ICS 6B Midterm Sample 1

Name: ____________________

UCI NetID : | | | | | | | | |

(**alpha-numeric; NOT your student ID**)

- Read the instructions of each question carefully.
- Place your answers in the boxed regions. Writing outside of the boxes will not be considered as part of your final answer.
- Your scratch work should stay on the exam booklet. This means no extra scratch paper– even if you have work on scratch paper, it won't be considered.
- Show your work. Your work will be considered as part of your answer.
- Write your name and UCI NetID on every page.
- This test is intended to take 45 minutes.
- This is a closed-book, closed-notes test. No notes or electronic devices are allowed (aside from the provided rules of inference sheet).
- Please keep in mind the academic honesty guidelines.
- Good luck!

Seat

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L.1: I can use propositional variables and logical connectives to represent statements; and interpret symbolic logical statements in plain language.

Given the below propositional variables:

- M: Frank is eligible for scholarship.
- F: Frank is intelligent.
- K: Frank has never failed in exams.

Translate the following sentences into propositional logic:

1. Frank is eligible for a scholarship when he is intelligent and has never failed in exams.

2. Frank has never failed in exams if he is eligible for a scholarship.

3. Frank is eligible for scholarship if and only if he is both intelligent and has never failed in exams.

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L.2: I can use Laws of Logic to simplify symbolic logical expressions.

We want to use the laws of propositional logic to prove the following:

$$p \to (\neg(p \land \neg q) \lor \neg r) \equiv \neg p \lor (\neg r \lor q)$$

Follow the steps below and use the propositional law associated with each step to finally prove the statement above.

p $\to (\neg(p \land \neg q) \lor \neg r)$	Law of logic
	De Morgan's law
	Double negation law
	Associative law
$\neg p \lor (\neg r \lor q)$	

L.3: I can write and use the truth table for a logical statement.

Please complete the following truth table.

p	q	$((p \lor q) \to \neg q) \to q$
True	True	
False	True	
True	False	
False	False	

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L.4: I can determine if a statement is a tautology and whether two statements are logically equivalent.

Show whether

$$((p \wedge (p \to q)) \to p)$$

is a tautology or not.

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Q.1 : I can determine whether a quantified statement over a given domain is true, false, or determined.

Let $Q(x, y)$ be the proposition that $3^x \leq 3^y$. x and y's domains are all positive integers. Which of the following statements are true? If it is true, give a 1 line justification. If false, provide a counterexample.

a. $\forall x \exists y Q(x, y)$

b. $\exists x \exists y Q(x, y)$

c. $\exists x \forall y Q(x, y)$

Q.2: I can translate between Quantified statements in English and Logic, including Nested Quantified statements.

You are given a list of applicants for a job. The predicates are as given below:

- $S(x)$: denote whether x is a graduate student.
- $H(x, y)$: denotes whether x scored higher than y in the interview.
- $L(x)$: denotes if the person came in late for the interview.

Give a logical expression that is equivalent to each English statement.

1. Everyone came late except for the graduate students.

2. At least one graduate student scored higher than all the non-graduate students.

3. All people who came on time scored higher than all the graduate students who came in late.

4. Exactly one non-graduate student scored higher than all of the graduate students during the interview.

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Q.3: I can find the negation of a Nested Quantified statement.

The left table contains numbered quantified statements. Write the number of the corresponding logically equivalent quantified statement in the right table.

Q	
1	$\exists x \exists y(\neg P(x) \wedge (y)$
2	$\forall x \forall y(P(x) \wedge Q(y))$
3	$\exists x \exists y(\neg P(x) \vee \neg Q(y))$
4	$\forall x \forall y(P(x) \vee Q(y))$
5	$\forall x \forall y(\neg P(x) \vee \neg Q(y))$
6	$\exists x \exists y(P(x) \wedge Q(y))$

A	
	$\neg \forall x \forall y(\neg P(x) \vee \neg Q(y))$
	$\neg \exists x \exists y(P(x) \wedge Q(y))$
	$\neg \forall x \forall y(P(x) \wedge Q(y))$
	$\neg \exists x \exists y(\neg P(x) \wedge \neg Q(y))$

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(scratch work)