

UNIT - V

RANDOMIZED AND APPROXIMATION ALGORITHMS

Dealing with NP-Hard.

⇒ Many combinatorial problems are NP hard.
↓
takes exponential time
and hence cannot be solved
within a reasonable amount of
time.

⇒ Many of the real world problems
are NP-hard
⇒ NP hard do not have effective polynomial
time algs.

⇒ Exponential algs. cannot be implemented as
they require more computing resources such
as memory and processor time.

⇒ one way to solve is to explore
alternative ways such as randomized and
approximation algorithms.

Randomness ⇒ encountered in games
dice, gambling, puzzles

⇒ decision making

⇒ educated guesses (or heuristics).

INTRODUCTION TO RANDOMIZED ALGS. (2)

⇒ Used in variety of fields such as

- * number theory.
- * computational geometry
- * graph theory
- * distributed computing

⇒ I/p's: for randomized algs. are similar to those of deterministic algs. along with a sequence of random bits that can be used

by the alg. for making random choices.

[I/p's similar to deterministic algs. and random choices are made as part of its logic]

↳ So algs. give diff o/p's even for same i/p.

Run time → in terms of random choices.

Adv

①. Simplicity.

②. Efficient.

③. Alg. complexity is better than most of the deterministic algs.

(3)

Randomness is defined as a state of the system whose behaviour follows no deterministic or predictable pattern.

Randomized alg. also called probabilistic alg. use the concept of randomness as a computing tool for alg. design.

Eg. Maze problem.

→ Deterministic alg. (Eg DFS or BFS) would construct a graph of all paths of the maze and exhaustively try and select a path. → takes random decision.

Deterministic

→ O/p is fixed for
- fixed i/p's. O/p's are
predetermined.

Randomized alg.

① O/p based on random decisions
② Accuracy of o/p is associated with prob.

Randomized alg. have negligible errors that can be ignored in long run. → Very effective

① \Rightarrow Another way of handling NP-hard ④
problem is by using approximation algs.

\Rightarrow For most of the optimization problems,
approximation algs. guarantee to find near-optimal
feasible solutions that close to actual optimal
solutions.

Principle of restriction.

According to this principle, NP-hard
problem (say A) is modified to another prob.
say B by relaxing certain constraints of
the problem such that solution is possible.

\Rightarrow Then modified problem B is solved
to obtain solutions that may approximate
the original solutions of problem A as
approximate solutions

Advant. of approx'

\Rightarrow guarantees near optimal solution
they utilize less resources than exact
exponential alg. and also they are faster
speed

④ They are not applicable for
decision problems.

④ solutions are not exact

Quiz

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- ① Reliability is an issue. [since all algs, not given correct ans. always].
- ② Quality of randomized algs. depends on the quality of the random number generator.

Randomized

→ known for its simplicity

→ very efficient

→ diff. results in every run.

→ Associated with a probability error

Deterministic

Complex compared to randomized algs.

Less eff'c.

no variation in o/p's for same i/p.

Deterministic o/p's.

Design principles

① Concept of witness. ⑤ Failing the given i/p. Satisfies property x . adversary.

② Fingerprinting

③ Checking identities

④ Random sampling and ordering.