1 Introduction

This lab is for you to practice working with the new material that we've covered: console input and conditionals. The first section is small questions about how conditionals work, and the second section walks through writing a program to apply the quadratic formula.

- Nothing is due for this lab. If you don't finish in class, we encourage you to solve the rest for practice, but it will not be collected or graded.
- Work in pairs, sharing a single laptop. What sort of social dynamics are helpful, rather than annoying?
- You may work in `Visual Studio` or `Xcode`, depending on your preference.

2 Exploring Conditionals

`if` statements allow us to do *conditional logic.* They have this form:

```
if (some condition) {
    some stuff that happens
}
```

The condition has to be something that can be true or false. This almost always means using a *relational operator*. Here are all of the operators:

C++ Symbol	Math Symbol	Description
`==`	$=$	equal to
`!=`	$\neq$	not equal to
`<`	$<$	less than
`<=`	$\leq$	less than or equal to
`>`	$>$	greater than
`>=`	$\geq$	greater than or equal to

Exercise 1 *Write conditional expressions that mean the same thing as each of the following (the first example is given):*

- $2x$ *is greater than* $3y$

  `2 * x > 3 * y`

- $5x$ *is not* 2
- n *is at least* 30
- a *is no greater than* x/y

Exercise 2 *Write a condition that is true when (and only when) an* `int n` *is an odd number. Test this by writing a simple program. Did you do it right?*

Exercise 3 *Can you think of a condition that is always true? What about one that is always false?*

Exercise 4 *What does this code snippet do?*

```
double a;
cout << "Enter a: ";
cin >> a;
if (a < 0) {
    a = -a;
}
cout << "New a: " << a << endl;
```

Else statements: Sometimes you want to do one thing if a condition is true, and something else if the condition is false. Here is the syntax for that:

```
if (some condition) {
    some stuff that happens if the condition is true
}
else {
    some stuff that happens if the condition is false
}
```

Exercise 5 *What is the output of the following code snippet?*

```
if (21 % 7 != 0) {
    cout << "red";
}
else {
    cout << "blue";
}
```

3 Quadratic Formula Program

Comment 1 *Many groups may not make it through this section. If you don't have much time left, consider just looking over the problem, and perhaps coming back to it later in the semester for exam review.*

Introduction. In a course like algebra 1, most teachers make their students memorize the formula for finding the roots of a quadratic equation.

The Problem:	$ax^2 + bx + c = 0$
The Solution:	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Recall that the ± is indicating that there are (potentially) two solutions:

$$x_1 = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

and

$$x_1 = \frac{-b + \sqrt{b^2 - 4ac}}{2a},$$

but there aren't any solutions at all when $b^2 - 4ac < 0$, because that would mean taking the square root of a negative number.

Exercise 6 *Write a program that uses the quadratic formula to solve quadratic equations. It should ask the user for* `doubles` *a, b, and c, and then it should display the solutions x_1 and x_2.*

Furthermore, if there are no solutions (i.e., $b^2 - 4ac < 0$), then the program should say so and stop.

Here is a sample of what the output will look like:

```
Quadratic formula program.
Enter a: 1
Enter b: 0
Enter c: -1
Solution x_1 = 1
Solution x_2 = -1
```

The rest of this handout is just helpful comments for writing this program.

Comment 2 *Start simple. Then add features. Here's a suggested plan of attack:*

1. *Start by making a working* `Hello` *program.*
2. *Write code to prompt the user for a, b, and c.*
3. *Write code to check if $b^2 - 4ac < 0$. If so, print a message that there are no solutions, and then stop.*
4. *Crunch out the formulas for x_1 and x_2, and display the solution.*

Comment 3 *The* `sqrt` *(square root) function is defined in the* `cmath` *library file, so to use* `sqrt` *in your program you need to put*

```
#include <cmath>
```

at the top of your program's code. Then you can write code like:

```
double x = sqrt(2312.12);
double y = 2 * sqrt(x) + 3;
```

4 An Extra Problem

Exercise 7 *(We don't think that any groups will get to here in class. This problem is here for later when you're preparing for the first exam, in case you are looking for more practice on conditionals.)*

Write a program that asks the user for a year, and decides if it is a leap year. (Look up what the (somewhat complicated) rule for leap years is.)