

**BITS PILANI, DUBAI CAMPUS**  
**Dubai International Academic City, Dubai**  
**First Semester 2013-14**  
Comprehensive Exam (Closed Book)

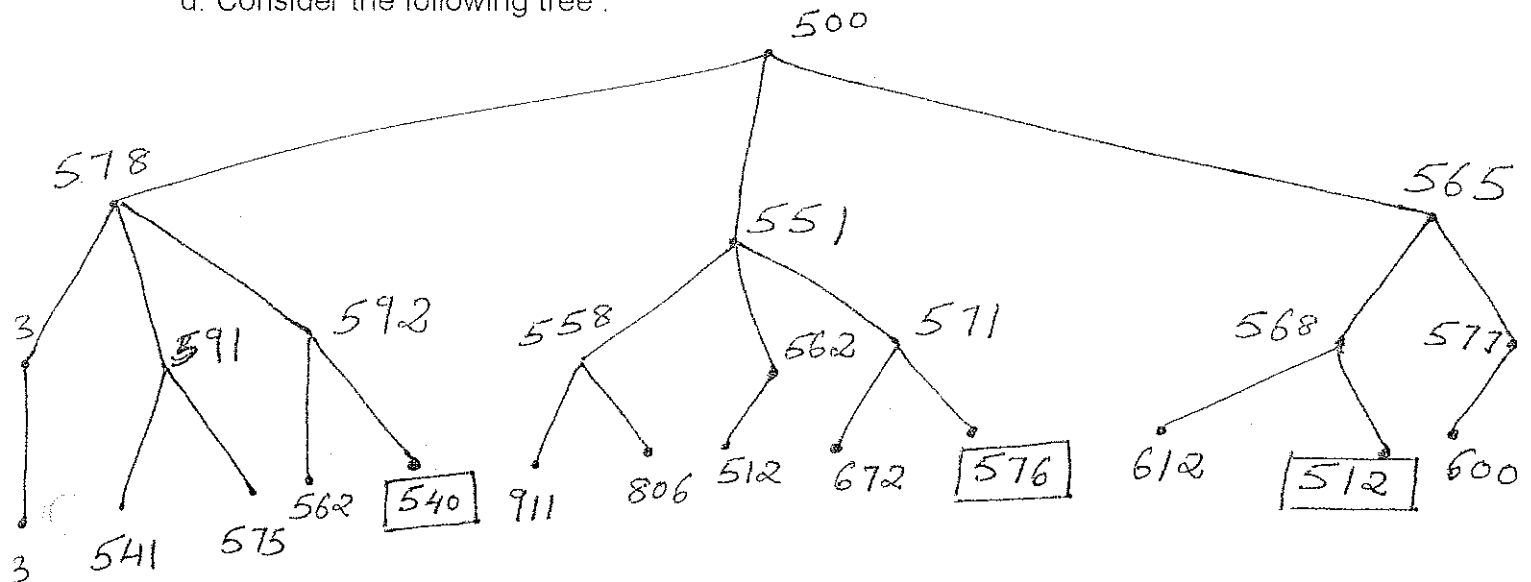
No. of Questions: 8
No. of Pages : 4

Course Number & Title : EA C461/CS F407 – Artificial Intelligence Marks : 80 Weightage : 40%

Duration : 3Hrs Date: 05- 1-2014 Time:12.30PM – 3.30PM Year : III,IV year

**Note : Answer All Questions**

- 1.a. Explain the difference between uninformed and informed search. List two examples of each type of algorithm. [2M]
- b. Give the **algorithm** for the Recursive Best First Search Algorithm ( RBFS) [4M]
- c. What shortcoming of A\* algorithm does the RBFS algorithm address and how does it achieve this ? [ 2M]
- d. Consider the following tree :



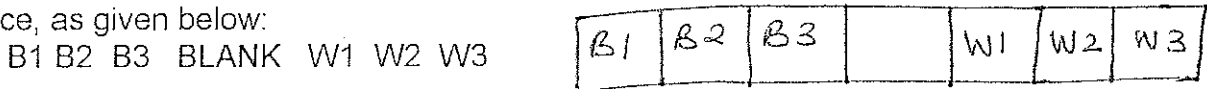
The numbers by the nodes denote the sum of the path cost and heuristic. The boxed nodes are goals. Describe in detail the order in which the RBFS algorithm searches the tree, state which of the three goals is found and why. Note that smaller numbers denote more desirable nodes. [6M]

2. i) Express the following statements in **Predicate Logic**.

- a. All bunnies are cute
- b. Every student who is taking AI is cool
- c. Every Bunny who is a student taking AI is cute and cool
- d. There is at least one student who doesn't hate (any of) the AI homework
- e. A Sister-in-law is your spouse's sister
- f. A First cousin is the child of your parent's siblings [ 1+1+1+2+2+2M]

ii) Check if  $\neg P \wedge Q \models P$  [2M]

3. A sliding-tile puzzle consists of three black tiles, three white tiles and an empty space, as given below:



- There are three legal ways of moving a tile, each with an associated cost:
- slide into the adjacent empty location | cost 1
- jump over one tile into the empty location | cost 1
- jump over two tiles into the empty location | cost 2

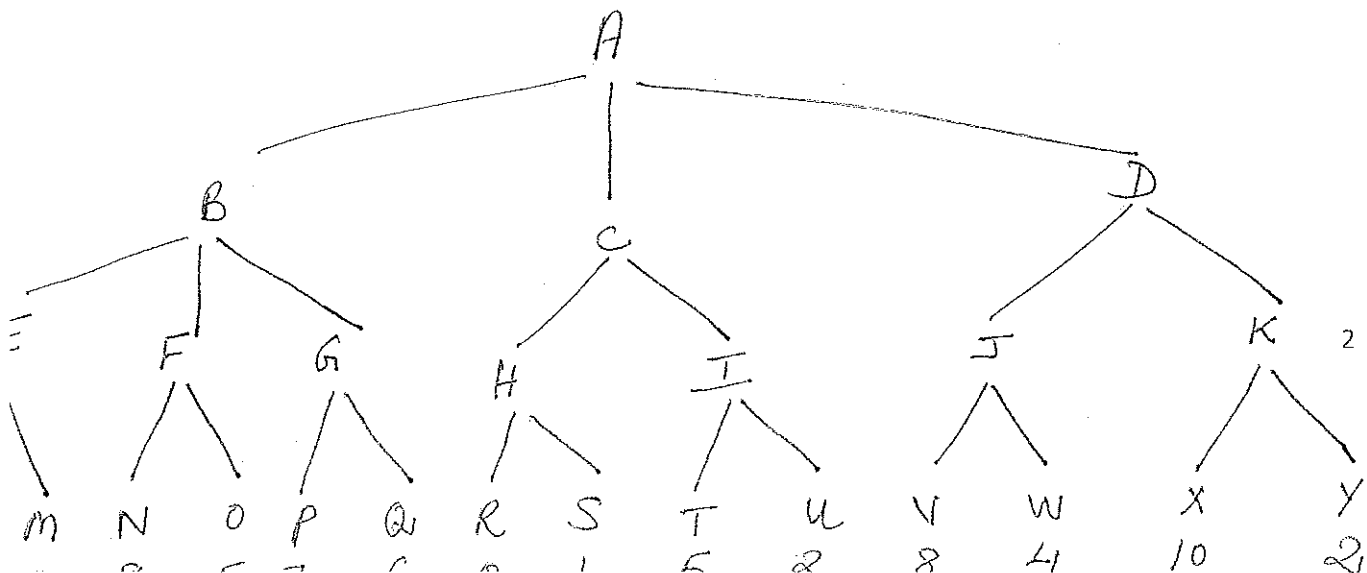
The goal is to have all the white tiles to the left of all the black tiles and to achieve this at minimum cost. The final position of the empty space is not important.

a) Represent the problem using the production rules [5 marks]

- 4.a. Why does search in game-playing programs always proceed forward from the current position rather than backward from the goal? [2M]
- b. Most game-playing programs do not save search results from one move to the next. Instead, they usually start completely afresh whenever it is the machines turn to move. Why? [2M]
- c. Consider the following game tree, and assume that the first player is the maximizing player:

i) Which move should the first player choose? [2 marks]

ii) Assuming that nodes are searched left-to-right using the alpha-beta algorithm, which nodes would not be examined? [4 marks]



5. Orville the robot juggler, drops balls quite often when its battery is low. In previous tests, it has been determined that the probability that it will drop a ball when its battery is low is 0.9. Whereas when the battery is not low, probability that it drops a ball is only 0.05. The battery was recharged not so long ago, and our best guess looking at Orville's record is that the odds that the battery is low are 9 to 1. A robot observer with a somewhat unreliable vision, reports that Orville dropped the ball. The reliability of the observer is given by the following probabilities.

$$P(\text{observer says that Orville drops} | \text{Orville drops}) = 0.8$$

$$P(\text{observer says that Orville drops} | \text{Orville does not drop}) = 0.2$$

- a. Draw the Bayes network 2M
- b. Calculate the probability that the battery is low given the observers report. [7M]

6. Consider the following story of the play Macbeth, by William Shakespeare:

The characters are Macbeth, Lady-Macbeth, Duncan and Macdu. Macbeth is an evil noble. Lady-Macbeth is a greedy ambitious woman. Duncan is a king. Macdu is a loyal noble. Macbeth is weak because Macbeth married Lady-Macbeth and because Lady-Macbeth is greedy. Lady-Macbeth persuades Macbeth to want to be king. Macbeth murders Duncan using a knife. Macdu is angry because Macbeth murdered Duncan and because Macdu is loyal to Duncan, Macdu kills Macbeth.

- a. Construct a semantic network representing the above story. [5M]
- b. Show the chain of reasoning leading to Macdu killing Macbeth. [2M]

7. Our goal is to construct a Decision tree for predicting flight delays. We have collected data for a few months and the summary is given in Table 1 given below.

Table 2: Decision tree data

Feature	Value = yes	Value = no
Rain	Delayed - 30, not Delayed - 10	Delayed - 10, not Delayed - 30
Wind	Delayed - 25, not Delayed - 15	Delayed - 15, not Delayed - 25
Summer	Delayed - 5, not Delayed - 35	Delayed - 35, not Delayed - 5
Winter	Delayed - 20, not Delayed - 10	Delayed - 20, not Delayed - 30
Day	Delayed - 20, not Delayed - 20	Delayed - 20, not Delayed - 20
Night	Delayed - 15, not Delayed - 10	Delayed - 25, not Delayed - 30

- a. Draw the decision tree and mention why you have chosen a specific node as the Root node. [5M]

**BITS PILANI, DUBAI CAMPUS**  
**Dubai International Academic City, Dubai**  
**First Semester 2013-14**  
**Test – 2(Open Book)**

No. of Questions: 3

No. of Pages : 1

Course Number& Title : EA C461/CS F407 – Artificial Intelligence Marks : 40 Weightage : 20%

Duration : 50 minutes Date: 06- 11-2013 Time:11.10 AM – 12.00PM Year : III,IV year

**Note : Answer All Questions**

1. Consider the given well-formed formula and convert it into the Clause Normal Form (CNF). Sothe the step by step conversion process **clearly**. [14M]

$$(\forall x) \{P(x) \Rightarrow \{(\forall y)[P(y) \Rightarrow P(f(x, y))] \wedge \neg(\forall y)[Q(x, y) \Rightarrow P(y)]\}\}$$

2. Represent the following statement as a **Semantic Network**. “Meena was watching television when she heard a noise behind her, when she turned around she saw a rat running”. [6M]
3. Give the following sentences, using resolution in First-order-predicate logic, prove that “**Ram is happy**”. (Show step clearly) [14M]
- Anyone who gets good job and has good knowledge is happy.
  - Anyone who studies well or has good experience can get a good job.
  - Ram did not study well but has good experience.
  - Anyone who has good experience has good knowledge.
4. Consider the following sentences . (Show steps clearly)
- John like all kinds of food.
  - Apples are food
  - Anything anyone eats and is still alive is food.
  - Bill eats peanuts and still alive.,

Prove that “**John like peanuts**”, using backward chaining.

[6M]

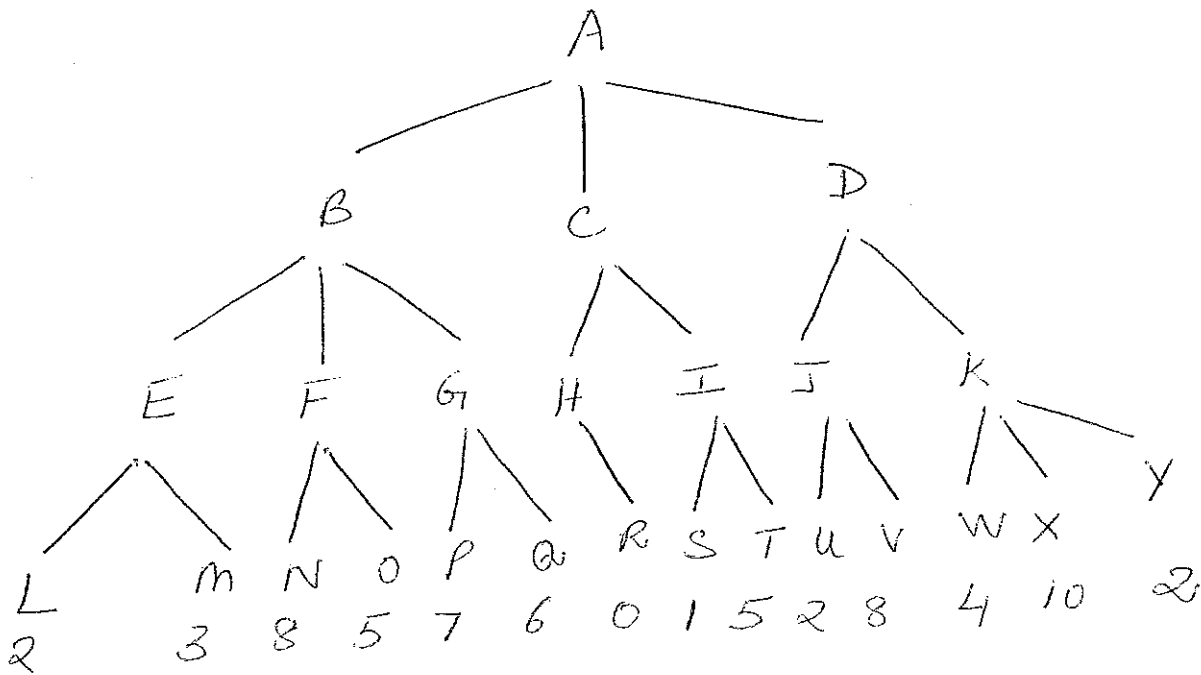
\*\*\*\*\*

1. Consider the given well formed formula and convert it into the Clause Normal Form ( CNF) . Show the step by step conversion process **clearly**. **14M**

$$\begin{aligned}
 (\forall x) \{ PCx \} &\Rightarrow \{ (\forall y) [ PCy \Rightarrow PCf(x,y) ] \\
 &\wedge \neg (\forall y) [ Q(x,y) \Rightarrow PCy ] \}
 \end{aligned}$$

2. Represent the following statement as a **Semantic Network**. " Meena was watching television when she heard a noise behind her, when she turned around she saw a rat running". **6M**





- (i) Which move should the first player choose? 3M
- (ii) Assuming that nodes are searched left-to-right using the alpha-beta pruning algorithm, which nodes would not be examined? 7M

b. Differentiate between the working of the Hill climbing technique and the Simulated Annealing technique. 5M

3.a. A Genetic algorithm is used to represent a travelling salesman problem where the salesman has to cover 6 cities, A, B, C, D, E, F where A is the starting point and G is the destination point, and each city is visited only once. Using this representation show the different steps involved in the GA process. Suggest a suitable evaluation function for the strings. 7M

b. Draw the state space representation and give a possible solution to the following problem with the following constraints.

4.a. A farmer, a wolf, a goat and grass would like to cross the river. The farmer can take only one person at a time and the wolf and goat cannot be left together and also the goat and grass cannot be left together. 10M

b. Discuss different areas where AI can be applied. 3M

\*\*\*\*\*ALL THE BEST\*\*\*\*\*





3. A Relational Probability Model (RPM) integrates the following two concepts  
\_\_\_\_\_ and \_\_\_\_\_.

2M

4. Draw a RPM to represent the fact “ A person’s blood type depends on the chromosome and chromosome depends on the chromosome inherited from his parents”. Remember that in humans and other complex organism’s one copy of each chromosome is inherited from each parent, and each chromosome exists in pairs.

4M



3. Given the expression  $P \rightarrow (Q \wedge R)$ , construct the truth table and write down if the form is a tautology, satisfiable or a contradiction with proper justification. 4M

4. Prove that  $P \rightarrow (Q \rightarrow R) \leftrightarrow (P \wedge Q) \rightarrow R$  using substitution. 4M