THE OPEN UNIVERSITY OF SRI LANKA
B.Sc DEGREE PROGRAMME: LEVEL 04
FINAL EXAMINATION: SEMESTER 1- 2014/2015
CSU2280: DEDUCTIVE REASONING AND PROLOG FOR ARTIFICIAL INTELLIGENCE

DURATION: **THREE HOURS** (3 HOURS)
Date: **18th May, 2015** Time: **1.00 pm – 4.00 pm**

Answer FOUR Questions ONLY.

Q1.

a) Briefly explain what is meant by "Reasoning".

b) What are the seven types of "Reasoning techniques"? Explain using suitable examples.

c) Explain the most suitable reasoning technique that can be used to solve each of the following problems;

i. Create a mobile application to display a particular place in a map.

ii. To develop a computer program to find the net pay for employees.

iii. To find the meaning of a given word by using an electronic dictionary.

d) ABC is an AI based software development company in Sri Lanka. They are planning to develop an e-medical system to give medical assistance for the users. This system also provides facilities to channel doctors online.

i. Which type of reasoning is best for the above program?

ii. Which reasoning technique/techniques can be used to develop the above program?

iii. What is the reasoning technique that cannot be used to solve the above problem? Justify your answer.

Q2.

a) Using suitable examples explain the vocabulary of propositional logic.

b) Briefly explain the terms, "Tautology", "Contradiction", and "Model assignment" by means of suitable examples.

c) Which of the following formulae is a Tautology? Use truth tables to justify your answer.

i. $[P \wedge (P \rightarrow Q)] \rightarrow Q$

ii. $\big((P \vee Q) \wedge (\neg P \vee R)\big) \rightarrow (Q \vee R)$

d) Translate the following propositional logic statements into English language statements.

i. $A \leftrightarrow (B \cup C)$

ii. $\neg(P \vee Q) \wedge \neg(P \rightarrow Q)$

Q3.

a) What are the differences between propositional logic and predicate logic?

b) The sentence "All human have a mother" has been written in predicate logic, as given in the following two different ways. Explain which interpretation is correct.

i. $\forall x Human(x) \rightarrow mother(x)$

ii. $\forall x Human(x) \wedge mother(x)$

c) Using your own words, explain the meaning of the following logic formulae.

i. $\exists x F(x)$

ii. $\exists x \forall y F(x, y)$

iii. $\forall x P(x) \wedge \forall y F(y)$

d) Using truth tables show that;

i. $\neg(P \wedge Q) \equiv \neg P \vee \neg Q$

ii. $\neg(P \vee Q) \rightarrow \neg P \wedge \neg Q$

Q4.

a) "Resolution is a much more powerful way of making inferences than use of inference rules". Do you agree with this statement? Explain briefly.

b) Briefly explain the following terms.

i. Skolemisation

ii. Unification

iii. Horn Clause

c) What are the nine steps for converting predicates to CNF?

d) Convert the following predicate into CNF.

$\forall x (P(x) \rightarrow Q(x) \wedge R(x))$

Q5.

a) What are the advantages of PROLOG?

b) Briefly explain the following terms in the context of PROLOG.

i. Source program

ii. Predicates and rules

c) Consider the following PROLOG predicates to answer the questions from (c) i to (c) iii.

```
parent(rathnapala, sunil).
parent(rathnapala, kamala).
parent(rathnapala, gamini).
parent(rathnapala, ruwini).
parent(gunadasa, tikiri).
parent(ramyawathi, tikiri).
parent(gunapala, saman).
parent(ramani, saman).
parent(seela, gamini).
parent(seela, ruwini).
parent(kamala, kasun).
parent(tikiri, kasun).
```

```
male(rathnapala).
male(sunil).
male(gamini).
male(kasun).
male(saman).
male(gunapala).

female(kamala).
female(ruwini).
female(seela).
female(ramani).
female(ramyawathi).
female(tikiri).
```

i. Create the following PROLOG rules;

`son/2, daughter/2, husband/2 and wife/2, mother/2, father/2`

(Assume that, all these rules have the standard meanings as their names imply.)

ii. Explain how PROLOG will answer the following queries;

a. `?- son(X, sunil).`

b. `?- daughter(rathnapala, kamala).`

iii. Create a rule named `aboutMe/1` that gives the all possible relations related to a given person.

(***Hint:*** *Your predicate should give at least the following information*)

```
?- aboutMe(saman)
   Saman is a male person
   Mother is ramani
   Father is gunapala
```

Q6.

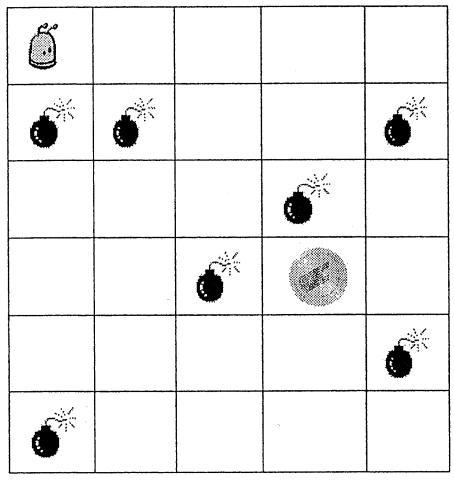
a) Briefly describe the following terms used in PROLOG.

i. `not/1`
ii. `true, !, fail`

b) Briefly describe the meaning of the following list operations.

i. `length/2`
ii. `flatten/2`
iii. `append/2`

c) The following figure shows a map of a path finding program that is needed to find the path from the starting position to the goal position (starting position (1,1), goal position (**4,4**)).



The Robot  Can move to any place (either vertically or horizontally). However, there are some bombs  in the map. Robot cannot move to the locations where bombs are placed. Your program must need to start by using the following PROLOG predicate.

```
go(state(1,1),state(4,4)).
```

You can use the following predicates.

```
member(X,[X|_]).
member(X,[_|T]):-member(X,T).

printLst([]).
printLst([H|T])    :-    printLst(T),write(H),nl.

go(Start,Goal)     :-    path(Start,Goal,Start).
path(Goal,Goal,L)  :-    write('Solution Path is: ' ), nl,
                         flatten(L,X),
                         printLst(X).

move(state(X,Y), state(X,Z)) :-
```

```
                                plsval(Y,Z),
                                not(notstate(X,Z)),
                                write('move to right'),nl.

path(State,Goal,L):-    move(State,Next),
```

i. Briefly explain the tasks of the following predicates.

   a. `member/2.`
   b. `path/3.`
   c. `flatten/2.`

ii. Define the cages that the Robot cannot move into.
(***Hint:*** *notstate(X,Y).*)

iii. Create two predicates named `plusval(+In, -Out)` and `subval(+In, -Out)` in order to add one to the input value and subtract one from the input value respectively.
(***Example:*** *plusval(34, X) gives X = 35, subval(34, X) gives X = 33*)

iv. Create a predicates named '`move(State,Next)`' that can be used to move left, up or down locations.
(***Hint:*** *use the above plusval/2 and subval/2 to add or subtract values respectively*)

v. What is the process/task of the following predicate?

```
move(state(X,Y), state(X,Y)) :- nl, fail.
```

vi. Briefly describe how this program runs on the following predicate.

```
go(state(1,1),state(1,3)).
```