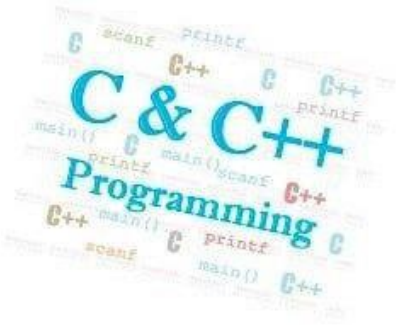
Data Structure & Algorithms

Assignment – 2



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Contents

Time and space analysis

1- Dijkstra algorithm
   - Time complexity: O (E * log(V)).
   - Space: O (V + E).

2- Bellman-Ford algorithm
   - Time complexity: O (V * E).
   - Space: O (E).

3- Floyd-Warshall algorithm
   - Time complexity: O (V^3).
   - Space: O (V^2).

Comparison between the three algorithms

1- Mean time to get the shortest path between 2 specific nodes.

V	Density	E	Dijkstra	Bellman-Ford	Floyd-Warshall
100	0.02	198	333	61	5,227
100	1	9900	3,440	7,414	9,800
250	0.001	62	345	66	19,640
250	1	62250	8,743	16,390	50,062
500	0.05	12475	5,965	9,625	289,280
500	1	249500	18,656	33,511	298,518
750	0.0001	56	315	56	461,570
1000	0.001	999	356	506	1,092,484
1000	1	999000	36,706	45,341	2,336,306
2000	0.009	35982	14,175	19,718	18,300,466
2500	1	6247500	137,411	155,858	36,638,937
5000	0.005	124975	25,009	27,144	291,155,355
5000	1	24995000	454,361	396,862	291,534,359

2- Mean time to get the shortest path between all pairs of nodes.

V	Density	E	Dijkstra	Bellman-Ford	Floyd-Warshall
100	0.02	198	5,196	9,563	5,308
100	1	9900	37,811	33,762	9,585
250	0.001	62	1,249	2,700	23,982
250	1	62250	292,301	300,588	47,598
500	0.05	12475	255,860	138,173	292,028
500	1	249500	1,927,037	2,388,335	300,550
750	0.0001	56	3,679	3,742	476,085
1000	0.001	999	8,508	35,007	1,096,072
1000	1	999000	16,029,209	19,356,004	2,385,315
2000	0.009	35982	3,820,865	2,204,556	18,358,946
2500	1	6247500	263,838,253	335,881,386	39,287,846
5000	0.005	124975	42,622,544	21,390,310	293,232,259
5000	1	24995000	-	-	290,298,737

Conclusion:

- In single source shortest path (SSSP) problem, never use Floyd-Warshall algorithm, it's the worst one.

- In SSSP problems, if the graph density is low, use Bellman-Ford algorithm, otherwise use Dijkstra's algorithm in case of non-negative weight.

- In All pairs shortest path (APSP) problems, in low densities use Dijkstra or Bellman-Ford algorithms, otherwise use Floyd-Warshall.

- In large graphs (large V) with high density use Floyd-Warshall algorithm, since it has the lowest space complexity.

THANKS 😊