

Design & Analysis of Algorithms

Lecture 4

Important Problem Types

Important Problem Types

- Problems are limitless
- Interest has been driven either by
 - The problem's practical importance or
 - Some specific characteristics making the problem an interesting research subject;
- Fortunately, these two motivating forces reinforce each other in most cases.

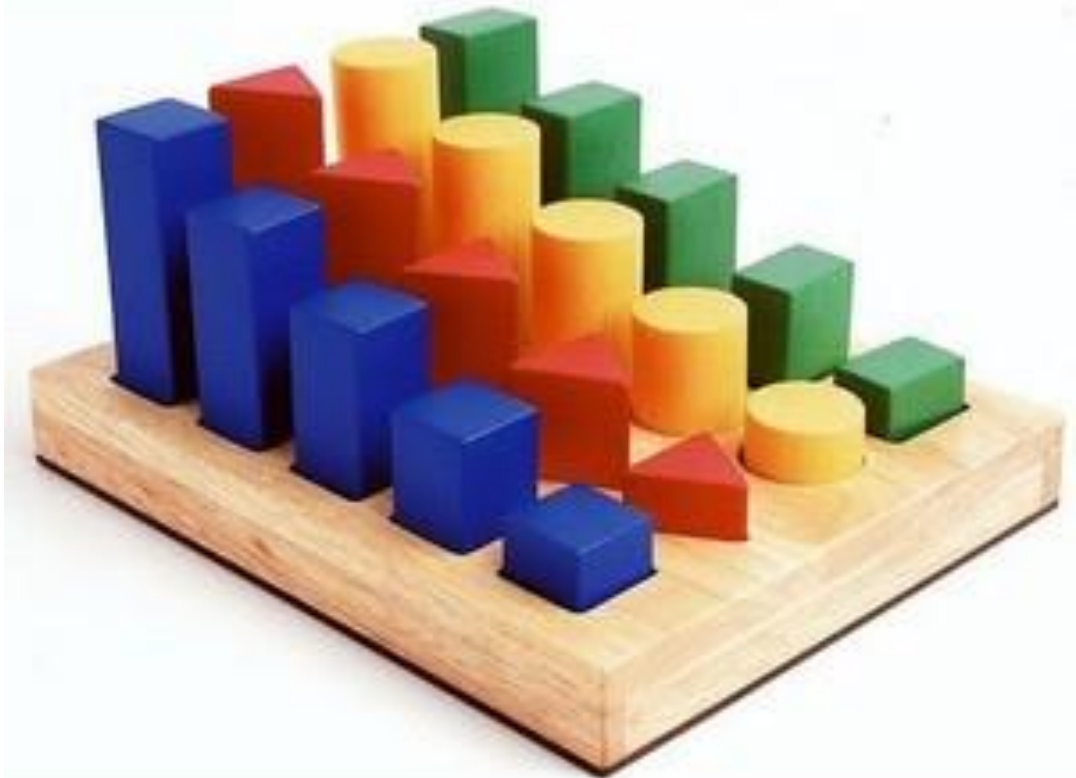
Important Problem Types

- Sorting
- Searching
- String processing
- Graph problems
- Combinatorial problems
- Geometric problems
- Numerical problems

Important Problem Types

Sorting

- Bubble
- Insertion
- Selection
- Heap
- **Merge**
- **Quick**



Important Problem Types



Searching

- Linear Search
 - $O(n)$
- **Binary Search**
 - **$O(\log n)$**
- Jump Search
 - $O(\sqrt{n})$
- Interpolation Search
 - $O(\log \log n)$

Important Problem Types

String processing

- searching for a given word in a text— **string matching**.
- **Boyer and Moore String Matching**

Important Problem Types

Graph problems

- graph-coloring problem
- **The traveling salesman problem (TSP)**
- Circuit board and VLSI chip fabrication
- X-ray crystallography
- Genetic engineering

Important Problem Types

Combinatorial problems

- These are problems that ask, explicitly or implicitly, to find a combinatorial object—such as a permutation, a combination, or a subset—that satisfies certain constraints.
- A desired combinatorial object may also be required to have some additional property such as a maximum value or a minimum cost.

Important Problem Types

Geometric problems

- Deal with geometric objects such as points, lines, and polygons.
- The **closest-pair problem**: given n points in the plane, find the closest pair among them.
- The **convex-hull problem** asks to find the smallest convex polygon that would include all the points of a given set.

Important Problem Types

- **Numerical problems**
- are problems that involve mathematical objects of continuous nature:
- solving equations and systems of equations
- computing definite integrals
- evaluating functions
- and so on.

References

- **Chapter 1:** Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, Pearson Education, Third Edition, 2017
- **Chapter 2:** Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, MIT Press/PHI Learning Private Limited, Third Edition, 2012.

Homework

- Radix Sorting
- Bucket Sorting
- Randomized Sorting
- Jump Search
- Interpolation Search