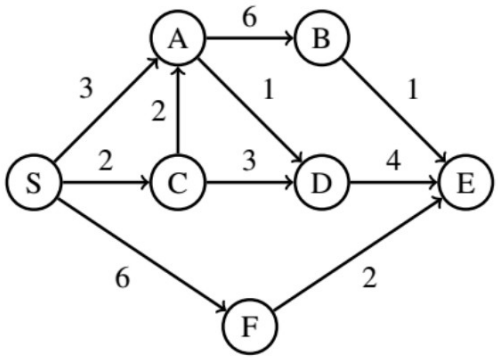
Data Structures & Algorithms (CS F211) Comprehensive Exam
Part B (Open Book)

There are 3 questions in Part B with total marks $6 + 14 + 20 = 40$. You can use books or notes (only hard copies). Time: (Part A) + (Part B) = 180 minutes.

1. Radix sort the following list of integers in base 10 (smallest at top, largest at bottom). Show the resulting order after each run of counting sort.

Original List	First Sort	Second Sort	Third Sort
583			
625			
682			
243			
745			
522			

2. Run Dijkstra's algorithm on the following directed graph, starting at vertex S. What is the order in which vertices get removed from the priority queue? What is the resulting shortest-path tree?



3. Consider an n-node complete binary tree T, where $n = 2^d - 1$ for some d. Each node v of T is labeled with a real number x_v. You may assume that the real numbers labeling the nodes are all distinct. A node v of T is a *local minimum* if the label x_v is less than the label x_w for all nodes w that are joined to v by an edge. You are given such a complete binary tree T, but the labeling is only specified in the following *implicit* way: for each node v, you can determine the value x_v by probing the node v. Show how to find a local minimum of T using only $O(\log(n))$ *probes* to the nodes of T. Give a proof of correctness of your algorithm and also prove its time complexity.