

Please upload your assignment to Moodle by Wednesday, and also bring a paper copy to class on next day. This assignment will be graded anonymously, so please don't list your name, but only your MAC ID.

As noted by the syllabus as well as in class, the scope and content of assignments are set by lectures, instead of any specific textbook. Please beware that different textbooks may use different symbolism or definitions. Lemmon's as a very old textbook, for example, uses soundness and validity differently from the lectures.

Assignments are meant to be challenging! You are encouraged to discuss your answers with other students (but write up your own answers individually).

Assignments are meant to be challenging! It's okay if you don't know the answers right away. In that case, **first look at your class notes, notes posted in the shared folder, or textbooks.** Try different answers to see if anything works. You are encouraged to discuss your answers with other students (but write up your own answers individually).

1. (0.6 points) For each of the following sentences, say what is the scope of the highlighted symbol:

(i) $\neg R \vee Q$

(ii) $\neg R \vee Q$

(iii) $\neg(R \vee Q)$

(iv) $\neg\neg Q$

(v) $(P \wedge Q) \rightarrow (\neg P \vee Q)$

(vi) $(P \wedge Q) \rightarrow (\neg P \vee Q)$

2. (1.2 points) Write down the truth-tables for the following. Please make sure you list all the intermediate steps.

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

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

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

$$C \wedge \neg(C \wedge \neg(A \wedge C))$$

$$(P \rightarrow Q) \rightarrow Q$$

$$(P \rightarrow Q) \vee \neg S$$

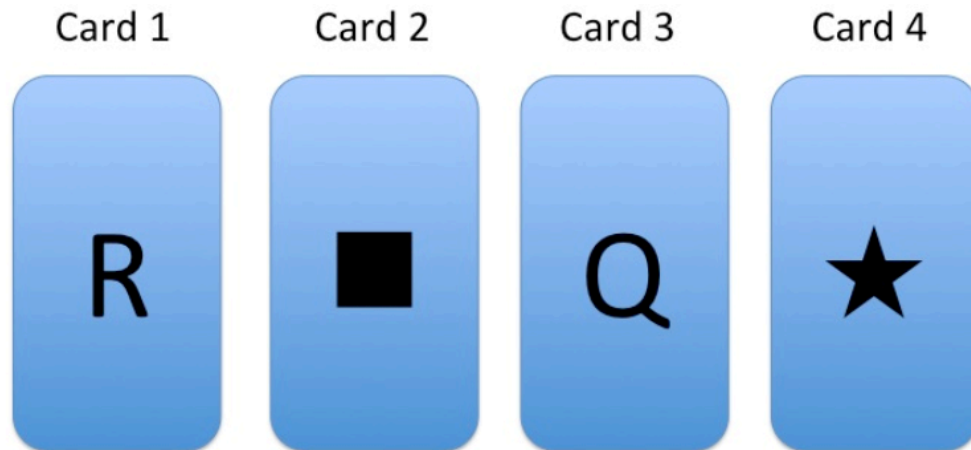
3. (2.2 points) Express the following texts as sentential expressions using sentential variables A, B, C, D, and connectives that we have learned. Also explain what each sentential variable represents; for example, A: Alex is happy. ('The four women' refers to Ann, Barbara, Claire and Dorothy.)

- (1) At least one of the four women is happy.
- (2) Exactly one of the four women is happy.
- (3) If one of the four women is happy, all of them are.
- (4) If one of the four women is unhappy, all of them are.
- (5) At least one of Ann and Dorothy is happy and at least one of Barbara and Claire unhappy.
- (6) Either one or three among Barbara, Claire and Dorothy are happy.
- (7) If the lines go down, then the transformer blows and the power goes out.
- (8) The power goes out if the lines go down or the transformer blows.
- (9) You'll get well in the world if you are neither more nor less wise, neither better nor worse than your neighbors.
- (10) There is time enough for everything in the course of the day if you do but one thing at once; but there is not time enough in the course of the day if you will do two things at a time.
- (11) If the mind, which rules the body, ever forgets itself so far as to trample upon its slave, the slave is never generous enough to forgive the injury; but will rise and smite its oppressor.

4. (1 point) You are on an island where there are two kinds of inhabitants: (1) Knights, who always tell the truth; (2) Knaves, who always lie. You meet two inhabitants: Zoey and Mel. Zoey tells you that Mel is a knave. Mel says, "Neither Zoey nor I are knaves." Can you determine who is a knight and who is a knave?

It's recommended that you construct a truth table to solve this puzzle, like what we did in class.

5. (Optional) We have a set of four cards in the figure below. Each card has the following property: it has a shape on one side, and a letter on the other side. We shuffle and mix the cards, flipping some over while we shuffle. Then, we lay out the four cards:



Given our constraint that each card has a letter on one side and a shape on the other, we know that card 1 has a shape on the unseen side; card 2 has a letter on the unseen side; and so on.

Consider now the following claim:

For each of these four cards, if the card has a Q on the letter side of the card, then it has a square on the shape side of the card.

Here is our puzzle: what is the minimum number of cards that we must turn over to test whether this claim is true of all four cards; and which cards are they that we must turn over? Of course we could turn them all over, but the puzzle asks you to identify all and only the cards that will test the claim.