
CS228M Surprise Quiz 4 (Spring 2026)

Max marks: 10

Duration: 10 mins

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- You are required to answer each question only in the sheet provided to you.
 - Only material written in the sheet will be graded.
 - The exam is open book and notes. However, you are not allowed to search on the internet or consult others over the internet for your answers.
 - Be brief, complete and stick to what has been asked.
 - Unless asked for explicitly, you may cite results/proofs covered in class without reproducing them.
 - If you need to make any assumptions, state them clearly.
 - **Do not copy solutions from others. Penalty for offenders: FR grade.**

Given below is an incomplete proof in first-order logic.

1.	$\varphi_1 \vee \varphi_2$	Law of Excluded Middle (LEM)
2.	φ_1	assumption
3.	$\neg(x = y) \vee (f(x) = f(y))$	\forall_i on 2
4.	φ_2	assumption
5.	$f(x) = f(x)$	$=_i$
6.	$\psi(x/w)$	Copy of 5, where $\psi(w) \equiv (f(x) = f(w))$
7.	φ_3	$=_e$ on 4, 6
8.	$\neg(x = y) \vee (f(x) = f(y))$	\forall_i on 7
9.	$\neg(x = y) \vee (f(x) = f(y))$	\forall_e on 1, 2-3, 4-8

Fill in the blanks below to complete the proof.

[3 marks] φ_1 is:

[3 marks] φ_2 is:

[4 marks] φ_3 is:
