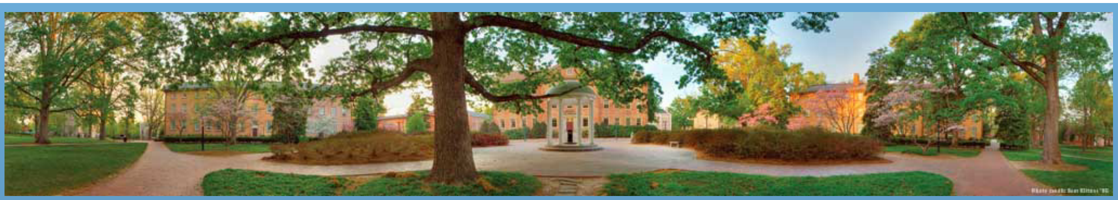


Math Notation	Name	Java Notation	Java Examples

=	Equal to	`==`	`balance == 0`
			`answer == 'y'`

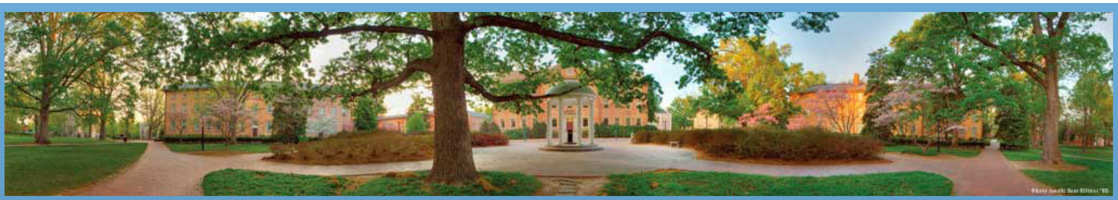
≠	Not equal to	`!=`	`income != tax`
			`answer != 'y'`

>	Greater than	`>`	`expenses > income`
≥	Greater than or equal to	`>=`	`points >= 60`
<	Less than	`<`	`pressure < max`
≤	Less than or equal to	`<=`	`expenses <= income`



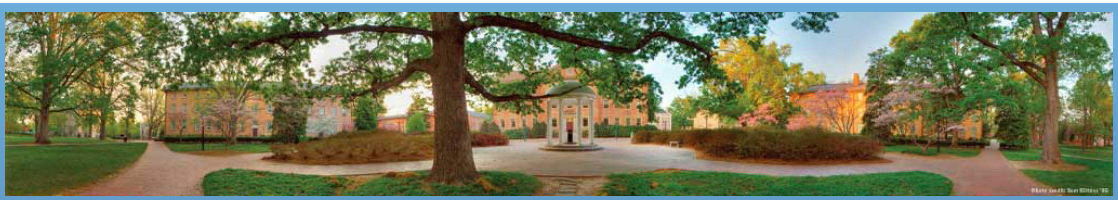
Boolean Expressions

- Expression?
  - An **expression** can be a variable, a value, or a combination made up by variables, values and operators
  - An expression **has a value**
  - **Arithmetic expression**: a combination of numbers with a number value
    - *10, taxRate/100, (cost + tax) * discount*
  - **String expression**: a combination of Strings with a String value
    - *“Hello”, “The total cost is ” + totalCost*



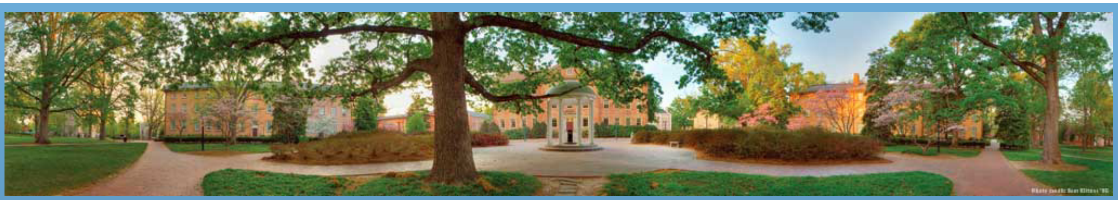
Boolean Expressions

- A combination of values and variables by comparison operators. Its value can only be ***true*** or ***false***
- Example expressions
  - *5 == 3; // false*
  - *variable <= 6; // depending on the value of variable*
    - What if variable is 5? What if variable is 6?
  - *myInt != temp; // depending on both values*
    - What if myInt is 0 and temp is 2? Am I lying?
- Syntax rule for if statement:
  - ***if (boolean expression)***
    { statements; }



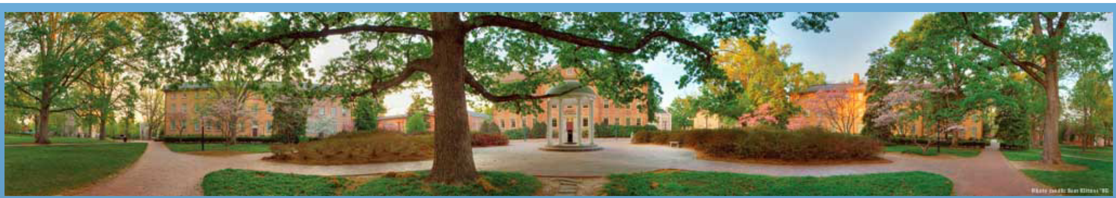
&&: and

- What if you need multiple expressions to be true?
- Syntax rule:
  - ***(expression) && (expression) && …***
    - Expressions go in ( )
  - (Time < 7) && (I’ve prepared breakfast)
- Will only be true if **ALL** statements are true



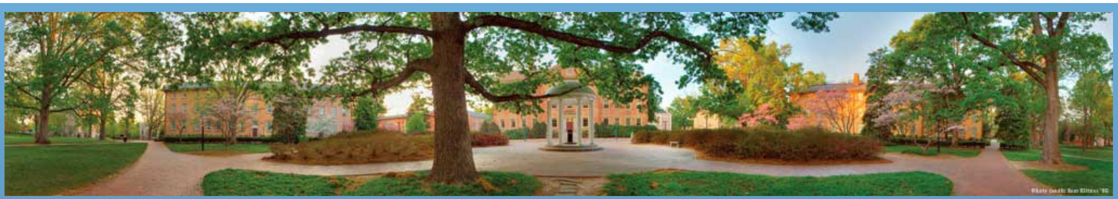
||: or

- What if you need ONE expression to be true out of many expressions
- Syntax rule:
  - ***(expression) || (expression) || …***
    - Again, expressions go in ( )
  - (I’ve had breakfast) || (Time > 7)
- Will be true if **ONE** expression is true



!: not

- Syntax rule:
  - *!(**expression**)*
    - Again, expressions go in ( )
  - !(I’ve had breakfast)
- Will be **true** if the expression is **false**
- **! is not recommended**
  - **You will get confused. Try to write expressions straightforward**
    - Use (cost != 3) instead of !(cost == 3)
    - Use (time <= 7) instead of !(time > 7)



Logical Operators

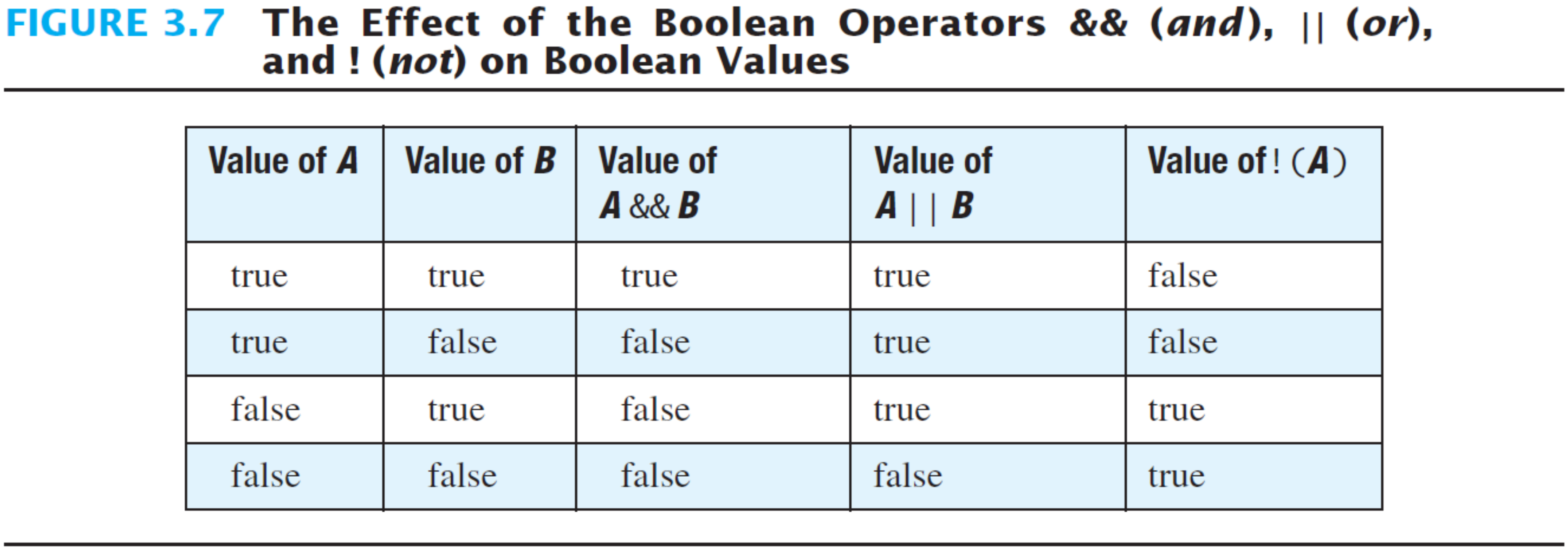
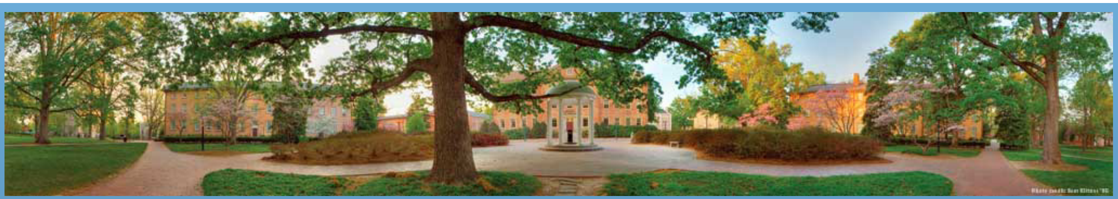


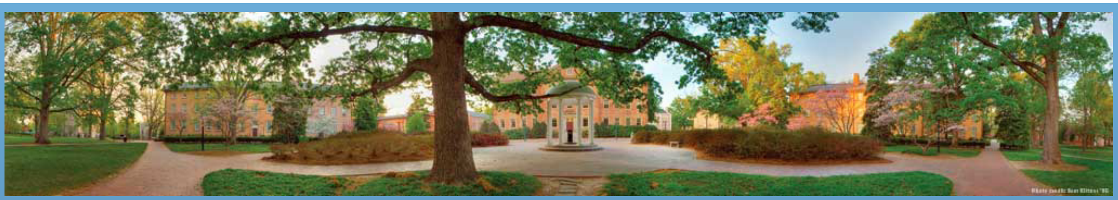
FIGURE 3.7 **The Effect of the Boolean Operators && (*and*), || (*or*), and ! (*not*) on Boolean Values**

Value of *A*	Value of *B*	Value of *A* && *B*	Value of *A* || *B*	Value of ! (*A*)
true	true	true	true	false
true	false	false	true	false
false	true	false	true	true
false	false	false	false	true



Comparison vs. Logical Operators

- Comparison operators connect values or variables
  - After connection, it’s a boolean expression
  - *a > b*
  - *c == d*
- Logical operators connect boolean expressions
  - *(a > b) && (c == d)*

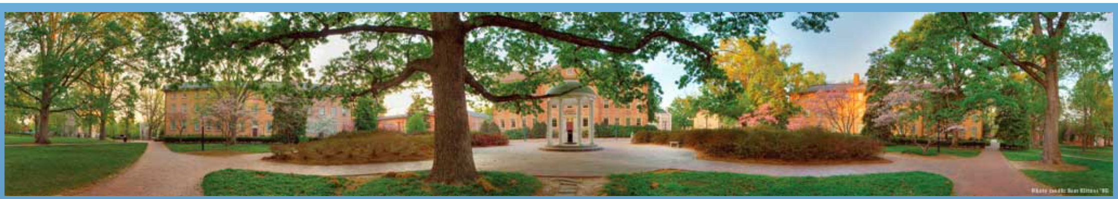


More Complex Boolean Expressions

- Combination of && and ||
  - *(((3 < 7)||(2==5)) && ((4!=2) && (1 <= 1)))*
  - *(((true)||(false)) && ((true) && (true))*
  - *(true) && (true)*
  - *true*
- *if (((I’m at Subway) && (You’re at Subway)) ||*

  ((I’m at Starbucks) && (You’re at Starbucks))

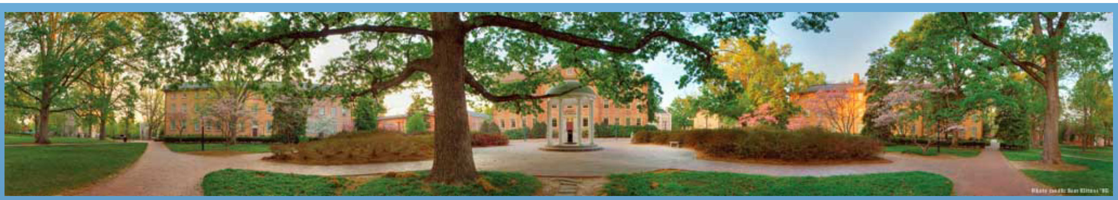
  ```
  {
      I will meet you;
  }
  ```



Boolean Variable

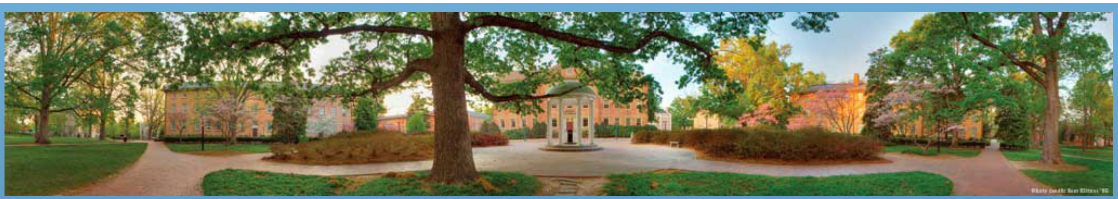
- A boolean variable saves a boolean value

```
boolean systemsAreOK =
  ((temperature <= 100) && (thrust >= 12000) && (cabinPressure > 30));
// You can use “=” to assign a boolean value to a boolean variable
if (systemsAreOK){
// It’s the same as if (systemsAreOK == true)
   System.out.println("Initiate launch sequence.");
    }
else{
    System.out.println("Abort launch sequence.");
    }
```



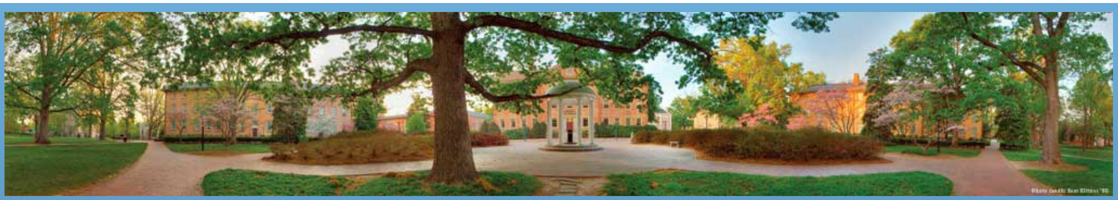
Assignment vs. Equal To

- *if (n1 = n2)*
  - **Error!!!!** It’s an assignment statement!
- *if (n1 == n2)*
  - Correct. It’s a boolean expression now.



String Comparison

- String comparison
  - *string1 == string2;   //BAD*
  - *string1.equals(string2);   //GOOD*
- Syntax
  - *String.equals(Other_String)*
  - *String.equalsIgnoreCase(Other_String)*

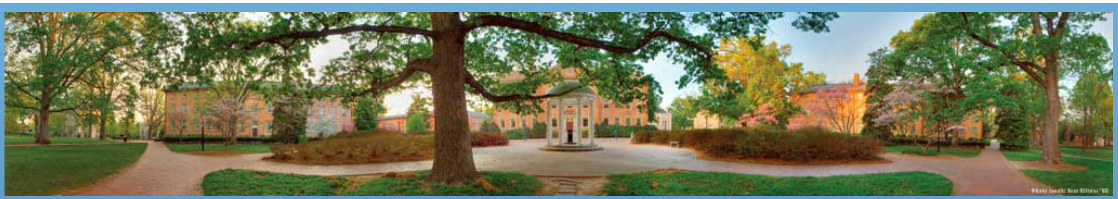


If and Else

- You can use only one if statement

  -
    ```
    if (boolean expression)
      { statements; }
    other statements;
    ```
    - *Other statements* will always be executed
- You can also use an if-else statement

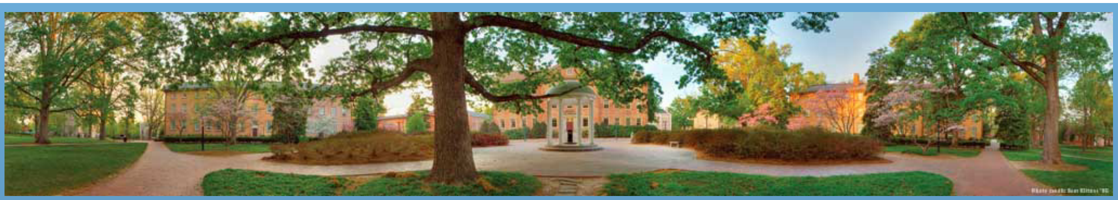
  -
    ```
    if (boolean expression)
      { statements 1; }
    else { statement 2; }
    ```
    - If the *expression* is true, run *statement 1*, otherwise run *statement 2*



Nested If and Else

```
if (time < 7){
    if (time < 6){
        cook hams and scramble eggs;
    }
    else{
        grab something from the fridge;
    }
}
else{
    go to school;
}
```

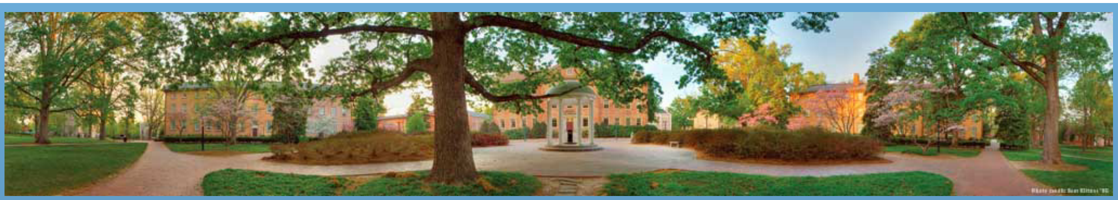
- What’s the logic flow?
  - If the time is smaller than 6, we cook breakfast;
  - If the time is between 6 and 7, we get something cold
  - If the time is greater than 7, we go to school



Nested If and Else

```
if (time < 6){
    cook hams and scramble eggs;
}
else{
    if (time < 7){
        grab something from the fridge;
    }
    else{
        go to school;
    }
}
```

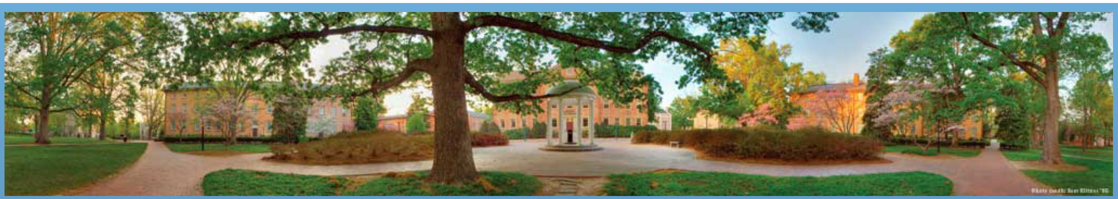
- What's the logic flow?
  - If the time is smaller than 6, we cook breakfast;
  - If the time is between 6 and 7, we get something cold
  - If the time is greater than 7, we go to school



Same Logic, Different Code

```
if (time < 6){
    cook hams and scramble eggs;
}
else{
    if (time < 7){
        grab something from the fridge;
    }
    else{
        go to school;
    }
}
```

```
if (time < 7){
    if (time < 6){
        cook hams and scramble eggs;
    }
    else{
        grab something from the fridge;
    }
}
else{
    go to school;
}
```

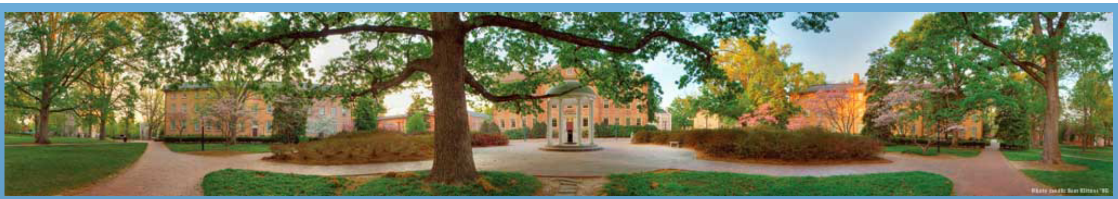


Without Else?

```
if (time < 6){
    cook hams and scramble eggs;
}
else{
    if (time < 7){
        grab something from the fridge;
    }
    else{
        go to school;
    }
}
```

```
if (time < 6 ){
    cook hams and scramble eggs;
}
if ( (time > 6) && (time < 7) )
    grab something from the fridge;
}
if (time > 7 ){
    go to school;
}
```

Exactly the same?

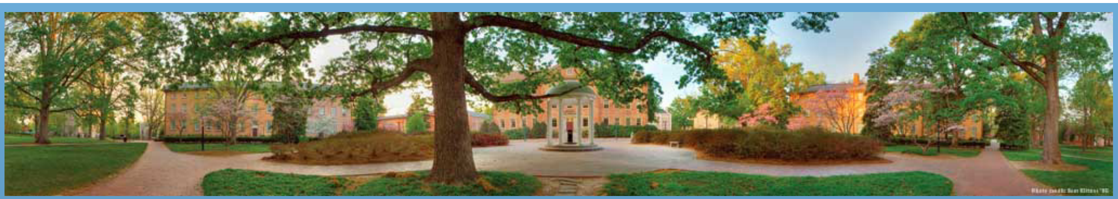


Without Else?

```
if (time < 6){
   cook hams and scramble eggs;
}
else{
   if (time < 7){
      grab something from the fridge;
   }
   else{
      go to school;
   }
}
```

```
if (time < 6 ){
   cook hams and scramble eggs;
}
if ( (time > 6) && (time < 7) )
   grab something from the fridge;
}
if (time > 7 ){
   go to school;
}
```

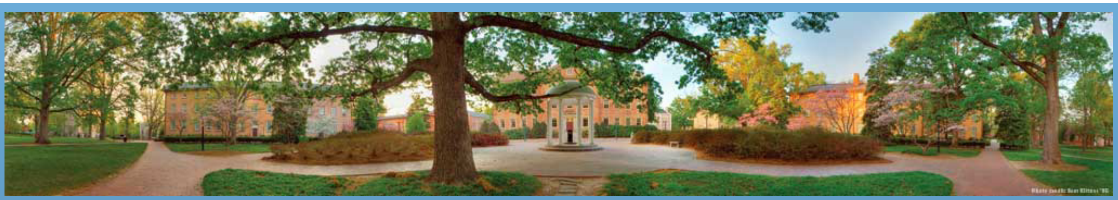
What if time is precisely 7?



Correct Code without Else

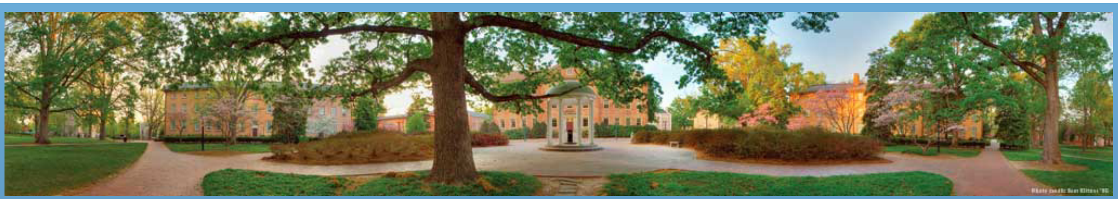
```
if (time < 6){
    cook hams and scramble eggs;
}
else{
    if (time < 7){
        grab something from the fridge;
    }
    else{
        go to school;
    }
}
```

```
if (time < 6 ){
    cook hams and scramble eggs;
}
if ( (time >= 6) && (time < 7) )
    grab something from the fridge;
}
if (time >= 7 ){
    go to school;
}
```

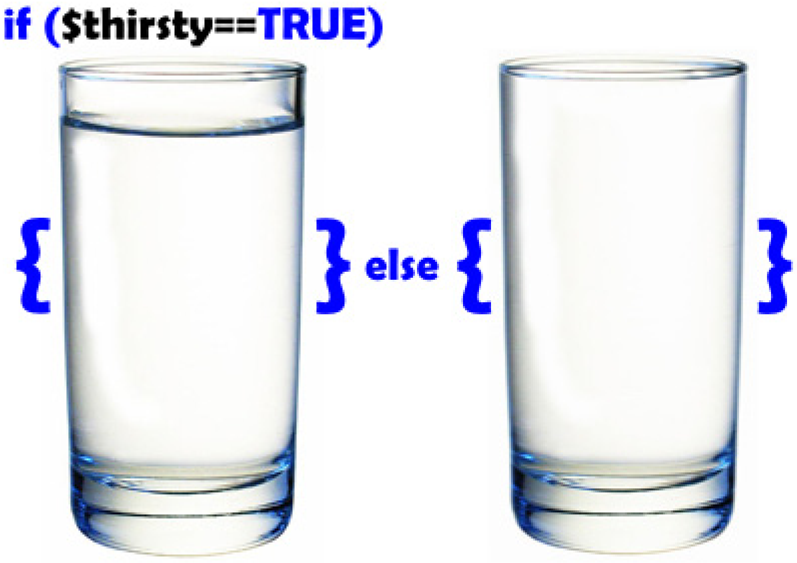


Using If and Else

- Use if-else statement
- Do not use two if statements
- Always pay attention to boundaries
  - Is it “>” or “>=”?
  - Is it “<” or “<=”?
  - Do you need a “==”?



If Thirsty



```
if ($thirsty==TRUE)
{ } else { }
```