Loops
Ch 3.3-3.4
Announcements

Will post homework tonight
if/else vs loops

if/else statements makes code inside only sometimes run

Loops make code inside run more than once

Both use boolean expressions to determine if the code inside is run
while loop

A while loop tests a bool expression and will run until that expression is false.

```cpp
while (i < 10) {
    // looped code
    // variable i should change in here
}
```

(See: whileLoop.cpp)
while loop

The *bool* expression is tested when first entering the while loop

And!

When the end of the loop code is reached (the } to close the loop)

```cpp
int i = 0;
while (i < 5) {
    cout << "Looping, i = " << i << "\n";
    i++;
}
cout << "Outside the loop, i = " << i << "\n";
```
It can be helpful to manually work out what loops are doing and how variables change in each loop iteration.

This will build an insight into how loops work and will be beneficial when working with more complicated loops.
while loop

3 parts to any (good) loop:

- Test variable initialized
  
  ```
  i=0;
  ```

- bool expression
  
  ```
  while (i < 10)
  ```

- Test variable updated inside loop
  
  ```
  i++; 
  ```
A **for loop** is a compacted version of the **while loop** (the 3 important parts are together). For loops are used normally when iterating over a sequence of numbers (i.e. 1, 2, 3, 4).

```c++
for (int i=0; i < 3; i++)
```

**Initialization**, **boolean expression**, **Update**

(See: forLoop.cpp)
A do-while loop is similar to a normal while loop, except the bool expression is only tested at the end of the loop (not at the start).

```cpp
cout << "How many times do you want to run the loop?\n";
cin >> i; // what happens if i is less than 1?
do {
    cout << "Looping, i = " << i << "\n";
i--;}
while (i > 0); // Note semicolon!
cout << "Outside the loop, i = " << i << "\n";
```

(See: doWhile.cpp)
do-while loop

Q: Why would I ever want a do-while loop?

A: When the first time the variable is set is inside the loop.

You can initialize the variable correctly and use a normal while loop, but this makes the logic harder.
Loops

99 bottles of beer on the wall, 99 bottles of beer!
Take one down, pass it around, 98 bottles of beer on the wall!

98 bottles of beer on the wall, 98 bottles of beer!
Take one down, pass it around, 97 bottles of beer on the wall!

97 bottles of beer on the wall, 97 bottles of beer!
Take one down, pass it around, 96 bottles of beer on the wall!
...

Write a program to output the above song
(See 99beer.cpp)
There are two commands that help control loops:

- **continue** tells the loop to start over again
- **break** stops the loop
The `continue` command can be issued to start at the next iteration of a loop.

```cpp
for (i = 0; i < 10; i++)
{
    // code will run everytime
    if (doSkip)
    {
        continue;
    }
    // code will not run
    // if doSkip is true
}
```

(See: continue.cpp)
break

break will exit the current loop

```c
for (i = 0; i < 10; i++)
{
    // code
    if (doSkip)
    {
        break;
    }
    // outside loop code
}
```

(See: break.cpp)
Infinite loops

(See: countingSheep.cpp)
while loop

https://www.youtube.com/watch?v=7-Nl4JFDLOU
Loops allow you to decide how many times a piece of code should run on the fly (i.e. at run time, not compile time)

You can either directly prompt the user how many times or make a special value to “exit” on

(See: sumLoop.cpp)
Debugging

When your program is not working, it is often helpful to add cout commands to find out what is going on.

Normally displaying the value of your variables will help you solve the issue.

Find up until the point where it works, then show all the values and see what is different than you expected.