Sri Sivasubramaniya Nadar College of Engineering, Kalavakkam – 603 110
(An Autonomous Institution, Affiliated to Anna University, Chennai)
UCS3412 – COMPETITIVE PROGRAMMING LABORATORY

Batch : 2024-2028
Academic Year: 2025-2026 (Even)

Assignment 3 : Algorithms using Branch and Bound

1. DAA Questions

Question 1: Emergency Response Route Optimization Using Branch-and-Bound

[CO2, K3]

An emergency response unit must visit multiple incident locations exactly once and return to the base station. Each route has varying travel times, and some routes are blocked. Apply the Branch-and-Bound technique to model and solve the problem of finding the minimum-time response route while pruning non-feasible paths. Compute the time complexity.

Hint for solving the problem:

Construct a search tree where each level represents the next incident location to be visited. Each node corresponds to a partial route starting from the base station. At every node branch by choosing one unvisited location as the next stop, accumulate travel time for the partial route and keep updating a lower bound on the total route time. For a partial route, compute a best-case remaining time (for example, using the minimum outgoing edge from each unvisited location or any other appropriate metric), which can be used as the lower bound. If the lower bound exceeds the best route found so far, prune that branch. If a required route between two locations is blocked, do not generate that branch at all.

Question 2: Profit Maximization in Smart Warehousing Using Branch-and-Bound

[CO2, K3]

A smart warehouse uses automated robots to select items for shipment. Each item has a profit, weight, and priority score. The robot has a fixed carrying capacity. Apply the Branch-and-Bound method to solve and optimize item selection while considering capacity and priority constraints. Compute the time complexity.

Hint for solving the problem:

Model the problem as a 0/1 Knapsack: each item can be either selected or not. Use Branch-and-Bound knapsack strategy by branching on include/exclude decisions and computing an upper bound using to prune branches that cannot improve the current best solution.

Question 3: Optimal Interview Scheduling Using Branch-and-Bound [CO2, K3]

A company needs to schedule interviews for multiple candidates across limited time slots. Each interview has a duration, priority, and deadline. Apply the Branch-and-Bound technique to develop an optimal interview schedule that maximizes total priority while meeting all deadlines.

Hint for solving the problem:

Build a schedule with one interview at a time. At each step, branch by deciding whether to schedule a particular interview in the remaining time slots. Maintain the current total priority and compute an upper bound on achievable priority from the unscheduled interviews. Prune any partial schedule that already misses a deadline or whose upper bound cannot beat the best schedule found so far.

2. Competitive Programming Questions

Question: You are given an integer array of jobs, where jobs[i] is the amount of time it takes to complete the ith job. There are k workers that you can assign jobs to. Each job should be assigned to exactly one worker. The working time of a worker is the sum of the time it takes to complete all jobs assigned to them. Your goal is to devise an optimal assignment such that the maximum working time of any worker is minimized. Return the minimum possible maximum working time of any assignment.

https://leetcode.com/problems/find-minimum-time-to-finish-all-jobs/description/