TA Evaluation Problem Set

1 Subject Knowledge Test

Horn clauses, named after Alfred Horn, are logical formula of a particular rule-like form. They may be of one of three types:

	Disjunctive form	Implication Form
Definite clause	$\neg p \vee \neg q \vee \ldots \vee \neg r \vee u$	$p \wedge q \wedge \ldots \wedge r \rightarrow u$
Fact clause	u	$\texttt{true} \rightarrow u$
Goal Clause	$\neg p \vee \neg q \vee \ldots \vee \neg r$	$p \wedge q \wedge \ldots \wedge r \rightarrow \texttt{false}$

The part of the Horn clause before or left of the implication ($\rightarrow$) is called the body and the one on the right is called the head. The body contains only conjunction of positive literals while the head consists of only one positive literal (or `false`). Let us limit ourselves to propositional logic for now. Consider the following sentences in propositional logic:

1. $A \vee B \rightarrow C \wedge D$
2. $A \vee B$
3. $A \wedge B$
4. $((A \rightarrow B) \wedge (B \rightarrow C)) \rightarrow (A \rightarrow C)$

Our goal is to convert these sentences to a conjunction of Horn clauses. For instance, the first one can be rewritten using De Morgan's law as:

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

And then we can convert each of the disjunctive clauses to Horn clauses and get:

$$A \rightarrow C$$
$$A \rightarrow D$$
$$B \rightarrow C$$
$$B \rightarrow D$$

Convert the other three sentences to conjunction of Horn clauses if you can or prove that such a conversion is not possible. Additionally explain your solution process step-by-step, create a rubric to grade this problem, identify common mistakes students might make and how they would address them, and provide an alternative method of solving the problem, if applicable.

2 Teaching Scenario Responses

Please explain briefly how you would handle each of these scenarios:

1. You notice a few students sharing answers for an assignment. What steps would you take?
2. A student comes to you in tears, saying they're overwhelmed and considering dropping the course. How would you respond?
3. During a group project, one student complains to you that another group member isn't contributing equally. What actions would you take?
4. You notice that a usually engaged student has become withdrawn and their performance is slipping. How would you approach this situation?
5. A student asks for an extension on an assignment due to mental health issues. How would you respond while maintaining fairness for all students?

3 Grading Exercise

Here is a problem from Eric's course and three candidate solutions. Design a rubric for the problem, grade them, and provide constructive feedback and criticism as you would in a course.

Problem: Which of the following expressions is an abbreviation of a sentence of Prop? If an expression is an abbreviation of a Prop sentence, then restore all the brackets that have been dropped in accordance with the Bracketing Conventions of the Logic Manual. If not, explain why not.

1. $\neg P\neg \vee R \vee Q \rightarrow \neg(P \wedge \neg\neg P)$
2. $P \wedge Q \wedge R \wedge R_{12} \rightarrow (Q \rightarrow R)$

Solution A:

1. $(\neg P) \vee (\neg\vee) \vee (R \vee (Q \rightarrow (\neg(P \wedge \neg(\neg P)))))$
2. This is not an abbreviation of a Prop sentence because R_{12} is not a valid propositional variable. Propositional variables should be single letters.

Solution B:

1. This is not an abbreviation of a Prop sentence because '$\neg\vee$' is not a valid connective in propositional logic.
2. $((((P \wedge Q) \wedge R) \wedge R12) \rightarrow (P \vee (Q \rightarrow R)))$

Solution C:

1. $(((\neg P) \vee (\neg \vee R)) \vee (Q \rightarrow (\neg(P \wedge (\neg\neg P)))))$
2. $((P \wedge Q) \wedge (R \wedge R_{12})) \rightarrow (P \vee (Q \rightarrow R))$