Kerry Ojakian's CSI 30 Class
Class Assignment #1

1. Which of the following statements are propositions? What are the truth values of those that are propositions?

   (a) Do not cheat!

   (b) When is class over?

   (c) There is a roach in this room.

   (d) Bronx Community College.

   (e) Honey never rots.

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2. Which of the following statements are propositions? What are the truth values of those that are propositions?

   (a) $x + y = 4$

   (b) $3 + 1 = 4$

   (c) $6 - 8 > 0$

   (d) $x = 9$

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3. Which of the following statements are propositions? What are the truth values of those that are propositions?

   (a) All integers are positive.

   (b) All numbers are interesting.

   (c) A negative integer is less than a positive integers.

   (d) There is a largest integer.

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4. Let P and Q be the propositions:

   P: Vic lives in California

   Q: Vic likes beer

   Express each of these propositions as an English sentence.

   (a) $\neg P$

   (b) $P \to Q$

   (c) $Q \leftrightarrow P$

   (d) $P \vee \neg Q$

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5. Let P and Q be the propositions:

   B: I am a student at BCC.

   M: I live in Manhattan.

   Express each of these propositions as an English sentence and state whether it is true or false *for you*.

   (a) B

   (b) $B \wedge M$

   (c) $B \vee M$

   (d) $\neg B \vee M$

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6. Let P and Q be the propositions:

   P: I am a student at BCC.

   Q: I am a student at CUNY.

   Express each of these propositions as an English sentence and state whether it is true or false *for anyone saying it (not just you)*.

   (a) $P \wedge Q$

   (b) $P \to Q$

   (c) $Q \to P$

   (d) $P \vee \neg P$

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7. Let P, Q, and R be the following propositions

   P: You do all the homework.

   Q: You attend every class.

   R: You get an A in this class.

   Write these propositions using P, Q, and R, along with the logical connectives.

   (a) You do all the homework, but you do not attend every class.

   (b) You get an A in the class, attend every class, and do all the homework.

   (c) If you do all the homework, and attend every class, then you will get an A in this class.

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8. Determine whether each of these conditional statements is true or false.

   (a) If $1 + 1 = 2$, then Trump is presient of the USA.

   (b) If $1 + 1 = 3$, then Rihanna is president of the USA.

   (c) If $1 + 1 < 5$, then $2 + 2 = 5$.

   (d) If $1 + 1$ is negative, then $2 + 2 = 5$.

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9. How many rows appear in a truth table for each of these compound propositions?

   (a) $X \vee \neg X$

   (b) $A \to (A \wedge \neg B)$

   (c) $(P \vee \neg Q) \leftrightarrow ((P \wedge Q) \to \neg P)$

   (d) $(A \vee B) \to (A \vee B \wedge \neg C)$

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10. Construct a truth table for the following proposition: $X \vee \neg X$

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11. Construct a truth table for the following proposition: $\neg A \wedge B$

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12. Construct a truth table for the following proposition: $\neg A \rightarrow (A \vee \neg B)$

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13. Show that the following proposition is a tautology (using a truth table):

$$A \leftrightarrow B \equiv (A \rightarrow B) \wedge (B \rightarrow A)$$

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14. Show that the following proposition is a tautology (just giving an argument in English without using a truth table): $A \rightarrow (A \vee B)$

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15. Show that the following proposition is a contradiction (just giving an argument in English without using a truth table): $P \leftrightarrow \neg P$

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16. Find an example of a conditional statement in propositional logic which is a tautology.

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17. Show that the following 2 propositions are **not** logically equivalent: $(A \rightarrow B) \rightarrow C$ and $A \rightarrow (B \rightarrow C)$

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18. Consider the following proposition: $A \vee B \wedge C$. Make 2 different choices of placing parentheses, so that you get 2 propositions which are **not** logically equivalent.

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19. We know that $\neg\neg P$ is equivalent to P. More generally, if we build up a proposition using only the letter P and the negation symbol, which of these propositions are equivalent to P?

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

    (a) Jose is smart and rich.

    (b) Mary takes the subway to BCC or walks to BCC

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

    (a) $A \vee \neg B$

    (b) Mary takes the subway to BCC or walks to BCC

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22. Use Python (showing your code) to determine if the propositional logic statement

$$\neg(A \wedge B) \vee (\neg C \wedge D)$$

is true or false under the various assignments to propositional variables.

(a) $A = T, B = F, C = T, D = F$ (b) $A = F, B = T, C = F, D = F$

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23. Use Python (showing your code) to find two different assignments to the variables that make the following the propositional logic statement true:

$$((\neg X \wedge Y \wedge \neg Z) \vee (X \wedge \neg Y)) \wedge (Y \vee Z)$$

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24. Are these system specifications consistent? (from Rosen 8th ed)

- Whenever the system software is being upgraded, users cannot access the file system.
- If users can access the file system, then they can save new files.
- If users cannot save new files, then the system software is not being upgraded.

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25. Are these system specifications consistent? (from Rosen 8th ed)

    - The system is in multiuser state if and only if it is operating normally.
    - If the system is operating normally, the kernel is functioning.
    - The kernel is not functioning or the system is in interrupt mode.
    - If the system is not in multiuser state, then it is in interrupt mode.
    - The system is not in interrupt mode.

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26. Construct a circuit that produces the output $x \vee (\neg y \wedge z)$ from input bits x, y, and z (only 3 standard gate types allowed: AND, OR, NOT).

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27. Construct a circuit that produces the output $(\neg a) \rightarrow (b \wedge c)$ from input bits a, b, and c (only 3 standard gate types allowed: AND, OR, NOT).
