

Course/ Batch: BTech/ SCSET
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Course Type: Core
Course Name: Design and Analysis of Algorithms

Tutorial Assignment: Week 6

Tutorial title: Greedy method

CO Mapping

Question no	CO1	CO2	CO3
Q1	✓	✓	
Q2	✓	✓	
Q3	✓	✓	
Q4	✓	✓	

Q1. Consider the weights and values of the items listed below. The task is to pick a subset of these items such that their total weight is no more than 11 Kgs and their total value is maximized. Moreover, a fraction of each item may be taken. Find the optimal solution to the given problem.

Item Number	Weights (Kg.)	Values (in Rs.)
1	10	60
2	7	28
3	4	20
4	2	24
5	8	48

- Q2.** i) How many bits are at least required for encoding the message 'MISSISSIPPI' using Huffman coding?
Construct the tree for optimal coding.
- ii) Decode 100010111001010 using the Huffman code that you generated.
- iii) Find the time complexity of constructing an optimal code using Huffman's algorithm.

Q3. Given a set of 10 classes along with their start time (s_i) and finish time (f_i), where $s_i < f_i$.

$$A_i = \{C_1, C_2, C_3, C_4, C_5, C_6, C_7, C_8, C_9, C_{10}\}$$

$$S_i = (1, 2, 3, 4, 7, 8, 9, 9, 11, 12)$$

$$F_i = (3, 5, 4, 7, 10, 9, 11, 13, 12, 14)$$

Suppose that you are in charge of scheduling a class into classrooms. At a time, only one class can be run into a classroom. You are allowed to schedule a maximum number of classes in a classroom. Find the minimum number of classrooms required to schedule all 10 classes without any conflict (non-overlapping classes).

Q4. In the Traveling Salesman Problem (TSP), a salesman wants to visit each of n cities and return to his starting point while traveling the shortest possible distance. The conditions of this tour are as follows:

- The salesman can visit each city exactly once.
- The goal is to find the best route that minimizes travel distance (or cost).

Consider the following distances between four cities:

City	A	B	C	D
A	0	20	15	30
B	20	0	25	35
C	15	25	0	20
D	30	35	20	0

The above matrix is symmetric in which every element denotes the distance between two cities, e.g., (i, j) denotes the distance between city i and j . Every city is connected to other cities. Consider the following greedy method:

1. Select a starting city.
2. Find the nearest city to your current one and go there if it was not visited earlier.
3. If there are still cities not yet visited, repeat step 2. Else, return to the starting city.

If the salesman wants to start his tour from city A, find the minimum total travel distance of his tour using the greedy method described above. Write the sequence of the cities that the salesman would visit.

Q5. Given a graph, your goal is to color the vertices with a minimum number of colors so that the end points of every edge are colored differently (i.e., no adjacent vertex has the same color). Consider the following greedy heuristic to color the graph.

- Step 1: All vertices are sorted according to the decreasing value of their degree in a list $V = \{v_1, v_2, \dots, v_n\}$.
- Step 2: Colors are ordered in a list $C = \{c_1, c_2, c_3, \dots\}$.
- Step 3: The first non-colored vertex v in V is colored with the first available color in C . Available means a color that was not previously used.
- Step 4: The remaining part of the ordered list V is traversed, and the same color is allocated to every vertex for which no adjacent vertex has the same color.
- Step 5: Steps 3 and 4 are applied iteratively until all the vertices have been colored.

Consider the following graphs. Apply the above heuristic to the following graphs and determine the number of colors required to color the graphs. Does greedy coloring always give optimal coloring?

