Assignment 1
CSE422 Summer 2025
BracU
Ipshita Bonhi Upoma

Deadline: August 08, 2025, 11:59PM

Part 1

1. Consider an 8 puzzle game.
   Initial State:
   1 2 3
   7 4 6
   0 5 8

   Goal state:
   1 2 3
   4 5 6
   7 8 0

   Here “0” represents the empty space.
   a. Construct the search tree.
   b. Simulate A* Algorithm on this problem using Manhattan distance as its heuristic. Compute heuristic when a state is pushed into the queue.
   c. If diagonal moves were allowed in Q1, would you make any changes in the heuristic function? Justify your answer.

Part 2

1. At the BRAC Tech Division Annual Dinner, eight colleagues — Rafiq, Shanta, Mizan, Laila, Nayeem, Farzana, Tarek, and Jobaida — are seated around a circular table. The seating must reflect both their professional collaborations and personal relationships to ensure comfort and avoid conflicts during the formal event.

   Certain colleagues work on the same projects and should be seated close together to encourage discussion. Rafiq and Shanta collaborate on the Smart Village ICT project, Mizan and Nayeem on the Bangla OCR AI system, and Farzana, Laila, and Jobaida are part of the Women in Tech Digital Literacy Campaign. These pairs or groups prefer to sit adjacent to maintain their team dynamics.

   However, personal and family relations require some distance. Rafiq is Shanta’s uncle, so they wish to avoid sitting next to each other for formality. Farzana and Tarek, being siblings, also request separation. Meanwhile, Laila and Mizan had a past personal disagreement and prefer not to sit beside each other. The goal is to find a valid circular arrangement that honors these preferences, remembering that in a circle, the first and last people are also neighbors.

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a. Encode the problems. (This means structuring the problem representation, defining the neighborhood. Examples given in lecture notes)
b. Demonstrate the Hill Climbing algorithm up to two iterations. Using the idea of the evaluation function for this problem, explain the problems with the Hill-Climbing algorithm.
c. Using the problem scenario, explain First-choice hill-climbing, Stochastic hill climbing and Random-restart hill climbing algorithm.
d. Let $T = 100$, $\alpha = .5$ and the change of temperature at each iteration be described by $T(k) = T_0 \alpha^k$. Demonstrate simulated annealing up to 3 iterations, find the optimal solution. In case you need it, let the random numbers generated are (0.2, 0.5, 1) Explain the significance of the change of temperature in simulated annealing using this problem as an example. What will happen if the temperature is increasing at each iteration of simulated annealing.
e. Demonstrate the Genetic algorithm up to 1 iteration.
f. What will happen if all the chromosomes in the initial population are the same? Explain why mutation is helpful in finding a better solution. Use the problem scenario as an example.

Part 3

1. For the following search trees, simulate the minimax algorithm and the alpha-beta pruning algorithm. Identify which subtrees are pruned using the alpha-beta pruning algorithm. At each node, show the alpha and beta values.
   Note: The circled numbers represent the utility values, where the circles represent terminal nodes.

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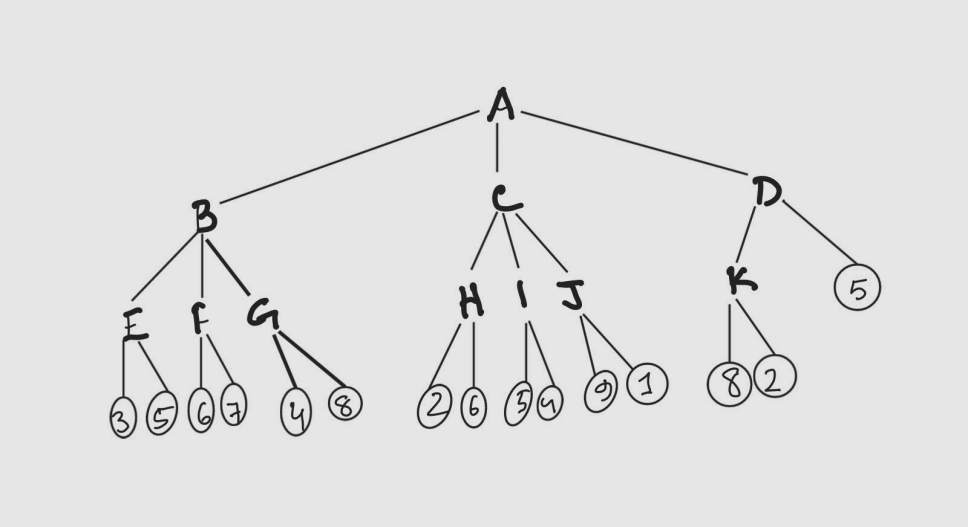

2. Now consider that the root node is controlled by the minimizing player for the graphs in question. Simulate the results using the minimax and alpha-beta pruning algorithms. Identify the subtrees that are pruned by the alpha-beta algorithm. Display the alpha and beta values at each node.
3. Draw a graph for which alpha-beta pruning will explore the same nodes as the minimax algorithm. Demonstrate the simulation over this graph.
4. Describe the role of maximizing and minimizing players in the minimax algorithm.
5. Discuss the concept of "utility values" in the context of the minimax algorithm. How are they calculated and used?