53 (IT 715) ARIN

2017

ARTIFICIAL INTELLIGENCE

Paper : IT 715

Full Marks : 100

Time : Three hours

***The figures in the margin indicate
full marks for the questions.***

Answer **any five** questions.

1. *(a)* With suitable examples distinguish between static, dynamic and semidynamic environments. 6

   (b) Compare and contrast informed and uninformed search with example.

   10

   (c) What is an inadmissible heuristic ? What is the advantage of using inadmissible heuristic ? 2+2=4

2. *(a)* Show how the Alpha-Beta algorithm (that uses alpha-beta pruning) explores the game tree of *figure* below, searching from left to right.

    (i) Fill in the leaves that are inspected by Alpha-Beta

    (ii) Show the cutoffs and label them with their type (alpha cutoff or beta cutoff)

    (iii) Mark the move that Alpha Beta will choose for MAX at the root.
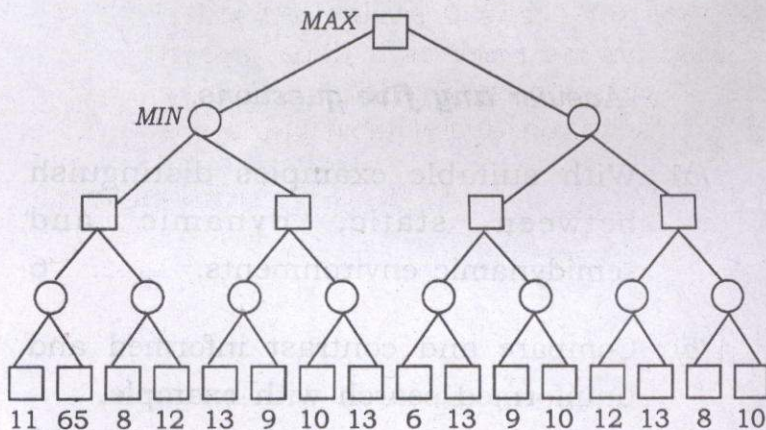
3+5+2=10

(b) Construct a 4-ply binary game tree, using the values 0 and 1 for the leaf nodes, such that there are no cutoffs with the Alpha-Beta pruning when searching from left to right.   6

(c) Will Alpha Beta algorithm ever yield an inferior solution as compared to the Minimax algorithm ? Justify your answer. 4

3. *(a)* With the help of suitable example problems explain the three forms of representations : 2+2+2=6

atomic, factored and structured.

(b) How do you think DPLL and WALKSAT are relevant to knowledge representation and reasoning ? 4

(c) Convert the following set of sentences to clausal form. Give a trace of the execution of DPLL on the conjunction of these clauses. 10

$$S1 : A \Leftrightarrow (B \vee E)$$

$$S2 : E \Rightarrow D$$

$$S3 : C \wedge F \Rightarrow]B$$

$$S4 : E \Rightarrow B$$

$$S5 : B \Rightarrow F$$

$$S6 : B \Rightarrow C$$

4. (a) Tony, Mike and John belong to the Alpine Club. Every member of the Alpine Club who is not a skier is a mountain climber. Mountain climbers do not like rain, and anyone who does not like snow is not a skier. Mike dislikes whatever Tony likes, and likes whatever Tony dislikes. Tony likes rain and snow. Prove that the given sentences logically entail that there is a member of the Alpine Club who is a mountain climber but not a skier.

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(b) Consider a world with objects King, Queen and Prince. Consider the following interpretation : 10

$I(X) = \text{King}, \ I(Y) = \text{Queen}, \ I(Z) = \text{Prince}$

$I(F) = \{< \text{King}, \text{Queen} >, < \text{Queen}, \text{Prince} >,$

$< \text{Prince}, \text{Prince} >\}$

$I(P) = \{\text{King}, \text{Queen}\}, \ I(Q) = \{\text{Prince}\}$

$I(R) = \{< \text{Queen}, \text{King} >, < \text{Prince}, \text{Queen} >,$

$< \text{Prince}, \text{Prince} >\}$

For each of the following sentences, say whether it is true or false in the given interpretation I :

(i) $Q(F(Z))$

(ii) $\exists n F(n) = Y$

(iii) $\forall n\, R(F(n), n)$

(iv) $\forall l, m\, R(l, m) \Rightarrow (\forall n\, R(l, n) \Rightarrow m = n)$

(v) $\forall u, v R(u, v) \Rightarrow (\forall w r(w, v) \Rightarrow u = w)$

5. (a) Consider the "have cake and eat cake too" planning problem as represented below :   10

Init (Have(Cake))

Goal (Have(Cake) ∧ Eaten (Cake))

Action (Eat(Cake)

PRECOND : Have(Cake)

EFFECT : ⌐Have(Cake) ∧ Eaten(Cake))

Action (Bake(Cake)

PRECOND : ⌐Have(Cake)

EFFECT : Have(Cake))

Give the planning graph for "have cake and eat cake too" problem. Mark all the mutex links and justify.

(b) The figure below shows a version of Shakey the robot's world consisting of four rooms lined up along a corridor, where each room has a door and a light switch. The following are Shakey's six-actions :

— Go (x, y, r), which requires that Shakey be At x and that x and y are locations in the same room r.

— Push a box b from location x to location y within the same room : Push (b, x, y, r). You will need the predicate Box and constants for the boxes.

— Climb onto a box from position x : climb up (x, b); climb down from a box to position x : climb Down (b, x). You will need the predicate On and the constant floor.

— Turn a light switch on or off : Turn On (s, b); Turn Off (s, b). To turn a light on or off, Shakey must be on top of a box at the light switch's location.

Write PDDL sentences for Shakey's six actions and the initial state from the following figure. Define all your constants, variables and predicates. Construct a plan for Shakey to get Box 2 into Room 2. Starting from a partial plan with 'Start' and 'Finish' actions, refine the plan using PoP (only three iterations). 10
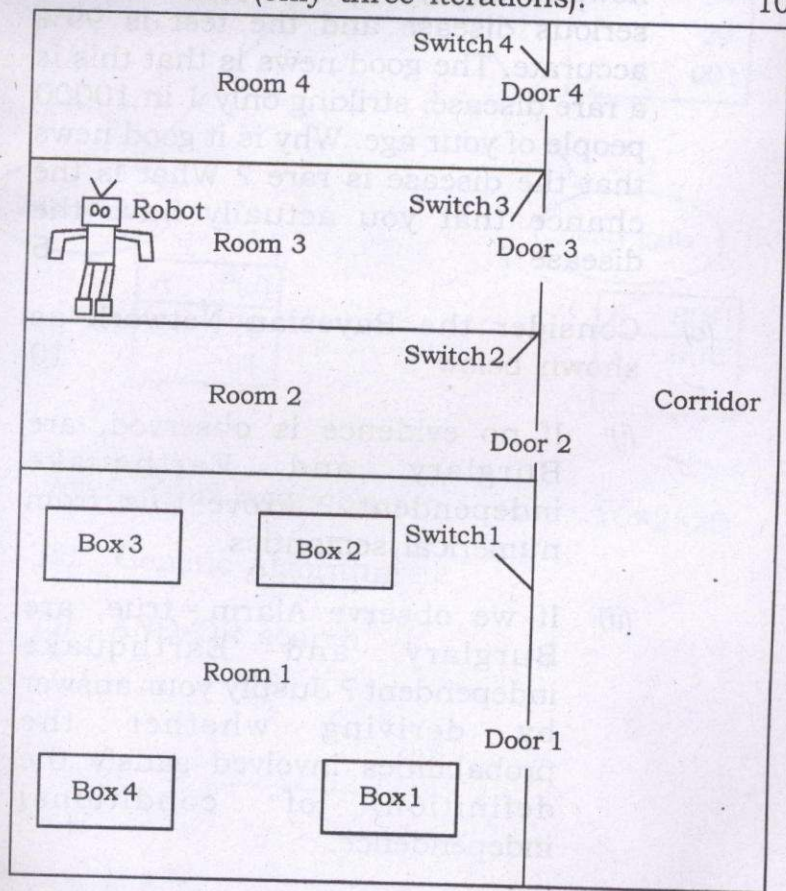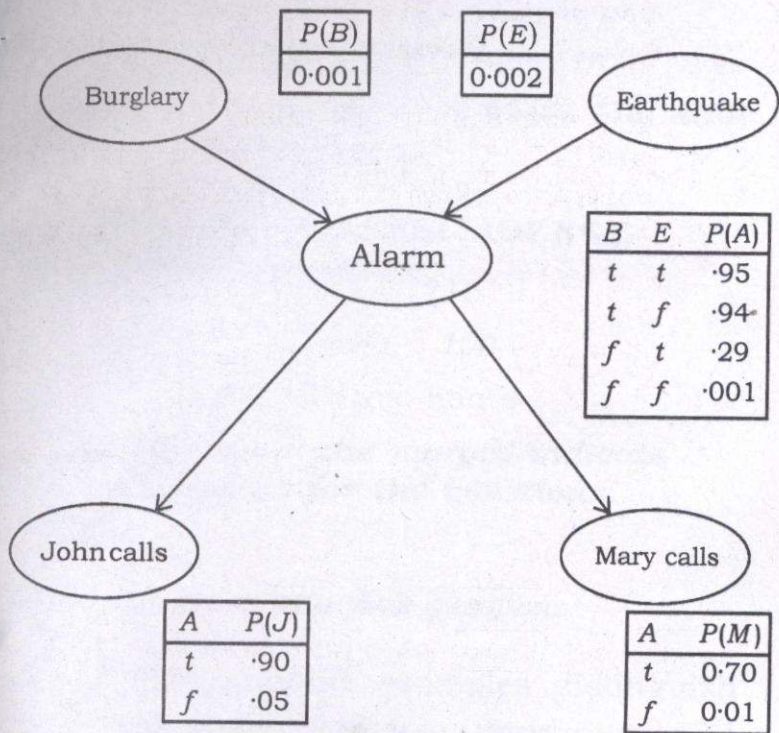
6. (a) What are the ontological and epistemological commitments of a language ? Specify the same for *pL*, *FOL* and probability theory. 5

(b) After your yearly checkup, the doctor has bad news and good news. The bad news is that you tested positive for a serious disease and the test is 99% accurate. The good news is that this is a rare disease, striking only 1 in 10000 people of your age. Why is it good news that the disease is rare ? What is the chance that you actually have the disease ? 5

(c) Consider the Bayesian Network as shown below : 10

   (i) If no evidence is observed, are Burglary and Earthquake independent ? Prove this from numerical semantics.

   (ii) If we observe Alarm = true, are Burglary and Earthquake independent ? Justify your answer by deriving whether the probabilities involved satisfy the definition of conditional independence.

		P(B)			P(E)		
		0·001			0·002		

Burglary   Earthquake

Alarm

B	E	P(A)
t	t	·95
t	f	·94
f	t	·29
f	f	·001

John calls   Mary calls

A	P(J)
t	·90
f	·05

A	P(M)
t	0·70
f	0·01

7. Write short notes on :   10×2=20

(a) Genetic Algorithm

(b) AND-OR search.

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