

Homework 2

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Due Jan 29 by 8am **Points** 20 **Submitting** a file upload **File Types** pdf
Available Jan 22 at 8am - Jan 29 at 8am

Suggested reading

Chapter 2, 4, 6.6 [DPV] (shortest path via DP)

Practice Problems (do not turn in)

[DPV] Problem 2.1 (Practice Fast Multiplication)

[DPV] Problem 2.5 (Solving recurrence)

[DPV] Problem 4.11 (length of shortest cycle)*

Give an algorithm that takes as input a directed graph with positive edge lengths, and returns the length of the shortest cycle in the graph (if the graph is acyclic, it should say so). Your algorithm should take time at most $O(|V|^3)$.

[DPV] Problem 4.21 (Currency trading)*

Shortest path algorithms can be applied in currency trading. Let c_1, c_2, \dots, c_n be various currencies...

(Binary search modified)* Design an $O(\log(n))$ algorithm to find the smallest missing natural number in a given sorted array. The given array only has natural numbers. For example, the smallest missing natural number from $A = [3, 4, 5]$ is 1 and from $A = [1, 3, 4, 6]$ is 2.

** For the last three practice problems your solution (which do not need to be turned in) should be in the D&C format: describe your algorithms in words, justify the correctness of the approach, and analyze the run time.*

Graded Problem

A sequence of integers is said to be an arithmetic progression if the difference of consecutive terms is constant. For example, $[-3, 0, 3, 6]$ and $[8, 6, 4, 2]$ are both arithmetic progressions.

You are given an arithmetic progression A of size n with one element missing! Design a Divide and Conquering algorithm to find the missing element.

Example: for $A=[2, 5, 8, 14]$ your output should be 11.

You can assume the missing element is not at the beginning or the end.

A complete submission will (a) describe your algorithm in words (no pseudocode!), (b) justify its correctness, and (c) analyze and state its runtime. Faster (and correct) in asymptotic Big O notation is worth more credit.

Brute force solutions will receive little to no credit.

You will upload a pdf of your **typed** solution. **Handwritten solutions will be penalized.**