Homework 1: Propositional Logic (and football)

Version 2: Updated 1/5 12 PM. We corrected the due date and a small typo in 2c
Due date: Thursday January 11th at 11:59 PM
If you work with others (and you should!), remember to follow the collaboration policy outlined in the syllabus.
In general, you are graded on both the clarity and accuracy of your work. Your solution should be clear enough that someone in the class who had not seen the problem before would understand it.
We sometimes describe approximately how long our explanations are. These are intended to help you understand approximately how much detail we are expecting. You are allowed to have longer explanations, but explanations significantly longer than necessary may receive deductions.

You should read the grading guidelines on the assignments page, but much of it will only be relevant with later homeworks.

1. Syllabus [4 points]

Read the syllabus and/or watch "Lecture 0" on panopto (Robbie will post Lecture 0 to Panopto sometime Saturday). If you have any questions about the syllabus, ask us on Ed!

On your homework submission write "I have watched lecture 0 and/or read the syllabus, and agree to follow the collaboration policies." for full credit.

2. College Football Translations! [16 points]

Translate the English statements into symbolic logic. You will need to define the propositions you use. Make sure the propositions you introduce are atomic (not the combination of smaller propositions).

(a) The IMA is closed on home football game days and on holidays.

Hint: It is possible that a home football game is on a holiday; in that case the IMA is still closed.
Hint: Make sure you understand what this sentence means in English! It's making a promise, and some of the other connectors might not be quite what you expect, depending on which translation you pick.

You must translate this sentence as an implication. *Hint: remember propositions need to unambiguously assert something. In all propostions, you need a subject and verb—you may need to infer those from context, but be sure to include it explicitly in your propostions.*

(b) The Florida State University football team will go to the playoffs if they win all their games and the committee isn't corrupt.

(c) Define a set of *at most five* atomic propositions. Then, use them to translate all of these sentences about football into logical notation. *Do not simplify the statements.* Note that we want you to translate the sentences as they appear; you should not add any knowledge about football in doing the translation. [8 points]

(i) If a football game comes down to the last second and the fans get a heart attack, then the UW football team must be playing well.

(ii) If Michael Penix and the UW football team play well, but the football game doesn't come down to the last second, it must be that Michigan stole signs.

(iii) fans get a heart attack only if Michael Penix doesn't play well.

3. #PENIX4HEISMAN!! Trickier translation [5 points]

The following sentence is idiomatic in English...but not very clear logically. Convert the statement into propositional logic (you'll need to define propositions first), then write an English sentence that has the same meaning, but is clearer logically.

(a) Unless the Huskies lose, Michael Penix throwing for more than 400 yards would mean he is the best quarterback and should have won the Heisman Trophy.

4. Inequivalence [12 points]

For each part, find a truth assignment (i.e. an assignment of `True` or `False` to the variables) to show the pair of statements are not equivalent. Explain why your assignments work (our explanations are 1-2 sentences).

(a) $p \to (q \to r)$ vs. $p \to (q \vee r)$

(b) $(p \vee q) \wedge r$ vs. $p \vee (q \wedge r)$

(c) $(p \vee q) \wedge \neg r$ vs $(p \wedge \neg q) \vee (\neg p \wedge \neg r)$

5. Compound Proposition [7 points]

Find a compound proposition involving the variables $a, b,$ and c that is true precisely when **exactly** one of the two conditions below is true (and false otherwise)

- **at least** two of a, b, and c are true
- a is false and at least one of b, c is true

Note the "exactly one" above; for example, we would want the statement to evaluate to false if a is false and both b, c are true (as then both conditions would hold, and we want exactly one to hold). In addition to writing an expression, explain why your answer works (1-2 sentences).
For this problem, you may only use the logical connectives: $\neg$, $\vee$, $\wedge$, $\to$

Hint: There are a few different ways to approach this question, but the easiest is probably to think of all the settings which will meet the conditions and make a statement that properly combines the elements of your list.

6. Staff Meeting or Football? [12 points]

Robbie and the TAs usually have their staff meetings Monday evenings. Everyone loves staff meetings, but Robbie (and a few of the TAs) love football too. And Monday evening is also when the football game will be. The TAs (being 311 experts) are ruthlessly and perfectly logical – they take each statement at its logical meaning; they do not believe Robbie will lie, but they do not accept unstated intentions.

Robbie wants to convince the TAs to cancel the staff meeting (which he thinks is the only way to watch the whole game). Since the TAs love both watching football and attending staff meetings, they would want to do both if possible (and would prefer having the staff meeting to nothing at all). Watching the football game and not having staff meeting would be acceptable, but only once they're convinced it's the best possible outcome.

(a) Robbie tells the TAs "If we cancel staff meeting, then we can watch the football game." The TAs respond, "It is not yet logical to cancel staff meeting." Why are they not yet convinced? (1-2 sentences)

(b) Robbie tries again: "Let's start over; forget the first promise." "If we don't cancel staff meeting, then we can't watch the football game."
The TAs respond "It is not yet logical to cancel staff meeting." Why will they not comply? (1-2 sentences)

(c) Give a logical sentence (or sentences) which will compel the TAs to cancel staff meeting. Robbie cannot just **assert** that the meeting is cancelled (e.g. you cannot just say "We will cancel staff meeting") you must give promise(s) to make it the only logical choice to cancel it.
Additionally, argue that the TAs will finally agree now to cancel the staff meeting. (2-4 sentences)
Hint: Your answer will have at least one implication, since you're making promise(s)!

7. Feedback [1 point]

Answer these questions on the separate gradescope box for this question.

Please keep track of how much time you spend on this homework and answer the following questions. This can help us calibrate future assignments and future iterations of the course, and can help you identify which areas are most challenging for you.

- How many hours did you spend working on this assignment (excluding any extra credit questions, if applicable)? Report your estimate to the nearest hour.
- Which problem did you spend the most time on?
- Any other feedback for us?