Design and Analysis of Algorithms

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DESIGN AND ANALYSIS OF ALGORITHMS

Fundamentals of Algorithmic Problem Solving

Slides courtesy of **Anany Levitin**

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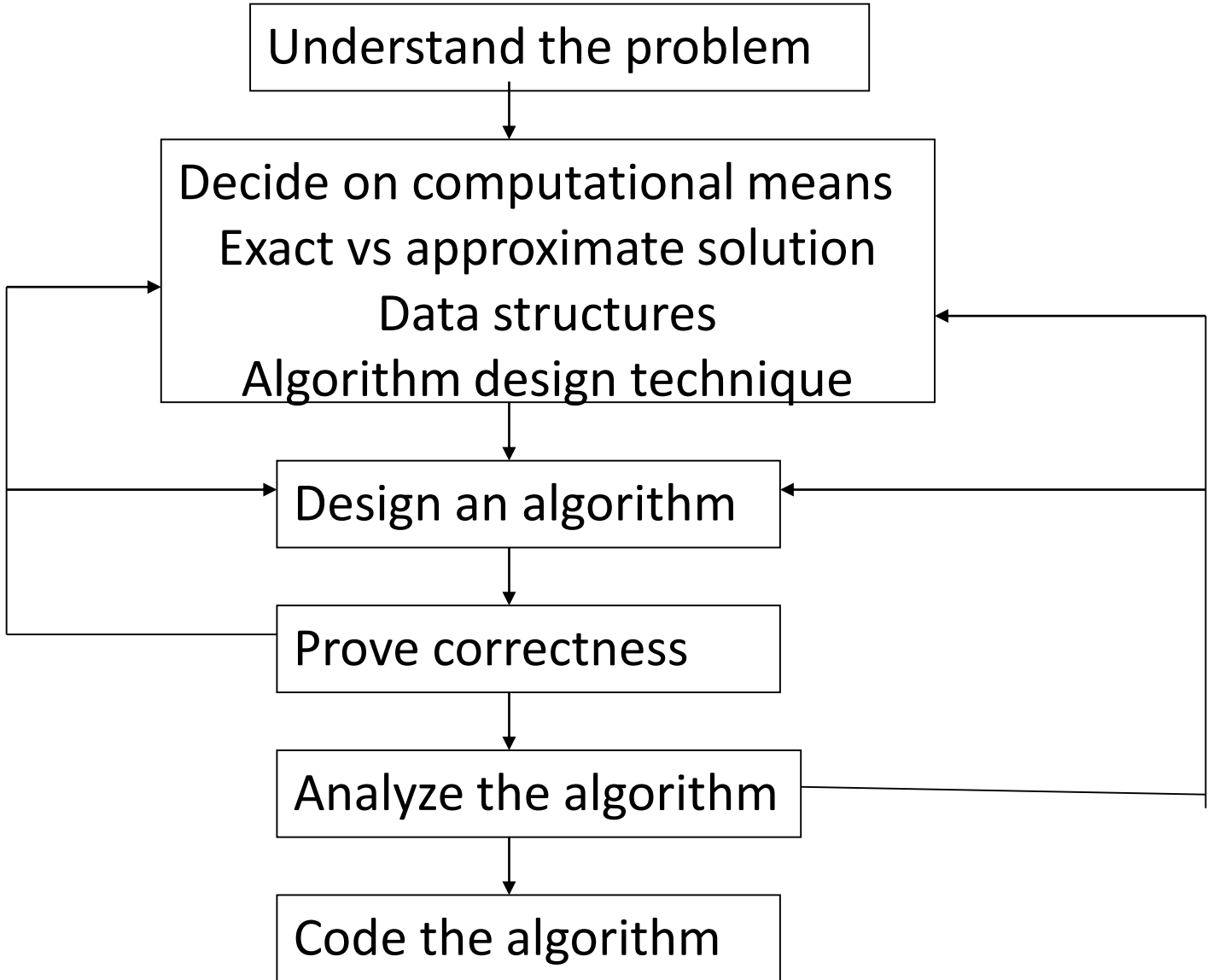
Algorithm Design and Analysis Process



Design and Analysis of Algorithms

Computational Means

Computational Device the algorithm is intended for

RAM Sequential Algorithms

PRAM Parallel Algorithms

Exact vs approximate solution

Travelling Salesman Problem

NP complete!!!

Approximate algorithm can be used to solve it

Deciding on Data Structure

- Linear

  Linear list, Stack, Queues
- Non Linear

  Trees, Graphs

Choice of Data structure for solving a problem using an algorithm may dramatically impact its time complexity

Dijkstra Algorithm

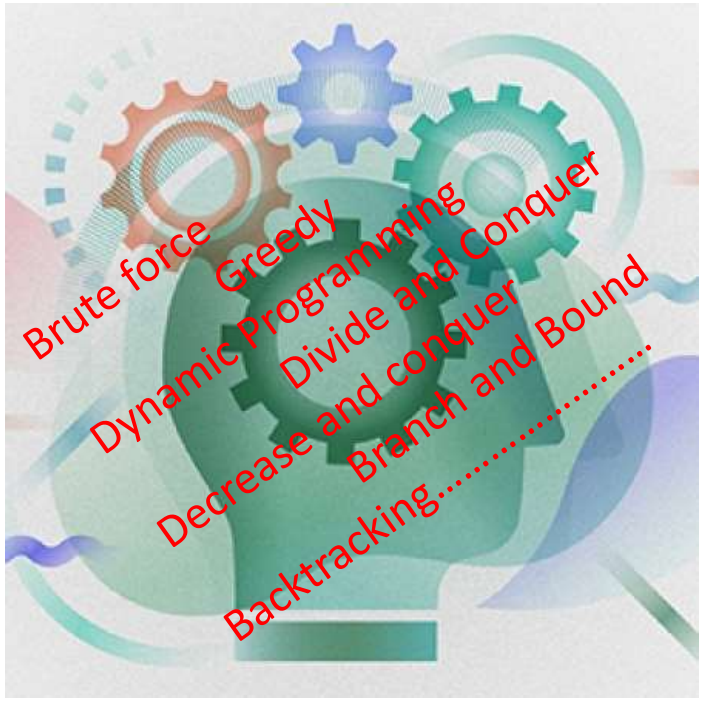
O(VlogV+E) with Fibonacci heap

Algorithm Design Technique

General approach to solving problems algorithmically that is applicable to variety of problems from different areas of computing

ADT serves as heuristic for designing algorithms for new problems for which no satisfactory algorithm exists!!!

Algorithm Designer's Toolkit



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Specifying an algorithm

- Natural Language
- Pseudo Code
- Flowchart

Design and Analysis of Algorithms

Specifying an algorithm

- Natural Language
- Pseudo Code
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Proving Correctness

Exact algorithms

Proving that algorithm yields a correct result for legitimate input in finite amount of time

Approximation algorithms

Error produced by algorithm does not exceed a predefined limit

Analyzing an algorithm

- Efficiency
  - Time efficiency
  - Space efficiency
- Simplicity
- Generality
  - Design an algorithm for the problem posed in more general terms
  - Design an algorithm that can handle a range of inputs that is natural for the problem at hand

Coding an algorithm

- Efficient implementation
- Correctness of program
  - Mathematical Approach: Formal verification for small programs
  - Practical Methods: Testing and Debugging
- Code optimization

THANK YOU

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