Loops

Sections 5.1, 5.6

Increment and Decrement Operators (5.1)

- C++ provides a shortcut to increment or decrement a variable by 1

```
int x = 99, y = 90;
x++; // this is equivalent to x += 1
x--; // this is equivalent to x -= 1
```

In a Loop

- Often, this is used to increment a loop counter

```
int x = 1;
while( x < 5 ){
    cout << " x : " << x << endl;
    x++; // increment
 }
```

Examples

- This can be used in an expression:

```
y = x++ + 9;
```

What does this mean?

- This can also be used in a conditional

```
( x-- > 9 )
```

What does this mean?

Practice

- Write one statement of code to do each of the following:

```
int x =0, y=1;
```

- Add x + 9 to y and increment x by 1
- Add x * 4 to y and increment x by 1
- Add y – 13 to x and decrement y by 1

Prefix vs Postfix

- ++x is *prefix*
  - The x += 1 happens *before* the expression is evaluated
- x++ is *postfix*
  - the x += 1 happens *after* the expression is evaluated

```
int y=0, x=0, z=0;
x = y++;
y = ++z;
z = x ++ + 1;
```

Examples

```
int x = 0, y = 0;

x = y++ * 2;
y = ++x / 2;

x = x++ + 1;
x = ++x + 1;

y = (y+ x++) * 2;
x = y++ + ++x;
```

Practice

- Write a single C++ statement to do each of the following:

```
int y = 0, x = 0, z = 0;
```

- Decrement x by 1 then add 2x to y
- Add 2y to x then increment y by 1
- Subtract 9x – 1 from y then decrement x by 1
- Increment y by 1 then add 8-2y to x
- Increment x and y each by 1 then add x+y to z

`for` loops (5.6)

- 3 main steps for loops:
  - Initialize, Test, Update
- `for` loops provide a concise way to do this

```
//  initialize   test       update
for (count = 0; count < 5; count++)
{
   cout << count << endl;
}
```

For vs While

- This for loop

```
for (count = 0; count < 5; count++)
{
   cout << count << endl;
}
```

- is equivalent to

```
count = 0;
while(count < 5)
{
  cout << count << endl;
  count ++;          // update happens at the end
}
```

Example

- Write a `for` loop that outputs odd numbers less than 10

Practice

- What does this output?

```
for (i = 5; i < 10; i+= 2)
{
   cout << i;
}
```

- Rewrite the for loop as a while loop

Problem

- Write a program that will print the sum of the odd integers between 1 and 50 inclusive. Write one program using a while and the other using a for loop

Practice

- Write a program that computes the factorial of a number. The factorial of a number is given by the formula
- The user will input N
  - N! = N*(N-1)*…*2*1
    - where 0!=1, 1!=1, 2!=2, 3!=6, …

Localized Declarations

```
for (int i = 0; i < n; i++)
{
  cout << i << endl;
}
cout << i << endl; // This will cause an error
```

- `i` is declared ONLY in the loop
- Convert this to a **`while`** loop

Potential Pitfalls

- What is the output of the following loop

```
for (count = 0; count < 5; count++)
{
   cout << count << endl;
   count++;
}
```

Practice

- What is the output of the following loop

```
for (count = 0; count < 10; count += 2)
{
   cout << count << endl;
}
```

Problem

- Write a program that allows the user to enter 20 integers, you should then print out the following:
  - The sum of all integers inputted
  - The average of all integers inputted
  - The largest integer of all integers inputted