THE OPEN UNIVERSITY OF SRI LANKA
B.Sc DEGREE PROGRAMME: LEVEL 04
FINAL EXAMINATION: SEMESTER 1- 2010/2011
CSU2280: DEDUCTIVE REASONING AND PROLOG FOR ARTIFICIAL INTELLIGENCE

DURATION: **THREE HOURS** (3 HOURS)

Date: **07th January, 2011** Time: **1.30 pm – 4.30 pm**

Answer FOUR Questions ONLY.

Q1.

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

b) What are the seven types of "Reasoning techniques"?

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

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

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

iii. To develop a 'help system' to identify computer problems that can provide information about software and hardware errors.

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) What are Syllogisms? Explain briefly.

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

e) Convert the following facts and rules into Propositional Logic.

If there is a good practice schedule, a cricket team can win the match. If the bowlers bowl well and the batsmen play well, then the team can win the game. If the batsmen play well and the bowlers do not play well, then the team does not win the game.

Bowlers play well and there is no good practice schedule.

Q3.

a) What are the differences between Propositional Logic and Predicate Logic?

b) Explain how Predicate Logic can address the limitations of Propositional Logic.

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) Explain, in your words, the meaning of the following Predicate Logic expressions.

i. $\forall x \exists y (x + p = y + q)$ Where, p and q are additional conditions. (These make the expression true.)

ii. $\exists x Q(x, y) \wedge \forall y P(y, x)$

e) Use the following two statements (S1 and S2) and the claim (C1) to answer the questions (i) and (ii).

S1: If the university is open and the road is clear, then either we go to the university or we go to home

S2: It is not the case that, if we do not go to the university then the road is not clear

C1: Either the university is open or we go to home

i. Translate the above S1, S2, and C1 into Propositional Logic using appropriate atomic propositions.

ii. Is C1 is a valid claim? Justify your answer.
(***Hint:*** *If C1 is valid, then* $(S1 \cap S2) \rightarrow C1$ *becomes a tautology*)

Q4.

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
```

Q5.

a) Briefly explain the following PROLOG predicates;

i. `setof/3`

ii. `assert/1`

b) Consider the following three tables.

Product ID	Product Name	Quantity	Unit Price
P01	Processor	50	8500
P02	Hard Disk	50	4500
P03	RAM	50	2500
P04	Monitor	50	12000
P05	Printer	50	5600
P06	Key board	50	600

Table 1: Product

Customer ID	Customer Name	Address
C001	Saman Kumara	Galle Rd, Colombo 3
C002	Gamini Silva	No 23, Panadura
C003	Samantha Perera	Nawala Road, Nugegoda

Table 2: Customer

Sales ID	Customer ID	Product ID	Quantity
S01	C001	P01	10
S02	C001	P02	5
S03	C001	P03	3
S04	C002	P01	2

Table 3: Sales

i. Create PROLOG rules named `addProduct/0`, `addCustomer/0` and `addSales/0` in order to add a new Product, Customer, and Sales record respectively by using the keyboard.
(***Hint:*** *after adding a new sales record you must change the Quantity value in the product table accordingly*)

ii. Create a PROLOG rule named `editProduct/0` and `editCustomer/0` to change the Product and Customer data respectively.

iii. Create a PROLOG rule named `delProduct/0`, `delCustomer/0`, and `delSales/0` to delete the given Product, Customer and Sales records respectively.

iv. Create a PROLOG rule to display the available product list, in the format given below.

```
-----------------------------------------
          Available Products
-----------------------------------------
Name                    Quantity
-----------------------------------------
Processor               40
Hard Disk               45
RAM                     47
Monitor                 50
.....                   .....
-----------------------------------------
```

c) Create a PROLOG rule named '`salesinfo/1`' to display sales details for a given customer. Your output format should be as follows.

Example:

```
? salesinfo('C001').
```

```
-----------------------------------------
          SALES DETAILS
-----------------------------------------
Customer Name :  Saman Kumara
Address:  Galle Rd, Colombo 3
-----------------------------------------
Product          Quantity      Price
-----------------------------------------
Processor        10            85000
Hard Disk        5             22500
Ram              3             7500
-----------------------------------------
```

Q6.

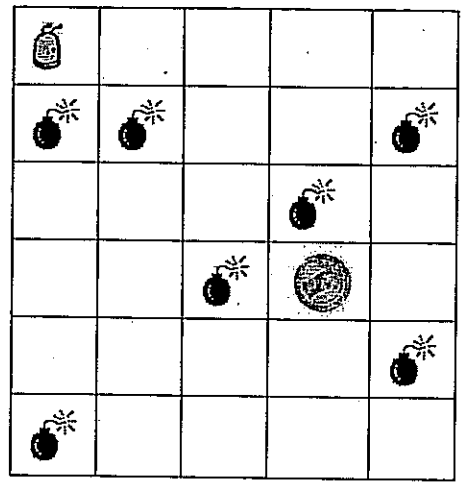
a) Briefly describe the following terms used in PROLOG.

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 3 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)).
```