CS 270 - Lab 4

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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): Elan Rubin

Member 2: Carmello Wheeler Timmons

Question 1 :

Let S be the set of integers x $\in \{0, 1, 2, 3, 4, 5\}$.

Show by *exhaustive testing* that each of the following is true or false. For example, we show $\forall x \in S\,(1 * x = x)$ is true below.

- $(1 * 0 = 0)$ is True
- $(1 * 1 = 1)$ is True
- $(1 * 2 = 2)$ is True
- $(1 * 3 = 3)$ is True
- $(1 * 4 = 4)$ is True
- $(1 * 5 = 5)$ is True

Therefore, $\forall x \in S\,(1 * x = x)$ is True.

Use this process to complete the following.

(a) Show all possible cases of $\forall x \in S\,((x > 2) \implies (x - 2 \geq 1))$?

(0>2)⇒(0-2≥1) is True
(1>2)⇒(1-2≥1) is True
(2>2)⇒(2-2≥1) is True
(3>2)⇒(3-2≥1) is True
(4>2)⇒(4-2≥1) is True
(5>2)⇒(5-2≥1) is True

(b) Is $\forall$ x $\in$ S ((x >2) ⇒ (x−2 ≥ 1)) True?

Yes, because every case was True

(c) Show all possible cases of $\forall$ x $\in$ S ((x >2) $\wedge$ (x−2 ≥ 1))?

((x>2)∧(x-2≥1)) ?

((0>2)∧(0-2≥1)) False
((1>2)∧(1-2≥1)) False
((2>2)∧(2-2≥1)) False
((3>2)∧(3-2≥1)) True
((4>2)∧(4-2≥1)) True
((5>2)∧(5-2≥1)) True

(d)Is $\forall$ x $\in$ S ((x>2) $\wedge$ (x−2 ≥ 1) True?

No, because not every case was True

Question 2 :

Adapted from http://intrologic.stanford.edu/public/exercise.php?exercise=exercise_06_04

For this problem, we have a set of 4 **Super Smash Bros.** players.

S = { Abby, Beth, Cody, Dan }

The following table shows which players have beat each other. An X in the table means the player in the row has beaten the player in the column. Assume multiple games have been played.

	Abby	Beth	Cody	Dan
Abby		X		X
Beth	X		X	
Cody		X		X
Dan	X		X	

The predicate `beat(a,b)` is true if a beat b at least once.

Determine if each of the following Predicate Logic statements is True or False.

(a) `beat(dan,cody)`

True

(b) ¬`beat(abby,dan)`

¬True =
False

(c) `beat(beth,cody)` ∨ `beat(beth,dan)`

True ∨ False =
True

(d) $\forall y \in S$ (`beat(beth,y)` $\implies$ `beat(abby,y)`)

For all of the people that Beth has beaten, Abby has beaten that person =
False
Because Beth has beaten Abby, but Abby has not beaten Abby

(e) $\forall y \in S$ (`beat(y,cody)` $\implies$ `beat(cody,y)`)

For all of the people beaten by Cody,
Cody has beaten that person =
True

Cody beat Beth and Dan,
and Beth and Dan have both beaten Cody

(f) $\forall y \in S$ ¬ `beat(y,y)`

For all people in the set, they haven't beaten themselves = True
Because nobody has beaten themself

(g) $\exists y \in S$ `beat(abby,y)`

There exists one person in the set who Abby has beaten = True
Because Abby beat Beth and Dan

(h) $\exists y \in S$ `beat(y, beth)`

There exists one person in the set who has beaten Beth = True
because Abby and Cody have beaten Beth

Question 3 :

Suppose W represents the set { grass, gazelle, lion, unicorn } and the predicate E on the set is defined as $E(x, y)$ is true when x eats y as defined by the following rules.

- Grass eats nothing.
- Gazelle only eat grass.
- Lions eat gazelle and other lions.
- Unicorns eats grass and gazelle.

(a) Write an expression in First Order Logic stating that there is an apex predator which eats everything.

∃x∈W ∀y∈W E(x,y)

(b) Is there an apex predator? Explain **why** your statement from the last question is true or false.

The FOL expression is False
There is no apex predator

Nothing in the set eats unicorns,
and unicorns don't even eat lions

(c) Translate into English the First Order Logic statement $\forall x \in W(E(\text{unicorn}, x) \implies \neg E(x, x))$
Is the statement True or False? Explain **why** it is true or false.

First translation: For all x in the set W, something in the set W (Unicorns eating x implies that the x doesn
t eat itself)

More simple translation: For all x in the set W, if a unicorn eats x, then x does not eat itself.

This is True because unicorns eat grass and gazelles, and neither of those (neither grass nor gazelles) eat themselves

Question 4 :

Consider the following two facts known about all files on a particular server.

Fact 1: if a file is locked then it can't be opened. (note: this is true for any file on the server)

Fact 2: there is a locked jpeg file on this server

Claim: somewhere on this server there is an unopenable jpeg file

Let S be the set of all files on this Server. Use the following predicates that apply to things in the set S.

Lx is true if and only if the file x is locked

Jx is true if and only if the file x is a jpeg

Ox is true if and only if the file x can be opened.

Use metalogic symbols to write an expression that the Claim can be proven from the Facts.

$\exists x \in S(Lx \wedge Jx),\ \forall x \in S(Lx \Rightarrow Ox) \therefore \exists (Jx \wedge \neg Ox)$