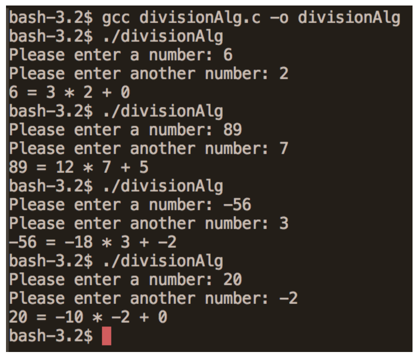
Problem 1. Go to the terminal application and make a new directory to store code. Inside this directory make another for this assignment. Add a *readme* file to this directory.

Problem 2. Write a C program to read in a number, and then display some silly math facts about that number, i.e. x times 7 is y, x^2 is z, etc. Add this program to github.

Problem 3. Write a C program that takes in two integers and outputs the division algorithm performed with those two numbers as inputs. Add that program to github. Below is an example of output.


```
bash-3.2$ gcc divisionAlg.c -o divisionAlg
bash-3.2$ ./divisionAlg
Please enter a number: 6
Please enter another number: 2
6 = 3 * 2 + 0
bash-3.2$ ./divisionAlg
Please enter a number: 89
Please enter another number: 7
89 = 12 * 7 + 5
bash-3.2$ ./divisionAlg
Please enter a number: -56
Please enter another number: 3
-56 = -18 * 3 + -2
bash-3.2$ ./divisionAlg
Please enter a number: 20
Please enter another number: -2
20 = -10 * -2 + 0
bash-3.2$
```

Problem 4. DeMorgan's laws state that

$$\neg(P \vee Q) \iff \neg P \wedge \neg Q \tag{1}$$
$$\neg(P \wedge Q) \iff \neg P \vee \neg Q \tag{2}$$

Prove one of these identities by way of a truth table.

Problem 5. Consider the following recursively defined function,

$$f(n) = \begin{cases} 1 & \text{if } n \leq 1 \\ n \cdot f(n/2) & \text{if } n \mod 2 = 0 \\ n + f(n-1) & \text{if } n \mod 2 = 1 \end{cases}$$

Calculate $f(20)$.

Problem 6. Let a, b be characters, ϵ be the empty string, and $\circ$ denote string concatenation. Consider the following definition of a foo,

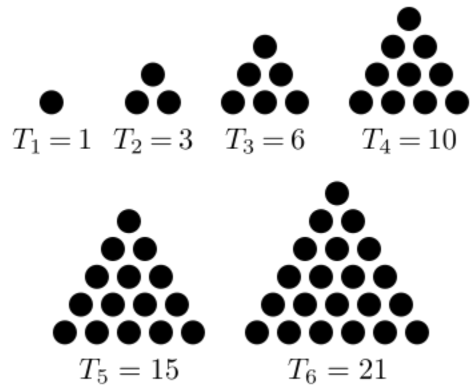
$$foo = \begin{cases} \epsilon \\ a \circ foo \circ a \\ a \circ foo \circ b \\ b \circ foo \circ a \\ b \circ foo \circ b \end{cases}$$

(a) Is aba a foo?

(b) Is $babb$ a foo?

(c) In more intuitive terms, what is a foo?

Problem 7. A *Triangular Number* counts objects that are arranged into equilateral triangles (see the image below, lifted from Wikipedia).



(a) Come up with a recursive definition for T_n, the n^{th} triangular number.

(b) Come up with a non-recursive formula for T_n (extra credit: prove this formula via induction).

(c) Let S_n denote the sequence of non-zero perfect squares, i.e. $S_1 = 1, S_2 = 4, S_3 = 9, \ldots.$ Prove that $S_n = T_n + T_{n-1}$ for $n \geq 2$. *Hint:* the closed formula from part (b) may be helpful, bonus if you can also devise a “proof by picture”.