Conditional Execution

REVIEW

So far, we have learned the following key computing concepts (besides the drawing commands):

1. A Processing program is a set of functions:

```java
void setup() {
    . . .
} // setup()

void draw() {
    . . .
} // draw()

void mousePressed() {
    . . .
} // mousePressed()
```

When a program like above is run the following execution order is followed:

- All commands in `setup()` are carried out in the sequence written.
- All commands in `draw()` are carried out in the sequence written.
- The sequence of commands in `draw()` is repeated 60 times/second.
- If a mouse is pressed, the execution is transferred to the `mousePressed()` function.
  After that, control goes back to `draw()`

2. Variables are names that hold a value of a given type. These are the types we have studied so far: `int`, `float`, `char`, `String`, and `boolean`.

3. Each type defines operations on values of that type. Here are the operations on the types we have studied:

   - `int`: + (addition), - (subtraction), * (multiplication), / (division), % (remainder)
   - `float`: + (addition), - (subtraction), * (multiplication), / (division)
   - `char`: no operations defined
   - `String`: + (concatenation)
   - `boolean`: && (logical-and), || (logical-or), ! (negation)

4. Variables can be assigned values by using the assignment statement:

```
<variable> = <expression>;
```
Making Decisions - Conditional Statements

In Processing, the `if`-statement facilitates creating decision points in a program where, during program execution, a set of statements may be carried out, or skipped. The decision to carry out or skip a set of statements is based on conditional expressions (also called Boolean expressions). Here are some examples of conditions:

- 5 is greater than 3
- 5 is less than 3
- 5 is equal to 3
- x is less than or equal to y
- POTUS is a woman.

Each of the sentences above is stating a condition. Every condition results in a yes/no answer. In Processing we call them true/false answers. That is, every conditional expression results in a boolean value. Look at the conditions above. Can you assign a true/false value to each of the above statements?

In the first four conditions above, we are comparing numbers. In Processing, there are several comparison operators to compare numbers:

- `<`  less than
- `<=`  less than or equal to
- `>`  greater than
- `>=`  greater than or equal to
- `==`  equal to
- `!=`  not equal to

The three conditions can be written in Processing as shown below:

```
(5 > 3)  5 is greater than 3
(5 < 3)  is less than 3
(5 == 3) 5 is equal to 3
(x <= y)  x is less than or equal to y
```

The above conditional expressions all yield true/false values. These expressions can be further combined using the three logical operations on Boolean values:

- `&&`  logical-and
- `||`  logical-or
- `!`  negation

For example, consider the statements below:

- 5 is greater than 3 and 5 is less than 10
- 5 is greater than 3 or 5 is less than 3
- 5 is not less than 3

We can use the logical operations to write these conditions in Processing:
(5 > 3) && (5 < 10)  5 is greater than 3 and 5 is less than 10
(5 > 3) || (5 < 3)  5 is greater than 3 or 5 is less than 3
!(5 < 3)  5 is not less than 3 (also written as (5 >=3))

Study the expressions shown above and make sure you can determine their \text{true/false} values. An expression with a logical-and ($\&\&$) is true only when both of its operands are true. An expression with a logical-or ($| |$) is \text{true} if any (one or both) operands are \text{true}. Otherwise, they are both \text{false}.

Now that we know about conditions, let us learn the if-statement.

Here are the various forms of the if statement:

1. **Simple if-statement**

   If ( <condition> ) {
       do something
   }

2. **If-else statement**

   If ( <condition> ) {
       do something
   }
   else {
       do something else
   }

**Example:** The sketch below shows how to use if-statements in a program:

```java
void setup() {
    size(500, 500);
    background(255);
} // setup()

float x = 10, y = 250, w = 20;
float speedX = 1;

void draw() {
    background(255);
    fill(255, 89, 23);
    noStroke();
    circle(x, y, w);
    x = x + speedX;
    if ((x+w/2 > width) || (x - w/2 < 0)) {
        speedX = -speedX;
    }
} // draw()
```
Study the program above. Then implement and run the sketch to observe how it works. Then, add statements to move the ball in y-directions and bounce off the top and bottom walls of the Drawing Window.

**Exercise 1:** Write a sketch so that it has a 500x500 Drawing Window. Depending on the location of the mouse it either sets the background to white, or black. The background should be white when the mouse is in the left half of the screen. Otherwise, it should be black.

**Exercise 2:** Write a sketch so that it has a 500x500 Drawing Window. Depending on the location of the mouse it either sets the background to white, or black. The background should be white when the mouse is in the top half of the screen. Otherwise, it should be black.

3. The most general form of if-statement

An if statement can have as many else-parts as may be needed. Thus, the general form of an if-statement is:

```plaintext
if ( <condition-1> ) {
    do thing-1
}
el{}
else if ( <condition-2> ) {
    do thing-2
}
else if ( <condition-3> ) {
    do thing-3
}
...
el{}
```