P29

The Open University of Sri Lanka
B. Sc. Degree Programme – Level 04
Final Examination 2008/2009
CSU 2280: Deductive Reasoning and PROLOG for Artificial Intelligence- **Paper I**
Duration: Two and a half hours

Date: 06.01.2009 Time: 1.00pm – 3.30 pm

Answer FOUR Questions ONLY.

Q1.

a. "Reasoning is the cognitive process of looking for reasons for beliefs, conclusions, actions or feelings". Do you agree with this statement? Justify your answer.

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

c. Give an example for each reasoning technique you have stated in Q1. (b).

d. Consider the following information and answer the questions given bellow.

Railway department needs to develop a fully automated online system to handle all the functionalities. Some of the major functions are listed bellow.

x. Any person can find train as he/she need.
y. Person can buy tickets online.
z. If some train is late or canceled, the systems automatically inform that by using SMS.

Which type of reasoning technique can be used to develop this automated system? Justify your answer.

Q2.

a. What are Syllogisms? Explain briefly.

b. What is the vocabulary of the prepositional Logic

c. Using Truth Tables or inference rules prove,
   i. $\neg(P \wedge Q) \equiv \neg P \vee Q$
   ii. $P \rightarrow Q, \neg Q, \neg R \mid -R$

d. What meant by the terms Tautology, Contradiction and Model assignment? Give examples for each of them.

e. Using Truth tables show, which of the following formulae is Tautologies.
   i. $[P \wedge (P \rightarrow Q)] \rightarrow Q$
   ii. $((P \vee Q) \wedge (\neg P \vee R)) \rightarrow (Q \vee R)$

Q3.

a. What is predicate logic?

b. Translate the following Sentences into predicate logic.
   i. Every boy loves some girl
   ii. Some girl loves some boys
   iii. Some sleepy students didn't answer any questions.
   iv. Every cat is black or white

c. Write the following Predicate Logic expressions in simple English.
   i. $\forall x(Px \wedge \neg Qx)$
   ii. $\forall x \neg(P(x) \rightarrow \exists x \forall z Q(x, y, z))$

d. Using the fact given bellow, show that,
   - It is not sunny and it is colder than yesterday.
   - We will go swimming only if it is sunny.
   - If we don't go swimming then we will play tennis.
   - If we play tennis then we will be home by sunset.

   Use the following:
   P= It is sunny."
   Q= It is colder than yesterday."
   R= We go swimming."
   S= We play tennis."
   T= We will be home by sunset."

Q4.

a. Briefly describe the following terms.
   i. Skolemisation
   ii. Conjunctive Normal Form (CNF)

b. Give the procedure of the CNF converting.

c. Consider the following paragraph

   "Everybody who is trainable or knows something is employable. Anybody who knows anything must have learned that particular thing. Nimal has learned carpentry work"

   Write the above paragraph in predicate logic

d. Convert the following predicate logic formulae into CNF.
   i. $P \vee (Q \rightarrow R)) \rightarrow S$
   ii. $\forall x(P(x) \rightarrow Q(x) \wedge R(x))$

Q5.

a. Using a suitable example, explain the limitations of propositional logic.

b. Explain how predicate logic can address these limitations of propositional logic

c. Using your own words, describe the following terms
   i. Resolution
   ii. Full clausal form

d. Consider the following sentences.

   i. Anyone passes Mathematics and passes Science is happy.
   ii. Anyone who studies or is lucky can pass all his exams.
   iii. Saman did not study but he is lucky.
   iv. Anyone who is lucky passes Science.

   Using resolutions show that 'Saman is happy"

Q6.

b. In the context of AI programming explain why Prolog is more popular than the other programming languages?

c. Briefly Explain the Following terms in PROLOG
   i. Facts
   ii. Queries

d. Consider the following facts.

   Kumari is a girl. She has three brothers. Kamal is the elder brother and Ruvan and Sunil are younger than kumari. Kumari's father is Somapala and her mother is Kamala. Premadasa and Seelawathi are Somapal's father and mother respectively.

   i. By using the above facts create PROLOG programs to represent,
   male(x) – x is a male.
   female(x) – x is a female.
   parent(x,y) – x is a parent of y.

   ii. Create the PROLOG rules for the relations, mother/2, father/2, grand_mother/2 and grand_father/2, husband/2, wife/2 (Use male/1, female/1, parent/2 rules).

   iii. Find the parent names who do not have children.

The Open University of Sri Lanka
B. Sc. Degree Programme – Level 04
Final Examination 2008/2009
CSU 2280: Deductive Reasoning and PROLOG for Artificial Intelligence- **Paper II**
Duration: Two and half hours

018

Date: 07.01.2009 Time: 9.30pm-12.00 noon

Answer FOUR Questions ONLY.

Q1.

a. Briefly describe the following terms
   i. Atom
   ii. Variable
   iii. Operators
   iv. Predicates

b. Which of the following are syntactically correct Prolog objects?
   i. Data
   ii. dataObjet
   iii. 'Student'
   iv. _myData
   v. 'My data'
   vi. my(saman, 12)
   vii. 46
   viii. 6(X, Y)
   ix. +(north, west)
   x. animal(Black(Cats))

c. Will the following machine operation succeed or fail? If they succeed, what are the resulting instantiation of variables?
   i. point(A, B) :- point(1,2).
   ii. Point(A, B) :- point(X, Y, Z).
   iii. Plus(2, 2) :- 4.
   iv. tringle(point(-1,0), P2, P3) = tringle(P1, point(1,0), point(),Y)).

d. Consider the following program,

```
fun(1, one).
fun(s(1), two).
fun(s(s(1)), three).
fun(s(s(s(X))), N) :- fun(X,N).
```

How will Prolog answer the following questions?
   i. fun(s(1), A).
   ii. fun(s(s(1), two).
   iii. fun(s(s(s(s(s(1))))), C).
   iv. fun(F, three).

Q2.

Consider the following two tables given below to answer the questions.

Student Table

Name	Index No	Level
Saman kumara	AS1234	2
Ruwan Silava	AS1235	2
Mihiri Gamage	AS1236	1

Result Table

Index No	Course code	Marks
AS1234	**CSU2280**	**56**
AS1235	**CSU2280**	**75**
AS1236	**CSU1179**	**54**

a. Implement the tables given above in PROLOG.

b. Create rules named **add_student/0, add_result/0** to add a new student and his result by using the key board.

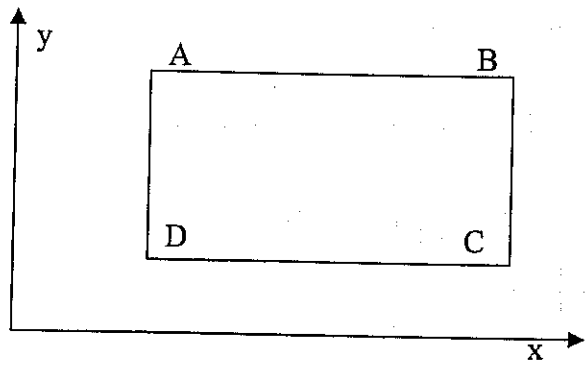
c. Create a rule named editResult/0 to change the result for a given Index No and Course code.

d. Create a rule to display student list for a given level. Your output should be in the following format.

```
-------------------------------------------
              Student list
-------------------------------------------
Level : 1
-------------------------------------------
No    Name                Index No
-------------------------------------------
1     Mihiri Gamage       AS1236
2     ..................  .........
-------------------------------------------
Total Number of student              2
===========================================
```

Q3.

Answer the following questions by using the picture given below. (A,B,C,D are the vertices of a rectangle.)



Each point of the rectangle can be represented by point(X, Y).

```
A = point(1.0,6.5).
B = point(6.5,6.5).
C = point(6.5,1.5).
D = point(1.0,1.0).
```

a. Write a prolog predicate to calculate the length and width of the rectangle.
`linelen(point(X1,Y1), point(X1,Y2), Len)`

b. Calculate the perimeter of the above object.
cal_perm(P1, P2, P3, P4).

c. Calculate the area of the above object
cal_area(P1, P2, P3, P4).

d. Write prolog rules to identify the following object types.
   i. rectangle (if length 1 ≠ Length 2)
   ii. square (if Length 1 = length 2)

e. Calculate lengths AB and AD (in meters), and convert them to yards.
   1 meter = 1.093yard

Q4.

a. Define List in Prolog?

b. What are the tasks of each of the following Built-in list operations in SWI Prolog?
   i. memberchk/2
   ii. sort/2
   iii. msort/2

c. Create PROLOG rules to carry out the following list operations

i. Write a prolog predicate named **delete_item/3** that deletes a given item in a list

ii. Write a prolog predicate name **append_item/3** that appends given two list

iii. Write a prolog predicate **printer_after(L,x),** where L is the list and x is a value in the list ,where all the elements after x should be printed.

iv. Write a prolog predicate name **printer_before (L,x),** where L is the list and x is a value in the list ,where all the elements before x should be printed.

d. Consider the following table and answer the questions given bellow

Name	Index No
Saman kumara	AS1234
Ruwan Silava	AS1235
Mihiri Gamage	AS1236

i. Create a predicate name, print_all_student/0 that prints all student names in ascending order

ii. Create a predicate name, print_format_one/1 that prints all student name after the index number is given.

iii. Create a predicate name count_student/2 that prints number of student who are in the list and before the given index number.

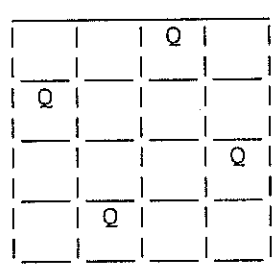
Q5.

a. Why Prolog is used to solve some AI problems? Describe your answer comparing the features with other Programming languages.

b. What are the some classical problems in AI? Describe two of them using examples.

c. Consider the following Program and Answer the questions given bellow.

The challenge is to set N queens in a chess game on an NxN grid so that no queen can "take" any other queen. Queens can move horizontally, vertically, or along a diagonal. The following diagram shows a solution for N=4 queens.



A solution to this puzzle can be represented as a special permutation of the list [1,2,3,4]. For example, the solution pictured above can be represented as [3,1,4,2], meaning that, in the first row place a queen in column 3, in the second row place a queen in column 1, etc. To test whether a given permutation is a solution, one needs to calculate whether the permutation has (or represents a situation where) two or more queens lie on the same diagonal. The representation itself prevents two or more queens in the same row or column. Two queens are on the same / diagonal if and only

if the sum of the row and column is the same for each; they are on the same \ diagonal if and only if the difference of their row and column is the same number. The following Prolog program has the details;

```
perm([X|Y],Z) :- perm(Y,W), takeout(X,Z,W).
perm([],[]).

takeout(X,[X|R],R).
takeout(X,[F|R],[F|S]) :- takeout(X,R,S).

solve(P) :-
     perm([1,2,3,4],P),
     combine([1,2,3,4],P,S,D),
     all_diff(S),
     all_diff(D).

combine([X1|X],[Y1|Y],[S1|S],[D1|D]) :-
     S1 is X1 +Y1,
     D1 is X1 - Y1,
     combine(X,Y,S,D).
combine([],[],[],[]).

all_diff([X|Y]) :-  \+member(X,Y), all_diff(Y).
all_diff([X]).
```

i. How do you Start the simulation?

ii. What is the task of the perm/2 Prolog predicate?

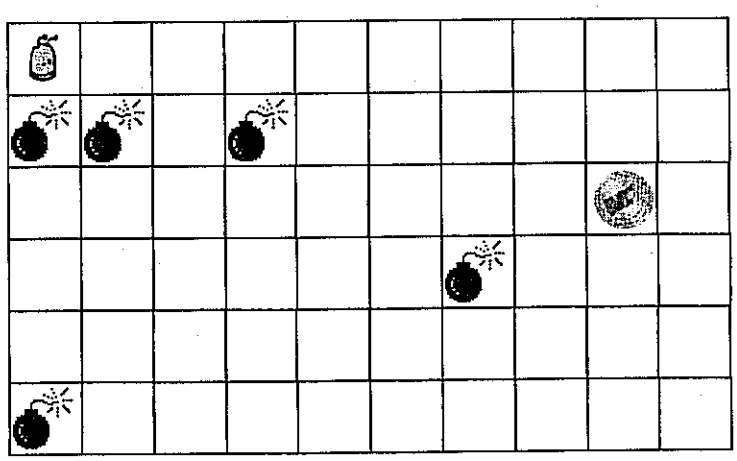
iii. What are the tasks of the predicates named combine/4 and all_diff/1.

iv. Explain briefly how this sample program run.

v. How do you improve this program for a 9x9 grid.

Q6.

The following figure shows a map of the path finding program that need to find the path from the start point to the goal position (stat position (1,1), goal position (9,3).)



Robot  Can move to any place (vertically and horizontally). However, there are some bombs  in the map. Robot cannot move that location. Your program must need to start by using the following prolog predicate

```
go(state(1,1),state(9,3)).
```

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).

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

a. Briefly show the task of the following predicates
   i. member/2.
   ii. printLst/2.
   iii. path/3.
   iv. flatten/2

b. Define the sqaures that the robot cannot move into.

c. Create two predicate named plusval(+In, -Out) and subval(+In, -Out) that add one to the input value and subtract one from the input value
   Example: plusval(34, X) gives X = 35, subval(34, X) X = 33

d. Create 5 predicates named '`move(State,Next)`' That can be move left, right up or down locations
   Hint: use plusval/2 and subval/2 to add or subtract values

e. What is the process of the following predicate.
   ```
   move(state(X,Y), state(X,Y)) :- nl, fail.
   ```

f. Briefly describe how this program runs on the following predicate.
   ```
   go(state(1,1),state(1,3)).
   ```