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AI Project 1

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OVERVIEW

For this assignment, we created 5 worlds to test our A* program. They are all square and have sizes of 10x10, 20x20, 25x25, 35x35, and 50x50. The files for these grids are included in this submission. Each board was run with each heuristic and the results can be found in results section.

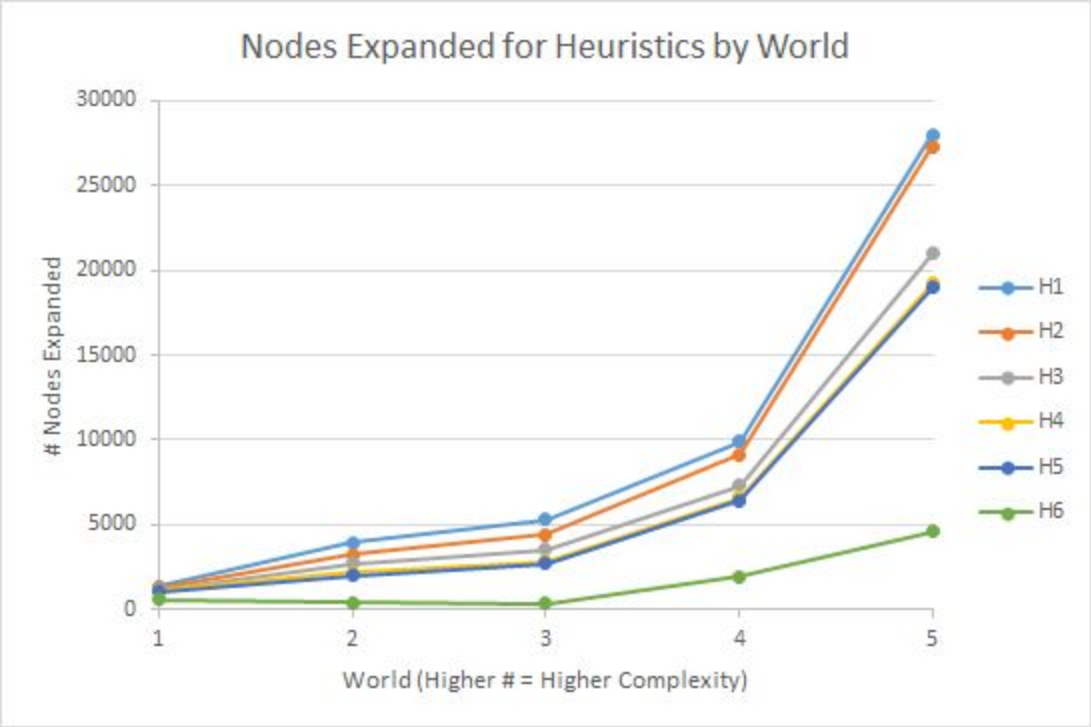
Heuristics

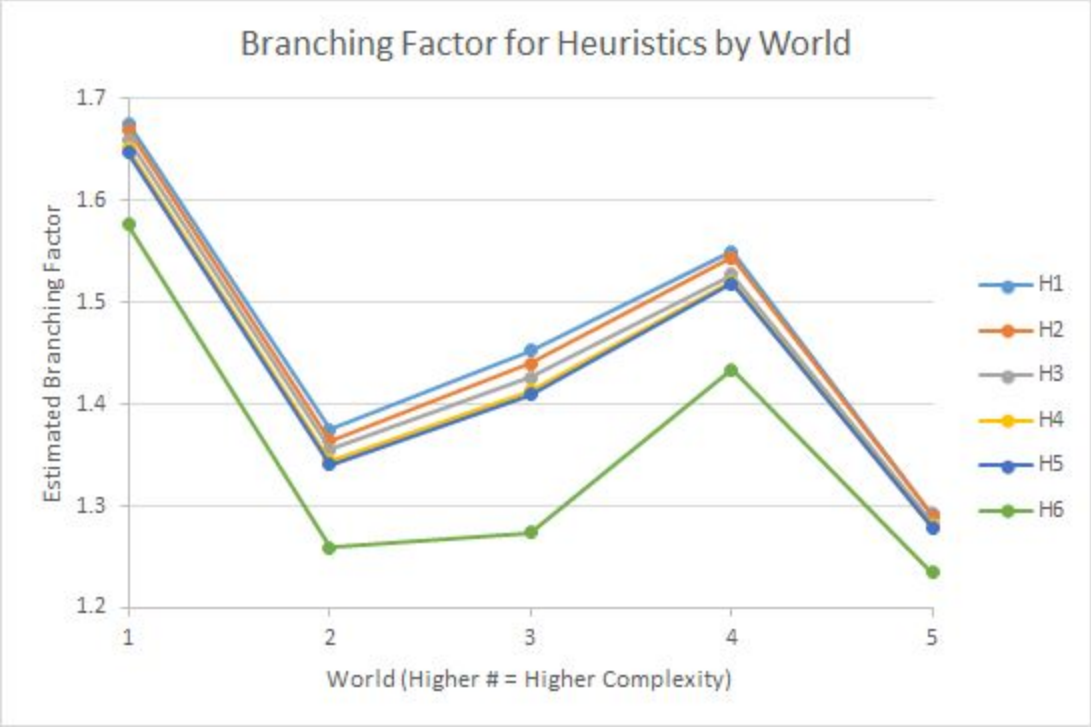
1. Constant heuristic of 0
2. Max(x and y distances from goal)
3. Min(x and y distances from goal)
4. Sum(x and y distances from goal)
5. Sum(x and y distances from goal) + minimum number of optimally possible of turns to reach goal
6. 3 * Heuristic 5

RESULTS

Heuristic	Board	Score	Path Length	Nodes Expanded	Branching Factor
1	grid10.txt	452	14	1373	1.675403136
2	grid10.txt	452	14	1306	1.669426756
3	grid10.txt	452	14	1201	1.659462175
4	grid10.txt	452	14	1122	1.65141655
5	grid10.txt	452	14	1083	1.647248708

6	grid10.txt	452	14	584	1.576162235
1	grid20.txt	451	26	3935	1.374887316
2	grid20.txt	451	26	3248	1.364778445
3	grid20.txt	451	26	2733	1.355746361
4	grid20.txt	451	26	2200	1.344481153
5	grid20.txt	451	26	2035	1.340455736
6	grid20.txt	451	26	399	1.259033886
1	grid25.txt	445	23	5333	1.452252868
2	grid25.txt	445	23	4405	1.440231917
3	grid25.txt	445	23	3528	1.426396856
4	grid25.txt	445	23	2838	1.412963599
5	grid25.txt	445	23	2691	1.409699944
6	grid25.txt	442	24	333	1.273801755
1	grid35.txt	382	21	9883	1.549647071
2	grid35.txt	382	21	9147	1.543946751
3	grid35.txt	382	21	7290	1.527352943
4	grid35.txt	382	21	6619	1.520346205
5	grid35.txt	382	21	6425	1.518194074
6	grid35.txt	382	21	1952	1.434463542
1	grid50.txt	348	40	28015	1.291768725
2	grid50.txt	348	40	27303	1.290937627
3	grid50.txt	348	40	21002	1.282497468
4	grid50.txt	348	40	19232	1.279677728
5	grid50.txt	348	40	18996	1.27928278
6	grid50.txt	348	40	4596	1.234694463


Nodes Expanded for Heuristics by World
30000
25000
20000
15000
10000
5000
0
Nodes Expanded
1
2
3
4
5
World (Higher # = Higher Complexity)
H1
H2
H3
H4
H5
H6


Branching Factor for Heuristics by World
1.7
1.6
1.5
1.4
1.3
1.2
Estimated Branching Factor
1
2
3
4
5
World (Higher # = Higher Complexity)
H1
H2
H3
H4
H5
H6

DISCUSSION & CONCLUSION

The 5 admissible heuristics all return the same path and the same score for each path. They do vary in effectiveness however. The more dominant the heuristic (the higher number 1-5) the fewer nodes it expands, thus the less memory it uses and the less time it takes. Heuristic 2 seems to expand around 10% fewer nodes on average than heuristic 1. Progressing up the heuristics produces similar results, each having incremental gains over the previous heuristic. Heuristic 5 is only slightly better than 4, but it is the best of all of them.

Heuristic 6 is an interesting case. It performs considerably better than any of the others in terms of memory and time use, usually cutting down the number of nodes expanded by a factor of 10 or more. The issue with 6 is that it sometimes does not yield an optimal path. It does always yield a path that works, but sometimes it includes non-optimal nodes due to its non-admissible heuristic. In general however, the cost of the non-optimal path is not much more than the optimal cost (compare 442 and 445). For certain scenarios, this might be useful; for instance, heuristic 6 might be useful in a scenario where the time to compute a path is more important than it being optimal.