HW #1

Kerry Ojakian's CSI 35 Class
Due Date: Tuesday February 10 (beginning of class)

General Instructions:

- Homework must be stapled, be relatively neat, and have your name on it.
- Use tutors, work with other students, but ... don't copy!

The Assignment

1. Suppose variables x and y already have values assigned to them. Write code that swaps the values between x and y (using an extra variable besides x and y).

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2. Define a function which takes one numerical input. If the input is negative, it returns 0; otherwise it just returns back the same input. Graph this function.
   Note: This function is famous in the AI neural net work; called the "ReLU" function.

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3. Suppose L is a list of positive integers, and b is a boolean variable. Write code that sets b to True if every entry in the list is even, and False otherwise.

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4. Some day we will prove that for all positive integers n, $1 + 2 + \cdots + n = \dfrac{n(n+1)}{2}$. Write a program that verifies this claim for n such that $1 \leq n \leq 1000$.

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5. Write a program that finds the sum of the first n odd positive integers; for example, if $n = 2$, the program should calculate 4, since $1+3 = 4$. Make conjecture about the value of this sum (no need to prove it! however, use data from your programs as evidence of your conjecture).

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6. Suppose you are given the following premises:

   (a) "It is sunny"

   (b) "If it is sunny then it is daytime"

   (c) "If it is daytime then you should study"

   Conclude from these premises that "You should study". Do this by translating the phrases into formal logic. Then give a structured proof where each line is justified by a named inference rule.

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7. Suppose you are given the following premises:

$$P \to Q, \quad A \to P, \quad \neg Q$$

Conclude $\neg A$, by giving a structured proof where each line is justified by a named inference rule.

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8. Suppose you are given the following premises:

$$(\exists x A(x)) \to (\forall y B(y)), \quad A(c)$$

Conclude $B(c)$, by giving a structured proof where each line is justified by a named inference rule.

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9. Prove that the sum of two integers which are both multiples of 5, results in a multiple of 5.

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10. Prove that the sum of any three odd integers is odd.

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11. Prove or disprove: If $a|bc$ then $a|b$ or $a|c$.

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12. Consider the following program:

$$\begin{array}{l} \text{if } x > 9: \\ \qquad x = 9 \\ \text{elif } x < -9: \\ \qquad x = -9 \\ \text{else:} \\ \qquad x = 0 \end{array}$$

   (a) Suppose the initial assertion is that $x = -70$. Determine what the final value of x will be, and prove it.

   (b) What are all the possible final values of x? Prove it (Hint: Use cases)

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13. Suppose n is an integer. Prove n is odd if and only if $n + 101$ is even.

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14. A **perfect square** is an integer that is equal to the square of another integer; for example 9 is a perfect square because $9 = 3^2$, but 18 is *not* a perfect square.

    (a) Prove that if m and n are both perfect squares, then nm is also a perfect square.

    (b) Prove or disprove: The sum of two perfect squares is a perfect square.
