Question1

Model2Ansewer

(5Marks)

Consider the following statements.

Ahmed likes only easy courses. Math courses are hard. All courses in the computer science department are easy. CS101 is a computer science course.

(a) Translate the sentences into predicate logic.

Ans :

1. (∀ x) x easy(x) -> likes(Ahmed, x) (1Mark)
2. (∀ x) math(x) -> ~easy(x)
3. (∀ x) cs-course(x) -> easy(x)
4. cs-course (CS101)

(b) Convert your sentences into clausal normal form. (2Marks)

Ans:

1. ~easy(x) v likes(Ahmed, x)
2. ~math(x)) v ~easy(x)
3- ~cscourse (x) v easy(x)
4. cscourse(CS101)

(c) What course would Ahmed like? Answer using proof methods of predicate logic (i.e. either resolution with refutation or application of inference rules).

Applying inference rules (2Marks)

Ans:

Combine 3 and 4 with resolution using substition x= CS101

5. easy(CS101)

Combine 5 and 1 with resolution using substition x= CS101

6. likes(Ahmed, CS101)

Therefore Ahmed likes CS101.

Question2

(5Marks)

An expert system used for weather forecasting of the rain and dust status has the following set of parameters and rules collected from different sensors.

R1: IF season = summer and temperature >35 THEN
pressure level = high

R2: IF season = winter and wind speed <30km/h and temperature,<10 THEN
pressure level = high , moisture level = low

R3: IF pressure level = high and wind speed >20km/h THEN
Rain = true , moisture level = high

R4: IF moisture level = low and season = summer THEN
Rain = false , Dust = true

R5: IF pressure level = high and moisture level = high THEN
Rain = true , Dust = false

Trace different reasoning algorithm with the following sensors input:
[temperature = 40 , wind speed = 25km/h , season= summer]
Explain briefly the inference process of above reasoning techniques

Reason forward (2.5Marks)

1. Request a value for each input parameter (may through sensors)
2. The queue of rules that this parameter is a premises for ={R1,R2}
3. Examine the first rule R1 to see if its premises is satisfied (R1 fire) , driving pressure level =high
4. R5 its premises use the pressure level value, then it is added to the end of the queue.
    a. R1 is removed and R2 is examined which is failed.
    b. R2 is removed and R3 is examined which is satisfied, deriving moisture level = high , Rain = true
    c. No other rules uses that value in its premises so no rules added to queue
    d. R3 is removed and R4 is examined which is failed
    e. R4 is removed and R5 is examined which derive the conclusion Rain = true , Dust = false
5. Output the values

Reason backward (2.5Marks)

Apply backward chaining: Goals (Rain , Dust).
Select the first top goal Rain = true
Rules R4 & R5 that derive that goal placed on the stack .
Rule R4 examined, the first parameter moisture level = low examined to see if it is in the database (which is not) So that makes moisture level = low as sub-goal (and go back to step 2).

- R2 & R3 derive value for (moisture level)
- Rule R2 examined , fail
- Rule R3 examined , examine-> R1 derive value for pressure level = high
- Premises of R1 statisfied and get (pressure level = high)
- Rule R3 examined ->R3 satisfied (Rain = true , moisture level = high)
- R5 all two premises true then it is satisfied and drive Rain = true , Dust = false

6. Output the values
7.

Question3

(5Marks)

Create a new prolog program file in your prolog programs directory. Add to it the definition of member given below. (2.5Marks)

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

Use member to find whether
Consider the definition of member given below:

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

Use member to find whether

1. 3 is a member of the list [1,2,3,4,5]
2. a is a member of the list [l,A,b,o,r,A,t,o,r,y]
3. ELEMENT is a member of the list [l,a,b,o,r,a,t,o,r,y]
4. item(ITEM,300) is a member of the list [item(a,100),item(d,300),item(x,500)]
5. Does the following query fails:

?- member([c],[a,b|[c]]).

3 is a member of the list [1,2,3,4,5]
yes

a is a member of the list [l,A,b,o,r,A,t,o,r,y] _____
A = a

ELEMENT is a member of the list [l,a,b,o,r,a,t,o,r,y] _____
?- member(ELEMENT, [l,a,b,o,r,a,t,o,r,y]).
ELEMENT = l ? ;
ELEMENT = a ? ;
ELEMENT = b ? ;
ELEMENT = o ? ;
ELEMENT = r ? ;
ELEMENT = a ? ;
ELEMENT = t ? ;
ELEMENT = o ? ;
ELEMENT = r ? ;
ELEMENT = y ? ;
no
item(ITEM,300) is a member of the list [item(a,100),item(d,300),item(x,500)]
ITEM = d

Do the following query fails:

```
?- member([c],[a,b|[c]]). _____
```

Yes

Define the predicate (2.5Marks)

```
between(N1,N2,X)
```

Which for, two given integers N1 and N2, generates through back tracking all the integers X that satisfy the constraint `N1 ≤ X ≤ N2`.

```
Example:
?- between(1, 3, X).
X = 1 ? ;
X = 2 ? ;
X = 3 ? ;
no
```

Answer:

```
between(N1,N2,N1):-
     N1 =< N2.
between(N1,N2,X):-
     N1 <N2,
     NewN1 is N1 + 1,
     between(NewN1,N2,X).
```