CS345: Design and Analysis of Algorithms

Assignment 4

Due Date: 4th November

Total Number of Pages: 1 Total Points 20

Instructions

1. For submission typeset the solution to each problem and compile them in a single pdf file. Hand-written solutions will not be accepted. You can use LaTeX or Word for typesetting.
2. Start each problem from a new page. Write down your Name, Roll number and problem number clearly for each problem.
3. For each question, give the pseudo-code of the algorithm with a clear description of the algorithm. Unclear description will receive less marks. Less optimal solutions will receive only partial marks.
4. Assume that sorting would have $O(n \log n)$ complexity.

Question 1. (10 points) Recall the example of a flow network with 6 nodes where the Ford-Fulkerson algorithm may never terminate. Furthermore, even in the asymptotic sense, the flow computed will be less than the maximum flow possible. Please provide a comprehensive analysis of this scenario, thereby showing how the algorithm may run forever.

Question 2. (10 points) Design a data structure to support the following two operations for a dynamic multiset S of integers, which allows duplicate values:

- INSERT(S, x): inserts x into S.
- DELETE-LARGER-HALF(S): delete the largest $\lceil |S|/2 \rceil$ elements from S.
- REPORT-MAX(S): report the largest element from the set S.

Explain how to implement this data structure so that any sequence of m operations mentioned above run in $O(m)$ time. Your implementation should also include a way to output the elements of S in $O(|S|)$ time.