CS 228M : Logic for Computer Science Spring 2026

Tutorial 1

Instructions:

- The following problems are meant for you to practice, so that your understanding of the topic improves.
- You must solve all problems to get the maximum benefit from practice problems.
- You must not submit your solutions to these problems. These are not going to be graded.
- A problem may have multiple solution techniques. Discussion among students is strongly encouraged in order to understand different perspectives.

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1. **Three Slots, Five Exams**
   You have the responsibility to schedule the exams into 3 slots S1,S2,S3.
   Exams:
   - M:Mathematics
   - P:Physics
   - C:Chemistry
   - Cs:Computer Science
   - H:History

   Constraints:
   - M and P cannot be in same slot (many students have overlap)
   - C must be in different slot from CS
   - Atleast one of M,P,C must be in S1
   - If H is in S1, then M cannot be in S3
   - As both CS and M are heavy courses they can't be in consecutive sots

   For each exam $X \in \{M, P, C, CS, H\}$ and each slot $i \in \{1, 2, 3\}$, use variable:

   $$X_i \quad \text{to mean "exam } X \text{ is scheduled in slot } S_i\text{."}$$

   For example M1 set to true would mean Mathematics is scheduled in slot 1.
   As an example, the constraint "Exam is scheduled in atleast one slot" can be encoded as: $(X_1 \vee X_2 \vee X_3)$.
   Write the complete propositional logic formula encoding all constraints (and additional ones needed for valid scheduling) such that every satisfying assignment gives a valid exam schedule.

2. **Natural deduction**

This question was inspired from my midsem's (CS 228, Autumn 2025) question 2

Prove $((p \to \bot) \to \bot) \vdash p$ using only the following proof rules:

1. $\to_i$: $\dfrac{p \vdash q}{p \to q}$
2. $\to_e$: $\dfrac{p \qquad p \to q}{q}$
3. $\bot_e$: $\dfrac{\bot}{p}$ for any propositional variable p
4. $(\to \bot)_e$: $\dfrac{(\phi \to \bot) \to \psi \qquad \phi \to \zeta \qquad \psi \to \zeta}{\zeta}$

3. **Sudoku Encoding**
   You are given a 4×4 sudoku grid with some cells already filled in at the start. As per the following rules of Sudoku:

   1. Every Row must contain all 4 numbers
   2. Every cell must be filled with exactly one of $\{1, 2, 3, 4\}$.
   3. Every Column must contain all 4 numbers
   4. The shown 2×2 subgrids should contain all 4 numbers

1		3	
			2
			3
2			1

4. Let p_1, p_2, p_3, q be propositional variables.

$$\Big(((p_1 \to q) \wedge (p_2 \to q)) \wedge (p_3 \to q)\Big) \to \Big((p_1 \vee p_2 \vee p_3) \to q\Big).$$