Decisions in Java – The IF Statement

Two Actions – The `if-else` Statement

In performing a task, we often want to take one of two possible actions depending on the conditions at the time.

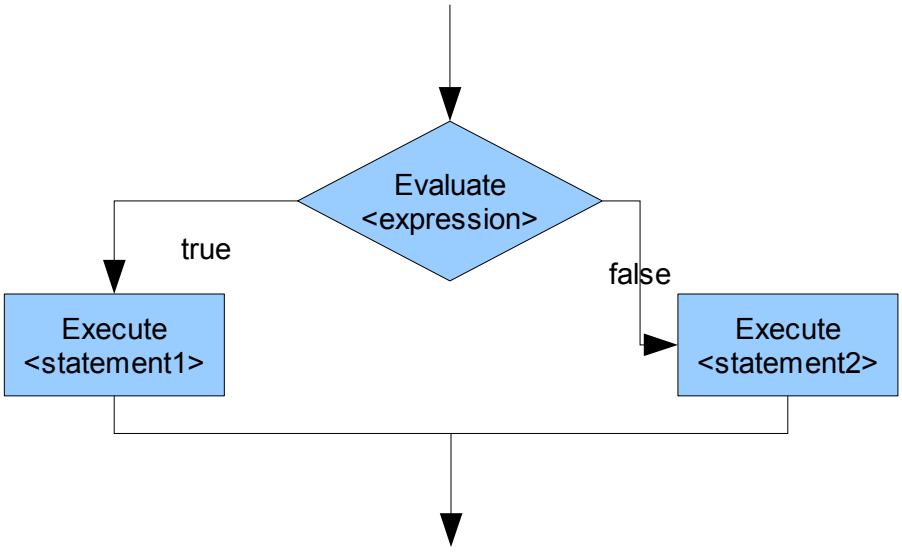
> If you have homework, then
> you should do it
> otherwise
> you can go to a movie.

Java uses an if statement similar to the form shown above.

```
if (<boolean expression>)
{
      <statement1 - to be executed for true expression>
}
else
{
      <statement2 - to be executed for false expression>
}
```

If the <boolean expression> evaluates to true, the first *block of code* will be executed. If the <boolean expression> evaluates to false, the second block of code will be executed.

It is also possible to illustrate the action of statements with a *flow chart*. As the program executes, we travel along the paths of the flow chart diagram, following the direction of the arrows.



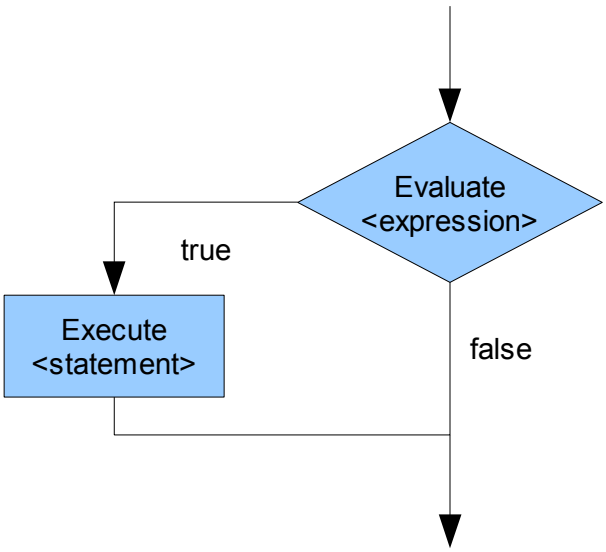
Example 1 – This program compares two integers supplied by the user and prints an appropriate message.

```
class IfElseDemo
{
      public static void main (String [] args)
      {
            int first, second;
            System.out.println("Please give one integer");
            first = In.getInt();
            System.out.println("and a second integer");
            second = In.getInt();

            if (first == second)
            {
                  System.out.println("The values are equal");
            }
            else
            {
                  System.out.println("The values are not equal");
            }
      }
}
```

One Action – The `if` Statement

There are times when we only want to take action when a condition is true, but we do nothing if the condition is false.



Java allows us to write an if statement that has no else branch.

```
if (<boolean expression>)
{
      <statement1 - to be executed for true expression>
}
```

Example 2 – This program determines the *magnitude* of a value using the *absolute value* method from the Math class. Any negative value is changed to positive, while positive values are unaffected.

```
class IfDemo
{
      public static void main (String [] args)
      {
            float number;
            System.out.print("Please enter a number: ");
            number = In.getFloat();

            if (number < 0)
            {
                  System.out.println("Negative changed to positive");
                  number = Math.abs(number);
            }
            System.out.println("The magnitude is " + number);
      }
}
```

Programming Template for If Statements

```
class <ClassName>
{
      public static void main (String [] args)
      {
            // declare any variables below

            // end of variable declarations

            if (<boolean condition>)
            {
                  <statements if condition is true>
            }
            else
            {
                  <statements if condition is false>
            }
      }
}
```

Exercises

1. Write Java statements to perform each task.

   (a) Add one to the value of **zeroCount** if the variable **total** has the value zero.

   (b) Add one to the value of **pageCount** if the variable **lineCount** is greater than **pageLength**.

   (c) Set the value of the boolean variable **leftSide** to **true** if the **int** variable **page** is even, and to **false** if **page** is odd.

   (d) Determine if the the **int** variable **n** is a perfect square and then display an appropriate message. (difficult question)

2. Write a program that will ask the user for two **int** values and determine which one has the greatest value (i.e., higher on the number line). The program should output something like, "The number *x* has the greatest value", where *x* is one of the numbers.

3. Write a program that will ask the user for two **int** values and determine if the first divides evenly into the second, displaying a message depending on the result. For example, the number 2 divides evenly into 4, but 4 does *not* divide into 2 (so order matters). Hint: You may find the modulo operator (%) useful here.

4. Write a program that will ask the user for two **float** values and compare their *magnitudes*. For example, if the user entered 3 and -9, the program should respond that -9 has the greater *magnitude*.

5. Write a program that solves an equation of the form $a x + b = 0$. The program should *prompt* the user for values of **a** and **b**, then solve the equation for **x** and print the results. The program should take appropriate action if **a** is zero.

6. A quadratic equation in the form $a x^2 + b x + c = 0$ has roots (or zeroes) given by

   $$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

   Write a program that determines the values of the roots, **root1** and **root2**, of the quadratic equation after asking the user to input values for **a**, **b**, and **c**. The program should take show appropriate messages if:

   (a) the value of **a** is zero (in which case, see Exercise #4), and
   (b) there are two, one, or zero real roots (you cannot take the square root of a negative number).

   Hint: There are two roots for the quadratic, which can be determined using the following code.

```
root1 = (-1 * b + Math.sqrt(b^2 - 4 * a * c)) / (2 * a);

root1 = (-1 * b - Math.sqrt(b^2 - 4 * a * c)) / (2 * a);
```

Solutions

1.

(a)
```
if (total == 0)
{
      zeroCount = zeroCount + 1;
}
```

(b)
```
if (lineCount > pageLength)
{
      pageLength = pageLength + 1;
}
```

(c)
```
// use modulo (%) to see if page is divisible by 2 (remainder 0)
// or not divisible by 2 (remainder 1)
remainder = page % 2;

if (remainder = 0)
{
      leftSide = true;       // page is even
}
else
{
      leftSide = false;      // page is odd
}
```

(d)
```
// determine square root of value, but rounded down
squareRoot = (int) Math.sqrt(value);

// square that result
rootSquared = squareRoot * squareRoot;

if (rootSquared == value)
{
      System.out.println(value + " is a perfect square");
}
else
{
      System.out.println(value + " is NOT a perfect square");
}
```

2.
```
class GreatestValue
{
      public static void main (String [] args)
      {
            int first, second;
            System.out.println("Please give one integer");
            first = In.getInt();
            System.out.println("and a second integer");
            second = In.getInt();

            // determine which value is greatest
            if (first >= second)
            {
                  System.out.println(first + " is the greatest value");
            }
            else
            {
                  System.out.println(second + " is the greatest value");
            }
      }
}
```

3.
```
class PerfectSquares
{
      public static void main (String [] args)
      {
            int first, second;
            System.out.println("Please give one integer");
            first = In.getInt();
            System.out.println("and a second integer");
            second = In.getInt();

            // check if second value divides evenly into the first
            // using the modulo operator - look for zero remainder
            if (second % first == 0)
            {
                  System.out.println(first + "divides into " + second);
            }
            else
            {
                  System.out.println(first + "does not divide into " +
                                          second);
            }
      }
}
```

4.
```
class Magnitudes
{
      public static void main (String [] args)
      {
            float x, y;
            System.out.println("Please give one real number");
            x = In.getFloat();
            System.out.println("and a second real number");
            y = In.getFloat();

            // compare the magnitudes of the values
            if (Math.abs(x) >= Math.abs(y))
            {
                  System.out.println(x + " has the greater magnitude");
            }
            else
            {
                  System.out.println(y + " has the greater magnitude");
            }
      }
}
```

5.
```
class SolveLinearEquation
{
      public static void main (String [] args)
      {
            float a, b, x;
            System.out.println("We will solve: a x + b = 0");
            System.out.println("Please give a value for a");
            a = In.getFloat();
            System.out.println("Please give a value for b");
            b = In.getFloat();

            // x = -b / a, but cannot divide by zero
            if (a != 0)
            {
                  x = -1 * b / a;
                  System.out.println("x = " + x);
            }
            else
            {
                  System.out.println("a = 0 gives division by zero");
            }
      }
}
```