

Fundamental Algorithm Techniques

Problem Set #3

Due: October 25, 2025

Problem 1 (Fibonacci Super Fast!). 1. compute Fibonacci with the relation:

$$\begin{bmatrix} F_{n+1} \\ F_n \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}^n \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

2. This can also be expressed as:

$$\begin{bmatrix} F_{n+1} \\ F_n \end{bmatrix} = \left(\begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix} \right)^{n/2} \begin{bmatrix} 1 \\ 0 \end{bmatrix},$$

use Master Theorem to discuss the complexity of this decomposition and show, explain why time complexity is then $\log_2(n)$.

Problem 2 (Levenshtein (Edit) Distance). Compute the edit distance between the strings: "SATURDAY" and "SUNDAY" using a tabular approach.

Problem 3 (0/1 Knapsack Algorithm!). 1. Why is Knapsack not greedy Algo., why dynamical programming?

2. Solve the Knapsack Algorithm for the course example.

3. Can you get space complexity to $\mathcal{O}(W)$?