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THE OPEN UNIVERSITY OF SRI LANKA
B.Sc DEGREE PROGRAMME: LEVEL 04
FINAL EXAMINATION: SEMESTER 1- 2013/2014
CSU2280: DEDUCTIVE REASONING AND PROLOG FOR ARTIFICIAL INTELLIGENCE

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

DATE: **25th June, 2014** TIME: **1.00 p.m. – 4.00 p.m.**

Answer FOUR Questions ONLY.

Q1.

a) "Reasoning is the process of going from what is known to what is not known" Do you agree with this statement? Explain briefly.

b) What are the seven types of "reasoning techniques"? Give an example for each reasoning technique.

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

i. Develop a computer program to find the students' z-core using the given A/L result sheet.

ii. Develop an automated airline reservation system.

iii. Develop a 'help system' to identify human desires.

d) *JONS system* is a computer selling company in Sri Lanka. They are planning to develop a computer based system to facilitate an online selling counter for their customers.

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

ii. Which reasoning technique(s) can be used to develop the above system?

iii. What is the reasoning technique that cannot be used to represent the above system? 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. $((P \vee Q) \wedge (\neg P \vee R)) \rightarrow (Q \vee R)$

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

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

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

d) Use the following two statements (S1 and S2) and the claim (C1) to answer the question (i).

S1: If the airport is closed and the weather is bad, then we cannot go on the trip

S2: It is not the case that, if we do not go on the trip then the weather is bad

C1: The weather is not bad then we go on the trip

Translate S1, S2, and C1 into propositional logic using appropriate atomic propositions.

i. Is C1 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) What are the differences between `setof/3` and `bagof/3` PROLOG predicates?

b) What is a list in PROLOG? Explain how values are read from a list.

c) Use Table 1 and Table 2 given below to answer the questions from (i) to (v).

Index No	Name	Age	Sex
A0011	S. K. Perera	34	M
A0012	M. S. Gunapala	32	M
A0013	N. S. Silva	30	F
A0014	R. T. Weeresinghe	28	F

Table 1: Student

Result ID	Index No	Subject	Mark
R01	A0011	csc2280	45
R02	A0011	csc2281	67
R03	A0011	csc2282	89
R04	A0012	csc2280	65
R05	A0013	csc2280	34
R06	A0014	csc2280	45
R07	A0014	csc2281	67

Table 2: Result

i. Implement the above two tables as a PROLOG database.

ii. Create PROLOG rules named `addStudent/0` and `addResult/0` in order to add a new Student and Result records respectively by using the keyboard.

iii. Create PROLOG rules named `editStudent/0` and `editResult/0` to change the Student and Result data respectively.

iv. Create PROLOG rules named `delStudent/0 and delResult/0` to delete the given Student and Result records respectively.

v. Create a PROLOG rule to display the student list, in the format given below.

```
------------------------------------------------------------
                Student List
------------------------------------------------------------
Name                          Index No      Sex
------------------------------------------------------------
S. K. Perera                  A0011         M
...
------------------------------------------------------------
```

d) Create a PROLOG rule named '`resultsheet/1`' to display result details for a given student. Your output format should be as follows.

Example:

```
? resultsheet('A0011').
```

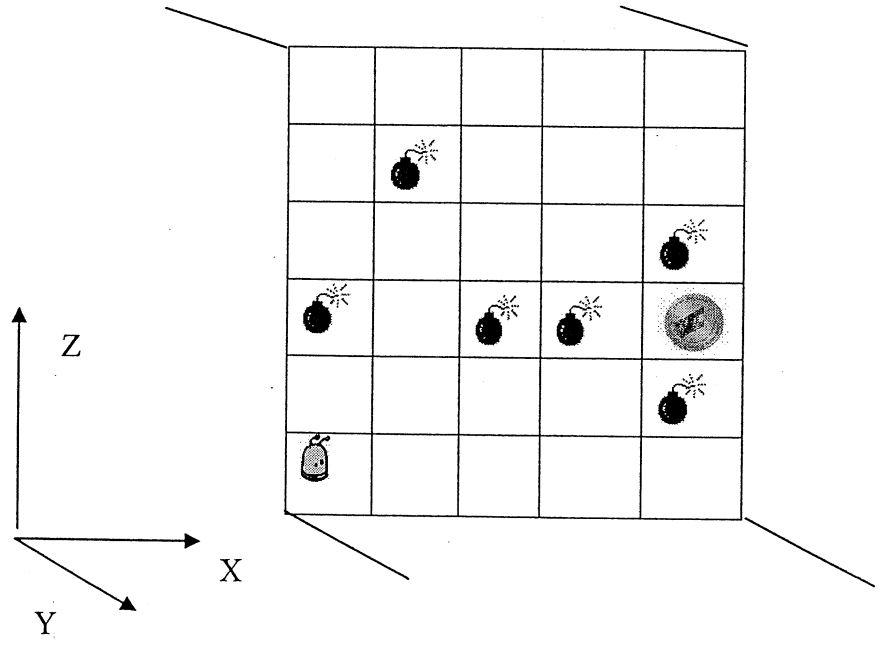
```
-----------------------------------------------
            RESULT DETAILS
-----------------------------------------------
Student name :  S. K. Perera
-----------------------------------------------
Subject                         Marks
-----------------------------------------------
csc2280                         45
csc2281                         67
csc2282                         89
-----------------------------------------------
Total number of records         3
-----------------------------------------------
```

Q6.

a) Briefly describe the following terms used in PROLOG.

i. `flatten/2`
ii. `length/2`
iii. `not/1`

b) The following figure shows a 3D map of a path finding program that needs to find the path from the starting position to the goal position (starting position (1,1,1), goal position (**5,3,3**)). Note that position (X,Y, Z) gives respective 3D location for the shape.



The Robot,  can move to any place (either X, Y or Z position). However, there are some bombs  in the map. Robot cannot move to the locations where bombs are placed. Bombs are located at the following locations (X, Y, Z locations).

B1 - (1, 2, 3)
B2 - (2, 4, 5)
B3 - (3, 1, 3)
B4 - (4, 3, 3)
B5 - (5, 3, 2)
B6 - (5, 3, 4)

The program must need to start by using the following PROLOG predicate.

```
go(state(1,1,1),state(5,3,3)).
```

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,Z), state(X1,Y, Z)) :-
                         plsval(X,X1),
                         not(notstate(X1,Y,Z)),
                         write('move to X'),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 be moved into.
(***Hint:*** *notstate(X, Y, Z).*)

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

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

```
go(state(1,1,1), state(5,3,3)).
```