Roll No.													

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Sem & AY: Odd Sem. 2019-20
Course Code: CSE 308
Course Name: ARTIFICIAL INTELLIGENCE
Program & Sem: B.Tech (CSE) & V DE

Date: 27th Sep 2019
Time: 11:00AM to12:00PM
Max Marks: 40
Weightage: 20%

Instructions:
(i) Answer ALL questions.

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries two marks. (5x2M=10M)

1. Discuss any two applications of Artificial Intelligence (C.O.NO. 1) [Knowledge]
2. Represent P → Q without the connective (→) and draw Venn Diagram for it. (C.O.NO. 2) [Comprehension]
3. Draw a Conceptual Graph for statement- "*John, Jack and James are brothers*". What is the arity of the graph (C.O.NO. 1) [Comprehension]
4. Define Horn clause with an example (C.O.NO. 2) [Knowledge]
5. Convert the given sentence to first order logic:
   "There are exactly two green apples"
   (C.O.NO. 2) [Comprehension]

Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries five marks. (4x5M=20M)

6. Explain the Knowledge Base Systems detailed architecture with the help of an example and appropriate diagram. (C.O.NO. 1) [Comprehension]

7. *"A frame is a data structure for representing stereotypical knowledge of some concept"* Illustrate with an example a class frame and instance frame.

(C.O.NO. 1) [Comprehension]

8. Can we change the order of Existential and Universal Quantifiers in FOL? Justify your answer with an example each. (C.O.NO. 2) [Comprehension]

9. Given Premises : $\begin{cases} \sim A \rightarrow (C \rightarrow D) \\ A \rightarrow B \\ \sim B \end{cases}$ (C.O.NO. 2) [Application]

   Prove: C

Part C [Problem Solving Questions]

Answer the Question. The Question carries ten marks. **(1x10M=10M)**

10. Convert the following to prepositional logic and prove the conclusion. Specify the inference rules used.

    "If the teens like it, then the sales volume will go up; Either the teens like it or the store will close; The sales volume will not go up. Therefore, the store will close."

    (C.O.NO. 2) [Application]

SCHOOL OF ENGINEERING

Semester: V

Course Code: CSE 308

Course Name: Artificial Intelligence

Date: 27th Sep 2019

Time: 1 Hour

Max Marks: 40

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	A	
1,3	CO 1	**Module 1**	2	2		4
6,7	CO 1	Module 1		5 5		10
11	CO 1	Module 1		10		10
2,4,5	CO 2	Module 2	2	2 2		6
8,9,10	CO 2	**Module 2**		5	5 5	15
12	CO2	Module 2			10	10
	Total Marks		4	24 7	15 5	55

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

[I hereby certify that All the questions are set as per the above guide lines. Dr. Smitha Rao]

Reviewers' Comments

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

SOLUTION

Semester: V

Course Code: CSE 308

Course Name: Artificial Intelligence

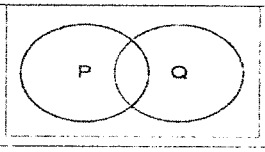
Date: 27-09-2019

Time: 1 Hour

Max Marks: 40

Weightage: 20%

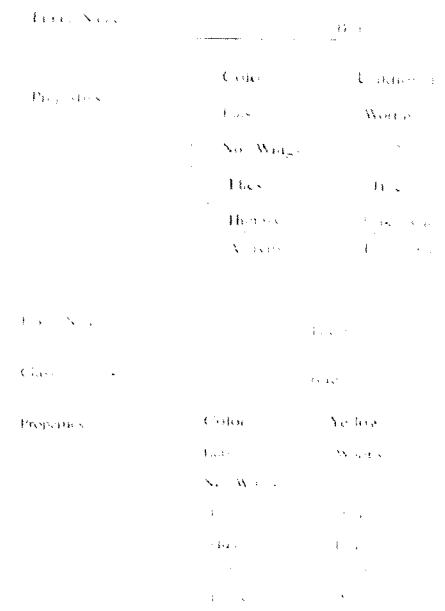
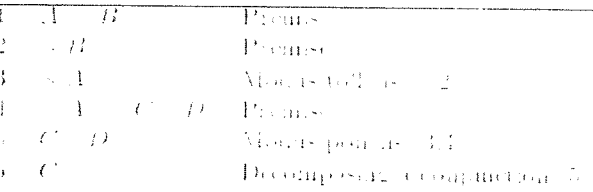
Part A (2 x 5 = 10 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	Any two applications of AI	Each Application if proper 1 mark	4 min
2	 $\neg pVq$,	Representation $\neg pVq$, carries 1 mark and proper Venn diagram carries 1 mark	4 min
3	Arity 3	Arity carries 1 mark and correct diagram carries 1 mark	4 min
4	A Horn clause is a clause (a disjunction of literals) with at most one positive, i.e. unnegated, literal. Ex. $P_1 \wedge P_2 \Rightarrow Q$ or $\neg P_1 \vee \neg P_2 \vee Q$ etc.	Proper definition carries 1 mark and proper example carries 1 mark	4 min

5	∃x ∃y apple(x) ∧ green(x) ∧ apple(y) ∧ green(y) ^ ¬(x=y) ∧ ∀z (apple(z) ∧ green(z)) → ((x=z) ∨ (y=z))	∃x ∃y apple(x) ∧ green(x) ∧ apple(y) ∧ green(y) ^ ¬(x=y) ∧ ∀z (apple(z) ∧ green(z)) Carries 1 mark → ((x=z) ∨ (y=z)) carries 1 mark	4 min

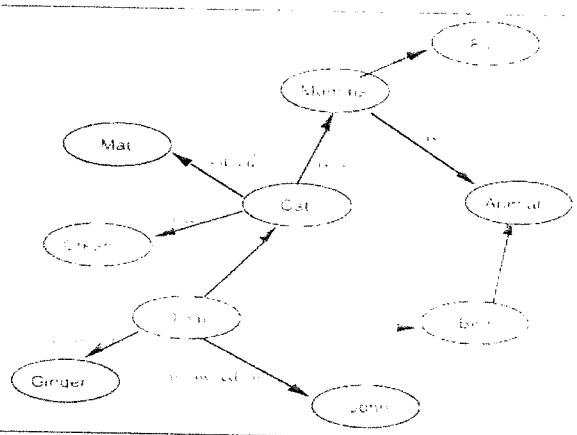
Part B

(4 x 5 = 20 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
6	KBS architecture diagram , explanation and example	Proper Diagram carries 2 marks Proper Explanation carries 2 marks Proper Example carries 1 mark	6 min
7	 Or any other proper frame structures	Example of class frame carries 2.5 marks and example of instance frame carries 2.5 marks	6 min
8	No. Switching the order of universals and existentials ***does*** change meaning: Example: • Everyone likes someone: • (∀x)(∃y) likes(x,y) • Someone is liked by everyone: • (∃y)(∀x) likes(x,y)	No carries 1 mark 2 marks	6 min
9		Each step carries 1 marks	6 min

10	Yes it's a tautology P | Q | P ∧ (P->Q) | ~(~P V ~Q) | (P^(P→ Q))←→ (¬ (¬ PV¬ Q)) F | F | | | T F | T | | | T T | F | | | T T | T | T | T | T	Answer carries 2 marks 3 marks for truth table for each component	6 min

Part C (1 x 10 =10 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
11		Each eclipse carries 1 mark	15 min
12	a. The argument is translated as follows: $T \rightarrow S$ $T \vee C$ $\neg S$ --- C The inference rules used are: From ($T \rightarrow S$) and $\neg S$ by modus tollens we deduce $\neg T$ From $\neg T$ and ($T \vee C$) by disjunctive syllogism we conclude C.	Conversion to Prepositional Logic carries 5 marks Each usage inference rules for simplification carries 2.5 marks	15 min

Roll No.													

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST – 2

Sem & AY: Odd Sem 2019-20 | **Date**: 16.11.2019

Course Code: CSE 308 | **Time**: 11:00 AM to 12:00 PM

Course Name: ARTIFICIAL INTELLIGENCE | **Max Marks**: 40

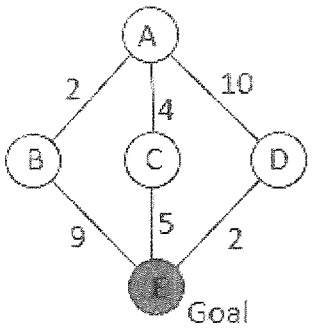
Program & Sem: B.Tech. & V | **Weightage**: 20%

Instructions: *Read questions carefully and answer all*

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries four marks **(5Qx4M=20M)**

1. What is meant by a Well Defined Problem? Explain with a suitable example. (C.O.NO.1) [Knowledge]
2. How are search algorithms classified? Give two examples under each category. Briefly explain the difference between Greedy search and A* search algorithms. (C.O.NO.3) [Knowledge]
3. Briefly explain Uniform-cost search algorithm? What is its disadvantage? Apply Uniform-cost search algorithm and find the cheapest path. (C.O.NO.2) [Knowledge]



4. What are the techniques used for optimizing backtracking? Explain any two with an example (C.O.NO.3) [Knowledge]
5. What is Bayes Rule? Mention product rule and arrive at its equation. (C.O.NO.1) [Knowledge]

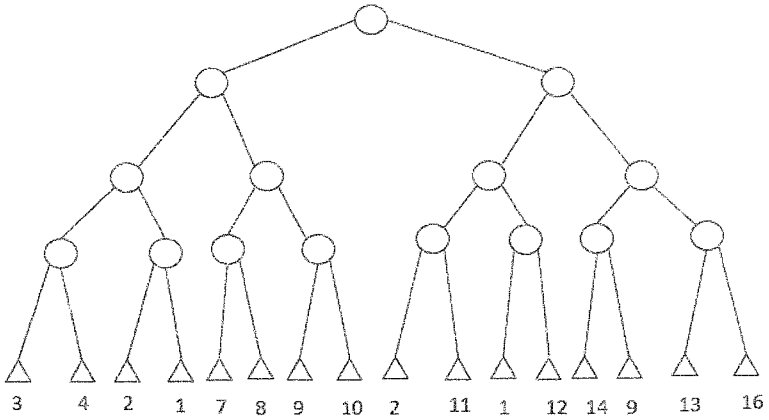
Part B [Thought Provoking Questions]

Answer both the Questions. Each Question carries five marks. (2Qx5M=10M)

6. What is an constraint satisfaction problem? Give two examples. Mention the constraint kind, variables and the constraint statements for the following cryptarthmetic puzzle: (C.O.NO.3)[Knowledge]

```
  S E N D
  M O R E
+.........
M O N E Y
.........
```

7. Given the following search tree, apply the alpha-beta pruning algorithm to it and show the search tree that would be built by this algorithm. Make sure that you show where the alpha and beta cuts are applied and which parts of the search tree are pruned as a result. (C.O.NO.2) [Knowledge]



Part C [Problem Solving Questions]

Answer the Question. The Question carry ten marks. (1Qx10M=10M)

8. You are given two jugs, a 4-gallon one and a 3-gallon one. Neither has any measuring mark on it. There is a pump that can be used to fill the jugs with water. How can you get exactly 2 gallons of water into the 4-gallon jug?
   Mention the state space, production rules and the rules used to arrive at the solution. (C.O.NO.2) [Application]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: ODD
Course Code: CSE 308
Course Name: Artificial Intelligence

Date: 16/11/19
Time: 1 Hour
Max Marks: 40
Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K			C			A			
1	1	3	*									4
2	3	3		*								4
3	2	3							*			4
4	3	3				*						4
5	1	3	*									4
6	3	3					*					5
7	2	3								*		5
8	2	3									*	10
	Total Marks		8	4		4	5		4	5	10	40

K =Knowledge Level C = Comprehension Level, A = Application Level

marks to be entered on the column.

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines. [Prof. Manish Bali]

Annexure- II: Format of Answer Scheme

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

SOLUTION

Semester: ODD

Course Code: CSE 308

Course Name: **Artificial Intelligence**

Date: 16/11/2019

Time: 1 Hour

Max Marks: 40

Weightage: 20%

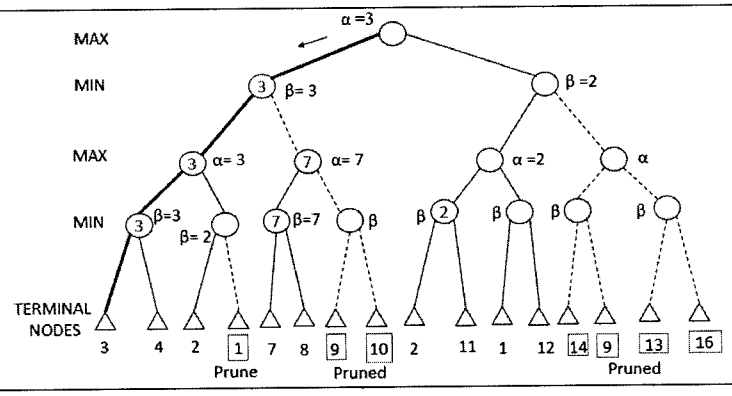
Part A (5 x 4 = 20)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	A problem can be defined formally by **five** components: 1.The ***initial state*** that the agent starts in. E.g. *In*(Bangalore). 2.A description of the possible ***actions*** available to the agent. E.g. from the state ***In***(Bangalore), the applicable actions are ----- {**Go**(Hosur), **Go**(Kunigal), **Go**(Kolar)} 3.A description of what each action does; the formal name for this is the ***transition model*** E.g. **RESULT** (In(Bangalore), Go(Hosur)) = In(Hosur) 4.The **goal test**, which determines whether a given state is a goal state. E.g. The agent's goal in Karnataka is the singleton set {In(Mysore)}. 5. A **path cost** function that assigns a numeric cost to each path. The problem-solving agent chooses a cost function that reflects its own	2+2	4 mins

	performance measure. E.g. The step costs for Karnataka are route distances.		
2	***Uninformed Search Algorithms***—algorithms that are given no information about the problem other than its definition. Although some of these algorithms can solve any solvable problem, none of them can do so efficiently Eg: Uniform-cost search, DFS, BFS ***Informed Search Algorithms***, on the other hand, can do quite well given some guidance on where to look for solutions E.g.: Greedy First search, A* search	2+2	4 mins
3	Uniform-cost search is a searching algorithm used for traversing a weighted tree or graph. This algorithm comes into play when a different cost is available for each edge. The primary goal of the uniform-cost search is to find a path to the goal node which has the lowest cumulative cost. **Disadvantage**: It does not care about the number of steps involve in searching and only concerned about path cost. Due to which this algorithm may be stuck in an infinite loop. **Optimal path**: ACE	2+1+1	4 mins
4	**Degree heuristic**: assign a value to the variable that is involved in the largest number of constraints on other unassigned variables. **Minimum remaining values (MRV):** choose the variable with the fewest possible values. **Least-constraining value heuristic**: choose a value that rules out the smallest number of values in variables connected to the current variable by constraints. **Forward Checking:** Keep track of all permissible values for variables	3+1	4 mins
5	Bayes rule: $P(cause \mid effect) = \frac{P(effect \mid cause)P(cause)}{P(effect)}$ Rearranging 2 parts of product rule: $P(a \wedge b) = P(a \mid b)P(b) = P(b \mid a)P(a)$ $P(a \mid b)P(b) = P(b \mid a)P(a)$	2+2	4 mins

	$P(a \mid b) = \frac{P(b \mid a)P(a)}{P(b)}$		

Part B (2 x 5 = 20 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
6	A constraint satisfaction problem is defined mathematically as a set of variables, a set of domains for each variable, and a set of constraints that limit which values in each domain are a valid assignment for each variable. E.g. Sudoko, n-queens, Cryptarthmetic AllDiff(S,E,N,D,M,O,R,Y) - D+E=Y+10*C10 - C10+N+R= E+10*C100 - C100+E+O=N+10*C1000 - C1000+S+M=O+10*C10000 - C10000=M	2.5+2.5	5 mins
7		Alpha Beta cuts- 3 Pruning- 2	5 mins

Part C (1 x 10 = 10 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
8	The state space for this problem can be described as the set of ordered pairs of integers **(x,y)** Where, X represents the quantity of water in the 4-gallon jug **X= 0,1,2,3,4** Y represents the quantity of water in 3-gallon jug **Y=0,1,2,3** **Start State: (0,0)** **Goal State: (2,0)** Generate production rules for the water jug problem **Production Rules:** **Rule** | **State** | **Process**	2+3+5	15 mins

1	(X,Y | X<4)	(4,Y) {Fill 4-gallon jug}
2	(X,Y |Y<3)	(X,3) {Fill 3-gallon jug}
3	(X,Y |X>0)	(0,Y) {Empty 4-gallon jug}
4	(X,Y | Y>0)	(X,0) {Empty 3-gallon jug}
5	(X,Y | X+Y>=4 ^ Y>0)	(4,Y-(4-X)) {Pour water from 3-gallon jug into 4-gallon jug until 4-gallon jug is full}
6	(X,Y | X+Y>=3 ^X>0)	(X-(3-Y),3) {Pour water from 4-gallon jug into 3-gallon jug until 3-gallon jug is full}
7	(X,Y | X+Y<=4 ^Y>0)	(X+Y,0) {Pour all water from 3-gallon jug into 4-gallon jug}
8	(X,Y | X+Y <=3^ X>0)	(0,X+Y) {Pour all water from 4-gallon jug into 3-gallon jug}
9	(0,2)	(2,0) {Pour 2 gallon water from 3 gallon jug into 4 gallon jug}

Initialization:
Start State: (0,0)
Apply Rule 2:
(X,Y | Y<3) -> (X,3)
{Fill 3-gallon jug}
Now the state is **(X,3)**

Iteration 1:
Current State: **(X,3)**
Apply Rule 7:
(X,Y | X+Y<=4 ^Y>0) (X+Y,0)
{Pour all water from 3-gallon jug into 4-gallon jug}
Now the state is **(3,0)**

Iteration 2:
Current State : **(3,0)**
Apply Rule 2:
(X,Y | Y<3) -> (3,3)
{Fill 3-gallon jug}
Now the state is **(3,3)**

Iteration 3:
Current State:**(3,3)**
Apply Rule 5:

(X,Y | X+Y>=4 ^ Y>0)	(4,Y-(4-X)) {Pour water from 3-gallon jug into 4-gallon jug until 4-gallon jug is full}

Now the state is **(4,2)**

Iteration 4:
Current State : (4,2)
Apply Rule 3:

(X,Y | X>0)	(0,Y) {Empty 4-gallon jug}

Now state is (0,2)

Iteration 5:
Current State : (0,2)
Apply Rule 9:

(0,2)	(2,0) {Pour 2 gallon water from 3 gallon jug into 4 gallon jug}

Now the state is **(2,0)**

Goal Achieved.

Roll No												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 2020
Course Code: CSE 308
Course Name: ARTIFICIAL INTELLIGENCE
Program & Sem:BTech (CSE) & V (DE-I)

Date: 20 December 2019
Time: 9:30 AM to 12:30 PM
Max Marks: 80
Weightage: 40%

Instructions:
(i) Read all the questions carefully and answer accordingly.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 1 mark. (15Qx1M=15M)

1.

a) ----------is an application of Artificial Intelligence (C.O.No.1) [Knowledge]

b). ----------is a computer program that reasons and uses a knowledge base to solve complex problems (C.O.No.1) [Knowledge]

c) ----------is a method of Knowledge representation using a graph made up of nodes and arcs where the nodes represents objects and arcs the relationship between the objects (C.O.No.1) [Knowledge]

d) A valid sentence or tautology is a sentence that is ---------- under all interpretations (C.O.No.2) [Knowledge]

e) A _____ clause is a clause (a disjunction of literals) with at most one positive, i.e. unnegated, literal (C.O.No.2) [Knowledge]

f) "Every elephant is gray": $\forall x\ Elephant(x) \rightarrow$ _____ (C.O.No.2) [Knowledge]

g) (p ∧ p->q)-> q is an inference rule which is known as ---------- (C.O.No.2) [Knowledge]

h) (p v q) ∧ (¬ p v r) - -> ----------is the inference result after applying resolution. (C.O.No.2) [Knowledge]

i) In searching----------is a test, which determines whether a given state is a goal state. (C.O.No.3) [Knowledge]

j). ----------is an example of constraint satisfaction problem (C.O.No.3) [Knowledge]

k). ----------is an example of an uninformed search algorithm that are given with no information about the problem other than its definition (C.O.No.3) [Knowledge]

l). ----------is an HMM problem which can be solved using Viterbi algorithm. (C.O.No.3) [Knowledge]

m) ----------is an application of machine learning (C.O.No.4) [Knowledge]

n) A ---------- is a decision support tool that uses a tree-like graph or model of decisions and their possible consequences, including chance event outcomes, resource costs, and utility (C.O.No.4) [Knowledge]

o) Classification and regression are types of ----------machine learning algorithms (C.O.No.4) [Knowledge]

Answer all the Questions. Each Question carries 2.5 marks (2Qx2.5M=5M)

2. Write short notes on Knowledge Base System with diagram (C.O.No.1) [Knowledge]
3. A* is an informed search algorithm. Briefly explain the algorithm with an example (C.O.No.3) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 10 marks. (3Qx10M=30M)

4. " *Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed* " Identify the two important categories of machine learning algorithms and explain them with examples [10M] (C.O.No.4)[Knowledge]

5. a) *" Logical inference is used to create new sentences that logically follow from a given set of sentences in Knowledge base"*
   1.It is not sunny this afternoon and it is colder than yesterday.
   2.If we go swimming it is sunny.
   3.If we do not go swimming then we will take a canoe trip.
   4.If we take a canoe trip then we will be home by sunset.
   Convert the above statements into prepositions and apply and specify the inference rules and prove that " we will be home by sunset".
   [5M] [C.O.No.2] [Comprehension]

   b) Suppose that a doctor knows that Glaucoma causes blindness in 40% of cases. She also knows that the probability in the general population of someone having blindness at any time is 1 / 10.She also has to know the incidence of Glaucoma in the population (1/ 40000).Help the doctor to find out the probability that the patient has Glaucoma.
   [5M] [C.O.No.3] [Comprehension]

6. a) " Amazon Alexa is a versatile digital assistant that answers questions and performs all sorts of tasks, Alexa can understand the natural language." Identify the technology behind this and briefly explain the steps/algorithms involved in that processing.
   [5M][C.O.No.4][Knowledge]

   b) "Classification is a supervised learning approach in which the computer program learns from the data input given to it and then uses this learning to classify new observation". Write short notes on any one classification algorithm.
   [5M][C.O.No.4] [Knowledge]

Part C [Problem Solving Questions]

Answer all the Questions. Each Question carries 15 marks. **(2Qx15M=30M)**

7. a) Define HMM by giving the formal definition, assumptions and examples

[5M](C.O.No.3) [Knowledge]

b) " *A Markov process is a stochastic process that satisfies the Markov property*

".Using the below state transition probability matrix (Table 1), draw the state diagram and find out the probability that next seven days will be " foggy – sunny – rainy - rainy-foggy-foggy-sunny" when today is sunny.

[10M](C.O.No.3) [Application]

TABLE 1

		Tomorrow		
T o d a y		S	F	R
	S	0.5	0.2	0.3
	F	0.2	0.7	0.1
	R	0.75	0.15	0.1

S- Sunny , F – Foggy , R- Rainy

8. a) Explain briefly about the techniques for optimizing the backtracking search

[5 M](C.O.No.3) [Knowledge]

b) Solve the following Game Tree (Fig. 1) using Alpha Beta Pruning and specify the values of Alpha and Beta of each nodes and show the pruned branches clearly

[10M](C.O.No.3) [Application]

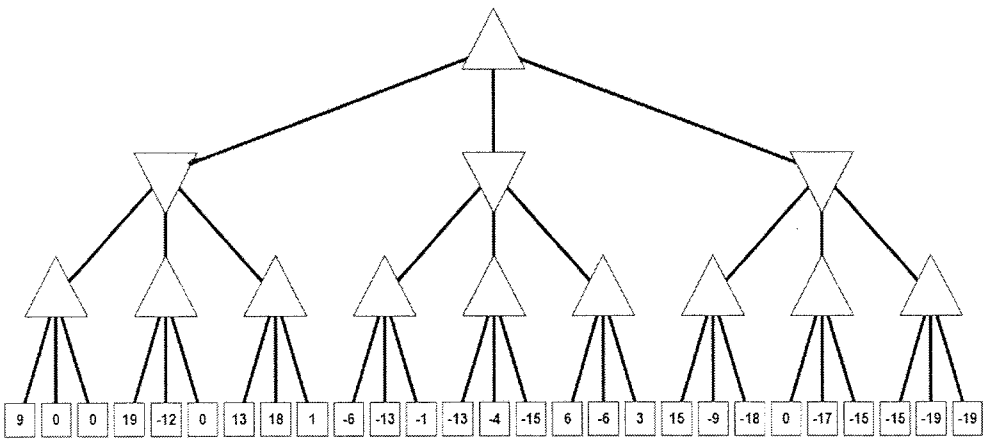


FIG. 1

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO (% age of CO)	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	A	
1	CO1,2, 3,4	1,2,3,4	20			20
2	CO4	4	10			10
3	CO2.CO3	2,3		10		10
4	CO4	4	10			10
5	CO4	4			15	15
6	CO3	3			15	15
	Total Marks		40	10	30	80

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature:

Reviewer Commend:

Format of Answer Scheme

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SOLUTION

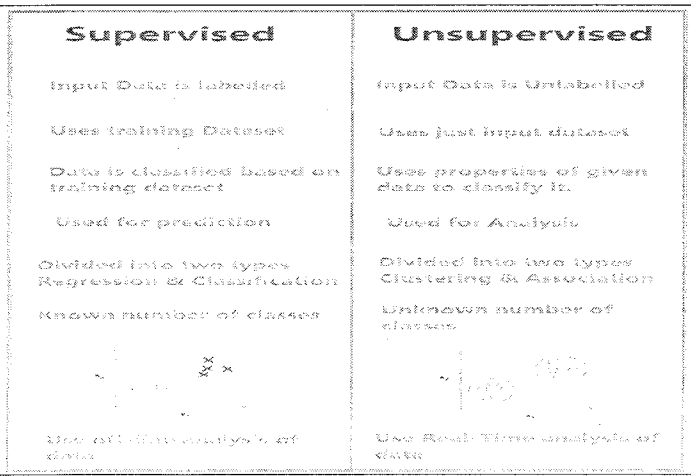
Semester: Odd Sem. 2019-20
Course Code: CSE 308
Course Name:Artificial Intelligence
Program & Sem:BTech,5th Sem

Date: 20.12.2019
Time: 3 HRS
Max Marks: 80
Weightage: 40%

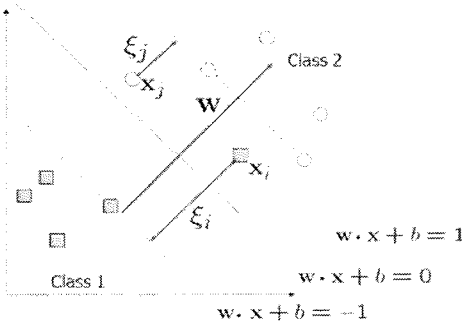
Part A (20Qx1M=20 marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	a-Deep Blue, b- KBS,c- Semantic network,d- true,e-Horn clause,f-gray(x),g-Modus Ponens,h- qvr,i-Goal test,j- map colouring problem,k-BFS/DFS/UCS,l-decoding,m-spam detection or any other application ,n-decision tree,o-supervised algorithms , p- Knowledge q-User Interface r- A* s- Machine Learning t- Dimension Reduction	**1 marks each**	**40 minutes**

Part B (3Q x 10M =30 Marks

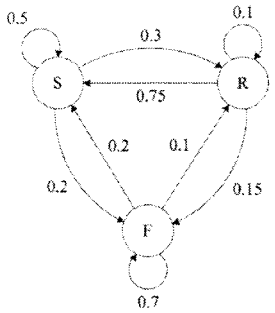
Q No	Solution	Scheme of Marking	Max. Time required for each Question
4		Supervised – 5 marks Unsupervised- 5 marks	25 minutes

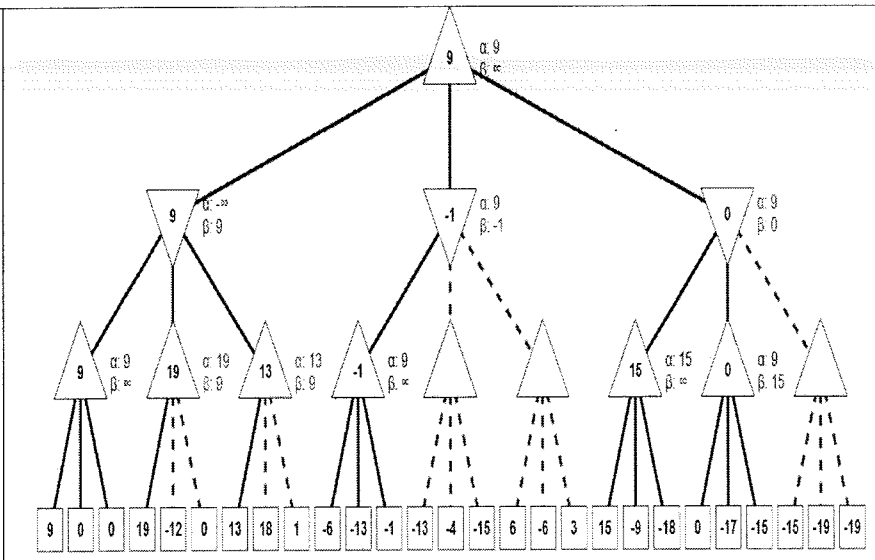
3	a) | Step | Reason | | --- | --- | | 1. $\neg p \wedge q$ | Hypothesis | | 2. $\neg p$ | Simplification using (1) | | 3. $r \rightarrow p$ | Hypothesis | | 4. $\neg r$ | Modus tollens using (2) and (3) | | 5. $\neg r \rightarrow s$ | Hypothesis | | 6. s | Modus ponens using (4) and (5) | | 7. $s \rightarrow t$ | Hypothesis | | 8. t | Modus ponens using (6) and (7) | b) P(b/G)=.4 P(b)=.1 P(G)=0.000025 P(G/b)=(P(b/G)xP(G))/P(b)=0.4x.000025/0.1=0.0001=1/10000	a) Prepositions- 1 mark Inference rules- 4marks b) Bayes – 5 marks	25 minutes
4 a)	• The application of computational techniques to the analysis and synthesis of natural language and speech. • **Natural Language Processing** or NLP is a field of Artificial Intelligence that gives the machines the ability to read, understand and derive meaning from human languages. • It is a discipline that focuses on the interaction between data science and human language, and is scaling to lots of industries. • Ex : Amazon's Alexa and Apple's Siri are examples of intelligent **voice driven interfaces** that use NLP to respond to vocal prompts • **Bag of Words** • Is a commonly used model that allows you to count all words in a piece of text. • Basically it creates an occurrence matrix for the sentence or document, disregarding grammar and word order. • These word frequencies or occurrences are then used as features for training a classifier. • **Tokenization** • Is the process of segmenting running text into sentences and words. • In essence, it's the task of cutting a text into pieces called *tokens*, and at the same time throwing away certain characters, such as punctuation. • **Stemming** • The process of slicing the end or the beginning of words with the intention of removing affixes • **Lemmatization** • Reducing a word to its base form and grouping together different forms of the same word	NLP definition -2.5 Steps-2.5	15 minutes

6b)	• *A Support Vector Machine (SVM) is a discriminative classifier formally defined by a separating hyperplane.* • *Given labeled training data (*supervised learning*), the algorithm outputs an optimal hyperplane which categorizes new examples.* *In two dimentional space this hyperplane is a line dividing a plane in two parts where in each class lay in either side.* 	Short notes – 5 marks	10 minutes

Part C (2Q x 15M = 30Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
7a)	Notation: $\lambda = (A, B, \Pi)$ (1) N: Number of states (2) M: Number of symbols observable in states $V = \{v_1, \cdots, v_M\}$ (3) A: State transition probability distribution $A = \{a_{ij}\}, \quad 1 \le i, j \le N$ (4) B: Observation symbol probability distribution $B = \{b_j(v_k)\}, \quad 1 \le i \le N, 1 \le j \le M$ (5) Π: Initial state distribution $\pi_i = P(q_1 = i), \quad 1 \le i \le N$ • **Markov assumption:** the state transition depends only on the origin and destination • **Output-independent assumption:** all observation frames are dependent on the state that generated them, not on neighbouring observation frames	HMM-5 marks Markov-10(5-transition diagram,5-solution)	15 minutes
7b)	**foggy-sunny-rainy-rainy-foggy-foggy-sunny**		20 minutes

	 **P(s)xP(f/s)xP(s/f)xP(r/s)xp(r/r)xP(f/r)xP(f/f)XP(s/f)** **=1x0.2x0.2x0.3x0.1x0.15x0.7x0.2=.0000252**		
8a)	**Degree heuristic**: assign a value to the variable that is involved in the largest number of constraints on other unassigned variables. **Minimum remaining values (MRV):** choose the variable with the fewest possible values. **Least-constraining value heuristic**: choose a value that rules out the smallest number of values in variables connected to the current variable by constraints. **Forward Checking:** Keep track of all permissible values for variables	5 marks(listing 1 mark,expln-4 marks)	10 minutes

8 b		Solution with alpha and beta values - 5 marks Pruning-5 marks	20 minutes