The Open University of Sri Lanka

B. Sc. Degree programe – Level 04

Final Examination 2005/2006

CSU 2280: Deductive Reasoning and PROLOG for AI- **Paper II**

Duration: Two and half hours

Date: 14/11/2006 Time: 9.30 am- 12.00 noon

Answer FOUR Questions ONLY.

Q1.

(a) Define the following terms

i. Tautology

ii. Contradiction

iii. Counter example

iv. Model assignment

(b) Using truth tables determine whether the following are Tautologies, Contradiction or neither.

i. $(\neg A \vee B) \wedge \neg(A \rightarrow B)$

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

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

(c) A = I eat apple, B = I have money,

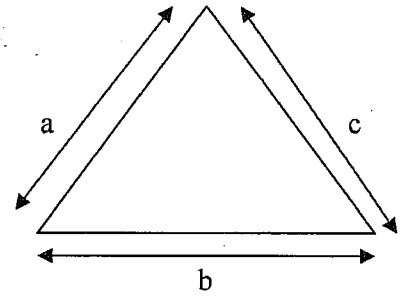
C = Apple is available in the fruit shop and D = apple is malodorous,

Using the above interpretation translate the following well- formed formulae into English.

i. $(B \wedge C) \rightarrow A$

ii. $(D \vee \neg B \vee \neg C) \leftrightarrow \neg A$

Q2. Answer the following questions by using the picture given below



(a) Write a prolog predicate named *read_values/3* to read three lengths a,b and c from keyboard.

(b) Calculate perimeter of the triangle. (*Hint:* perimeter = a+b+c)

(c) Write a prolog rule to identify the following triangle types.

i. Equilateral triangle.(a=b=c)

ii. Isosceles triangle.(a=b≠ c),(a=c≠ b),(a≠ b=c)

iii. Unequal triangle.(a≠ b≠ c)

(d) Create a prolog predicate to identify a right angled triangle.

Hint: use Pythagoras law

Q3. Consider the following prolog database

```
Subject(pm, Pure Maths);
Subject(am, Applied Maths);
Subject(ph, Physics);

Student(s01, Ruvan Perera),
Student(s02, Sunil Silva),
Student(s03, Kumari de silva),

Result(s01, pm, 70),
Result(s01, am, 35),
Result(s01, ph, 50).
```

a. Correct the above Prolog program

b. Write Prolog predicates to,

i. Add a new student

ii. Add new Results

iii. Update/change existing results

c. Create a Prolog program to display the following outputs

i. ? stu_list.

```
Student list
------------
Kumari de silva
Ruvan Perera
Sunil Silva
```

ii. ? result(s01).

```
Index No: s01
--------------
Subject  Marks
--------------
am         35
ph         50
pm         70
```

Q4.

a. Briefly describe the terms *Atom, Number, Variable* and *List* in Prolog.

b. Following is a part of a Prolog program developed to calculate the length of a list.

```
len([H|T], N)  :- len(T, N) .
len([],X).
```

i. Complete the above program

ii. Describe step-by-step how prolog answers the following queries.

a. len([1,2,3,4],N).

b. len([1,2,[3,2]],N).

iii. Modify above Program to calculate summation of the numbers in a list.

iv. Create Prolog predicate to calculate the average of the given list.

Q5.

a. Explain, how prolog deals with

i. Backtracking

ii. Handling negation

b. Describe how the following program works

```
diff(X,Y) :- X = Y ,!, fail; true.
```

c. Write a Prolog procedure starmap(N) to print N number of stars on the screen. For example,

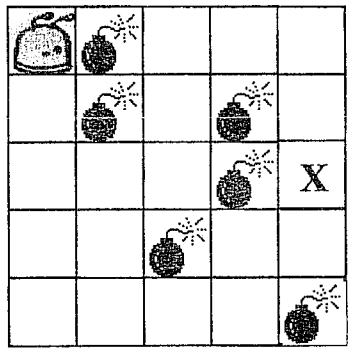
```
? Starmap(7)
*******
Where N=7
```

d. Extend the above program to draw a bar chart. Your output must appear as follows. Then explain how it works.

```
barchart([1,9,3,5]).
1 *
9 *********
3 ***
5 *****
```

Q6.

Following is a simple game where a robot is initially at (1,1) position. The robot needs to move to the position (5,3). But there are several bombs in between as shown in the map.



A part of the simulation program is as follows.

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

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

path(Goal,Goal,L)    :-   flatten(L,X),printLst(X).
path(State,Goal,L)   :-   move(State,Next),
                          not(member(Next,L)),
                          path(Next,Goal,[Next|L]),nl,!.

plsval(X,Y) :- Y is X + 1.
```

```
mulval(X,Y) :- Y is X - 1.

opp(X,Y) :- Y is X + 1.
opp(X,Y) :- Y is X - 1.

move(state(X,Y), state(X,Z)) :-
                          plsval(Y,Z),not(notstate(X,Z)).

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

notstate(2,1).
notstate(2,2).

go(Start,Goal)       :-   path(Start,Goal,Start).
```

Answer the questions below by using the above simulation program.

a. What is the task of each of the following prolog predicates.
   i. member/2
   ii. printLst/1
   iii. state/2
   iv. move/2
   v. notsate/2

b. Add an ther *move/2* Prolog predicate to *move left*, *move up* and *move down*

c. Add other *notstate/2* prolog predicate.

d. What is the process of the following Prolog predicate.

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

e. How do you run this simulation in the console window? Assume that robot is in (1,1) location and goal is (5,3) location.