

# DESIGN AND ANALYSIS OF ALGORITHMS

## CSE2012

Dr. Ramesh Ragala

January 3, 2022

## • **Course Objectives:**

- To provide a mathematical foundation for analyzing and proving the efficiency of an algorithm.
- To focus on the design of algorithms in various domains of computer engineering.
- To provide familiarity with main thrusts of work in algorithms sufficient to give some context for formulating and seeking known solutions to an algorithmic problem.

- **Expected Course Outcome:** On completion of this course, student should be able to
  - Ability to use mathematical tools to analyze and derive the running time of algorithms and prove the correctness.
  - Explain and apply the major algorithm design paradigms.
  - Explain the major graph algorithms and their analyses.
  - Explain the major String Matching algorithms and their analysis.
  - Explain the major Computational Geometry algorithms and their analysis.
  - Provide algorithmic solutions to real-world problem from various domains.
  - Explain the hardness of real world problems with respect to algorithmic efficiency and learning to cope with it.

## • **Algorithm Development**

- Stages of algorithm development for solving a problem:
  - Describing the problem
  - Identifying a suitable technique
  - Design of an algorithm
  - Proof of Correctness of the algorithm

## ● Algorithm Design Techniques

- Brute force techniques:
  - Travelling Salesman Problem
- Divide and Conquer:
  - Finding a maximum and minimum in a given array
  - Strassen's Matrix multiplication
- Greedy techniques:
  - Huffman Code and Data Compression
  - Fractional Knapsack problem
- Dynamic programming
  - 0/1 Knapsack problem
  - Matrix chain multiplication
  - LCS
  - Travelling Salesman Problem
- Backtracking Technique:
  - N-Queens Problem
  - Knights Tour on Chess Board

- **String Matching Algorithms**

- Naïve String matching Algorithms
- KMP algorithm
- Rabin-Karp Algorithm

- **Computational Geometry Algorithms**

- Line Segments
  - properties
  - intersection
- Convex Hull finding algorithms
  - Graham's Scan Algorithm
  - Jarvis's March Algorithm

## • Graph Algorithms

- All pair shortest path
  - Floyd-Warshall Algorithm
- Network Flows
  - Flow Networks
  - Maximum Flows
  - Ford-Fulkerson Algorithm
  - Push Re-label Algorithm
  - Minimum Cost Flows
  - Cycle Cancelling Algorithm



## • Complexity Classes

- P and NP Class
- Reducibility
- NP-completeness
- SAT (without proof)
- 3-SAT
- Vertex Cover
- Independent Set
- Maximum Clique

- **Approximation and Randomized Algorithms**

- Approximation Algorithms
  - set-covering problem
  - Vertex cover problem
  - K-center clustering
- Randomized Algorithms
  - Hiring problem
  - Finding the global Minimum Cut

- **Recent Trends**

- Guest Lecture by Industry Expert

- Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms, Third edition, MIT Press, 2009.

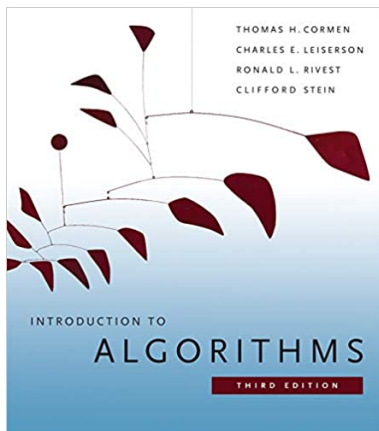


FIGURE: Front cover of the book

- Jon Kleinberg, Éva Tardos, Algorithm Design, Pearson education, 2013

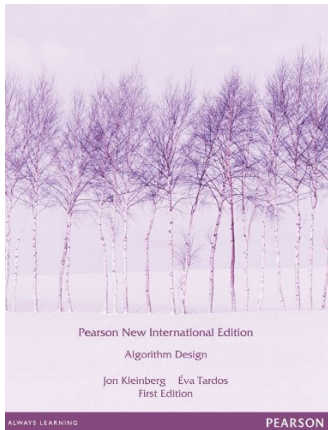


FIGURE: Front cover of the book

- Ravindra K. Ahuja, Thomas L. Magnanti, and James B. Orlin, “Network Flows: Theory, Algorithms, and Applications”, Pearson Education, 2014

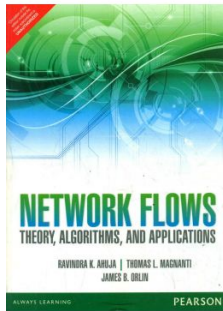


FIGURE: Front cover of the book