CS F364
Design & Analysis of Algorithms

ALGORITHMS - COMPLEXITY

Structure of problems:

What makes problems hard?

Examples

Structure of Problems – Path problems

- Shortest Path problem is solvable in polynomial time:
  - Dijkstra's algorithm
- Longest Path problem is $\mathbb{NP}$-complete
  - Exercises:
    1. Provide an input instance for this problem for which Dijkstra's algorithm – naively modified – will fail.
    2. Argue that **Greedy Choice and Optimal Sub-structure** properties do not hold for this problem.
    3. Provide an intuitive explanation of why this problem is much more difficult than the Shortest Path problem

Structure of Problems – Network Problems

- Broadcast Path problem is tractable
  - There exist polynomial time algorithms for Minimal Spanning Trees.
- Multicast Path (Steiner Tree) problem is $\mathbb{NP}$-Complete
  - Exercises:
    1. Provide input instances for this problem for a typical MST algorithm – naively modified – will fail.
    2. Argue that **Greedy Choice and Optimal Sub-structure** properties do not hold for this problem.
    3. Provide an intuitive explanation of why this problem is much more difficult than the MST problem