

DESIGN AND ANALYSIS OF ALGORITHMS

Sorting and Searching

- insertion sort
- merge-sort
- quick-sort
- lower bound on sorting
- linear-time sorts: counting; radix
- linear-time selection

Tools of the trade

- math background
- pseudo-code conventions
- loop invariants
- asymptotic notation
- divide and conquer; setting up recurrences
- solving recurrences
 - master method and substitution method

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Tools of the trade

- The hiring problem – average-case analysis
 - Linearity of expectation

Randomized Algorithms

- Randomized quicksort
- Randomized selection

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Tools of the trade

Randomized Algorithms

Dynamic Programming

Graphs

- Representation and some properties
- Shortest Paths
- The rod-cutting problem
 - optimal sub-structure
 - overlapping sub-problems
- All-Pairs Shortest Paths
- Knapsack
- Optimal Binary Search Trees

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Tools of the trade

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Greedy Algorithms

Graphs

- Representation and some properties
- Shortest Paths
- **BFS**
- **Spanning Trees**

- **Activity Selection**
- **Huffman** compression **codes**
- **Breadth-First Search** on Graphs
- The **Dijkstra shortest-paths** algorithm
- **Minimum Spanning Trees**

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NP-completeness

Graphs

- Representation and some properties
- Shortest Paths
- BFS
- Spanning Trees
- **Hamiltonian cycles, TSPs, cliques**, etc.

- **Reductions**
- Some NP-hard problems
 - PARTITION
 - KNAPSACK
 - BIN-PACKING
 - HAMILTONIAN CYCLE
 - etc.
- The classes **P, NP, co-NP**
- The **first** NP-complete problem