# BRAC University

## Department of Computer science and engineering

Subject: CSE 422 Title: Artificial Intelligence
Marks: 60 Time: 3h
Answer any 5.

1) 3 + 4 + 5

a) Explain the operation of the following simple Knowledge based agent.

```
function KB-AGENT(percept) returns an action
  static: KB, a knowledge base
          t, a counter, initially 0, indicating time
  TELL(KB, MAKE-PERCEPT-SENTENCE(percept, t))
  action ← ASK(KB, MAKE-ACTION-QUERY(t))
  TELL(KB, MAKE-ACTION-SENTENCE(action, t))
  t ← t + 1
  return action
```

b) Using nesting quantifier develop first order logic for the following sentences.
Everyone likes some kind of food
Someone likes all kinds of food
There is a kind of food that everyone likes

c) Explain the expression KB = $(B_{1,1} \leftrightarrow (P_{1,2} \vee P_{2,1})) \wedge \neg B_{1,1}$ and $\alpha = \neg P_{1,2}$, in context with Wumpus world. Convert KB in conjunctive normal form.

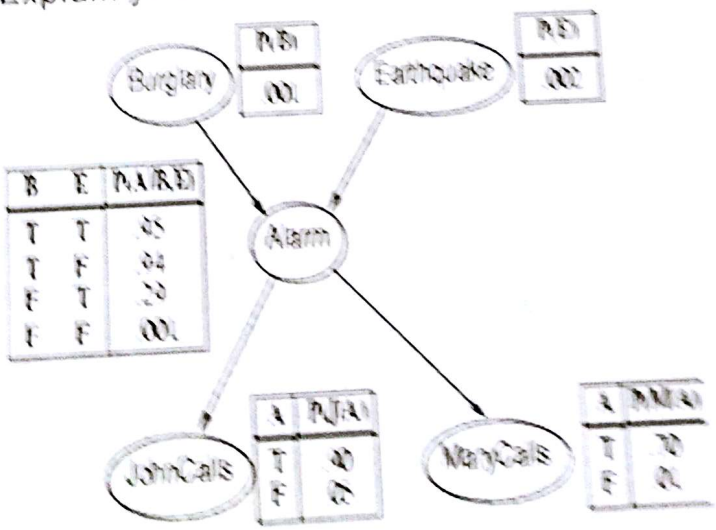
2) 3 + 4 + 5

a) What is unification? Based on the following find the value of θ.

| p | q | θ |
|---|---|---|
| Knows(John,x) | Knows(John,Jane) | |
| Knows(John,x) | Knows(y,OJ) | |
| Knows(John,x) | Knows(y,Mother(y)) | |
| Knows(John,x) | Knows(x,OJ) | |

b) The law says that it is a crime for a Bangladeshi to sell weapons to hostile nations. The country Nono, an enemy of Bangladesh, has some missiles, and all of its missiles were sold to it by Captain Clive, who is Bangladeshi. Prove that Captain Clive is a criminal by using resolution.

c) You are at work, neighbor John calls to say your alarm is ringing, but neighbor Mary doesn't call. Sometimes it is set off by minor earthquakes. What is the probability that burglar is there? Explain your answer.



3)

3+4+5

a) Explain why it is a good heuristic to choose the variable that is most constrained but the value that is least constraining in a CSP search.

b) What is the structure of a simple learning agent?

c) Based on the game of Wumpus world, after detecting nothing in [1,1], moving right and detecting breeze in [2,1], what will be model for next three possible moves (using knowledge base) assuming that only pits exist?

4)

3+4+5

a) With an example show how do you construct Bayesian network.

b) How can Wumpus world agent be presented by an algorithm? What will the agent do in order to resolve the game?

c) Explain why the forward chaining algorithm and backward chaining algorithm are used. What is Horn form? Find the goal which is to conclude the color of a pet named Fritz, given that he croaks and eats - ies, and that the rule base contains the following four rules:

If X croaks and X eats flies Then X is a frog

If X chirps and X sings Then X is a canary

If X is a frog Then X is green

If X is a canary Then X is yellow

5)

3+4+5

a) Decision trees can express any function of the input attributes. Draw a decision tree for XOR representation of two variables A and B.

b) Based on following joint probability distribution, find P(¬ Cavity) and P(Toothache| Catch). Using the following table, calculate information gain for attributes Patron and Price.

| | *toothache* | | *¬ toothache* | |
|---|---|---|---|---|
| | *catch* | *¬ catch* | *catch* | *¬ catch* |
| *cavity* | .108 | .012 | .072 | .008 |
| *¬ cavity* | .016 | .064 | .144 | .576 |

| Example | Attributes | | | | | | | | | | Target |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Alt* | *Bar* | *Fri* | *Hun* | *Pat* | *Price* | *Rain* | *Res* | *Type* | *Est* | *Wait* |
| $X_1$ | T | F | F | T | Some | $$$ | F | T | French | 0–10 | T |
| $X_2$ | T | F | F | T | Full | $ | F | F | Thai | 30–60 | F |
| $X_3$ | F | T | F | F | Some | $ | F | F | Burger | 0–10 | T |
| $X_4$ | T | F | T | T | Full | $ | F | F | Thai | 10–30 | T |
| $X_5$ | T | F | T | F | Full | $$$ | F | T | French | >60 | F |
| $X_6$ | F | T | F | T | Some | $$ | T | T | Italian | 0–10 | T |
| $X_7$ | F | T | F | F | None | $ | T | F | Burger | 0–10 | F |
| $X_8$ | F | F | F | T | Some | $$ | T | T | Thai | 0–10 | T |
| $X_9$ | F | T | T | F | Full | $ | T | F | Burger | >60 | F |
| $X_{10}$ | T | T | T | T | Full | $$$ | F | T | Italian | 10–30 | F |
| $X_{11}$ | F | F | F | F | None | $ | F | F | Thai | 0–10 | F |
| $X_{12}$ | T | T | T | T | Full | $ | F | F | Burger | 30–60 | T |

6) Write short note on

a) Diagnostic probability from causal probability

b) Use of AC-3

c) Entailment, soundness and completeness

d) Decision tree and its learning