Quiz I

Algorithms Analysis and Design
IIIT Hyderabad, Monsoon 2025

September 1, 2025

There are 3 questions 10 marks each. Maximum Marks: 30. Time: 45 min

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1. We studied three types of multiplication algorithms in class using divide-and-conquer, namely (a) integer multiplication (`Karatsuba`), (b) matrix multiplication (`Strassen`) and (c) polynomial multiplication (`(FFT)`). If someone claims that in at least one among these three problems, it is asymptotically faster to square one operand than to multiply two operands, would you believe it? Justify your answer. $(2\frac{1}{2} + 5 + 2\frac{1}{2})$ marks

2. Let X be a set of n intervals on the real line. A coloring of X assigns a color to each interval so that any two overlapping intervals are differently colored. Design, analyze, prove the correctness/optimality of as well as compare with a naive approach, an algorithm to compute the minimum number of colors needed to color X. $(4\frac{1}{2} + 1\frac{1}{2} + 3 + 1)$ marks

3. Given a sorted array A of n distinct integers, design an $O(\log n)$ time algorithm to find if for some i, the i^{th} ranked element in A is i. What can you do if two sorted arrays A and B (of sizes n and m respectively) are given and you need to solve the same problem on their union, that is, find if for some i, the i^{th} ranked element in $(A \cup B)$ is i. $(5 + 5)$ marks

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ALL THE BEST!