



PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – May / June 2026

Date: 30-05-2026

Time: 09:30 am – 12:30 pm

School: SOCSE	Program: CBC, CBD, CDV, COM, CSD, CSE, CSG, CSI, CSN, IST	
Course Code: CSE2264	Course Name: Essentials of AI	
Semester: IV	Max Marks: 100	Weightage: 50%

CO - Levels	CO1	CO2	CO3	CO4	CO5
Marks	20	20	20	20	20

Instructions:

- (i) Read all questions carefully and answer accordingly.
- (ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks.

10Q x 2M=20M

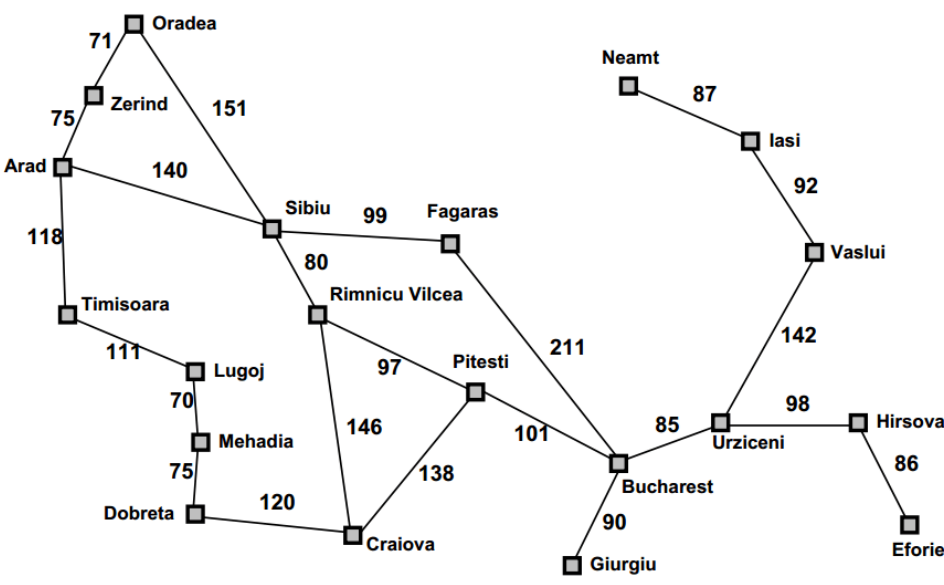
1.	State the name of the data structure used to keep track of the frontier in Breadth First Search.	2 Marks	L1	CO1
2.	State the term for the set of unvisited neighbours in an uninformed search algorithm.	2 Marks	L1	CO1
3.	Write down the recurrence for Alpha-Beta pruning of a game tree when we have maximum pruning . The tree has a branching factor of b and we explore up to a height of m.	2 Marks	L1	CO2
4.	Compute the value of $f(x)$ after 1 iteration of gradient descent, where $f(x) = x^2$, learning rate = 0.2, and $x_0 = 3$.	2 Marks	L1	CO2
5.	State the full forms of CNF and DNF in the context of logic.	2 Marks	L1	CO3
6.	If we have 2 clauses, namely $C1 = (A \vee B)$ and $C2 = (\sim B \vee C)$, state the clause which we infer using propositional resolution on the clauses C1 and C2. Here, the symbol " $\vee$ " represents a disjunction and the symbol " $\sim$ " represents negation.	2 Marks	L1	CO3

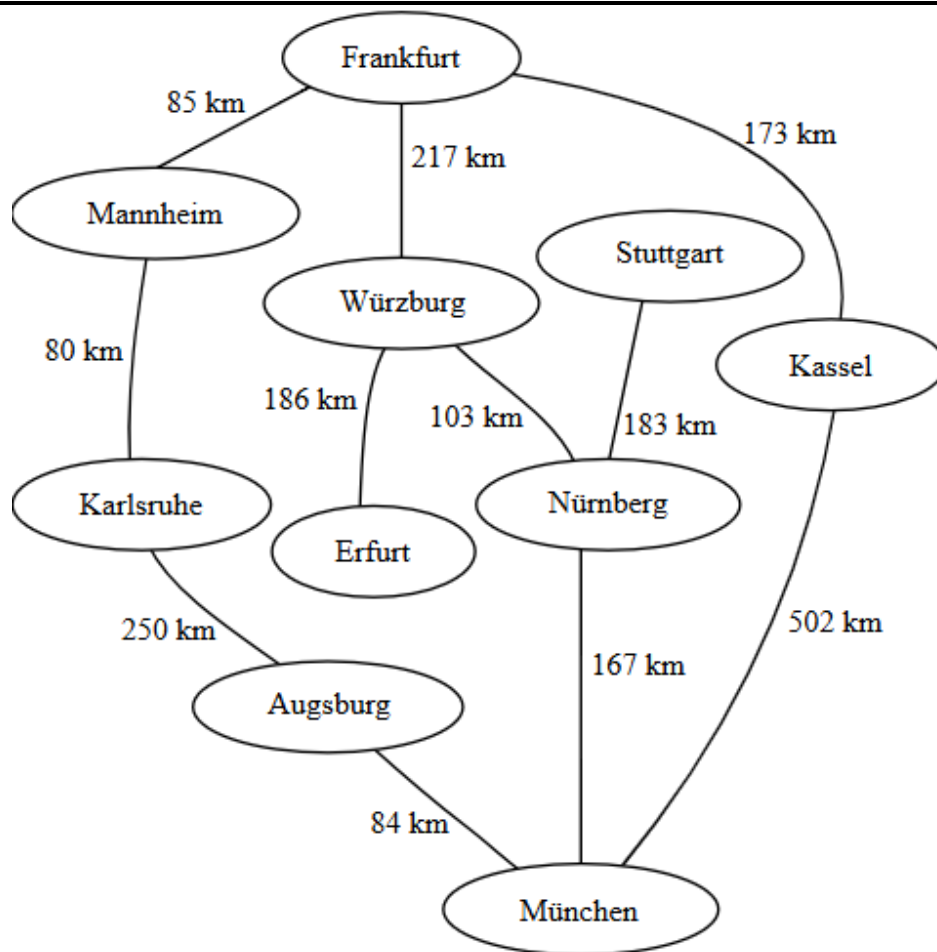
7.	State the time complexity of the Viterbi algorithm. Consider that we tag a sequence of N observations, with a tag from a set of T tags.	2 Marks	L1	C04
8.	The Viterbi Algorithm has 3 types of probabilities. Two of them are the transition and initial probability. State the third.	2 Marks	L1	C04
9.	Recall the definition of a confusion matrix. A confusion matrix is an N*N matrix, C, where $C[i][j]$ denotes the number of times the classifier classified an instance belonging to class i as one of class j. Based on this, state the expression for the value of the recall for class i.	2 Marks	L1	C05
10.	State true or false. The softmax function receives a vector as input and returns a probability distribution.	2 Marks	L1	C05

Part B

Answer the Questions.

Total Marks 80M

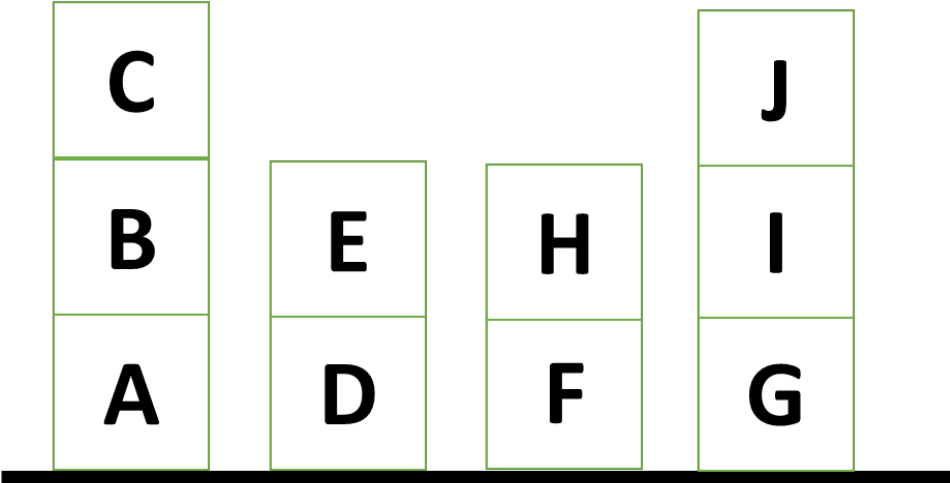
11.	Consider the below map of Romania and perform weighted A* Search ($w = 3$) for finding the Shortest Path TO Bucharest from each of the following nodes – Drobeta, Eforie, Neamt, and Oradea .	16 Marks	L2	C01																																										
Romania with step costs in km <table><tr><th colspan="2">Straight-line distance to Bucharest</th></tr><tr><td>Arad</td><td>366</td></tr><tr><td>Bucharest</td><td>0</td></tr><tr><td>Craiova</td><td>160</td></tr><tr><td>Dobreta</td><td>242</td></tr><tr><td>Eforie</td><td>161</td></tr><tr><td>Fagaras</td><td>178</td></tr><tr><td>Giurgiu</td><td>77</td></tr><tr><td>Hirsova</td><td>151</td></tr><tr><td>Iasi</td><td>226</td></tr><tr><td>Lugoj</td><td>244</td></tr><tr><td>Mehadia</td><td>241</td></tr><tr><td>Neamt</td><td>234</td></tr><tr><td>Oradea</td><td>380</td></tr><tr><td>Pitesti</td><td>98</td></tr><tr><td>Rimnicu Vilcea</td><td>193</td></tr><tr><td>Sibiu</td><td>253</td></tr><tr><td>Timisoara</td><td>329</td></tr><tr><td>Urziceni</td><td>80</td></tr><tr><td>Vaslui</td><td>199</td></tr><tr><td>Zerind</td><td>374</td></tr></table>					Straight-line distance to Bucharest		Arad	366	Bucharest	0	Craiova	160	Dobreta	242	Eforie	161	Fagaras	178	Giurgiu	77	Hirsova	151	Iasi	226	Lugoj	244	Mehadia	241	Neamt	234	Oradea	380	Pitesti	98	Rimnicu Vilcea	193	Sibiu	253	Timisoara	329	Urziceni	80	Vaslui	199	Zerind	374
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12.	Consider the following map of Southern Germany (from the Wikipedia article on Breadth-First Search) and perform Dijkstra's Single Source Shortest Path from Erfurt . You need to compute all the shortest path distances and the actual path to each of the vertices.	16 Marks	L2	C01																																										



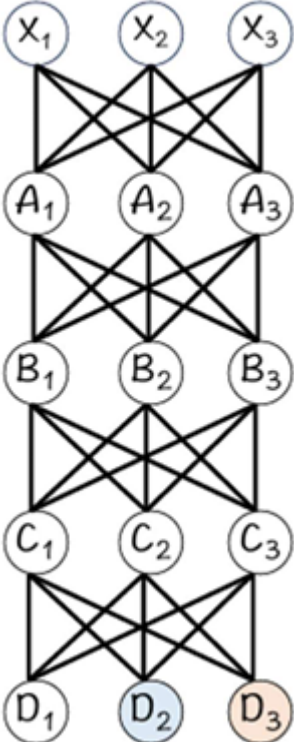
Once done, in your answer sheet, **complete the following table** (two entries are shown for you):

City	Distance from Erfurt	Shortest Path from Erfurt
Erfurt	0	Erfurt -> Erfurt
Würzburg	186	Erfurt -> Würzburg
Nürnberg		
Frankfurt		
München		
Stuttgart		
Mannheim		
Augsburg		
Karlsruhe		
Kassel		

13.	Solve the cryptarithmic puzzle – TO + TO = CAT in BASE 5 .	16 Marks	L3	C02
Or				
14.	In the class, we discussed extensively about the 4 Queens problem. Now, solve the 5 Queen's Problem.	16 Marks	L3	C02

15.	The blocks world is a representation of the different blocks stacked on top of each other. A sample is as follows:  The following are the predicates which we use to represent this scenario: • Top(x, y) = x is placed on top of y • Table(x) = x is on the table • Above(x, y) = x is above y For each of the following, predict whether the statement will be either TRUE or FALSE. Consider that FORALL represents the Universal Quantifier, and EXISTS represents the Existential Quantifier. 1. FORALL x Table(x) 2. EXISTS x Table(x) 3. EXISTS x Top(x, g) 4. EXISTS x Top(x, b) 5. Above(a, b) 6. Above(c, d) 7. ~EXISTS x Top(x, a) 8. FORALL x Table(x) -> ~EXISTS y Top(x, y)	16 Marks	L2	C03
Or				
16.	Recall that a satisfiable formula is one in which, for a certain set of input values, we get a value of TRUE as the output. Let us consider a formula $F(a,b,c,d,e) = (a \vee \sim b \vee c) \wedge (c) \wedge (\sim c \vee d \vee \sim e) \wedge (a \vee \sim b \vee \sim c) \wedge (b \vee d) \wedge (a \vee e)$. In order for us to show that it is satisfiable, we need to find a	16 Marks	L2	C03

	valid assignment for the variables a to e, such that the formula $F(a,b,c,d,e)$ evaluates to TRUE. Observe the following observations: - Each clause (Eg. $a \vee \sim b \vee c$) should evaluate to TRUE. - Intermediately, if we evaluate a variable within a clause to be TRUE, we can consider that the entire clause will evaluate to TRUE. - Intermediately, if we evaluate a variable within a clause to be FALSE, we can remove that variable from the clause as <REST OF CLAUSE> OR FALSE = <REST OF CLAUSE>. In this way, compute an assignment for the variables a to e, such that $F(a,b,c,d,e) = \text{TRUE}$. NOTE: Alternatively, you can also try out all other values from a to e such that $F(a,b,c,d,e)$ will evaluate to TRUE.			
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17.	Given an input vector $Z = [2024, 2025, 2026]$, calculate the value of $\text{Softmax}(Z)$, up to 3 decimal places.	16 Marks	L3	C05
Or				
18.	Consider the below Neural Network. The weights and biases of each layer are given as follows: $W_A = \begin{bmatrix} 0 & 3 & 3 \\ 0 & 0 & 3 \\ 3 & 3 & 0 \end{bmatrix}, W_B = \begin{bmatrix} 3 & 0 & 3 \\ 0 & 3 & 0 \\ -3 & 0 & 3 \end{bmatrix}, W_C = \begin{bmatrix} 0 & 0 & 3 \\ 0 & 3 & 0 \\ 3 & 0 & 0 \end{bmatrix}, \text{ and } W_D = \begin{bmatrix} 3 & 3 & 0 \\ 0 & 3 & 3 \\ 3 & 0 & 3 \end{bmatrix}$ $b_A = [0, 3, 0], b_B = [0, -3, 0], b_C = [0, -1, 0], \text{ and } b_D = [0, 1, 0]$ 	16 Marks	L3	C05

	Calculate the number of parameters of the neural network. Now, for an input $\mathbf{X} = [0, 1, 2]$, calculate the value of the output. Assume that ALL LAYERS use ReLU as the activation function.			
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19.	In the Mahabharat epic, Shakuni used a loaded dice, which would have the probability of getting a 6 being 0.20, and the probability of getting all other numbers being the same. Fred Flintstone has a two headed coin (a coin which has heads on both sides). - State the set of possible outcomes for a single dice roll by Shakuni. - Compute the probability of Shakuni rolling the dice N times and getting 6 on the Nth roll. - Compute the probability of Shakuni rolling the dice thrice and getting 6 three times. - Compute the probability of the event of Shakuni rolling a number that is not equal to 6.	16 Marks	L3	CO4
Or				
20.	Let us consider a variant of the coloured ball problem, but this time, with 2 pots instead of 3. The first pot, P1 has 60 white balls and 40 black balls. The second pot, P2 has 40 white balls and 60 black balls. For our coloured sequence, a pot (either P1 or P2) is first chosen, a ball is picked from it, and its colour (the observation) is noted. The ball is then replaced into the pot. To further simplify things, each pot can be chosen at random, with equal probability. Calculate the Best State Sequence and the Best Sequence Probability for the observation sequence B B B B B B. You must mention the Viterbi probability and back-pointer at each and every step.	16 Marks	L3	CO4