

Parallel Shortest Path Algorithms

15-418/618 Project

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SUMMARY

Dijkstra's Algorithm

Bellman-Ford Algorithm

OpenMP

MPI

GHC

PSC

BACKGROUND

Graphs and Single Source Shortest Path Problem



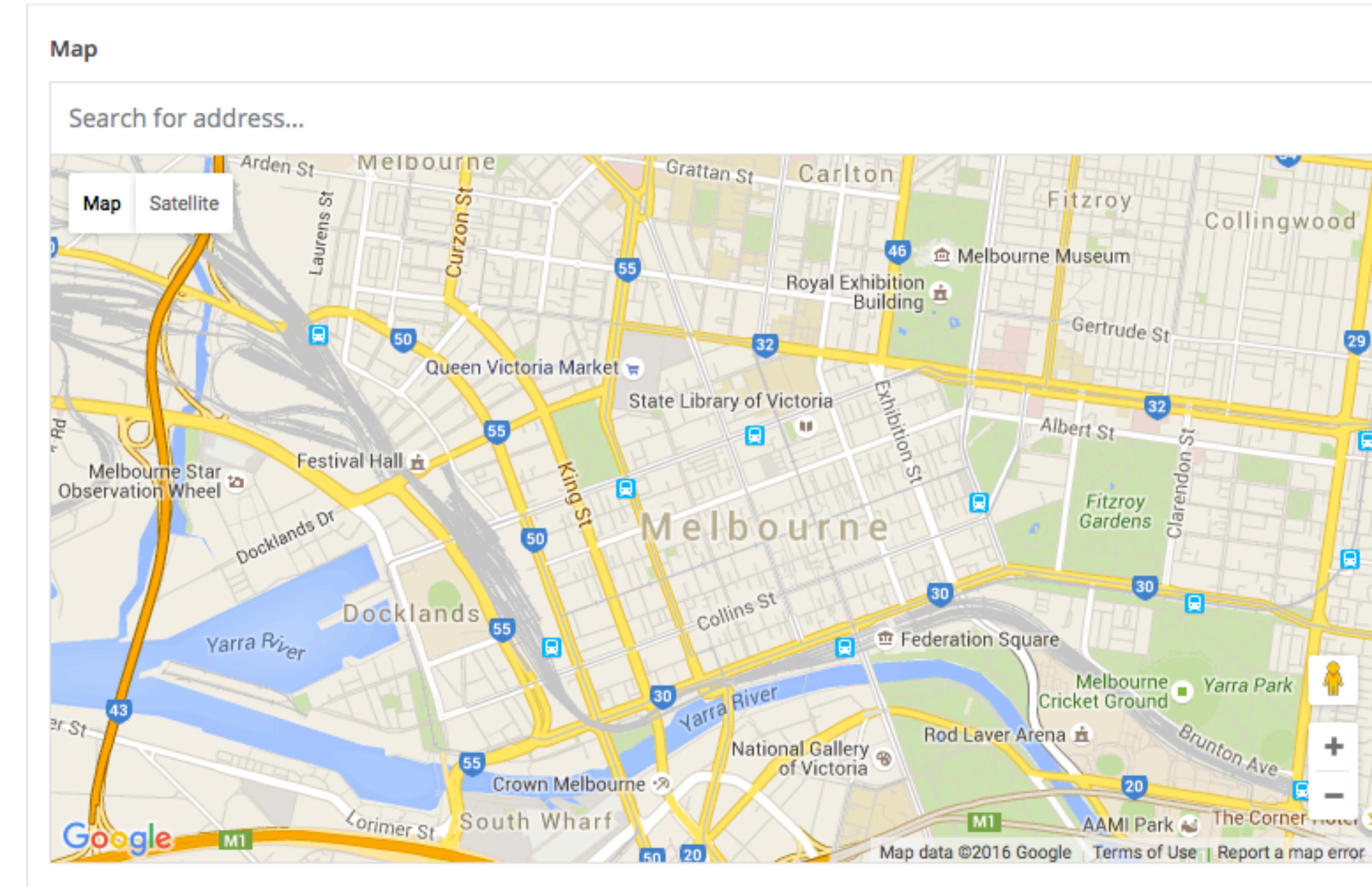
BACKGROUND

Graphs and Single Source Shortest Path Problem



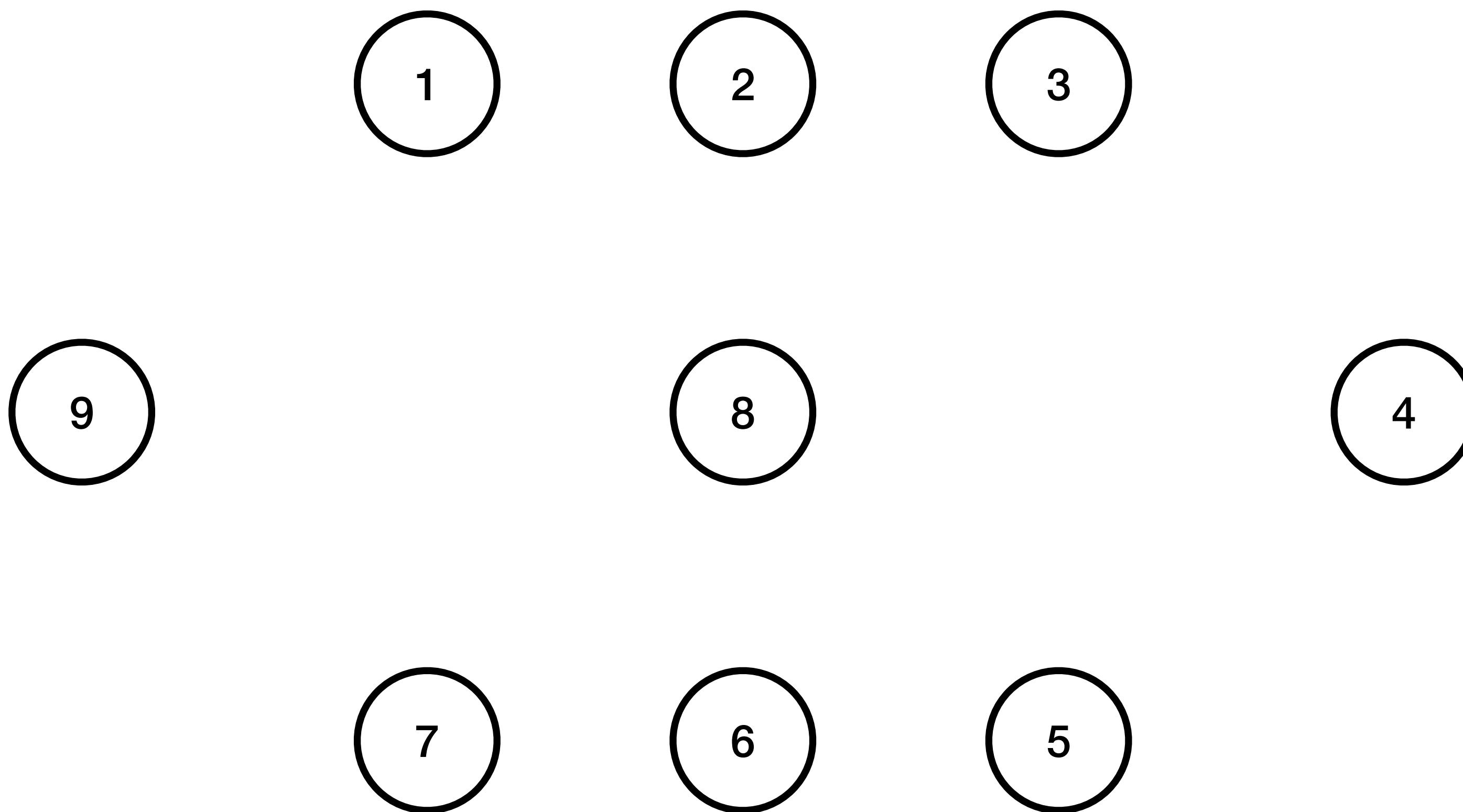
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Graphs and Single Source Shortest Path Problem



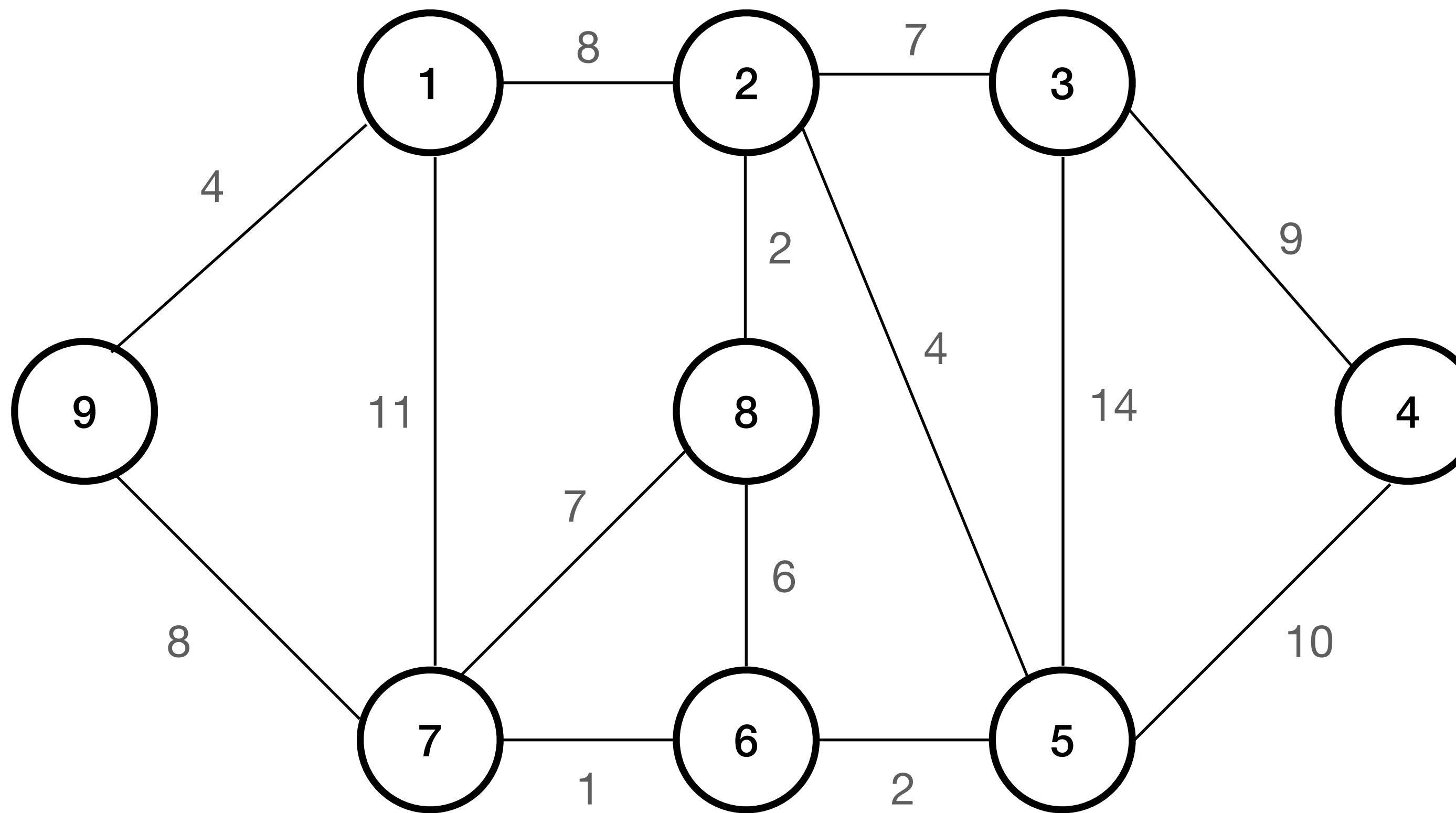
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Graphs and Single Source Shortest Path Problem



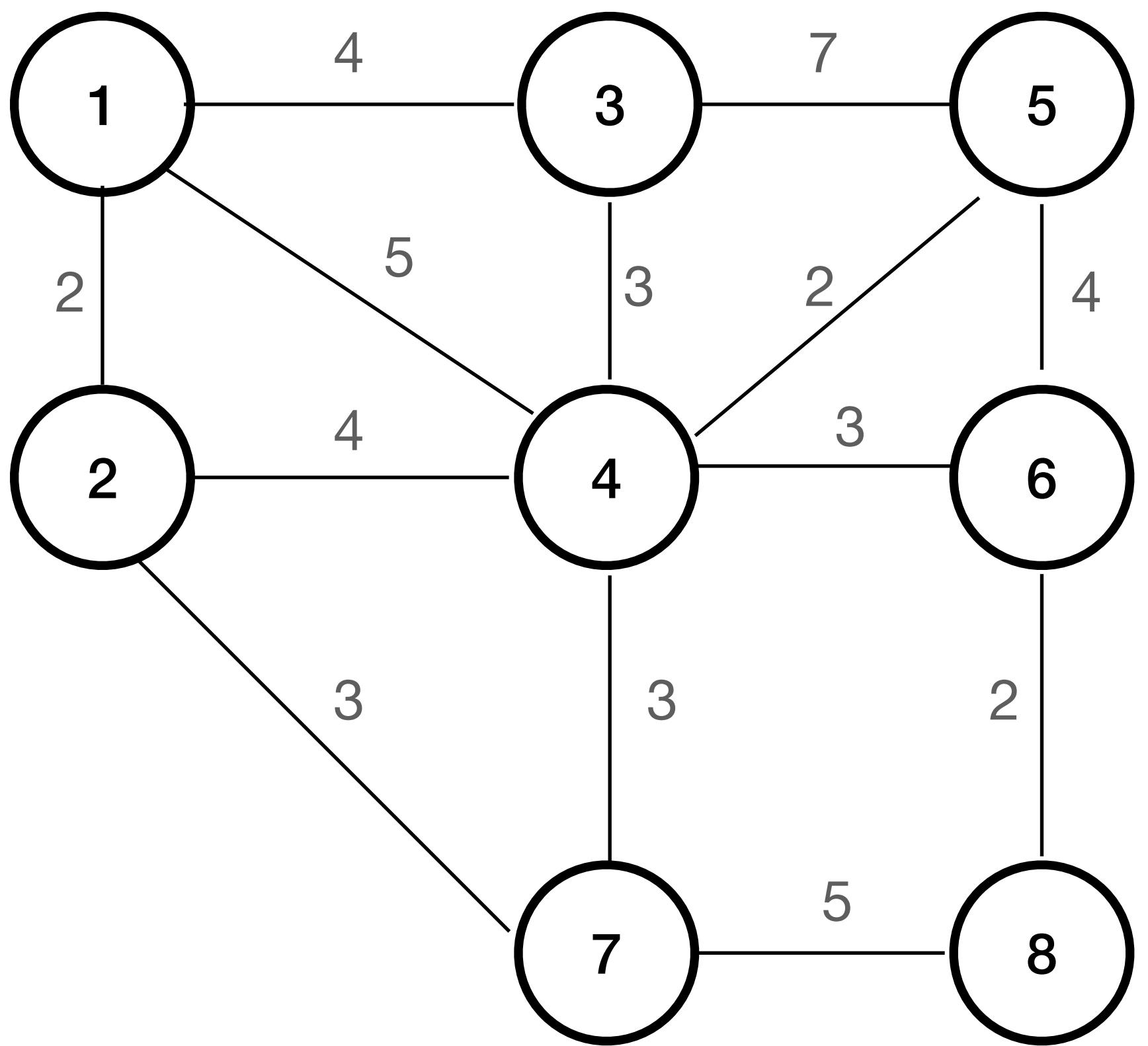
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Graphs and Single Source Shortest Path Problem



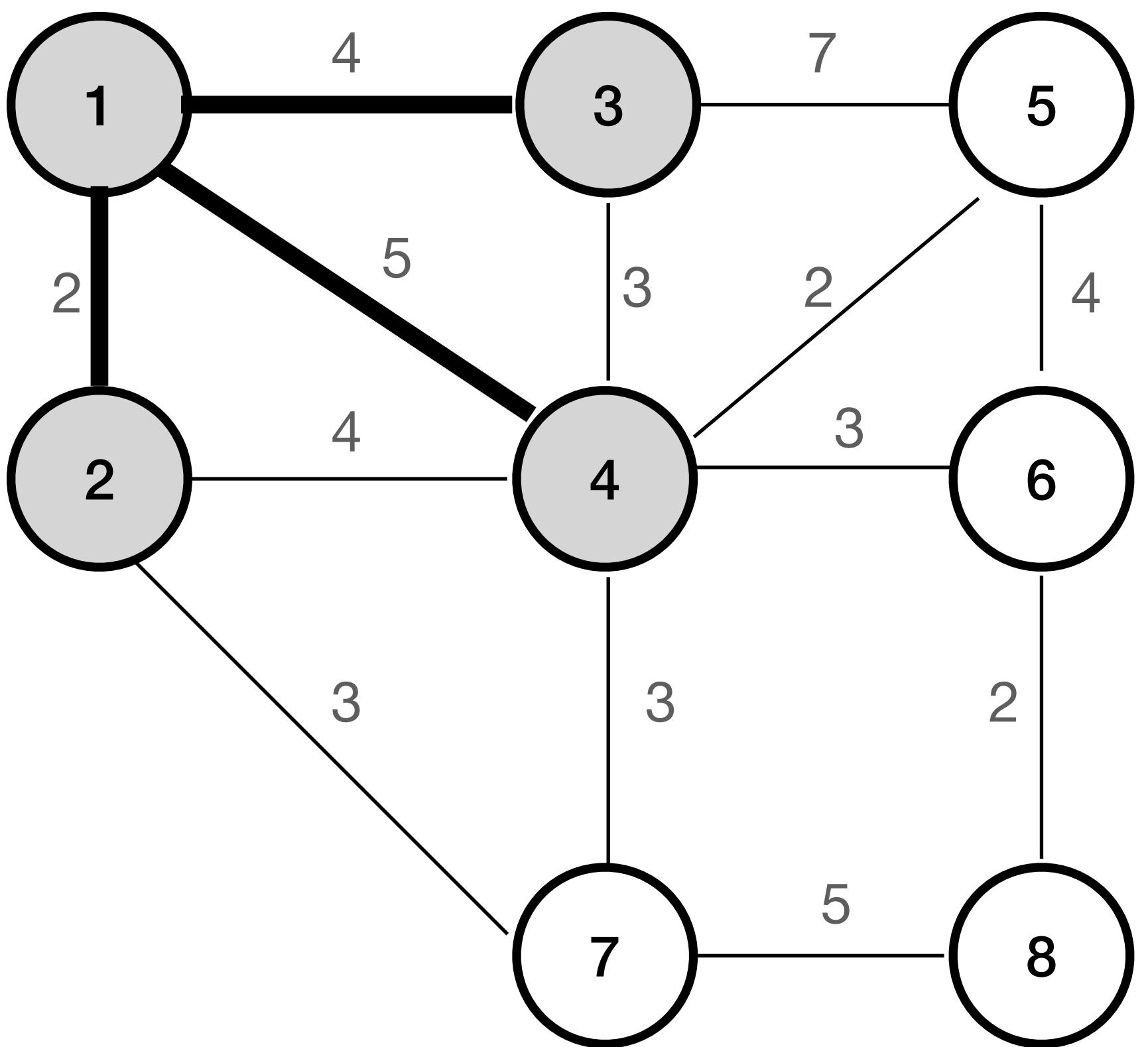
BACKGROUND

Bellman-Ford Algorithm



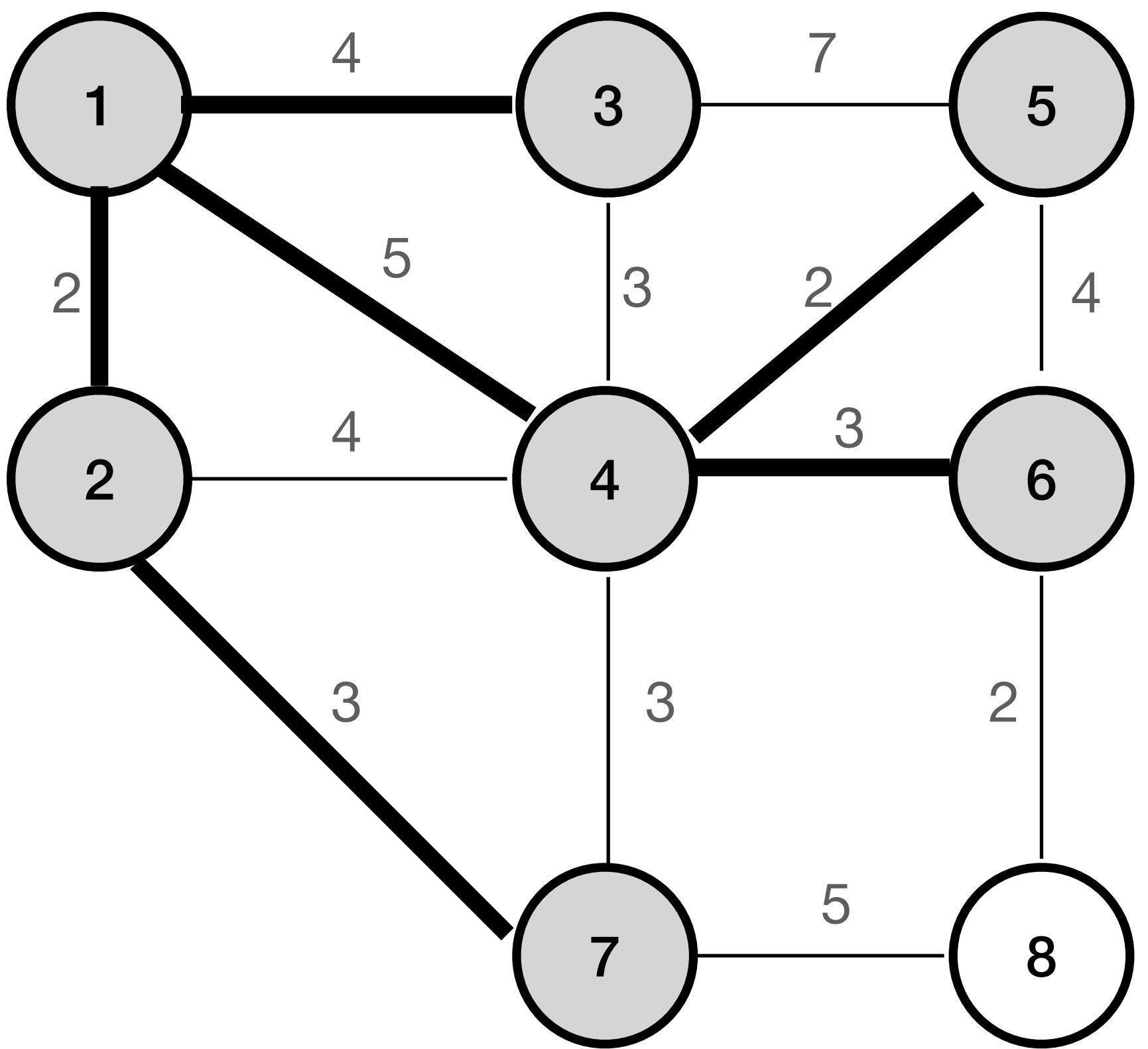
BACKGROUND

Bellman-Ford Algorithm



BACKGROUND

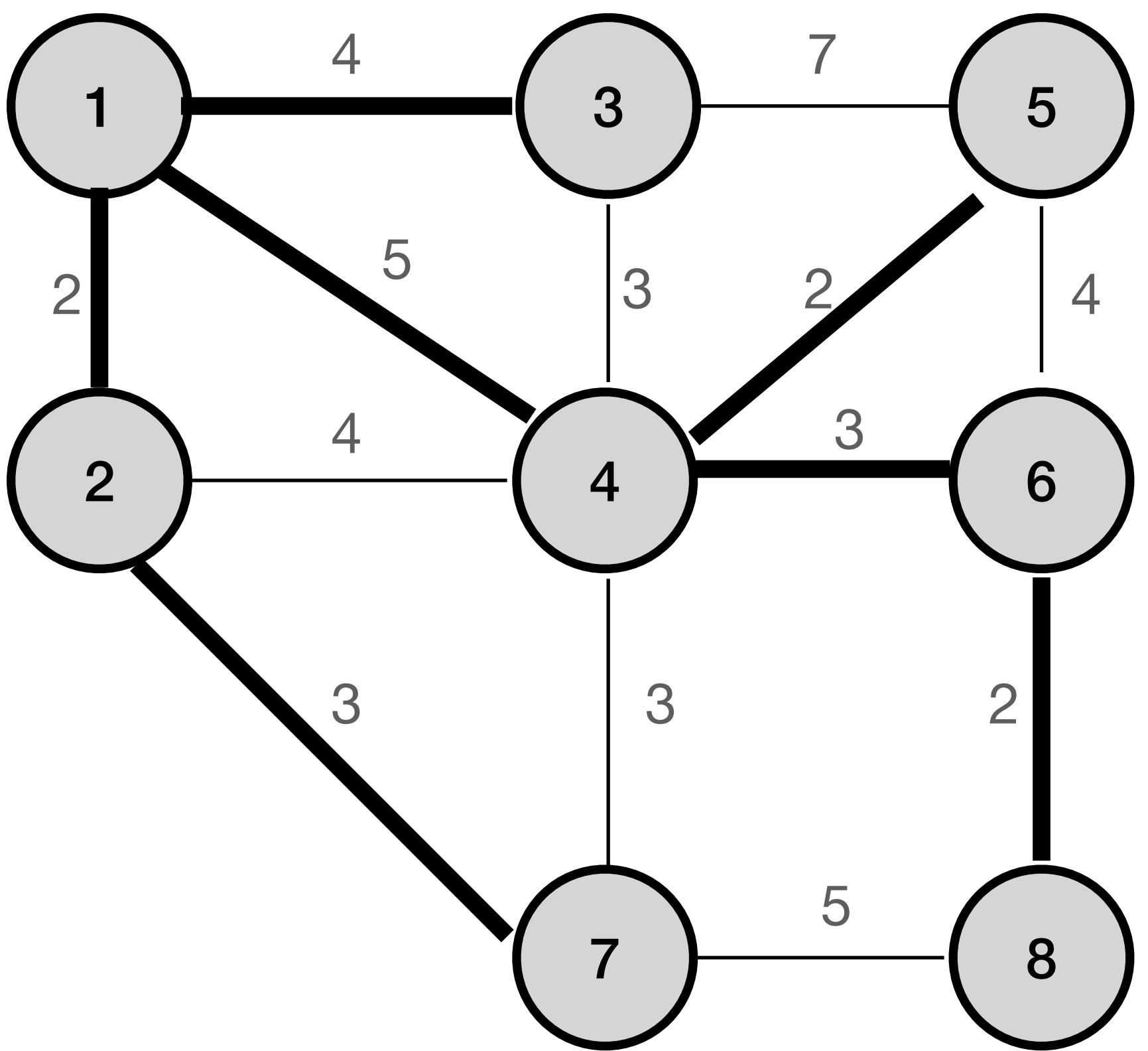
Bellman-Ford Algorithm



1	1	2	3	4	5	6	7	8
0	2	4	5	∞	∞	∞	∞	∞
0	2	4	5	7	8	5	∞	∞

BACKGROUND

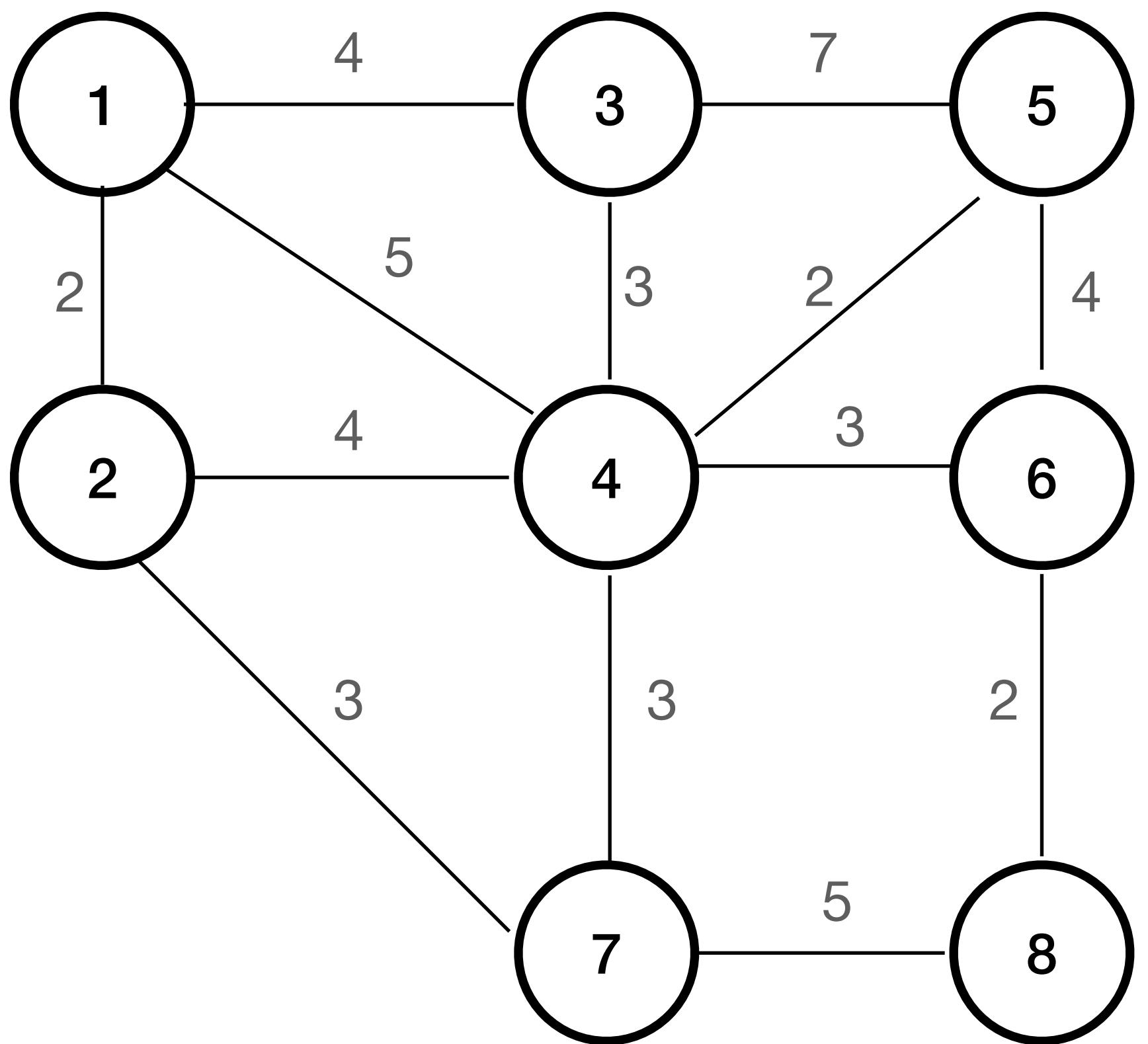
Bellman-Ford Algorithm



	1	2	3	4	5	6	7	8
1	0	1	2	3	4	5	6	7
0	1	0	2	4	5	∞	∞	∞
0	2	4	5	7	8	5	∞	
0	2	4	5	7	8	5	10	

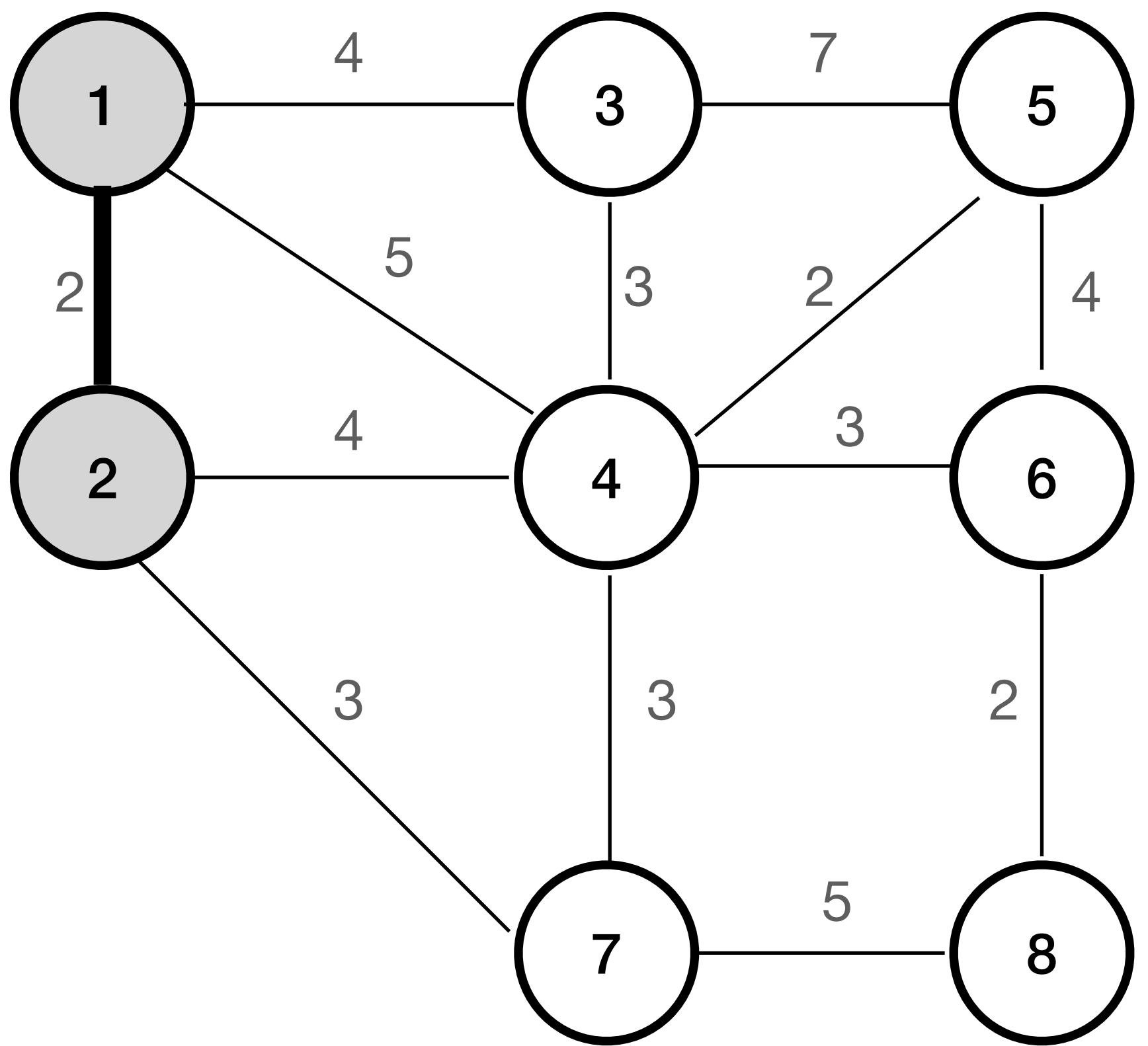
BACKGROUND

Dijkstra's Algorithm



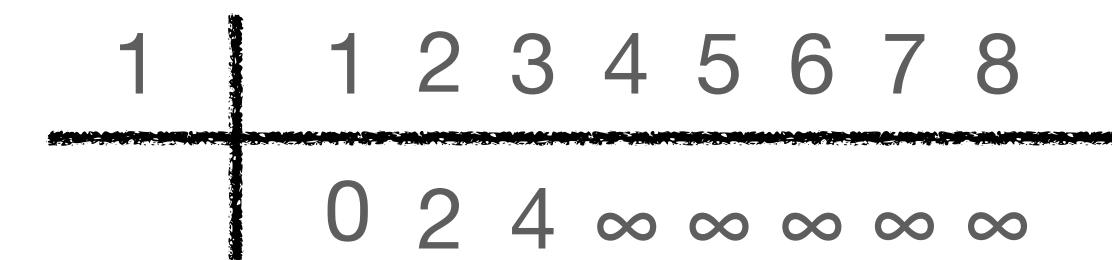
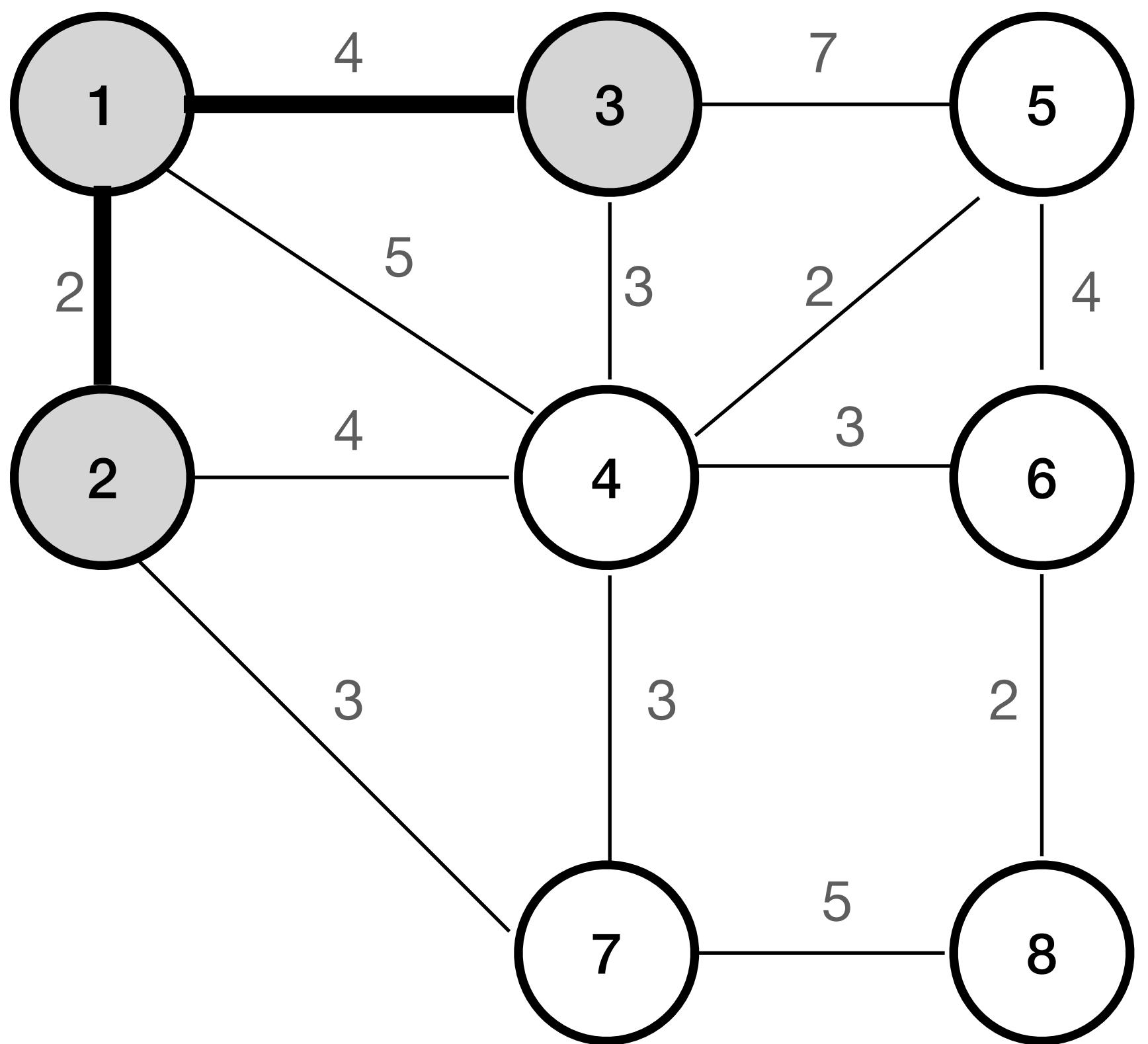
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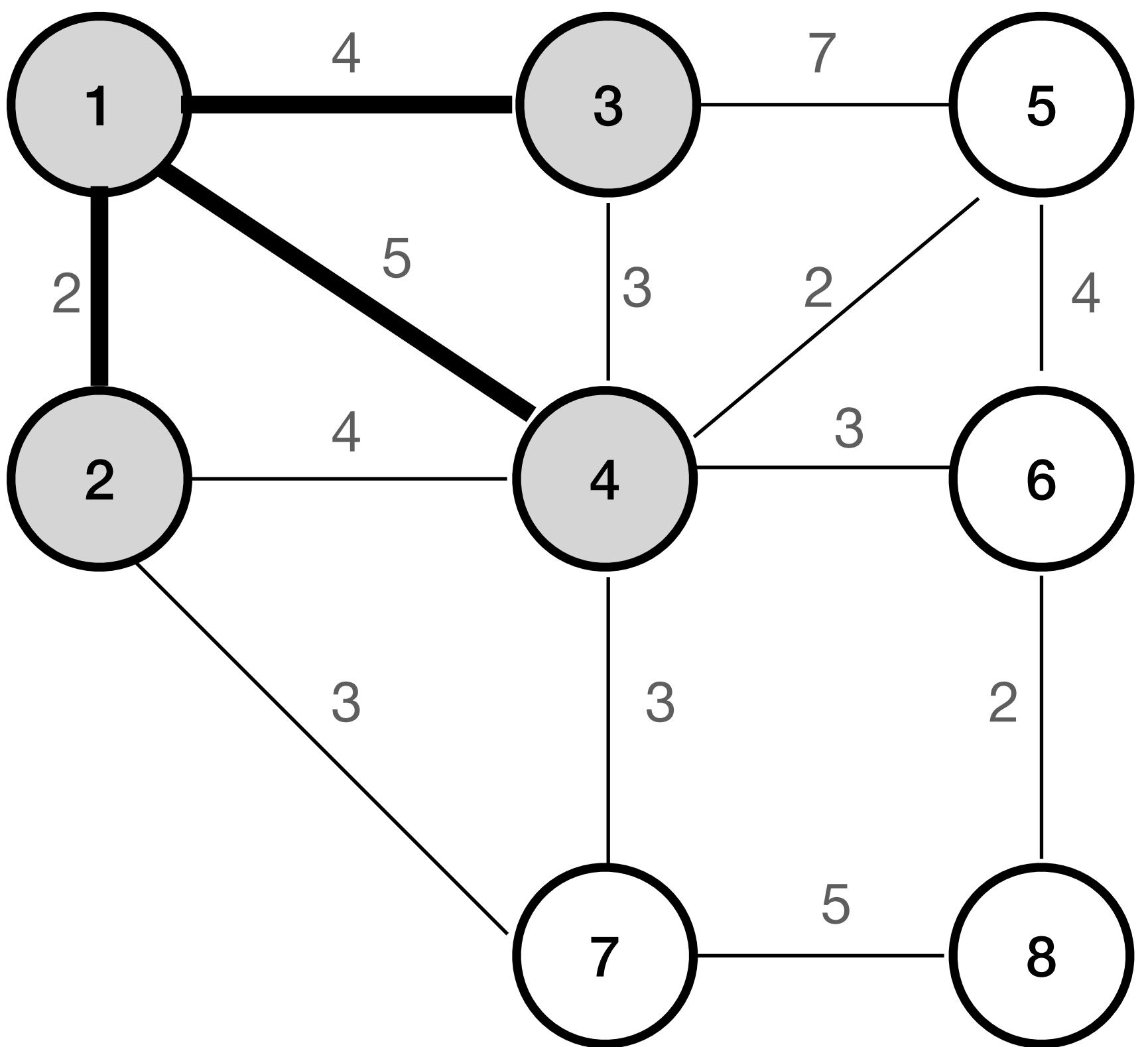
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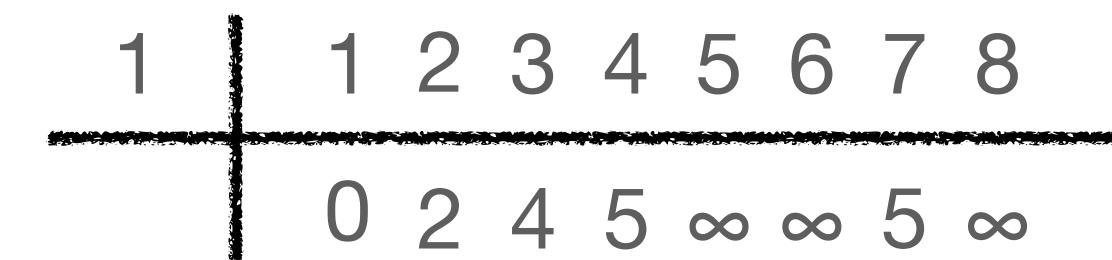
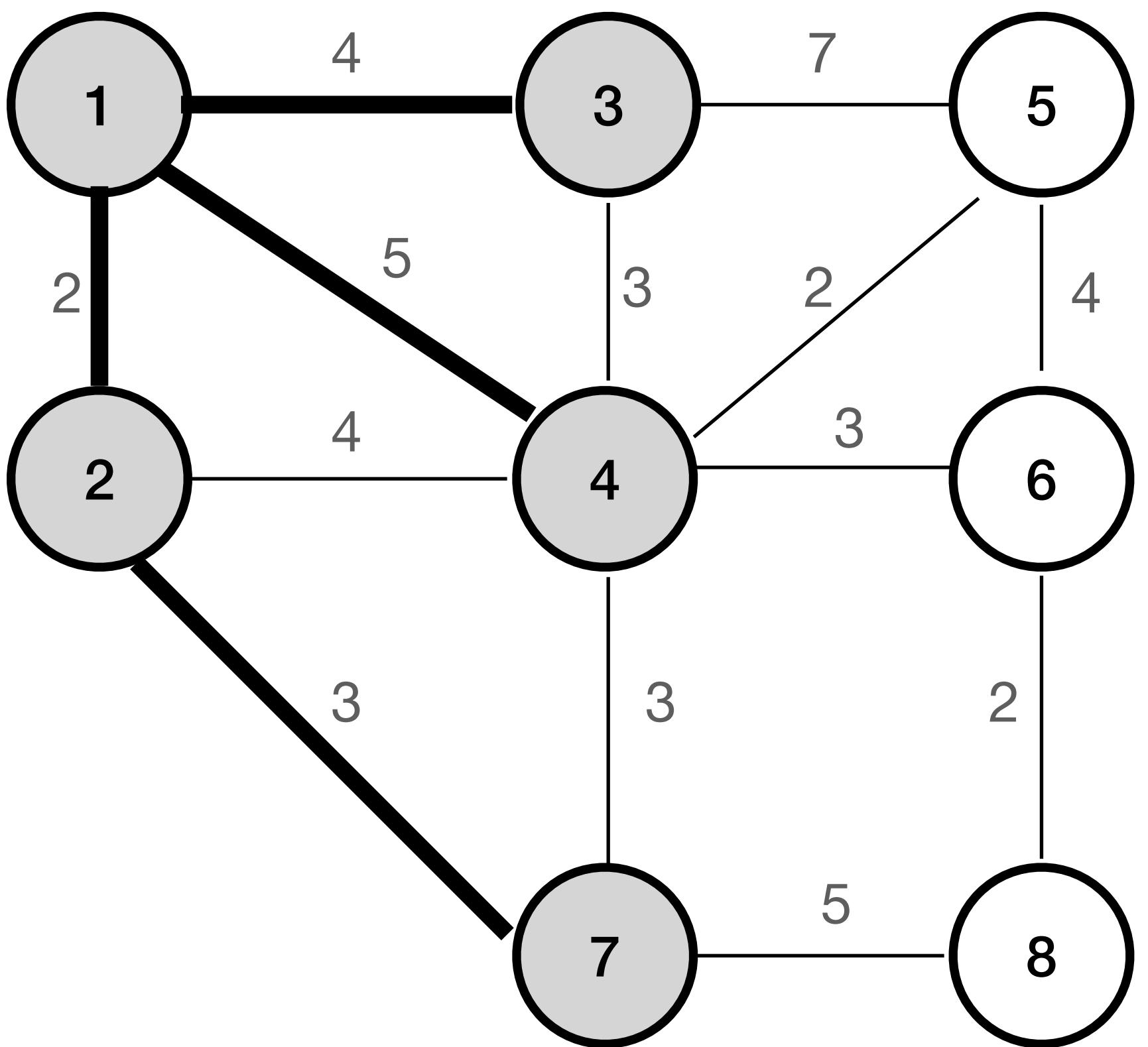
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Dijkstra's Algorithm



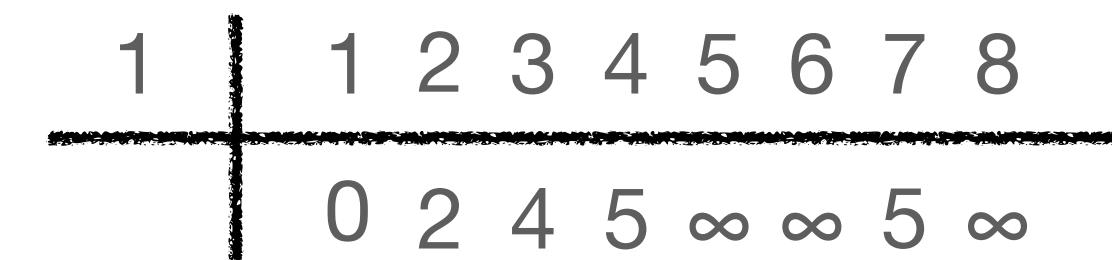
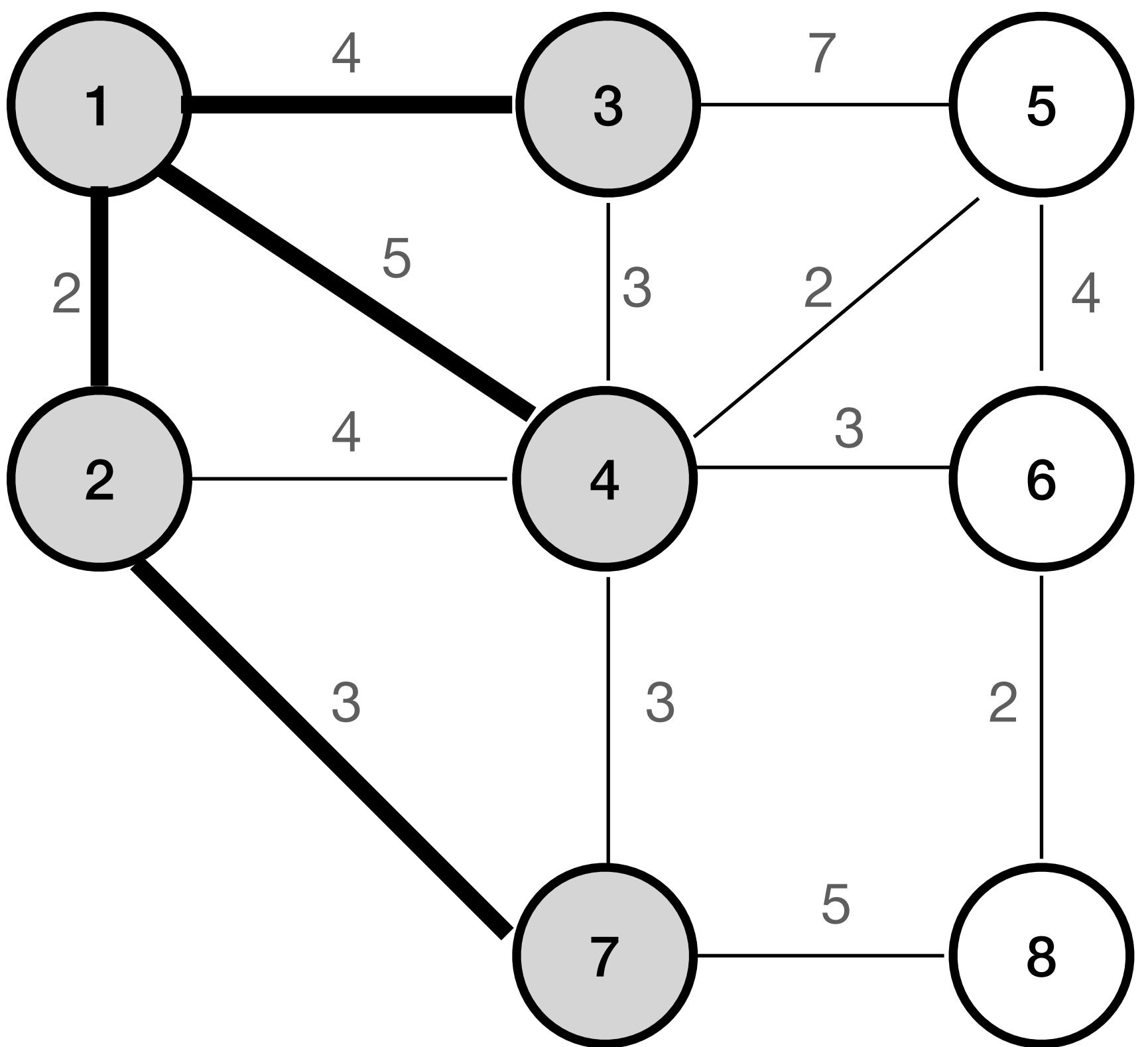
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Dijkstra's Algorithm



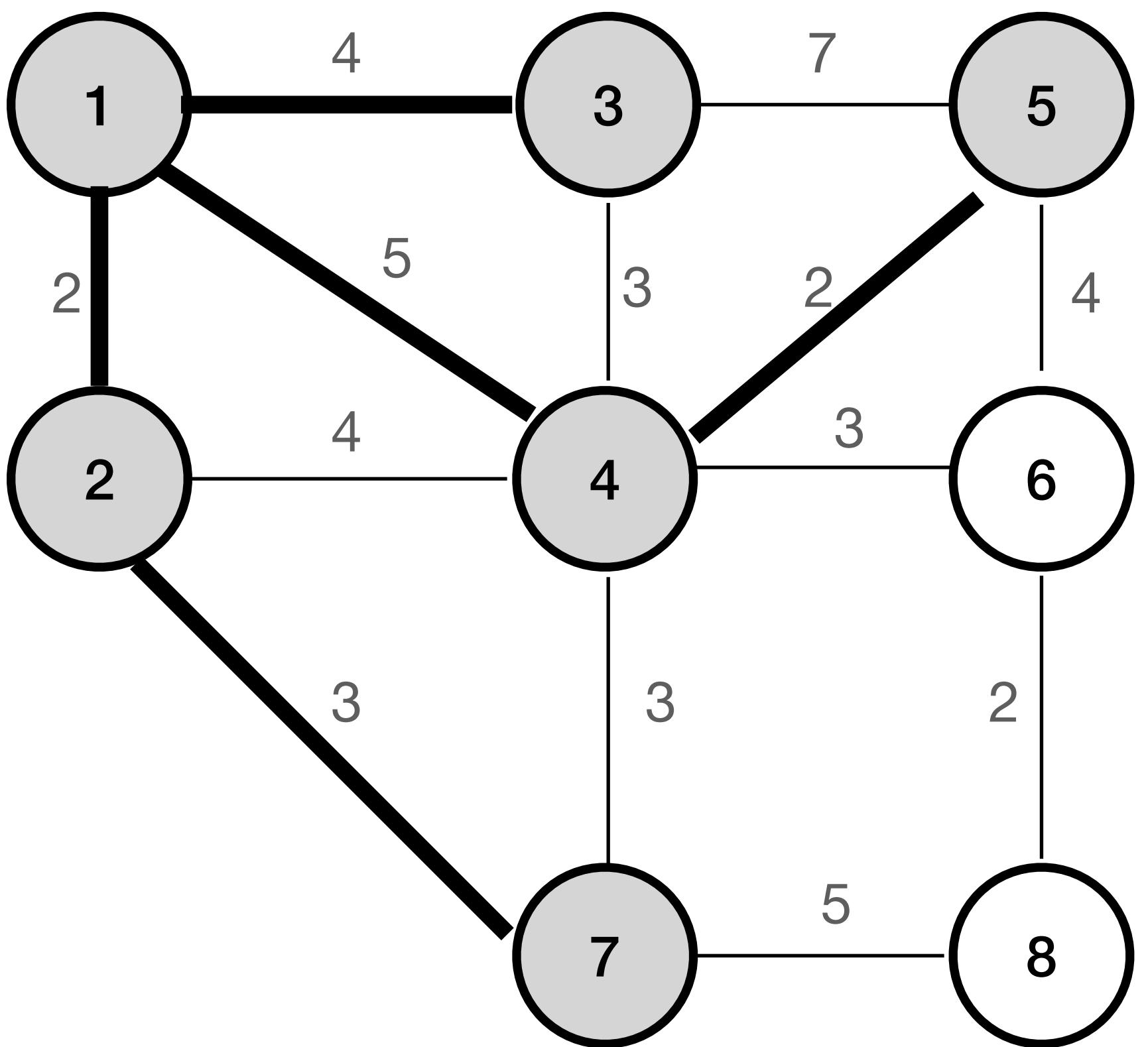
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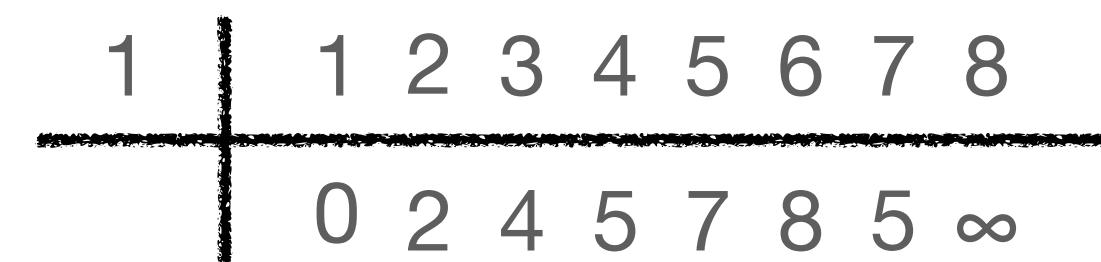
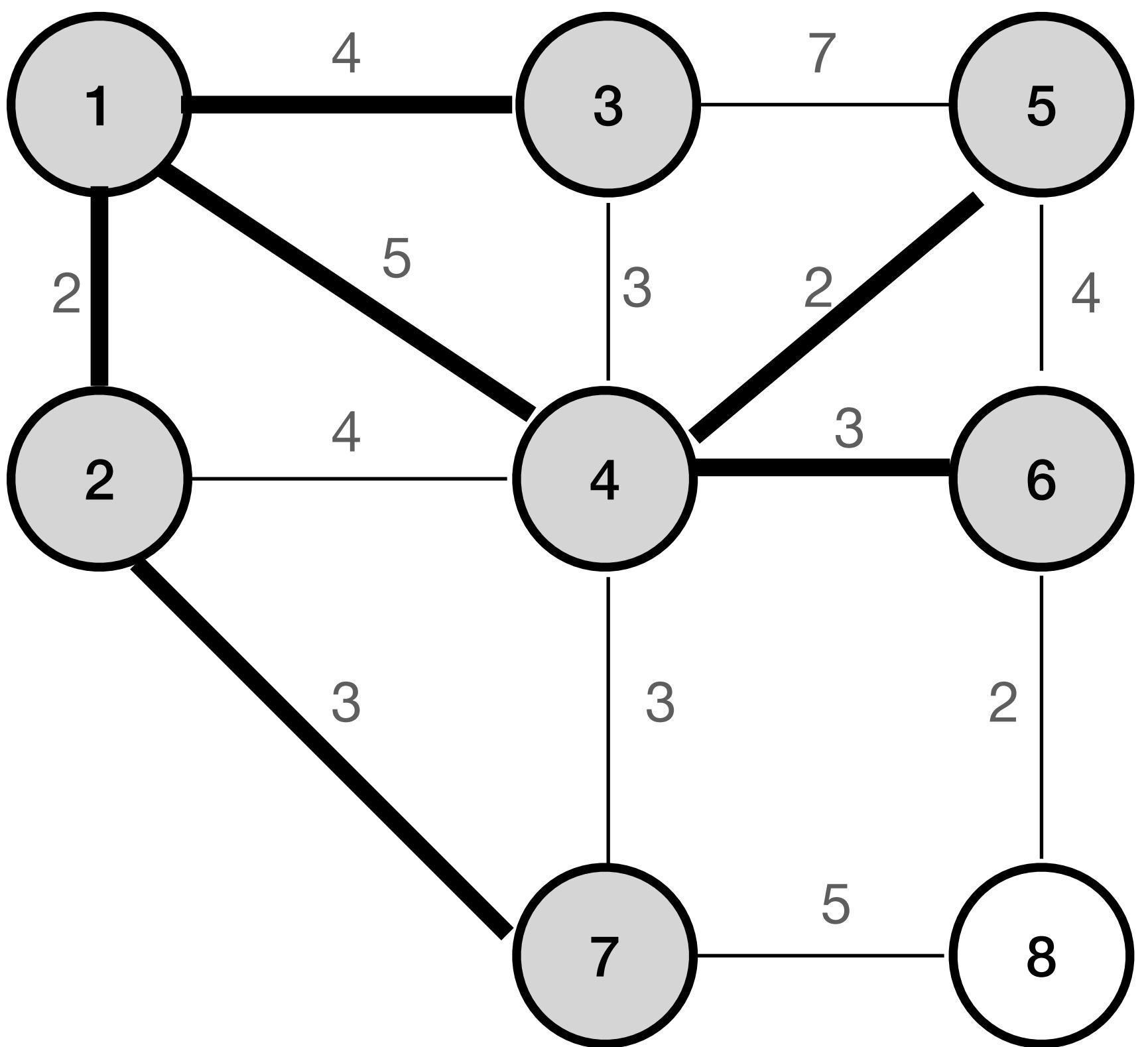
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Dijkstra's Algorithm



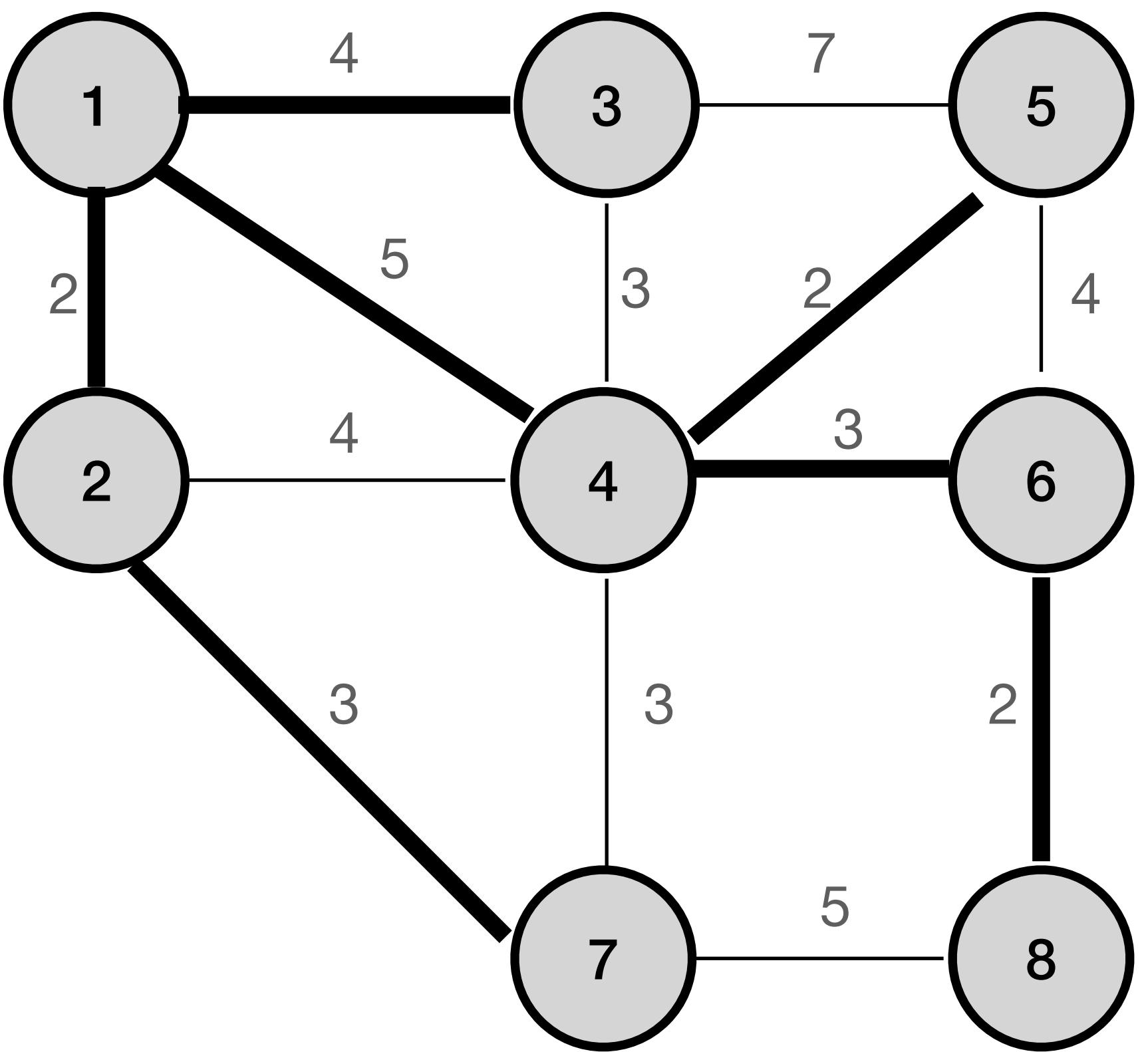
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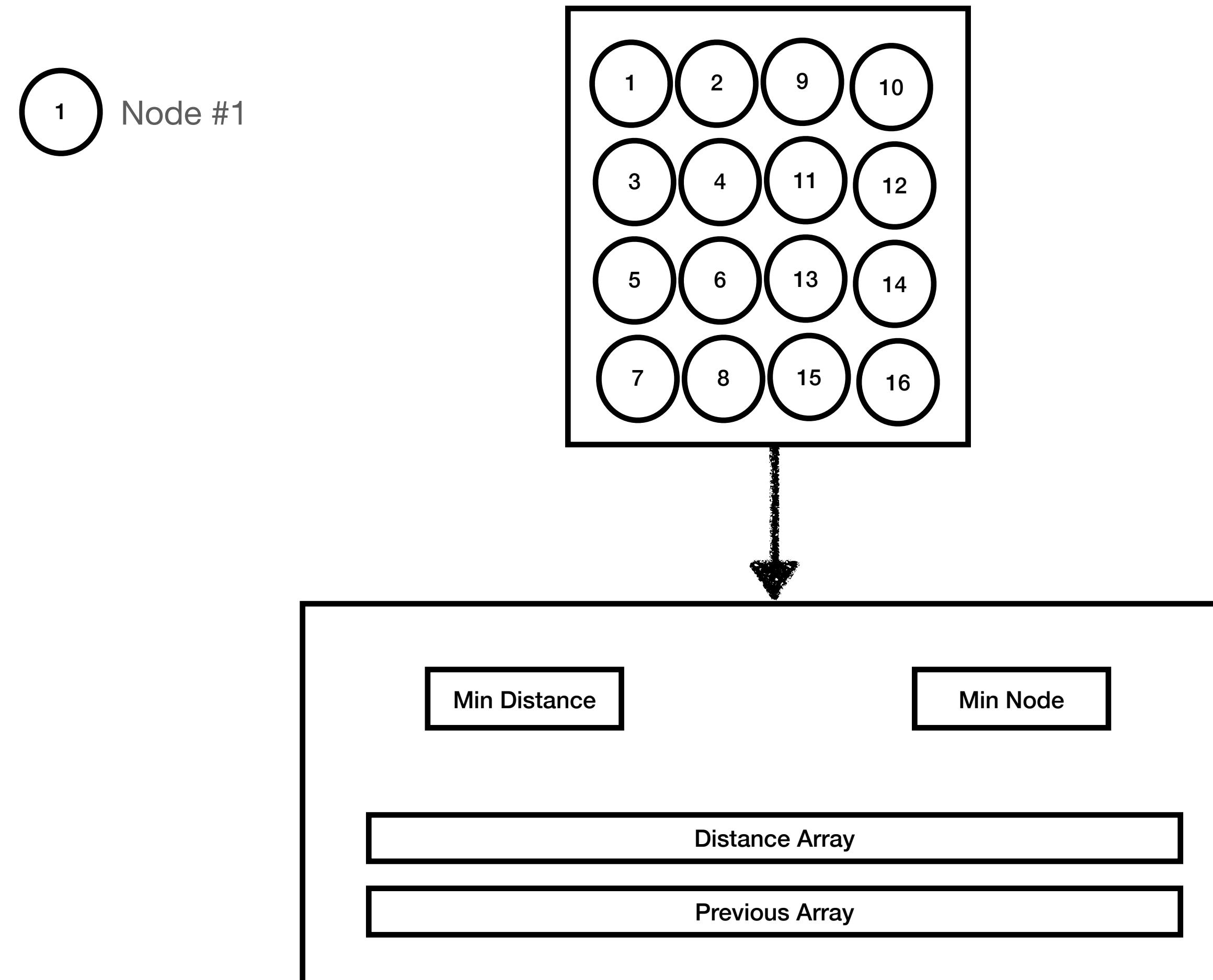
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Dijkstra's Algorithm



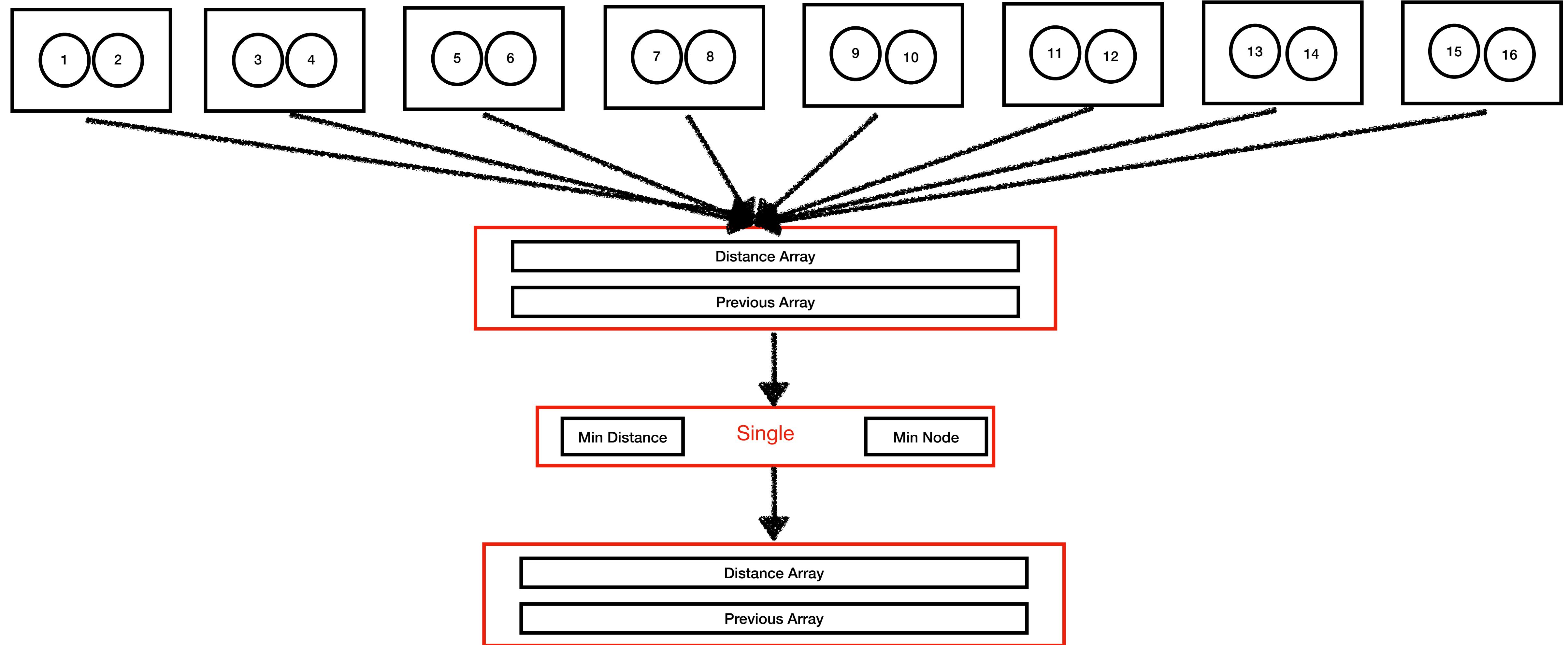
APPROACH

Parallel Dijkstra with OpenMP



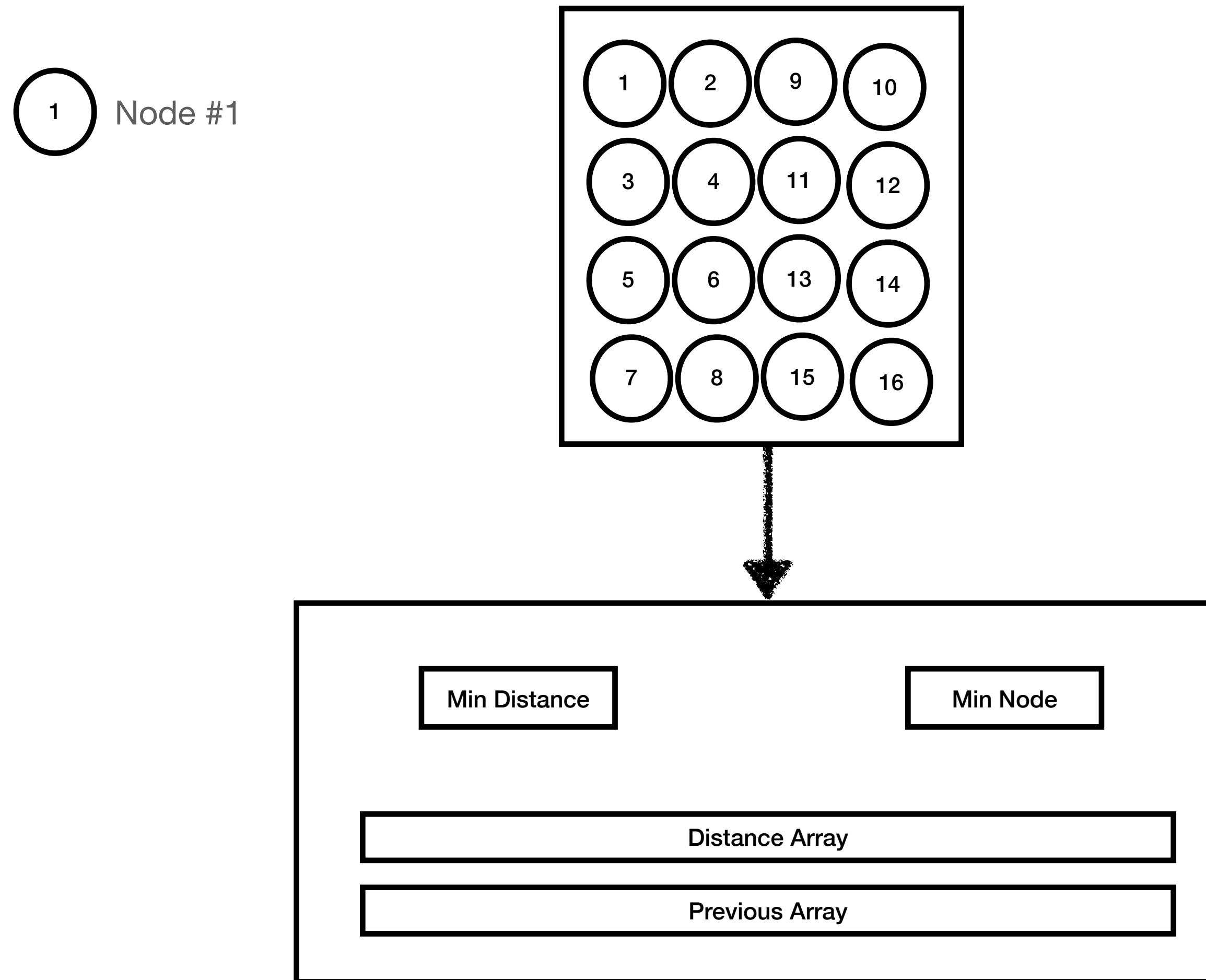
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Parallel Dijkstra with OpenMP



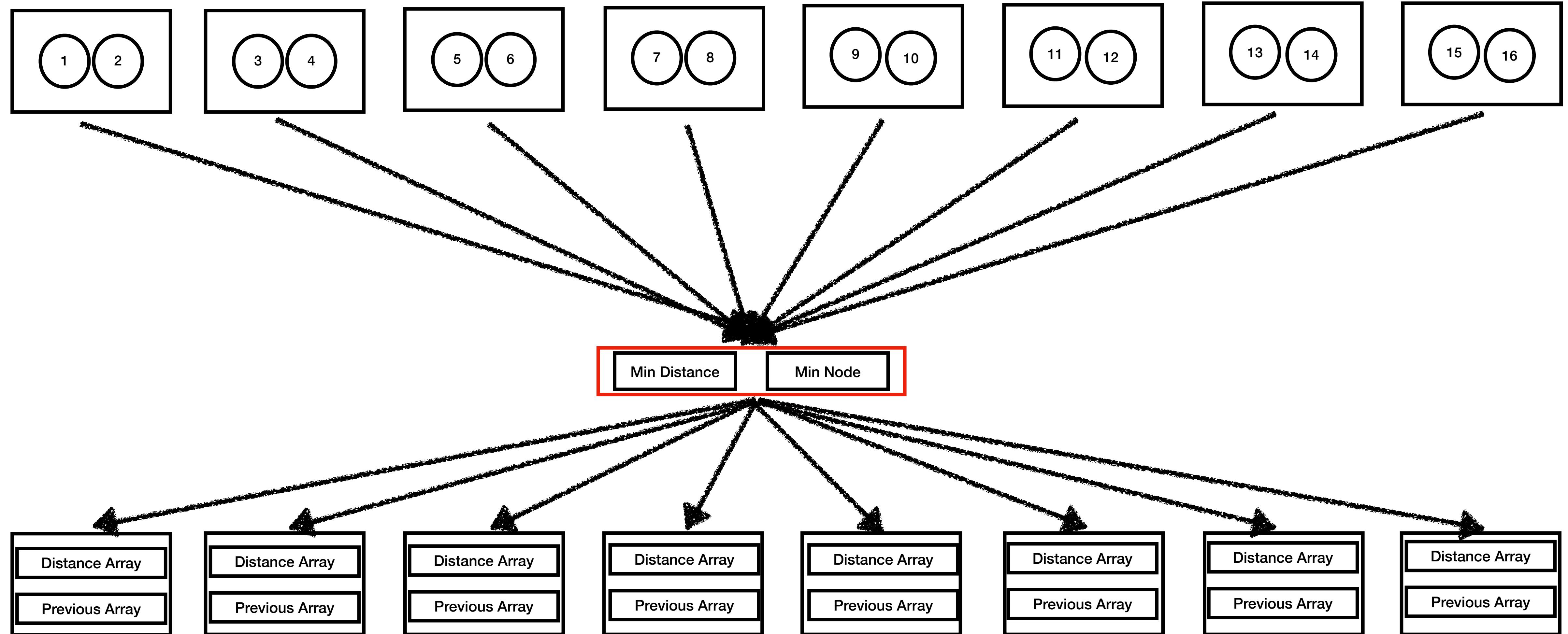
APPROACH

Parallel Dijkstra with MPI



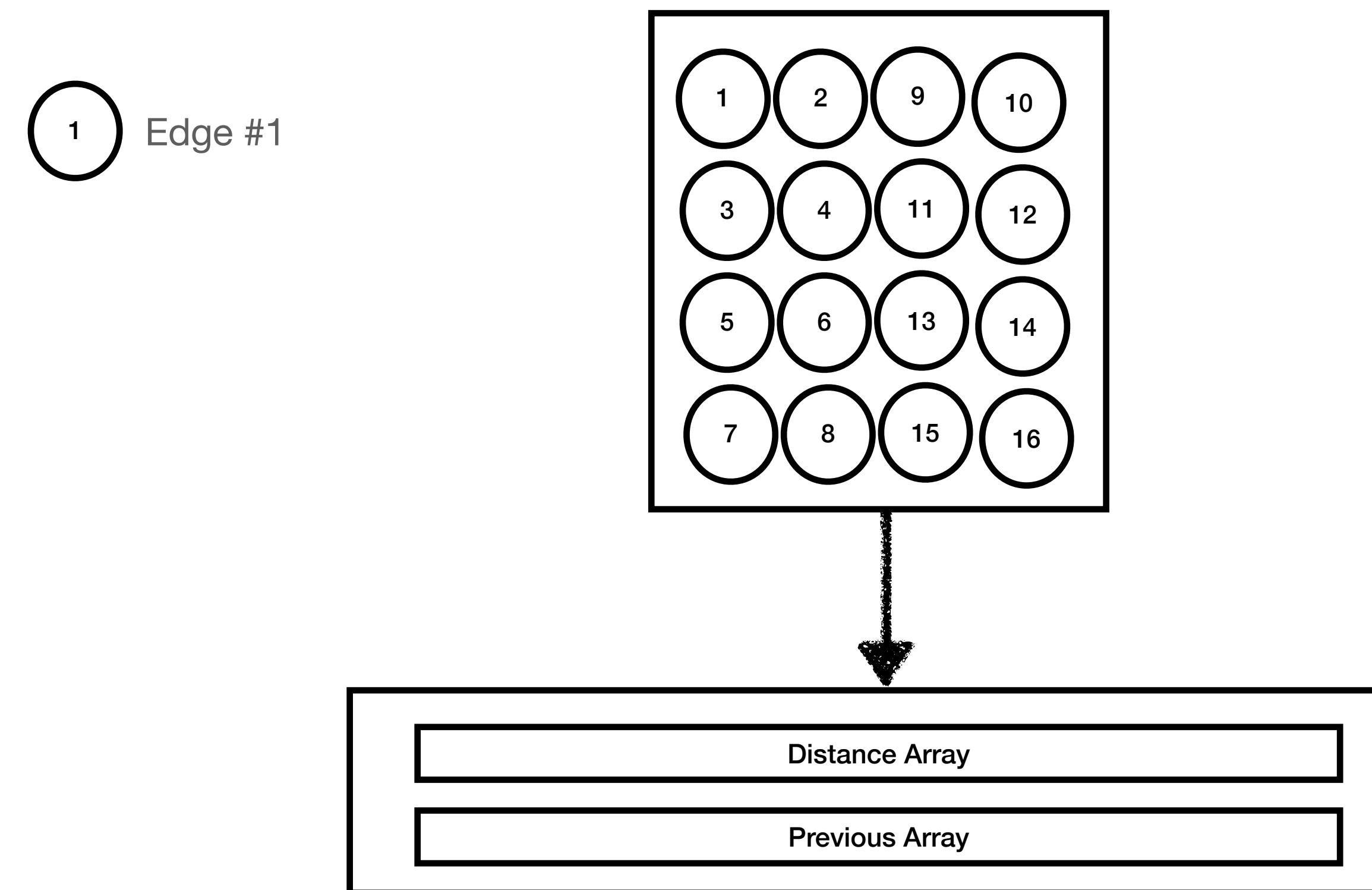
APPROACH

Parallel Dijkstra with MPI



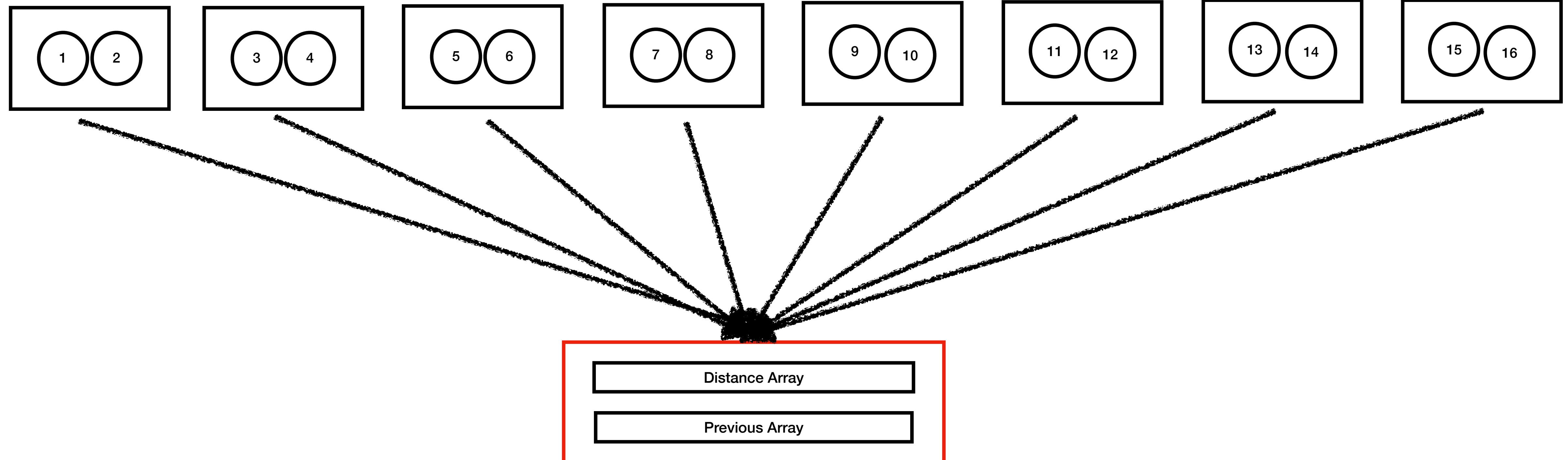
APPROACH

Parallel Bellman-Ford with OpenMP



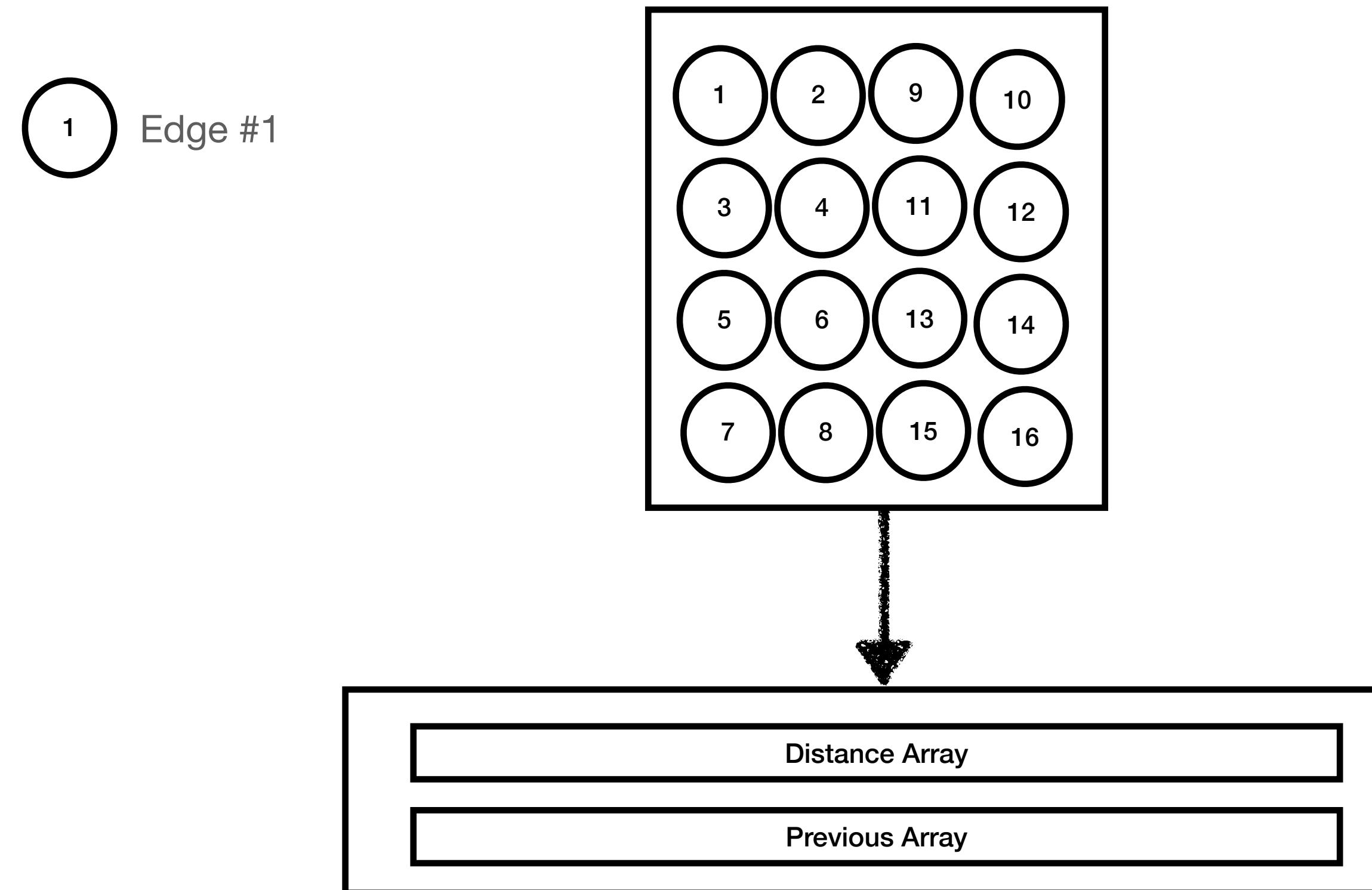
APPROACH

Parallel Bellman-Ford with OpenMP



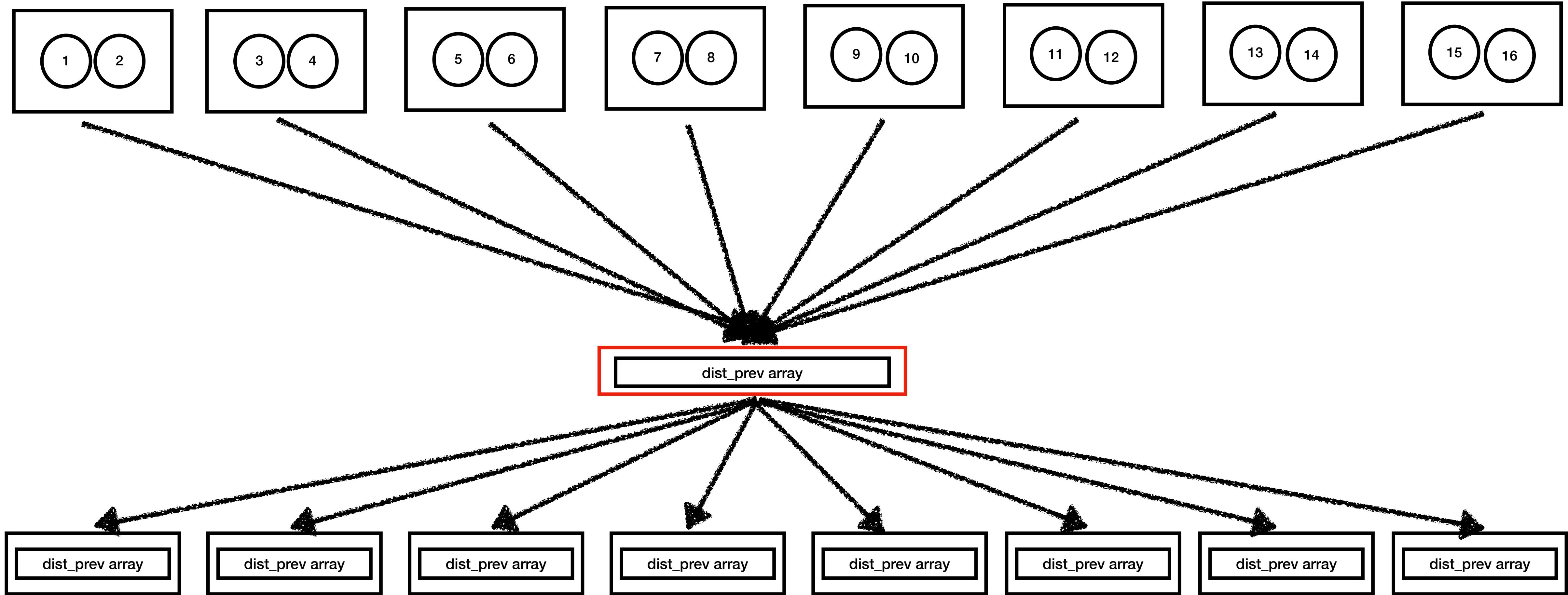
APPROACH

Parallel Bellman-ford with MPI



APPROACH

Parallel Bellman-ford with MPI



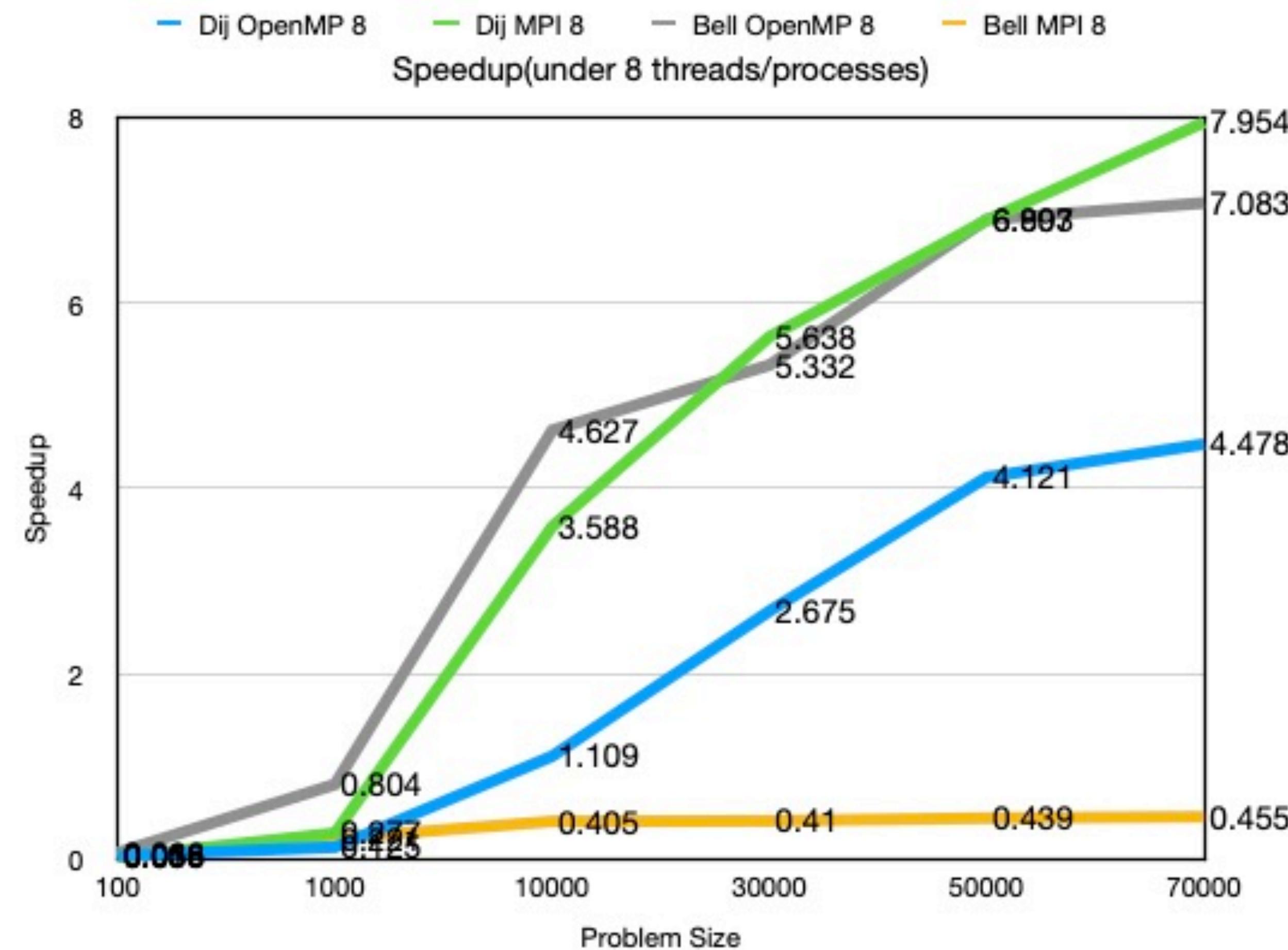
RESULTS

Evaluation

	100	1000	10000	30000	50000	70000
Dij Seq	0.000035	0.001116	0.124092	1.049662	3.272296	6.968730
Dij OpenMP 4	0.000768	0.005897	0.082828	0.419291	1.060356	2.196711
Dij OpenMP 8	0.000970	0.008895	0.111924	0.392330	0.793979	1.556058
Dij MPI 4	0.001434	0.002780	0.042123	0.304660	0.920431	1.870061
Dij MPI 8	0.001957	0.004026	0.034584	0.186187	0.474450	0.876178
Dij MPI 16	0.003236	0.004062	0.038404	0.150001	0.313979	0.546564
Dij MPI 64	0.005280	0.009895	0.051327	0.149658	0.258482	0.396511
Bell Seq	0.000044	0.003513	0.384447	3.320095	9.320354	17.986922
Bell OpenMP 4	0.000429	0.004002	0.122059	0.916564	2.615442	4.945052
Bell OpenMP 8	0.000667	0.004372	0.083080	0.622684	1.350126	2.539595
Bell OpenMP 16	0.001160	0.005904	0.081985	0.374742	0.850444	1.564601
Bell OpenMP 64	0.110504	0.090854	0.167659	0.461632	0.980443	1.521513
Bell MPI 4	0.001133	0.011458	0.753334	6.335346	17.073723	34.224464
Bell MPI 8	0.001487	0.015885	0.949913	8.092773	21.207064	39.562006

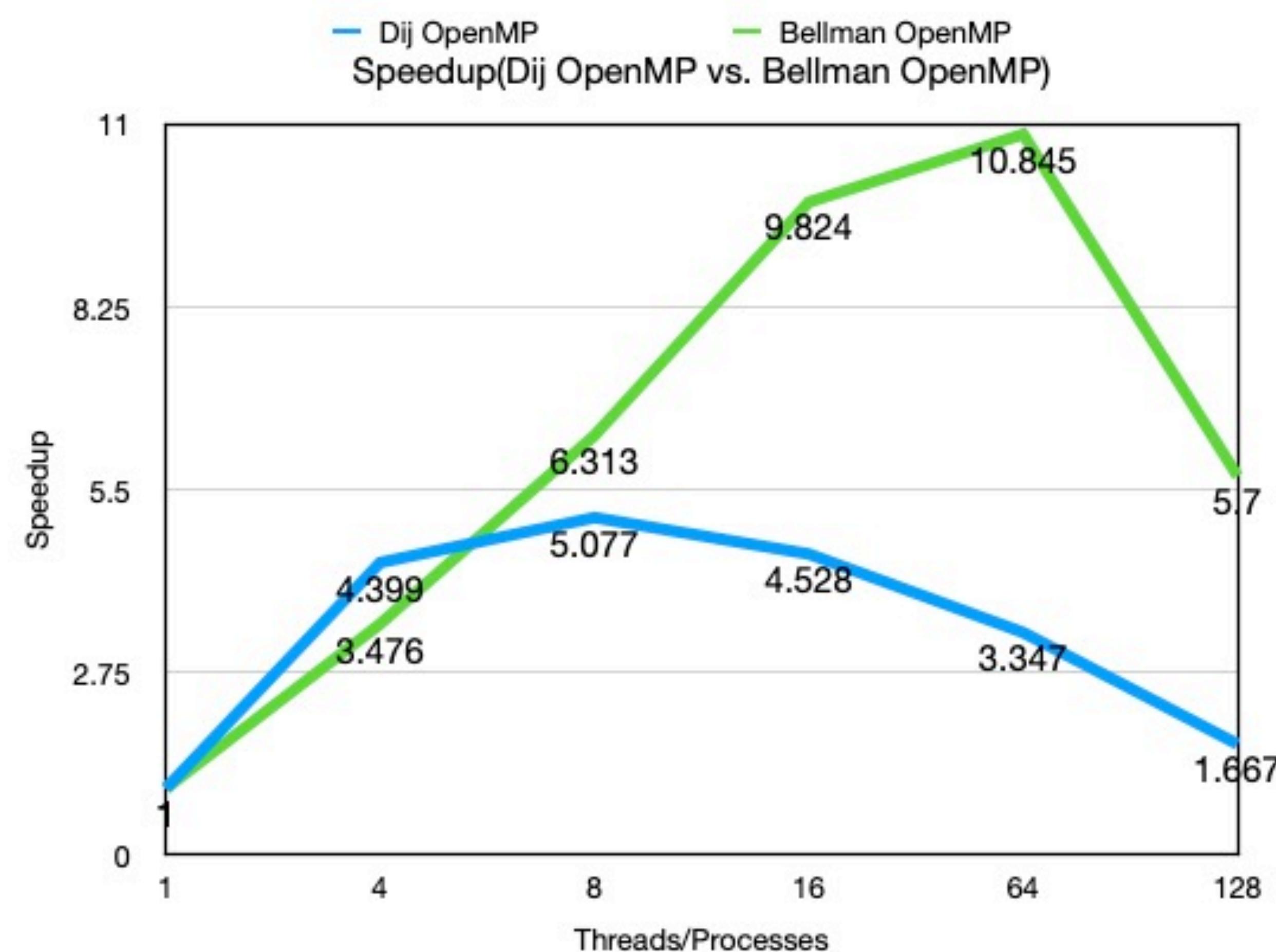
RESULTS

Problem Size



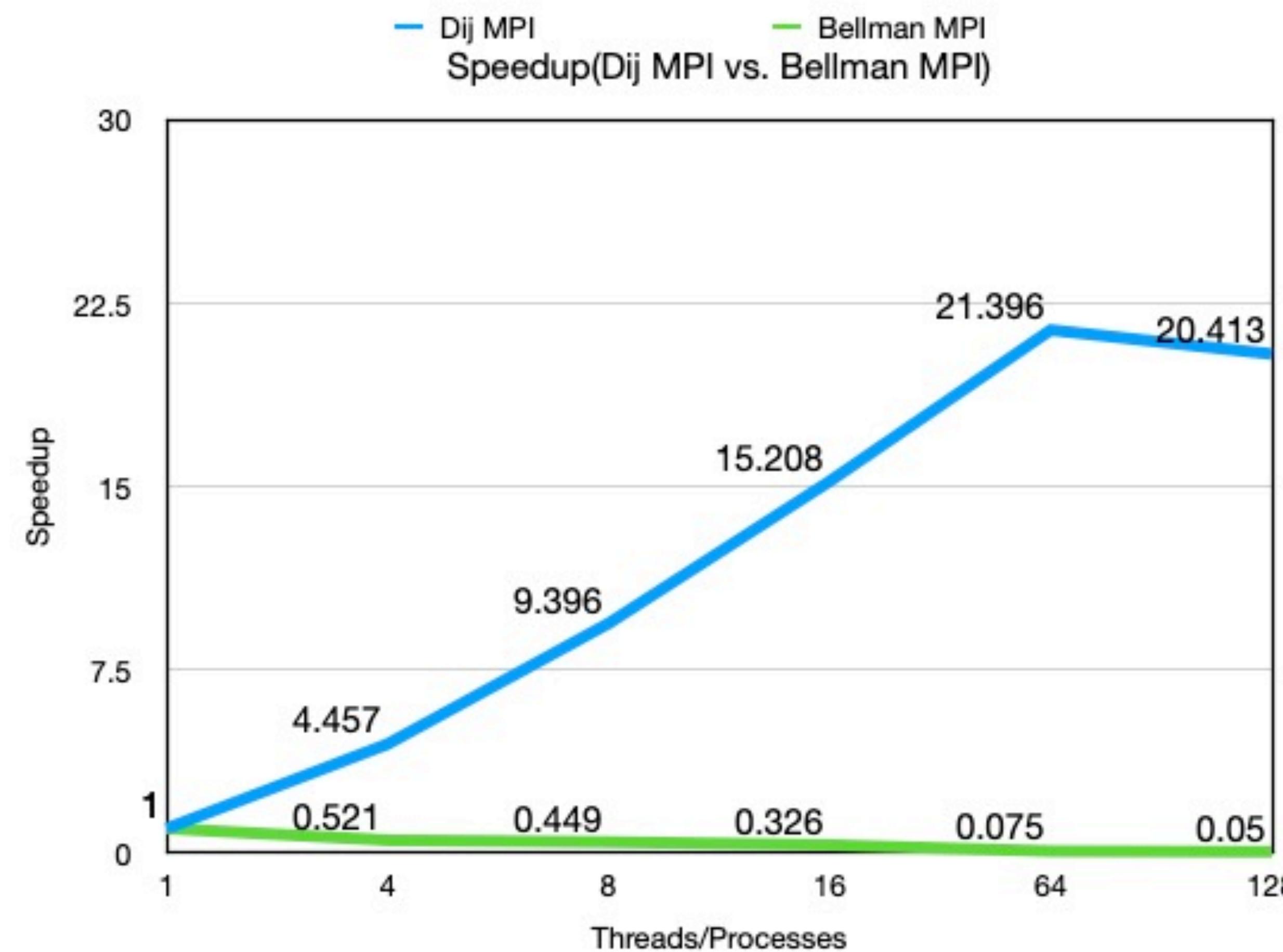
RESULTS

OpenMP Dijkstra vs. Bellman Ford



RESULTS

MPI Dijkstra vs. Bellman Ford



Thank you