

Tutorial 6 Exercises

COMP526: Efficient Algorithms

11–12 November, 2024

Exercise 1. Suppose you are given an array $A = A[0..n)$ containing the price history of shares of a stock of the Acme Corporation. That is, $A[i]$ stores the price of a share of Acme stock on day i . Given this price history, you would like to find the maximum profit achievable by buying and selling a single share of Acme stock during the time interval $0..n - 1$. That is, you wish to find the maximum possible value of $P[s] - P[b]$ where $b \leq s$ is the day on which you buy the stock and s is the day on which you sell the stock.

- (a) Explain how this problem can be solved in $\Theta(n^2)$ time using a brute force approach.
- (b) Devise a divide and conquer algorithm for this problem. Be sure to:
 - explain how the array A is divided;
 - describe how sub-solutions can be combined to an overall solution;
 - analyze the running time of your procedure.
- (c) (Challenge.) Can you solve the profit maximization problem in $O(n)$ time?

Exercise 2. Consider the the pattern $P = ABACADABA$ on the alphabet $\Sigma = \{A, B, C, D\}$.

- (a) Compute the deterministic finite automaton (DFA) for searching for the pattern P in a text T
- (b) Compute the look-up table $\delta[][]$ corresponding to the DFA you found in part (1).
- (c) Use your DFA or lookup table to search for P in the text $T = [0, 30)$ below.

$T = ABABACABABACADBABABACADABAABAB$

For each index $i = 0, 1, \dots, 29$ write the state that the DFA is in after reading the character at index i in T .