Assignment #3
Due: 22nd of April, 2021

NOTE: Read this please

1 - Take a print of this assignment (If there is no nearby printer then write it again in the same format along with the spaces provided for answer.
2 - some questions may need you to do some rough work. Do it on a blank sheet and write on the top of the sheet 'Rough Work'
3 - Solve it using pen
4 - Take snaps
5 - Make a pdf
6 - Submit

Part 1: Propositional Logic

1. (**8 Marks**)
   What are the truth values of the following statements?
   a. If $2 > 3$ then $5 = 5$
   b. If $3 > 2$ then $5 = 6$
   c. $3 > 2$ if and only if $2+3x = 2 + 3x$.
   d. $100 = 100$ if and only if $3 + 2x = 3 + 3x$

   Notes on solving this
   1. Write only true or false nothing else. This will make my life easy

2. (**5 Marks**)
   Are these system specifications consistent? "Whenever the system software is being upgraded, users cannot access the file system". "If users can access the file system, they can save new files". "If users cannot save new files, then the software system is not being upgraded"

   Notes on solving this

   1: "if p then q" is equivalent to "q whenever p" so think over statement one before solving.

   2: Show all the details of the propositional assignments to variables. Also write logic expression corresponding to every statement.

   3: Assume the following propositions,

   P = The system software is being upgraded
   Q = User can access the file system
   R = User can save new files

3. (**Marks 20)**
   The following question relates to the inhabitants of the island of knights and knaves created by Smullyan where **Knights always speak lies and Knaves always speak the truths** (Read this twice). You encounter two people A and B. Determine if possible what

A and B are if they address you in the ways described. If you cannot determine what these two people are, can you draw any conclusions?

a. A says "at least one of us is a knave" and B says nothing.

b. A says "The two of us are both knights" and B says "A is a knave"

Notes on solving this

Do a rigorous analysis as we performed in the class by taking care of all the possibilities for both A and B. Significant portion of the marks are dedicated to the analysis.
Also assume the following prepositions.
P = A is a knight ¬P = A is a knave
Q = B is a knight ¬Q = B is a knave

Part 2: Quantifiers

4. (**Marks 6**)
Suppose the domain of the Q(x,y,z) consists of the triplets x,y,z where x = {0, 1, 2}, y = z = {0, 1}. Write out these propositions using conjunction, disjunction and negation.
   a. ∀y Q(0,y,0) =
   b. ∃x Q(x,1,1) =
   c. ∃z ¬ Q(0,0,z) =

5. **(4 marks)**
Find the truth values of the following where P(x,y) = x^2 > y and the domain of x = {1,2,3,4,5} and the domain of y = {20,21,22, 23, 24}?
   a. ∀x∀y P(x,y) =
   b. ∃x∀y P(x,y) =
   c. ∀x∃y P(x,y) =
   d. ∃x∃y P(x,y) =

Part 3: Rules of Inference

6. **(Marks 5)**
Use the principle of resolution to show that the hypothesis "Chohan works hard", "If Chohan works hard then he is a dull boy", "if Chohan is a dull boy, he will not get a job" imply the conclusion "Chohan will not get the job"
Notes on solving this
1: First write it in proper form that is premises and conclusion.
2: Apply first step of resolution that is determine the clauses corresponding to premises and conclusion.
3: Repeatedly apply rule of resolution and obtain an empty clause if possible.
4. Assume the following propositions
   P = chohan works hard, Q = chohan is a dull boy, R = chohan will get a job

7. **(5 Marks)**
a. Suppose that Prolog facts are used to define the predicates mother(M, Y) and father(F, X), which represent that M is the mother of Y and F is the father of X,

respectively. Moreover, we also have the rules sister(X,Y) and brother(X,Y) which states that X is the brother/Sister of Y. Write a Prolog rule to define the predicate cousin(X, Y), which represents that X and Y are cousins in terms of the rules mother, father, brother and sister

Notes on solving this

Cousin means that X's father/ mother and Y's father/mother are brothers/sisters.

Part 4: Relations

8. **(8 Marks)**

   Find out all the possible relations on the set A = {2, -2} which are (Marks 8)

   a. Reflexive
   b. Symmetric
   c. Anti Symmetric
   d. Transitive

Good luck