Loops

Sections 5.1, 5.6
Increment and Decrement Operators (5.1)

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

```cpp
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

```cpp
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:

  ```c
  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

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

```c
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:
  o Initialize, Test, Update

• for loops provide a concise way to do this

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

- This for loop

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

- is equivalent to

```cpp
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?

```cpp
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

\[ N! = N \times (N-1) \times \ldots \times 2 \times 1 \]

where 0! = 1, 1! = 1, 2! = 2, 3! = 6, …

• The user will input N
Localized Declarations

```cpp
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

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

- What is the output of the following loop

```cpp
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