CS 270 - Lab 5

M. Boady, B. Char, J. Johnson, G. Long, S. Earth

1 Introduction

You may work in teams of **one** or **two** students. Submit one copy for the entire group.

Write your answers on this lab sheet. Only what is written on this lab sheet will be graded.

This lab is due at the end of the class period. You may not continue to work on it once class has ended.

This lab contains 4 questions.

Grading

- 25 points - Putting everyones names on this page
- 20 points - Earned for each correct question (Answer is fully correct)
- 5 points - Earned for **partial credit** any question

No additional point amounts can be earned. You cannot earn 7 points on a question for example.

The maximum score for a lab is 100. If you get everything correct, that adds up to 105 points but will be reduced to 100.

A question will be marked correct as long as it covers all requirements of the question. It does not need to be perfect, but must be fully correct. A single typo or very minor issue where the intention is clear and all requirements are met would still earn full points.

We want you to complete questions fully, not try to earn partial credit on multiple questions. You may ask your Professor/Course assistant questions during lab.

Labs must be done in the presence of an instructor and/or course assistant or credit will not be given.

Partners should alternate each class day which person is physically typing and submitting the lab.

Do not split up the problems or you risk not finishing on time due to the cumulative nature of the questions.

Enter the name of the student in the group

Member 1 (submitter): Joshua Koo

Member 2: Elan Rubin

Question 1 :

Prove the following using **First Order Logic**. You **must** write out your proof as the answer to this question. **Only** what is written on this paper is graded.

You may use `https://proofs.openlogicproject.org` to help solve the proof and verify your correctness. Nothing done in the Proof Checker is graded, only what you write on this lab sheet.

You may use **Basic Rules** and **Derived Rules**.

Prove: $\forall x \forall y (Gxy) \therefore \exists x Gxx$

Construct a proof for the argument: $\forall x \forall y Gxy \therefore \exists x Gxx$

1	$\forall x \forall y Gxy$	
2	$\forall y Gay$	∀E 1
3	Gaa	∀E 2
4	$\exists x Gxx$	∃I 3

NEW LINE

NEW SUBPROOF

Congratulations! This proof is correct.

Question 2 :

Prove the following using **First Order Logic**. You **must** write out your proof as the answer to this question. **Only** what is written on this paper is graded.

You may use `https://proofs.openlogicproject.org` to help solve the proof and verify your correctness. Nothing done in the Proof Checker is graded, only what you write on this lab sheet.

You may use **Basic Rules** and **Derived Rules**.

Prove: $\forall x(Px \implies Bx), \exists x Px \therefore \exists x Bx$

Construct a proof for the argument: $\forall x(Px \to Bx)$, $\exists xPx$ ∴ $\exists xBx$

1	$\forall x(Px \to Bx)$	
2	$\exists xPx$	
3	$Pc \to Bc$	∀E 1
4	Pc	
5	Bc	→E 3, 4
6	$\exists xBx$	∃I 5
7	$\exists xBx$	∃E 2, 4–6

NEW LINE NEW SUBPROOF

Congratulations! This proof is correct.

Question 3 :

(a) Let M be the predicate for "wears a mask". Let C be the predicate for "has a cold". Let a be the constant for Drexel student Alice and b be the constant for Drexel student Bob. Let the universal quantifier be over the set of all Drexel students.

Translate the following into plain english.

$\neg Ma \implies \forall x(Ca \implies Cx), Ca, \neg Cb \therefore Ma$

M = "wears a mask"
C = "Has a cold"

If Alice does not wear a mask, then for all students, if Alice has a cold, then all students will have a cold
Alice has a cold
Bob does not have a cold
Therefore, Alice is wearing a mask

(b) Prove the following using **First Order Logic**. You **must** write out your proof as the answer to this question. **Only** what is written on this paper is graded.

You may use `https://proofs.openlogicproject.org` to help solve the proof and verify your correctness. Nothing done in the Proof Checker is graded, only what you write on this lab sheet.

You may use **Basic Rules** and **Derived Rules**.

Prove: $\neg Ma \implies \forall x(Ca \implies Cx), Ca, \neg Cb \therefore Ma$

1	$\neg Ma \to \forall x(Ca \to Cx)$	
2	Ca	
3	$\neg Cb$	
4	$\quad \neg Ma$	
5	$\quad \forall x(Ca \to Cx)$	→E 1, 4
6	$\quad Ca \to Cb$	∀E 5
7	$\quad Cb$	→E 2, 6
8	$\quad \bot$	¬E 3, 7
9	Ma	IP 4–8

NEW LINE NEW SUBPROOF

Congratulations! This proof is correct.

Question 4 :

Prove the following using **First Order Logic**. You **must** write out your proof as the answer to this question. **Only** what is written on this paper is graded.

You may use `https://proofs.openlogicproject.org` to help solve the proof and verify your correctness. Nothing done in the Proof Checker is graded, only what you write on this lab sheet.

You may use **Basic Rules** and **Derived Rules**.

Prove: $\exists x(Bx \lor Cx), \forall x(Bx \implies Cx) \therefore \exists x(Cx)$

Construct a proof for the argument: $\exists x(Bx \lor Cx)$, $\forall x(Bx \to Cx) \therefore \exists xCx$

1	$\exists x(Bx \lor Cx)$	
2	$\forall x(Bx \to Cx)$	
3	$Bc \to Cc$	$\forall$E 2
4	$\quad Bc \lor Cc$	
5	$\quad\quad Bc$	
6	$\quad\quad Cc$	$\to$E 3, 5
7	$\quad\quad \exists xCx$	$\exists$I 6
8	$\quad\quad Cc$	
9	$\quad\quad \exists xCx$	$\exists$I 8
10	$\quad \exists xCx$	$\lor$E 4, 5–7, 8–9
11	$\exists xCx$	$\exists$E 1, 4–10

NEW LINE

NEW SUBPROOF

Congratulations! This proof is correct.