Indian Institute of Technology Kharagpur

CS31005 Algorithms II – Class Test 1

Total marks: 30 Duration: 1 hour

Answer all questions.

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1. Design an algorithm to check if a flow network has a unique minimum capacity $s-t$ cut, and if not, then output two different minimum capacity $s-t$ cuts. Explain your algorithm in plain English. Write the pseudocode of your algorithm. Prove the correctness of your algorithm. What is the running time of your algorithm?

[3+3+5+4=15 Marks]

2. Consider the problem of insertions and deletions of positive integers into a table that is solved by the following algorithm $\mathcal{A}$: Let the current table size be i.

   ▷ Elements are inserted into the current table till the table is full. When we try to insert an element but the table already has i elements, a new table of size $2i$ is created and all elements including the new element are inserted into the new table while the old table is forgotten.

   ▷ Elements may be deleted from the current table up to the point where the table contains $i/4$ elements. When an element has to be deleted but the table has $i/4$ elements, then a new table of size $i/4$ is created and all elements minus the element to the currently deleted are copied onto the new table while the old table is forgotten.

   (a) Describe a method to analyse the amortized running time of an insertion operation in the algorithm $\mathcal{A}$. Prove the correctness of the analysis.

   (b) Describe a method to analyse the amortized running time of a deletion operation in the algorithm $\mathcal{A}$. Prove the correctness of the analysis.

[5+2.5+5+2.5=15 Marks]
