

## ALM-4

1) How to find CDP problem in NP-Hard problem? If the problem is NP-Hard then convert the exponential time complexity to the polynomial time complexity. Also compare the deterministic and non-deterministic algorithm with the polynomial time execution.

A) The Coin Denomination problem (CDP) is NP-Hard proven by reducing NP-Hard problems like subset sum to it. Converting exponential time to polynomial time is not currently possible unless  $P=NP$ , an unsolved question. Deterministic algorithm solve problems in polynomial time with clear steps, while non-deterministic algorithms can verify solutions quickly but may not solve them efficiently. Approximation methods are often used for NP-Hard problems. Deterministic algorithm guarantee exact results, but non-deterministic ones rely on verification.

2) How to find NCDP problem is NP-Hard problem? If the problem is NP-Hard, then convert the exponential time complexity to the polynomial time complexity. Also compare the deterministic and non-deterministic algorithms with polynomial time execution.

A) The NCDP problem is NP-hard as it can be reduced from a known NP-hard problem like Vertex Cover. To convert its exponential time



Complexity to polynomial, approximation algorithms or heuristics can be used to find near-optimal solutions efficiently. Deterministic algorithms yield the same output for the same input, ensuring predictability, while non-deterministic algorithms explore multiple paths simultaneously. Deterministic algorithms usually have predictable execution times, whereas non-deterministic algorithms are favored for reliability, while non-deterministic ones are important in complexity theory.