Unit 1

Q1) Brief explanations of the scenarios are provided.

1. **Supermarket Barcode Scanners: These devices read and interpret barcodes on products to retrieve pricing and product information instantly at checkout counters.**
2. **Web Search Engines: These systems process user queries to retrieve the most relevant information from the vast resources available on the internet.**
3. **Autonomous Vehicles: These are self-driving cars that navigate roads, avoid obstacles, and follow traffic laws with minimal human intervention.**
4. **Robotic Vacuum Cleaner: These autonomous devices navigate around a home, detecting obstacles and efficiently cleaning floors by adapting to different types of surfaces and room layouts.**

For each scenario:

A. **What type of agent is used?**
B. **What type of environment does it operate in?**
C. **what extent are the following computer systems instances of artificial intelligence?**

Q2) Brief explanations of the scenarios are provided.

1. **Smart Home Lighting System: These systems automatically adjust the lighting in a home based on the time of day, occupancy, and user preferences to enhance comfort and energy efficiency.**
2. **Automated Customer Support Chatbots: These bots interact with customers in real-time, providing answers to common questions and guiding them through simple processes without human intervention.**
3. **Stock Market Trading Systems: These systems analyse financial data and execute trades in the stock market, aiming to maximise profit by predicting market trends and reacting to changes instantly.**
4. **Health Monitoring Wearables: These devices continuously track vital signs such as heart rate, sleep patterns, and physical activity levels, providing users with insights into their health and recommending actions to improve well-being.**

For each scenario:

A. **What type of agent is used?**
B. **What type of environment does it operate in?**
C. **To what extent are these systems instances of artificial intelligence?**

Unit 2

Q1) You are developing an AI-based system to optimise the layout of components on a printed circuit board (PCB) for an electronic device. The goal is to minimise the total wire length between components while avoiding overlap and ensuring the components remain within specified physical constraints.

The search space is vast, with numerous possible component layouts, and the fitness function (total wire length) contains several local minima.

Which search algorithm (BFS, DFS, UCS, Greedy Best-First Search, A*, Hill Climbing, or Genetic Algorithm) would you choose to solve this problem, and why(explain your reasoning), And discuss suitability of each algorithm. (5 Marks)

Q2) Imagine an autonomous drone tasked with delivering packages in a dense urban city. The city has skyscrapers, traffic, weather conditions (like wind), and no-fly zones. The drone must navigate through the city to deliver the package efficiently while considering obstacles, energy consumption, and legal restrictions like no-fly zones.

Heuristic Functions:

Euclidean Distance :

The straight-line distance between the drone's current location and the delivery destination. This heuristic assumes the drone can fly directly to the destination without considering obstacles or legal restrictions.

Manhattan Distance :

The sum of the absolute vertical and horizontal distances to the destination. This is more suited for environments where the drone can only fly in certain directions due to streets and skyscrapers forming a grid-like structure.

Wind Resistance Heuristic:

Estimates the flight time based on current wind conditions. This could be non-admissible as it might overestimate the time due to unpredictable gusts of wind, making the drone take suboptimal paths.

Obstacle Avoidance Heuristic:

A heuristic that estimates the number of obstacles (buildings, no-fly zones) between the drone and its destination. This heuristic helps the drone avoid these obstacles while aiming to stay on the shortest path.

Battery Usage Estimate:

This heuristic calculates the estimated battery consumption based on current environmental conditions (wind, altitude, etc.) and past flights. It could be non-admissible since it may overestimate the energy required, leading the drone to avoid certain paths that might actually be shorter.

Flight Path Safety Heuristic:

Estimates the risk involved in taking certain paths based on proximity to no-fly zones and heavily congested airspaces. This is non-admissible because it could overestimate the danger and unnecessarily avoid safe but efficient routes.

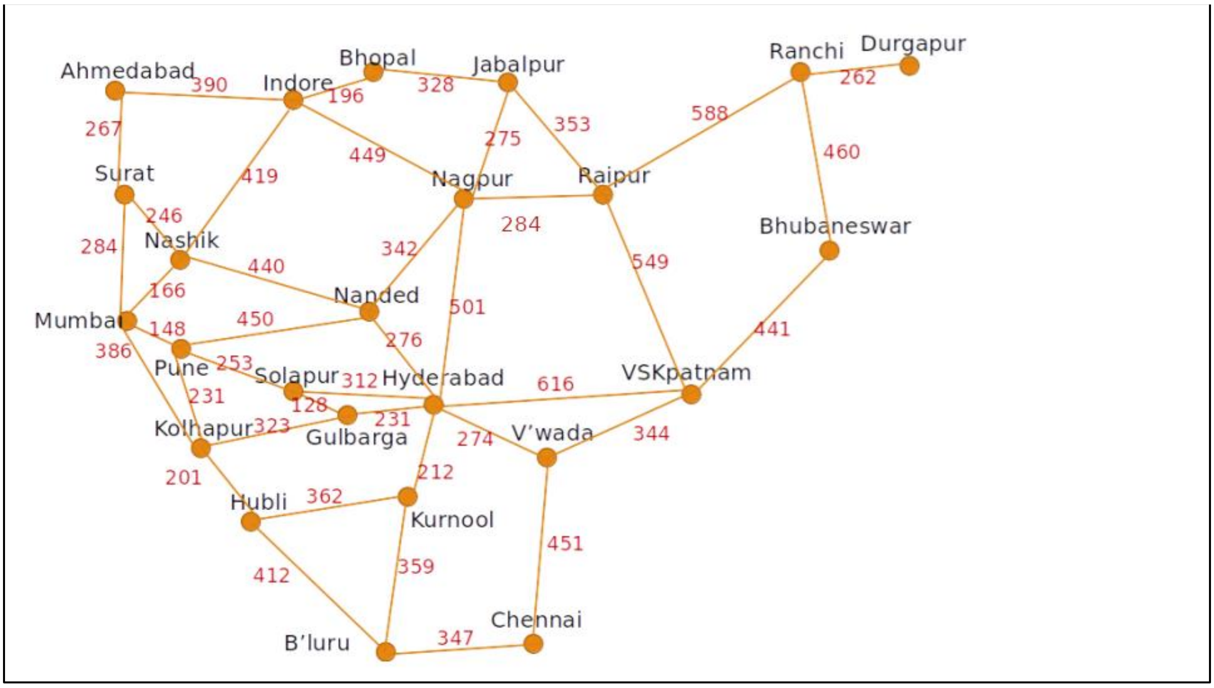
A) Among these six heuristics, Which are admisable and which are not admisable heuristics?

B) Rank the heuristics functions based on their expected performance for A* in this autonomous drone tasked with delivering packages, considering both optimality and efficiency.* ***(5 Marks)***

B) Ranking the Heuristics Based on Performance for A*

Q3) Does A ∗ search always expand fewer nodes than BFS? Justify your answer.

Q4) Describe the working of Greedy Best First Search and A* Algorithms to search for the optimal route from Hyderabad to Mumbai in the following graph.

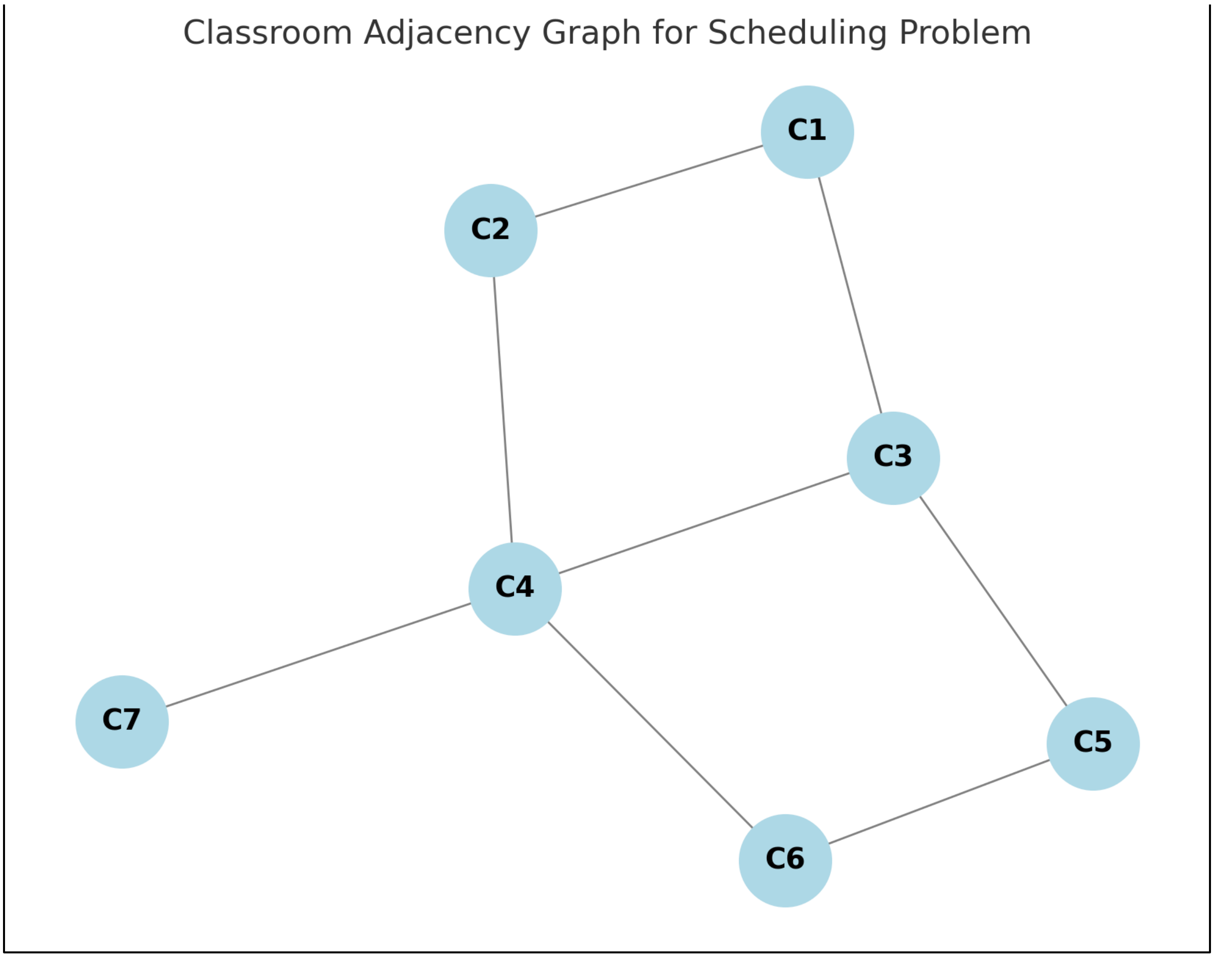


Straight line distance to Mumbai

City	Distance	City	Distance	City	Distance
Ahmedabad	439	Pune	120	Ranchi	1372
Jabalpur	866	Solapur	356	Hyderabad	621
Durgapur	1573	Vijayawada	870	Kolhapur	300
Gulbarga	460	Surat	232	Nagpur	688
Raipur	944	Kurnool	655	Nasik	140
Bengaluru	845	Nanded	466	Visakhapatnam	1101
Kurnool	655	Chennai	1033		

UNIT-3

Q1) Consider the challenge of scheduling classes in a school with seven classrooms (C1, C2, C3, C4, C5, C6, C7) and three available time slots (T1, T2, T3). Each classroom must be assigned a time slot such that no two adjacent classrooms (based on proximity) have the same time slot, similar to the graph colouring problem. The adjacency between classrooms is depicted in the figure below.



Formulate the problem as a CSP(Define the variables, domains, and constraints) And Solve the problem.

Q2)

Consider scheduling buses at university. We have 4 bus routes (R1, R2, R3, R4) and 3 available buses (B1, B2, B3). The routes require buses at the following times:

R1: 7:00 AM to 9:00 AM

R2: 8:00 AM to 10:00 AM

R3: 9:00 AM to 11:00 AM

R4: 10:00 AM to 12:00 PM

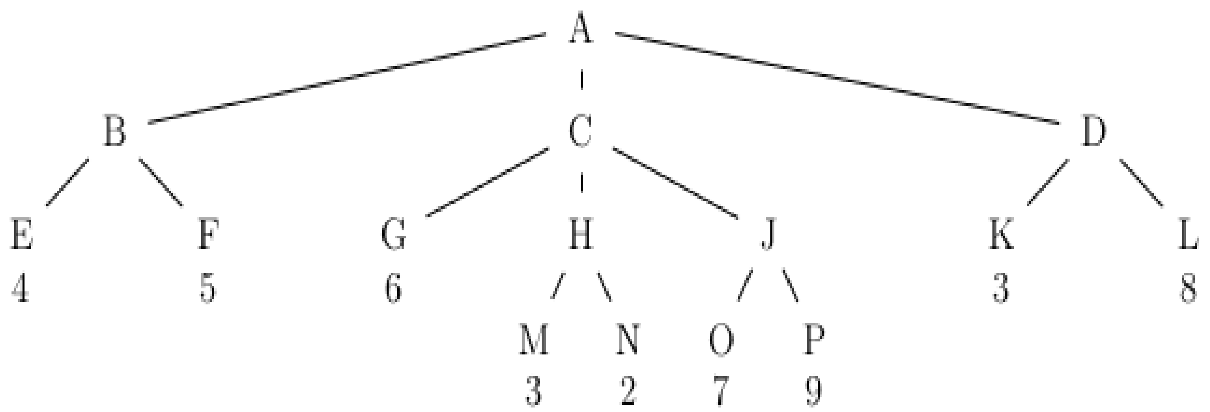
Assume that a bus can only serve one route at a time, and Bus B3 is too small for Route R1, and Buses B2 and B3 are too small for Route R3.

Show the search with forward checking by writing the domain for each variable at every step in detail. Use the variable ordering (R1, R2, R3, R4) and the value ordering (B1, B2, B3).

Variable	R1	R2	R3	R4
Initial Domains				

Q3)

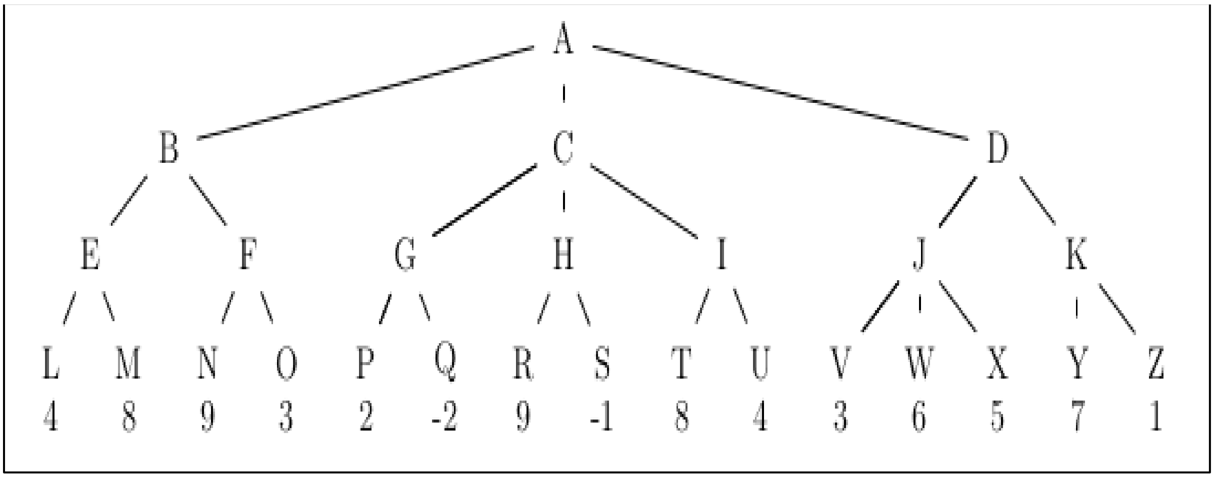
Consider the following game tree. Assume it is the maximising player's turn to move. The values under the leaves are the static evaluation function values of the states at each of those nodes.



1. What is the minimax value of node A?
2. Which move would be selected by Max?
3. List the nodes that the alpha-beta algorithm would prune (i.e., not visit). Assume children of a node are visited left-to-right

Q4)

Consider the following game tree. Assume it is the maximising player's turn to move. The values under the leaves are the static evaluation function values of the states at each of those nodes.



1. Label each non-leaf node with its minimax value.

2. Which move would be selected by Max?

3. List the nodes that the alpha-beta algorithm would prune (i.e., not visit). Assume children of a node are visited left-to-right