# CSCI 135 Software Design and Analysis, C++
# Homework 2
# Due 09/19/08

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**Problem 1**
Do labs 3 and 4 on the course website.

**Problem 2: Nested loops**
The objective of this problem is to explore nested loops, i.e. a loop which has another loop in its body, here's an example:

```
while (cond1) {

  . . .

  while (cond2) {

    . . .
  }

  . . .
}
```

The above code shows an example of nested loops. In general, a **while**, **for**, or **do while** may be used for either loops. Of course nesting can have as many levels as we want. For instance, we may have 3 or 4 nested loops.
Here's an example that would produce the multiplication table with two nested loops (try it):

```
for (int i=1; i<10; i=i+1) {
  for (int j=1; j<10; j=j+1) {
    if (i*j<10)
      cout<<'' '';
    cout<<i*j<<'' '';
  }
  cout<<''\n'';
}
```

The first for loop iterates values of $i$ from 1 to 9. The body of the first for loop contains a second for loop that iterates values of $j$ from 1 to 9. The body of the second for loop outputs $i \times j$ in some appropriate format (using an if

statement). This is possible since the second loop is contained in the body of the first loop and, therefore, $i$ is also in the scope of the second loop. Finally, when the second loop ends, the first loop prints a new line.
(a) Write a function called fact that computes the factorial of an integer $n$, denoted $n!$, where

$$n! = \prod_{i=1}^{n} i = 1 \times 2 \ldots \times n$$

The factorial of 0 is 1 by definition (empty product). You will only need a single loop inside the function to do that.

```
int fact(int n) {

  //some declarations

  while (. . .) {

    //do the work
  }

  return . . .
}
```

(b) Write a program that outputs the following Pascal triangle using two nested for loops.

```
1
1  1
1  2  1
1  3  3  1
1  4  6  4  1
1  5 10 10  5  1
1  6 15 20 15  6  1
1  7 21 35 35 21  7  1
1  8 28 56 70 56 28  8  1
```

Note that for a given row $i$ and a given column $j$, the value in the triangle

$$P(i,j) = \binom{i}{j} = \frac{i!}{j!(i-j)!}, j \leq i$$

where both rows and columns start at 0.

(c) A better alternative to compute the entries of the triangle is to note that, for $j > 0$,

$$\frac{P(i,j)}{P(i,j-1)} = \frac{i-j+1}{j}$$

Therefore, starting with $P(i,0) = 1$, we can compute the rest of the entries of the $i^{th}$ row. Implement this idea using loops.