

Homework 1: Propositional Logic

Due date: Wednesday October 2 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. 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) CSE’s doors are unlocked weekdays and on days with a special event.

Hint: It is possible that a special event is on a weekday; in such cases the doors are unlocked.

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 propositions, you need a subject and verb—you may need to infer those from context, but be sure to include it explicitly in your propositions.*

- (b) The art installation in the atrium doesn’t move only if the power goes out and there’s no backup battery.
- (c) Define a set of *at most five* atomic propositions. Then, use them to translate all of these sentences 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 the context in doing the translation. [8 points]
- (i) If my laptop blue-screens on Monday and Tuesday, then I need a new laptop.
- (ii) If I need a new laptop, but my laptop didn’t blue-screen on Monday, then I must have dropped my laptop on Wednesday.
- (iii) I drop my laptop on Wednesday, if I need a new laptop.

3. 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 atomic propositions first), then write an English sentence that has the same meaning, but is clearer logically.

- (a) Unless WiFi is unavailable, if you open panopto and log-in, you can watch lecture recordings.

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 logically equivalent. Explain why your assignments work (our explanations are 1-2 sentences).

(a) $p \rightarrow (q \rightarrow r)$ vs. $(p \rightarrow q) \rightarrow r$

(b) $a \wedge (b \vee c)$ vs. $(a \wedge b) \vee c$

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

5. Highly Illogical [12 points]

This problem is inspired by the Star Trek universe. A “transporter” is a teleportation machine. Food is “replicated” instead of taken out of the freezer. “Ice cream” is still delicious.

As a result of a tragic transporter accident, you have been named the legal guardian of T’Vin, a young Vulcan child. T’Vin is ruthlessly and perfectly logical – he takes each statement at its logical meaning; he does not believe you will lie, but he does not accept unstated intentions.

You want T’Vin to clean his room, and (like many parents) you’ve resorted to bribery – you are willing to replicate some ice cream in exchange for compliance. T’Vin loves ice cream and hates cleaning. His first choice would be to get ice cream and not clean; his second choice would be to get ice cream and clean.

Said differently, he would rather have ice cream and clean his room than do neither, but he will not clean his room without the reward of ice cream, nor will he clean if he has any hope of getting ice cream some other way.

- (a) You tell T’Vin “If you don’t clean your room, then I won’t replicate you any ice cream.” He looks at you and says “It is not yet logical to clean my room.” Why will he not comply? (1-2 sentences)
- (b) You try again: “Forget the first promise,” you say. “If you clean your room, then I will replicate you some ice cream.” Still he says, “It is not yet logical to clean my room” Why is he not cleaning? (1-2 sentences)
- (c) Give a logical sentence (or sentences) which will compel T’Vin to clean his room. You cannot just **assert** that T’Vin will clean his room (e.g., you cannot just say “You will clean your room.”) you must give promise(s) to make it the only logical choice to clean. Additionally, argue that it will be the only logical choice to clean his room. (2-4 sentences)

6. 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?