

**ALGORITHMS,
PROBLEM SOLVING**

AND

**ALGORITHMIC
PROBLEM SOLVING**

BY ELIAS

WHAT TODAY IS ABOUT?

- The power of abstraction
- Algorithms
- Problem Solving
- Redundancy and Efficiency
- Memes
- Redundancy

WHAT TODAY IS NOT ABOUT?

- Mathematical proofs
- Memorizing algorithms

LET'S START BY MEMORIZING THIS PROOF

$$\begin{aligned}d_{i0} &= \sum_{k=1}^i w_{\text{del}}(a_k), && \text{for } 1 \leq i \leq m \\d_{0j} &= \sum_{k=1}^j w_{\text{ins}}(b_k), && \text{for } 1 \leq j \leq n \\d_{ij} &= \begin{cases} d_{i-1,j-1} & \text{for } a_i = b_j \\ \min \begin{cases} d_{i-1,j} + w_{\text{del}}(a_i) \\ d_{i,j-1} + w_{\text{ins}}(b_j) \\ d_{i-1,j-1} + w_{\text{sub}}(a_i, b_j) \end{cases} & \text{for } a_i \neq b_j \end{cases} && \text{for } 1 \leq i \leq m, 1 \leq j \leq n.\end{aligned}$$

ABSTRACTION

THE PURPOSE OF ABSTRACTION IS **NOT**
TO BE VAGUE, BUT TO CREATE A **NEW**
SEMANTIC LEVEL IN WHICH ONE CAN BE
ABSOLUTELY PRECISE.

- EDSGER DIJKSTRA

ABSTRACTION

**A PROCESS OF HIDING THE
DETAILS OF A SYSTEM**

**THINK OF EVERYTHING AS A BLACK BOX
WITH TWO HOLES, INPUT AND OUTPUT**

WHAT IS AN ALGORITHM?

**AN ALGORITHM IS A FINITE SEQUENCE OF WELL-
DEFINED, COMPUTER-IMPLEMENTABLE
INSTRUCTIONS, TYPICALLY TO SOLVE A PROBLEM!**

- WIKIPEDIA

EXAMPLE OF A PROBLEM

EPHREM

BUT WHAT IS A PROBLEM?

**A PROBLEM IS A QUESTION THAT
REQUIRES A SOLUTION!**

- Pairing your socks after laundry - Finding the fastest route to go to work - Figuring out how to get a date with your crush

HOW DO WE COMPARE ALGORITHMS?

EFFICIENCY, EFFICIENCY, EFFICIENCY!

ANALYSIS

HOW GOOD IS THE ALGORITHM?

TIME COMPLEXITY

SPACE COMPLEXITY

BOUNDS

SOME WELL KNOWN / MOST USED ALGORITHMS

- Sorting - Searching - Graph/Path traversal - Dijkstra -
A* - Travelling salesman

SORTING
MATCHING EVERY PAIR OF SOCKS

SEARCHING
FINDING A SPECIFIC BOOK IN A LIBRARY

BINARY SEARCH
A SPECIAL CASE OF SEARCHING
STEPIING STONE TO MORE ADVANCED
BINARY TREE ALGORITHMS

GRAPH TRAVERSAL
FINDING THE SHORTEST PATH BETWEEN
TWO POINTS, GOOGLE MAPS

DIJKSTRA

**A SPECIAL CASE OF GRAPH TRAVERSAL
FINDS THE SHORTEST PATH STARTING
FROM A SINGLE POINT**

A*

A SMARTER VERSION OF DIJKSTRA

TRAVELLING SALESMAN
A SPECIAL CASE OF GRAPH TRAVERSAL
SOOPER DOOPER HARD TO SOLVE

MEME ALGORITHMS

BOGO SORT (AKA STUPID SORT) -

MIRACLE SORT -

CODE TIME

STRATEGIES TO SOLVE PROBLEMS

- Brute force
- Divide and conquer
- Greedy
- Dynamic programming

