School of Computing

NWC

SRM INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University u/s 3 of UGC Act, 1956)

OPTIMIZED *DIJKSTRA'S ALGORITHM* FOR FASTER SHORTEST PATH CALCULATION

FINDING THE SHORTEST PATH FROM A SINGLE SOURCE TO ALL NODES IN A WEIGHTED GRAPH WITH NON-NEGATIVE EDGES.

LIMITATIONS OF STANDARD DIJKSTRA'S ALGORITHM

- CAN BE MEMORY-INTENSIVE FOR DENSE GRAPHS.
- DOESN'T HAVE A WAY TO PRUNE UNNECESSARY PATHS EARLY.
- SLOWER FOR LARGER GRAPHS
- ASSUMES ALL EDGE WEIGHTS ARE NON-NEGATIVE

TIME COMPLEXITY

O(V^2)

SPACE COMPLEXITY

O(V)

ADVANTAGES OF OPTIMISED DIJKSTRA'S ALGORITHM

- FIBONACCI HEAP: IMPROVES PRIORITY QUEUE OPERATIONS
- BI-DIRECTIONAL SEARCH: SEARCHES FROM BOTH SOURCE AND DESTINATION, REDUCING WORK BY ~50%.
- UPDATES DISTANCES TO NEIGHBOURS

TIME COMPLEXITY

O(V) (A* Heuristic)

SPACE COMPLEXITY

O(KV) Compressed Graph, where k is a small constant)

Future Applications of Optimized Dijkstra's Algorithm

Smart Transportation & Autonomous Systems

- Faster navigation for self-driving cars & delivery drones
- Real-time traffic rerouting for ride-sharing & logistics

Robotics & AI Pathfinding

- Warehouse robots & drones optimize movement
- Faster game AI & NPC navigation

Network & Communication Systems

- 5G & Internet routing for reduced latency
- Efficient data center traffic management

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