CS204: Algorithms

Mid Semester, Spring 2016

IIT Patna

Attempt all questions. Do not write anything on the question paper.

Time: 2 Hrs | Full marks: 30

1. Solve it: $T(n) = \log n + T(\sqrt{n})$ (5)

2. Given a sequence of n matrices - $\{A_1, A_2, \ldots, A_n\}$, you need to find out $X = A_1 \times A_2 \times \cdots \times A_n$.

   (a) Present an algorithm to find out X using *minimum* number of multiplications and an *ordering* of those multiplications.

   (b) Present a working example to demonstrate your algorithm.

   (c) Find complexity of your algorithm. (4+3+3)

3. In finding k-th smallest element out of n elements in the worst-case linear time, the input elements are divided into groups of 5. Will the algorithm work in linear time if they are divided into groups of (a) 3 (b) 7. Justify your answers. (5)

4. Given an array $A[0, \ldots, n-1]$ having the following property
   $A[i] > A[i-1]$ for all i such that $0 < i < k$ and
   $A[i] < A[i+1]$ for all i such that $k < i < n$.
   For example $[1, 2, 9, 7, 6, 3, 0]$ satisfies above property while $[1, 3, 4, 8, 2, 6]$ does not. Assume all the elements are distinct. Develop an efficient algorithm to find the maximum element in such array. (5)

5. Present a methodology to sort n integers in the range of 1 to $(n^2 - 1)$ in $O(n)$ time. (Hints: Select appropriate base) (5)