HW #1

Kerry Ojakian's CSI 30 Class
Due Date: Tuesday Feb 24 (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. Determine whether each of these statements is true or false.

   (a) If 7 is even, then Mickey Mouse is president of the USA.

   (b) If $1 - 1 < -1$ or $2 + 3 > 5$.

   (c) If 2 is prime, then The Bronx is not in NYC.

   (d) $128 + 188$ is positive and $2 + 2 = 4$.

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2. Construct a truth table for the following proposition: $(\neg A \wedge A) \rightarrow B$.
   Also, given an explanation (from the meaning of the proposition) for why it is a tautology.

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3. Show that the following 2 propositions are logically equivalent:
   $A \leftrightarrow B$ and $(A \rightarrow B) \wedge (B \rightarrow A)$

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4. Use De Morgan's laws to find the negation of each of the following statements.

   (a) $\neg A \wedge B$

   (b) BCC is in CUNY or BCC is not in NYC

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5. Is this system specification consistent?

   - If students are being graded, professors cannot teach.
   - If professors can teach, then students can learn.
   - If students can learn, then students are not being graded.

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6. Determine the truth value of each of these statements if the domain consists of all integers

   (a) $\forall x \ (x < 2x)$

   (b) $\exists u \ (3u + 7 = 34)$

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7. Determine the truth value of each of these statements if the domain consists of all integers

   (a) $\exists u \forall x \; x < \sqrt{u}$

   (b) $\forall x \exists u \; x < \sqrt{u}$

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8. Let $N(x)$ be the predicate: "x lives in NY".
   Let $B(y)$ be the predicate: "y lives in The Bronx".
   Express each of the following statements in terms of N and B, quantifiers, and logical connectives. Let the domain consist of residents of humans.

   (a) Someone lives in NY.

   (b) Everyone who lives in The Bronx lives in NY.

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9. 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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10. 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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11. 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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12. 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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13. 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).
