A* Algorithm

Parallel Implementation

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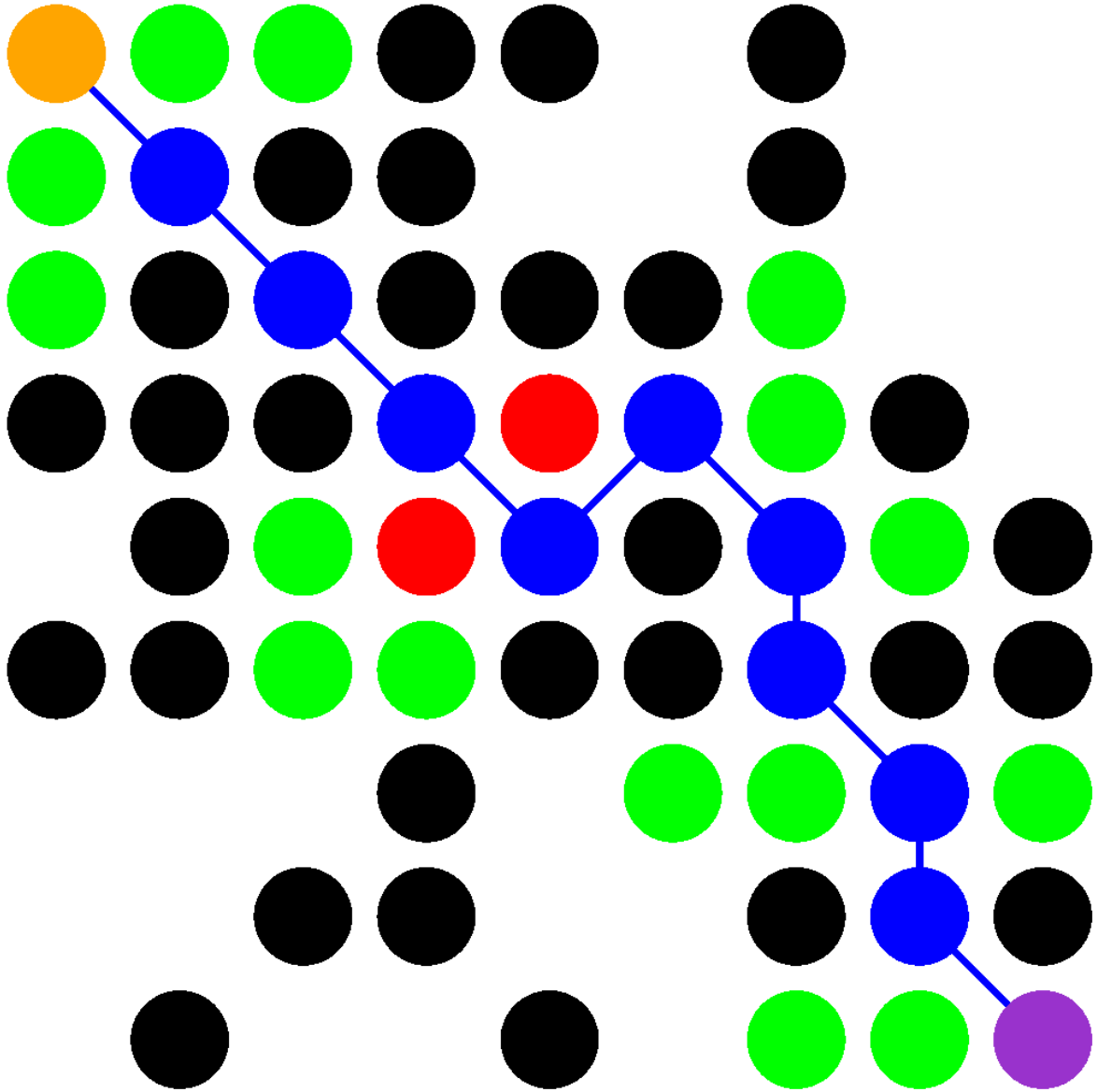
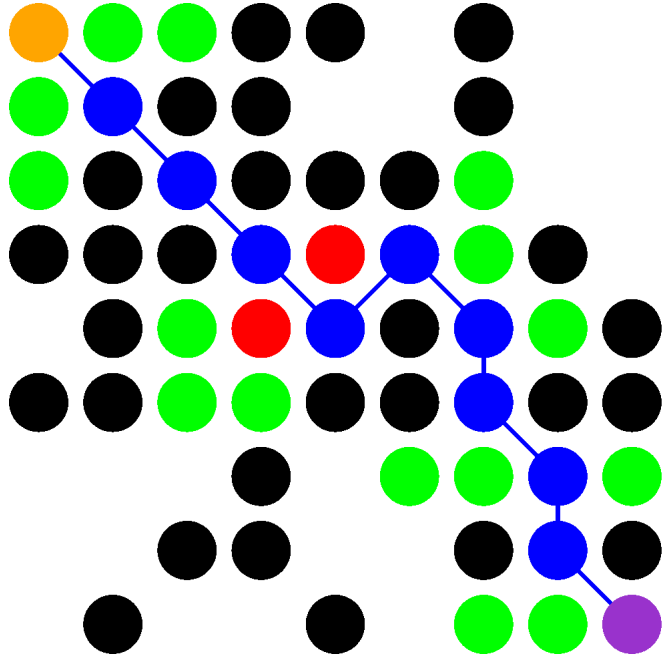


Introduction

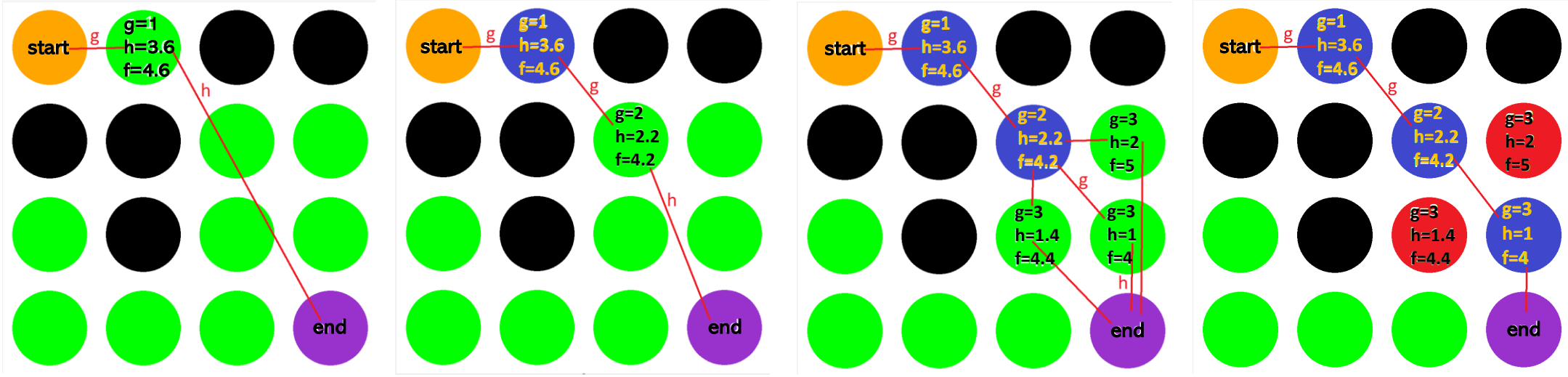
- A star is a search algorithm that search through a space of possibilities for an optimal solution out of all possible solutions.
- A star is typically applied to a path finding type of search problems.
- Starting from a specific node of a graph, the algorithm aims to find a path to a given end node with the smallest cost.
- The algorithm extend one path at a time, and to determine which path to extend it uses a cost function.
  - f(n) = g(n) + h(n)



Example

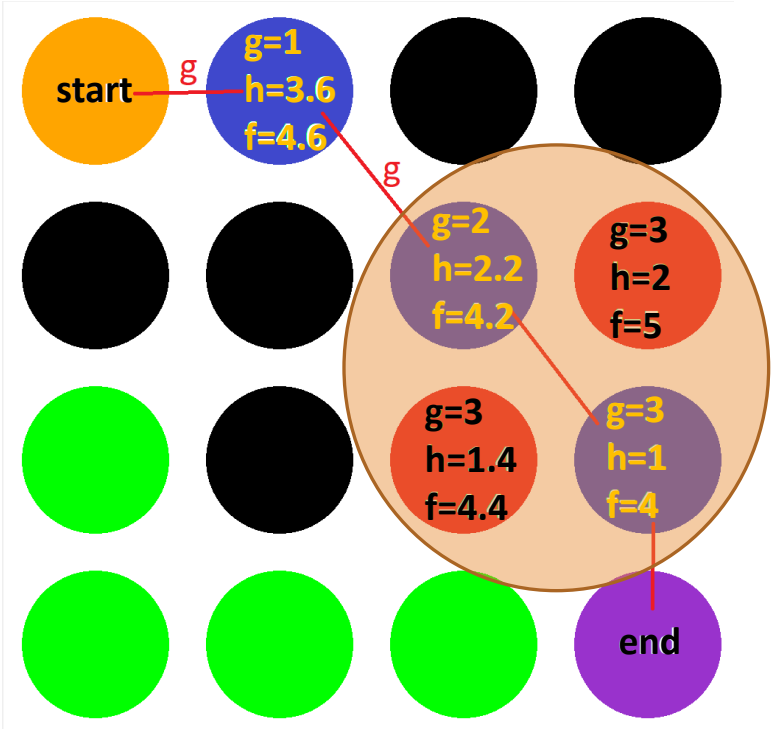
f(n) = g(n) + h(n)

The cost function f(n) is formatted by adding the cost from the start node to the current node (g(n)) and an estimation of the cheapest cost path from the current node to the end node (h(n)). h(n) is called the heuristic function.



Proposed Parallel Approaches

- We have tried several solutions, all of them showed better sequential approach compared with the parallel approach.
- Current Approach: parallelize the highlighted circle on the right. Parallel for used.
- Had to use Mutex to make sure same memory resources are not used at the same time



Demo

Result – Same Random Seed was used

nxn	TBB (Sec)	Sequential (Sec)
1000	0.206	0.171
2000	1.002	0.954
3000	2.548	2.573
3500	3.618	3.698
4000	4.800	4.813
4200	5.157	5.347
4400	5.643	5.852

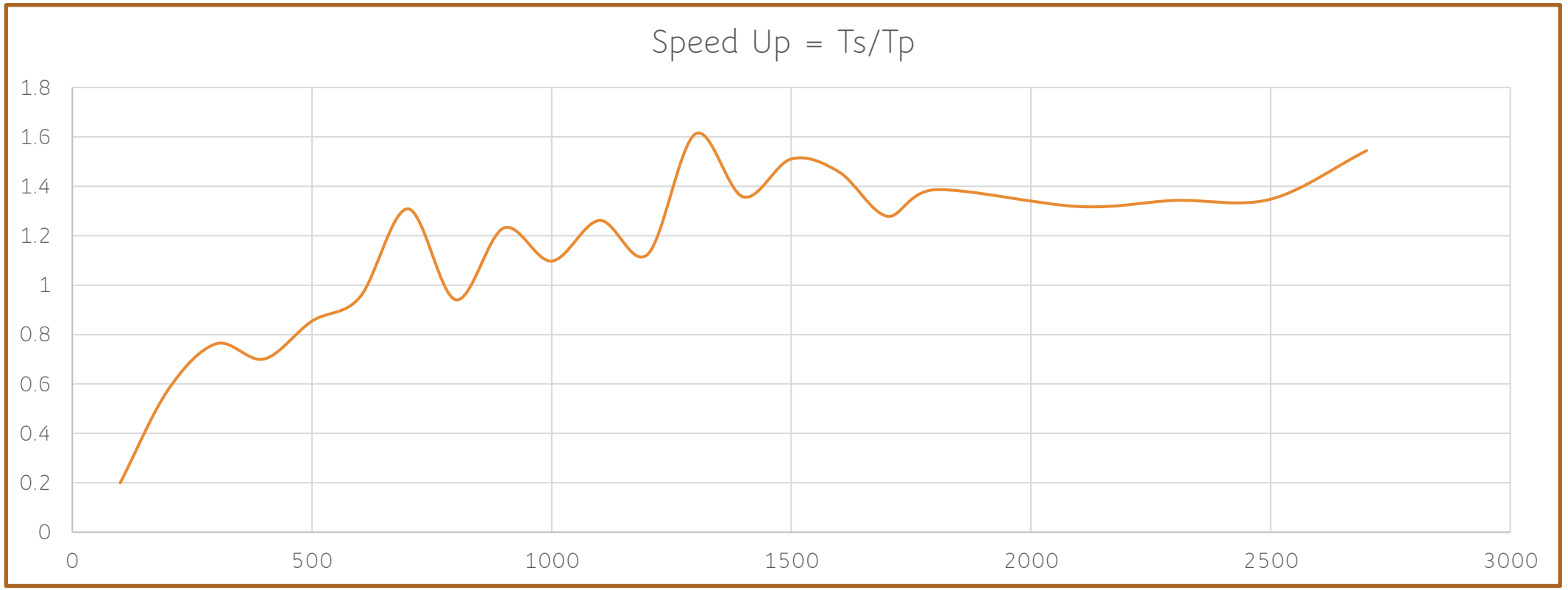
Result – Same Random Seed was used

nxm	TBB (Sec)	Sequential (Sec)
100 x 100	0.005	0.001
200 x 100	0.026	0.015
300 x 100	0.059	0.045
400 x 100	0.107	0.075
500 x 100	0.220	0.188
600 x 100	0.248	0.236
700 x 100	1.639	2.145
800 x 100	0.321	0.302
900 x 100	1.475	1.816
1000 x 100	0.677	0.743
1100 x 100	1.630	2.057

nxm	TBB (Sec)	Sequential (Sec)
1200 x 100	0.862	0.969
1300 x 100	13.440	21.667
1400 x 100	2.280	3.094
1500 x 100	6.965	10.523
1600 x 100	7.072	10.308
1700 x 100	1.857	2.375
1800 x 100	5.298	7.343
2100 x 100	3.079	4.058
2300 x 100	8.433	11.324
2500 x 100	11.183	15.073
2700 x 100	152.816	235.984

Result (ATOM) – Same Random Seed was used

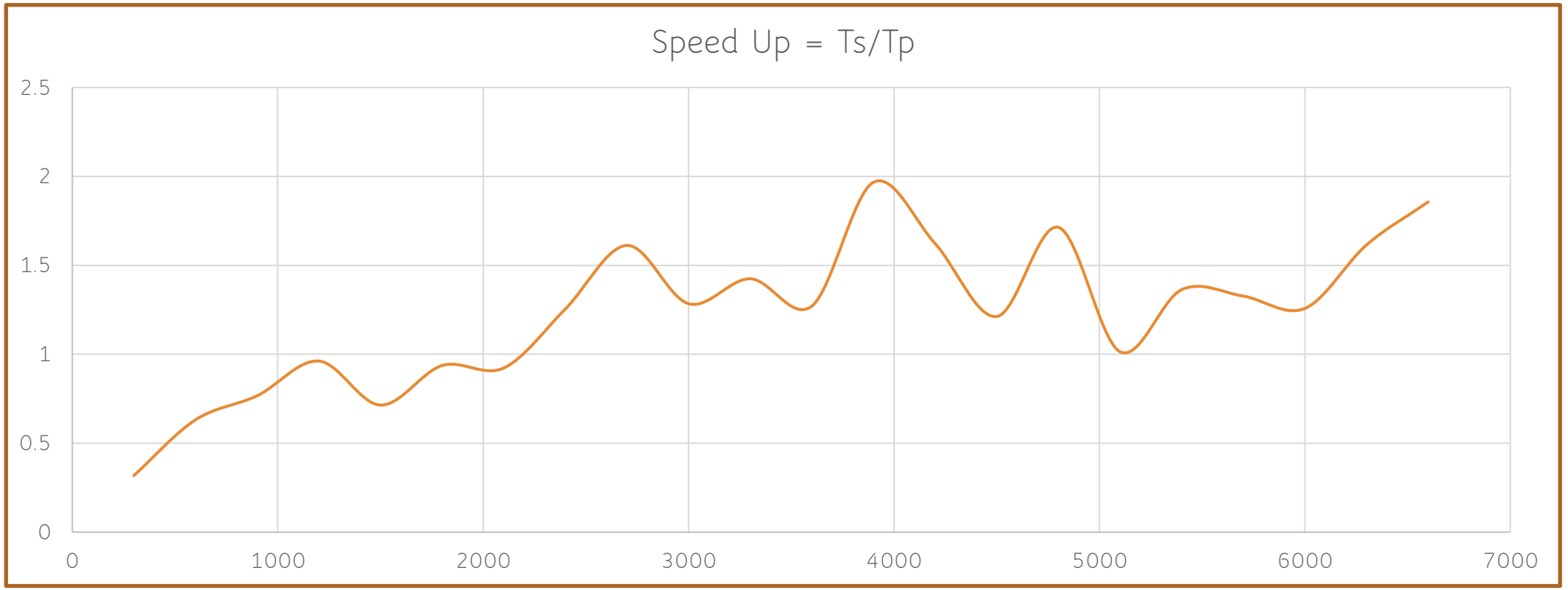
Speed Up



n, (m = 100)

Result (XPS) – Same Random Seed was used

Speed Up



n, (m = 100)