Attempt all the questions.

CLO#	1	2	1	1	3
Q#	1	2	3	4	5
Total Marks	08	16	08	15	08
Obtained Marks		7.25	05	8.5	

[C1]: To introduce the notion of intelligence and the so called artificiality associated with it, and how these can be modelled in computational system 2.5/8

Question No 1: Fill in the blanks with the correct terms to complete the statement. Cutting and Overwriting will lead to ZERO marks. [8 Marks]

1. Pruning allows us to ignore portions of the search tree that make no difference to the final choice, and α utility functions allow us to approximate the true utility of a state without doing a complete search.
2. In game parlance, we say that this tree is one move deep, consisting of two half-moves, each of which is called _____.
3. Random move is allowed to escape plateaus in hill climbing?
4. The formal definition of entailment is $\alpha \models \beta$ iff $\alpha \subseteq \beta$
5. If variable is left with no more values, then AC-3 (constraint propagation) can immediately return failure.

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6. The term backtracking search is used for a depth-first search that chooses values for BACKTRACKING SEARCH one variable at a time and backtracks when a variable has no value to assign.

7. If the heuristic function is the number of attacking pairs in the 4-queens problem, then write the global minimum for the hill-climbing search. 0 attacks.

8. Path consistency tightens the binary constraints by using implicit constraints that are inferred by looking at domains of variables.

[C2]: Knowledge of CSP and ability to apply its techniques practically.

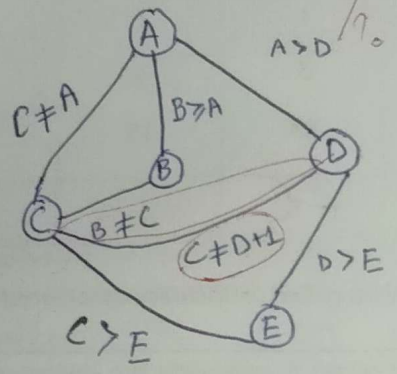
[2+8+2+2+2 = 16 Marks]

Constraint Specification Problem

Question No 02:

Consider a CSP with variables: A, B, C, D, and E, where the domain of each variable is {1, 2, 3, 4} and the constraints are: A > D, D > E, C ≠ A, C ≥ E, C ≠ D, B ≥ A, B ≠ C, B > 2, and C ≠ D + 1.

a. Construct the constraint graph that represents the above problem and show all the constraints. Make the graph node consistent if required.



Make the graph node consistent by removing unary constraint.

b. Before doing any value assignment, enforce arc consistency using the AC-3 algorithm. Fill the table below to show all the inconsistent arcs you found, and the value(s) removed to make it consistent.

A {2, 3, 4}
B {3, 4}
C {1, 2, 4}
D {1, 2, 3}
E {1, 2, 3}

Arc (var1, var2)	Constraint (var1 * var2) [e.g., var1 > var2]	Value(s) removed
A — D	A > D	1 from A
D — A	D < A	4 from D
D — E	D > E	1 from D
E — D	E < D	3, 4 from E

C − E	C > E	1 from C
E < C	E < C	Nothing remove
B − A	B ≥ A	Nothing remove
A − B	A ≤ B	4 from A
C − D	C = D + 1	2 from D
C − D	C ≠ D	3 from C

c. Write the remaining values for each variable.

A	B	C	D	E
2, 3	3, 4	2, 4	3	1, 2

d. Now encircle the variable that will be picked next by the Minimum Remaining Value (MRV) heuristic? Pick the right-most variable in case of a tie.

A	B	C	D	E

e. For the above variable, what value will be assigned using the Least Constraining Value (LCV) heuristic? Pick the right-most value in case of a tie.

Least Constraining Values are B and E, there is tie between them, so will choose E (right-most value. E = 2

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CI: To introduce the notion of intelligence and the so called artificiality associated with it, and how these can be modelled in computational systems.

[6 + 2 = 8 Marks]

Beyond Classical Searches

Question No 03:

Part A: In **Simulated Annealing**, assume that the current state's evaluation function value is 15 and the current temperature is T = 10. Consider the following randomly selected successor states and decides the move or compute the probability of moving to the successor state,

i. The selected successor state's value is 6?

$P = e^{\frac{-\Delta E}{T}} = e^{\frac{-(15-6)}{10}} = e^{-9/10} = 0.41$

ii. The selected successor state's value is 10?

$P = e^{\frac{-(15-10)}{10}} = e^{\frac{-5}{10}} = 0.61$

iii. The selected successor state's value is 15?

$P = e^{\frac{-(15-15)}{10}} = e^{\frac{0}{10}} = 1$

iv. The selected successor state's value is 25?

$P = e^{\frac{-(15-25)}{10}} = e^{1} = 2.718$

Part b: Prove/Justify each of the following statements with suitable assumptions, or give a counterexample: (2)

Local beam search

i. is the Breadth-first search.

ii. is the Hill-Climbing search.

Local beam become Hill-Climbing, if beam width k = 1, it will select among the best neighbour, more specific it become deepest ascent climbing. 0.5

Simulated Annealing:

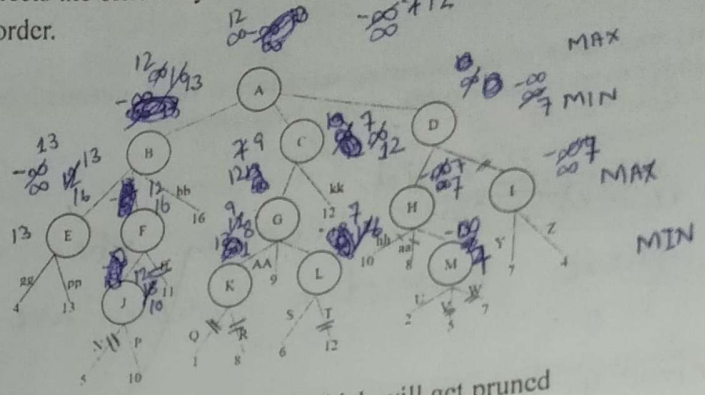
iii. perform like Hill-Climbing search if the temperature, T, becomes very high.

SA perform down Hill move, when T is high according to the evalution function probability. Unlike simple hill climbing which doesn't move down hill.

[C1]: To introduce the notion of intelligence and the so called artificiality associated with it, and how these can be modelled in computational systems. [4+4+4+3 = 15 Marks] 8.5

Adversarial Searches

Question No 04: Consider a Game tree below and assuming both rational agents are playing the game with **MAX agent** is having a first turn. Use Alpha beta pruning to find optimal path for MAX agent. As we know ordering affects the efficiency of Pruning, you are required to prune this tree in both left to right and right to left order.



a) Write names of all nodes in left to right order which will get pruned

~~H~~, ~~R~~, ~~T~~, V, ~~W~~, ~~I~~ (Y, Z) 3.5

b) Write names of all nodes in right to left order which will get pruned

~~ag~~, hh, ~~Q~~, ~~N~~, 3

a) Write complete optimal paths for MAX Agent in both L->R and R->L Order, starting from node A

L-R Path: A → B → E → 13 ; R->L Path: A → C → 12

b) How Ordering affects the efficiency of pruning? Which order is more efficient?

Left to right is efficient, as it has pruned most of the node, traversal was reduced, cost was effective and saves time.

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[C3]: To introduce students with computational intelligence theory and techniques used to design and develop intelligent systems. [6 + 2 = 8 Marks]

Knowledge Based Reasoning

Question No 05:

Part A: Decide whether each of the following sentences is valid, unsatisfiable, or neither. Verify your answers using the equivalence rules. Justify your answer.

i. $(A \leftrightarrow B) \wedge (\sim A \vee B)$

Valid, because when both are true there respective value are also true.

ii. $((y \wedge) \Longrightarrow P) \wedge (y \Longrightarrow \neg) \wedge (\Longrightarrow \neg y) \wedge y$

This statemet have syntax issue with it, neither

iii. $((Smoke \wedge Heat) \Rightarrow Fire) \Leftrightarrow ((Smoke \Rightarrow Fire) \vee (Heat \Rightarrow Fire))$

Unsatisfiable, we have used the wrong inference instead of $\wedge$, we put $\vee$ to infer it.

Part b: Which of the following are correct. (Give Logical Reason)

i. $(A \vee B) \wedge (\neg C \vee \neg D \vee E) \models (A \vee B)$

It is logically incorrect, Became we put a conjenction it will not entails true.

ii. $(A \vee B) \wedge (\neg C \vee \neg D \vee E) \models (A \vee B) \wedge (\neg D \vee E)$

Correct, here in this case B (Right side) value is subset of α (left side), always true.