The Design and Analysis of Algorithm
Important Problem Types

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Sorting

- The sorting problem is to rearrange the items of a given list in non decreasing order.
- Numbers
- Alphabet
- character strings
- Sort student records in alphabetical order of names or by student number or by student grade-point average.
- Such a specially chosen piece of information is called a key. Computer scientists often talk about sorting a list of keys even when the list's items are not records but, say, just integers

Searching

- The searching problem deals with finding a given value, called a search key, in a given set (or a multi set, which permits several elements to have the same value).
- There are plenty of searching algorithms to choose from.
- They range from the straightforward sequential search to a spectacularly efficient but limited binary search and algorithms based on representing the underlying set in a different form more conducive to searching.
- For searching, too, there is no single algorithm that fits all situations best.
- Some algorithms work faster than others but require more memory; some are very fast but applicable only to sorted arrays; and so on.
- Unlike with sorting algorithms, there is no stability problem, but different issues arise.

String Processing

- A string is a sequence of characters from an alphabet.
- Strings of particular interest are text strings, which comprise letters, numbers, and special characters; bit strings, which comprise zeros and ones; and gene sequences, which can be modeled by strings of characters from the four-character alphabet {A, C, G, T}.
- It should be pointed out, however, that string-processing algorithms have been important for computer science for a long time in conjunction with computerlanguages and compiling issues.
- One particular problem—that of searching for a given word in a text—has attracted special attention from researchers. They call it string matching.
- Several algorithms that exploit the special nature of this type of searching have been invented.

Graph Problems

- One of the oldest and most interesting areas in algorithmics is graph algorithms.
- Informally, a graph can be thought of as a collection of points called vertices, some of which are connected by line segments called edges.
- Graphs can be used for modeling a wide variety of applications, including transportation, communication, social and economic networks, project scheduling, and games. Studying different technical and social aspects of the Internet in particular is one of the active areas of current research involving computer scientists, economists, and social scientists.

Graph Algorithms

- graph-traversal algorithms (how can one reach all the points in a network?), shortest-path algorithms (what is the best route between two cities?), and topological sorting for graphs with directed edges (is a set of courses with their prerequisites consistent or self contradictory?).
- Challenging algorithm:
- traveling salesman problem (TSP): is the problem of finding the shortest tour through n cities that visits every city exactly once.
- graph-coloring problem: seeks to assign the smallest number of colors to the vertices of a graph so that no two adjacent vertices are the same color

Combinatorial problems

- From a more abstract perspective, the traveling salesman problem and the graph coloring problem are examples of combinatorial problems.
- A desired combinatorial object may also be required to have some additional property such as a maximum value or a minimum cost.

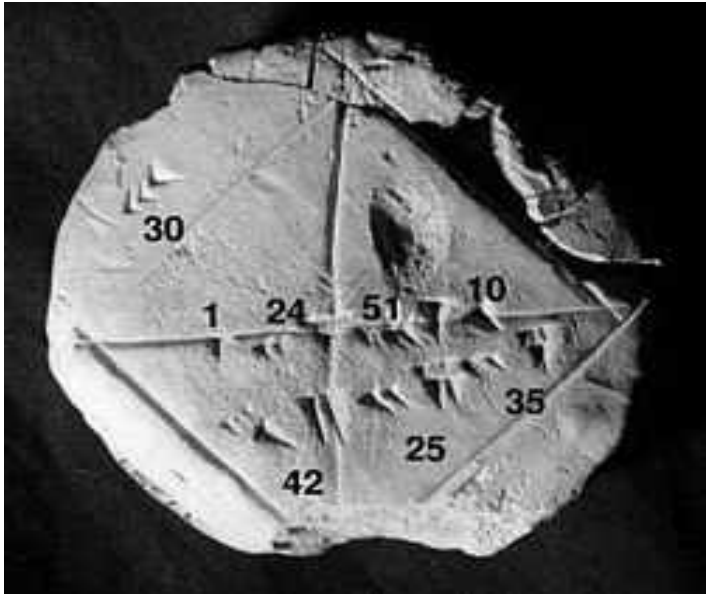
Geometric problems

- Geometric algorithms deal with geometric objects such as points, lines, and polygons.
- The ancient Greeks were very much interested in developing procedures (they did not call them algorithms, of course) for solving a variety of geometric problems, including problems of constructing simple geometric shapes—triangles, circles, and so on—with an unmarked ruler and a compass.
- today people are interested in geometric algorithms with quite different applications in mind, such as computer graphics, robotics, and tomography.
- Closest-pair problem is self-explanatory: 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.

Numerical Problems

Numerical problems, another large special area of applications, are problems that involve mathematical objects of continuous nature:

- solving equations and systems of equations, computing definite integrals, evaluating functions, and so on.



Thanks for your attention

Any question are appreciating