Register No: | | | | | | | | |

Sri Sivasubramaniya Nadar College of Engineering, Kalavakkam – 603 110

(An Autonomous Institution, Affiliated to Anna University, Chennai)

B.E. / B.Tech. End Semester Theory Examinations, Nov / Dec 2021

Fifth Semester

Computer Science and Engineering

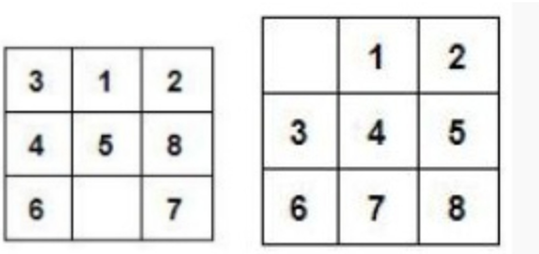
UCS1504 ARTIFICIAL INTELLIGENCE

(Regulations 2018)

Time: **Three Hours** | **Answer ALL Questions** | Maximum:**100 Marks**

K1: Remembering K2: Understanding K3: Applying K4 :Analyzing K5: Evaluating

PART – A (10 × 2 = 20 Marks)

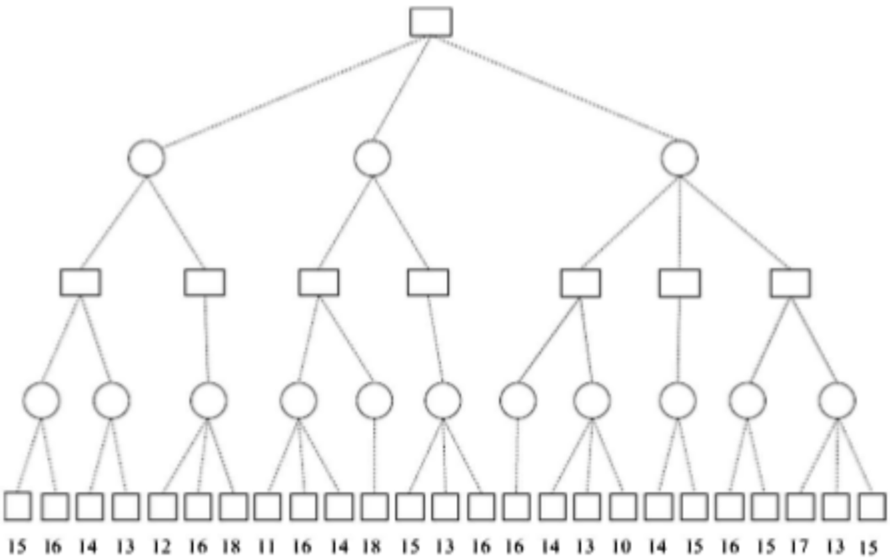
01.	K3	Compare the role of artificial intelligence in supermarket bar code scanners. and web search engines.	CO1
02.	K3	Differentiate between agent functions and agent programs.	CO1
03.	K1	State the elements necessary to formally define a search problem.	CO1
04.	K2	Find the number of steps taken by the greedy hill climbing search to go from the state shown on the left (A) to state shown on the right (B) where h(n) is the number of misplaced tiles in state S with respect to B  (A) (B)	CO1
05.	K2	Write logical formulas for the following sentences i. Horses, cows, and pigs are mammals ii. Every mammal has a parent.	CO2
06.	K3	Convert $(B \Rightarrow A) \wedge (C \wedge A \Rightarrow D) \wedge (A \wedge B \Rightarrow 0) \wedge (1 \Rightarrow D) \wedge (E \Rightarrow 0)$ to clausal form	CO2
07.	K1	Express conditional probabilitiy in terms of unconditional probabilities?	CO3

08.	K3	Let s be the proposition that a patient has a stiff neck and m the proposition that the patient has meningitis doctor knows that the disease meningitis causes the patient to have a stiff neck, say, 70% of the time. The doctor also knows some unconditional facts: the prior probability that a patient has meningitis is 1/50,000, and the prior probability that any patient has a stiff neck is 1%. Compute P(m|s)	CO3
09.	K2	Explain how a taxi driving agent might gradually learn about the traffic using unsupervised learning	CO4
10.	K1	Illustrate the importance of loss function in learning with an example.	CO4

PART – B (5 × 6 = 30 Marks)

11.	K2	With suitable example illustrate how goal based agents supports decision making.	CO1
12.	K3	Prove that if a heuristic is consistent, it must be admissible. Construct an admissible heuristic that is not consistent	CO1
13.	K2	Here are two sentences in the language of first-order logic: i. $\forall x \exists y (x \geq y)$ ii. $\exists y \forall x (x \geq y)$ Show that (i) logically entails (ii)	CO2
14.	K2	Consider two medical tests, A and B, for a virus. Test A is 95% effective at recognizing the virus when it is present, but has a 10% false positive rate (indicating that the virus is present, when it is not). Test B is 90% effective at recognizing the virus, but has a 5% false positive rate. The two tests use independent methods of identifying the virus. The virus is carried by 1% of all people. Ssppose that a person is tested for the virus using only one of the tests, and that test comes back positive for carrying the virus. Which test returning positive is more indicative of someone really carrying the virus? Justify your answer	CO3
15.	K2	Imagine you grow a very large, complex decision tree from a training set which contains many features (attributes). The training set accuracy for your tree is very high, but the test set accuracy (as measured on held out data) is very low. Explain why the accuracy on the training data could be so much higher than on the test data.	CO4

PART – C (5 × 10 = 50 Marks)

16.	K2	Explain the difference between model based utility agent and model based reflex agent with suitable illustrations	CO1
		OR	
17.	K2	Describe in detail the properties of task environment	CO1
18.	K2	Show how Alpha-Beta pruning explores following game tree, searching from left to right. a. Mark the leaves that are inspected. b. Show the subtrees that are pruned. c. Show the move that Alpha-Beta will choose for MAX at the root. 	CO1
		OR	
19.	K2	Consider a state space where the start state is numbered 1 and each state k has two Successors: numbered 2k and 2k + 1. i. Draw the portion of the state space for states 1 to 15. ii. Suppose the goal state is 11. List the order in which nodes will be visited for breadth first search, depth-limited search with limit 3, and iterative deepening search. iii. How well would bidirectional search work on this problem? What is the branching factor in each direction of the bidirectional search?	CO1

<table>
<tr><td>20.</td><td>K3</td><td>Consider the following sentence:
[(Food ⇒ Party) ∨ (Drinks ⇒ Party)] ⇒ [(Food ∧ Drinks) ⇒ Party].
i. Determine, whether this sentence is valid,
ii. Convert the sentence into CNF, showing each step,
iii.Prove the validity using resolution.</td><td>CO2</td></tr>
<tr><td colspan="4">OR</td></tr>
<tr><td>21.</td><td>K3</td><td>Suppose you are given the following axioms:
1. $0 \leq 3$.
2. $7 \leq 9$.
3. $\forall x\ x \leq x$.
4. $\forall x\ x \leq x + 0$.
5. $\forall x\ x + 0 \leq x$.
6. $\forall\ x, y\ x + y \leq y + x$.
7. $\forall\ w, x, y, z\ w \leq y \wedge x \leq z \Rightarrow w + x \leq y + z$.
8. $\forall\ x, y, z\ x \leq y \wedge y \leq z \Rightarrow x \leq z$
Give a backward-chaining proof of the sentence $7 \leq 3 + 9$.</td><td>CO2</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>22.</td><td>K3</td><td>As Nambi approaches his home, he finds that the smoke alarm is sounding. Was there fire in his home or was the alarm triggered by an earthquake? He turns on radio and hears that there was an earthquake. The random variables and their conditional dependencies are shown in the Bayes Net. The probabilities of fire and earthquake are given as P(F=1) = 0.01 and P(E=1) = 0.000001. Calculate the probabilities P(F = 1|A = 1) and P(F = 1|A = 1,R = 1)

E= Earthquake F= Fire

R = Radio A = Alarm
<table><tr><td>E</td><td>R=1</td></tr><tr><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td></tr></table>
<table><tr><td>F</td><td>E</td><td>A = 1</td></tr><tr><td>0</td><td>0</td><td>0.0001</td></tr><tr><td>0</td><td>1</td><td>0.99</td></tr><tr><td>1</td><td>0</td><td>0.99</td></tr><tr><td>1</td><td>1</td><td>0.9999</td></tr></table></td><td>CO3</td></tr>
</table>

OR			
23.	K3	Consider the problem of predicting a coin flip on the basis of several previous observations. Imagine that you observe three coin flips, and they all come up heads. You must now make a prediction about the (distribution of the) outcome of a fourth flip. i. What is the maximum likelihood estimate for the probability that the fourth flip will be heads ii. Draw a Bayes' net which expresses the assumptions that a single coin is chosen, then the flip outcomes are indentically distributed and conditionally independent given the coin type. Your network should include a node for the unobserved fourth flip	CO3
24.	K3	You are given 8 examples each characterised by three features and output class. Calculate the information gain of each of the three features. Which feature should be chosen as the root of the decision tree?	CO4

F1	F2	F3	y
A	C	H	+
A	D	G	+
A	C	G	-
A	D	G	+
B	D	H	-
B	D	H	-
B	C	H	+
B	C	G	-

OR

<table>
<tr>
<td>25.</td>
<td>K3</td>
<td>Consider you have been hired to build a quality control system to decide whether car engines coming off an assembly line are bad or good. However, this decision must be based on three noisy boolean observations: the engine may be wobbly (motion sensor- W), rumbly (sound sensor- R), or hot (heat sensor- H). Each sensor gives a Boolean observation: true or false.
<table>
<tr><td>B</td><td>W</td><td>R</td><td>H</td></tr>
<tr><td>Good</td><td>False</td><td>False</td><td>true</td></tr>
<tr><td>Good</td><td>False</td><td>true</td><td>False</td></tr>
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<tr><td>Good</td><td>False</td><td>False</td><td>False</td></tr>
<tr><td>bad</td><td>true</td><td>False</td><td>False</td></tr>
<tr><td>bad</td><td>true</td><td>true</td><td>False</td></tr>
<tr><td>bad</td><td>False</td><td>true</td><td>true</td></tr>
</table>
B ∈ {bad, ok} Evidence: W, R, H ∈ {true, false}. The company has records for several engines which recently came off the assembly line: Suppose you are given an observation of a new engine: W=false, R=true, H=false. What prediction would your naive Bayes classifier make: bad or good</td>
<td>CO4</td>
</tr>
</table>

Course Outcomes:

CO1 – Identify, Formulate, Understand and solve AI problems using search techniques (K3)
CO2 – Elucidate the concept of knowledge representation and inference using logics (K2)
CO3 - Elucidate the concept of knowledge representation under uncertainty (K3)
CO4 - Elucidate the concept of Learning in AI applications
CO5 – Implement various search, inference and learning algorithms in AI (k4)