Kara La'Brooy 757553

COMP20003

Assignment Two

Deliverable Two

Experimentation

Results Tables

Depth	1	Propagation	Max	Depth	1	Propagation	Average
Run	Score	Max Tile	Time (ms)	Run	Score	Max Tile	Time (ms)
1	1488	128	0	1	1856	128	0
2	6696	512	30	2	2904	256	10
3	1484	128	10	3	3064	256	10
4	4372	256	20	4	1688	128	0
5	1188	64	0	5	2112	256	0
6	2204	128	10	6	3744	256	10
7	3464	256	20	7	3688	256	20
8	3444	256	10	8	1584	128	0
9	5304	512	20	9	1992	128	0
10	1320	128	10	10	2508	128	10
Average	3096.4	236.8	13	Average	2514	192	6
Depth	2	Propagation	Max	Depth	2	Propagation	Average
Run	Score	Max Tile	Time (ms)	Run	Score	Max Tile	Time (ms)
1	5476	512	30	1	1780	128	0
2	3168	256	20	2	5536	512	30
3	3348	256	20	3	3408	256	10
4	3444	256	10	4	1484	128	10
5	6568	512	30	5	4676	512	20
6	7040	512	40	6	724	64	0
7	3356	256	20	7	2660	256	10
8	14296	1024	70	8	3724	256	20
9	3140	256	20	9	3296	256	10
10	11788	1024	50	10	7464	512	40
Average	6162.4	486.4	31	Average	3475.2	288	15
Depth	3	Propagation	Max	Depth	3	Propagation	Average
Run	Score	Max Tile	Time (ms)	Run	Score	Max Tile	Time (ms)
1	7316	512	50	1	4436	256	30
2	7104	512	50	2	6036	512	40
3	7012	512	50	3	3244	256	20
4	3116	256	20	4	1648	128	10

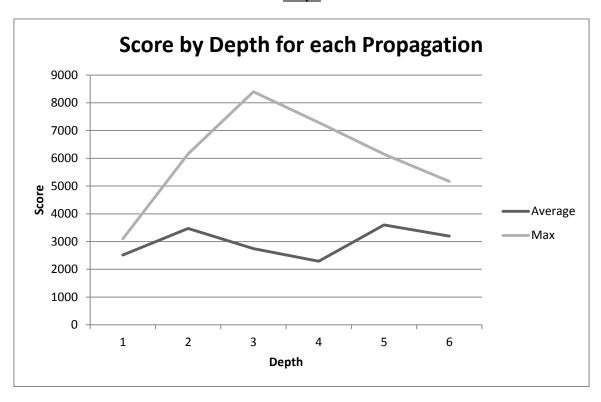
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5	7020	512	50	5	2624	128	20
6	11456	1024	70	6	2232	128	20
7	12164	1024	80	7	1464	128	20
8	6320	512	40	8	1772	128	10
9	10600	1024	60	9	1516	128	10
10	11876	1024	70	10	2516	128	20
Average	8398.4	691.2	54	Average	2748.8	192	20
Depth	4	Propagation	Max	Depth	4	Propagation	Average
Run	Score	Max Tile	Time (ms)	Run	Score	Max Tile	Time (ms)
1	7016	256	70	1	1472	64	20
2	6720	512	80	2	3204	256	30
3	6444	512	70	3	1876	128	20
4	11328	1024	110	4	2492	256	30
5	6364	512	70	5	1708	128	20
6	5408	512	60	6	3260	256	50
7	6956	512	80	7	1564	128	20
8	1252	64	10	8	1780	128	30
9	11840	1024	130	9	3420	256	40
10	9580	1024	90	10	2148	128	20
Average	7290.8	595.2	77	Average	2292.4	172.8	28
Depth	5	Propagation	Max	Depth	5	Propagation	Average
_							
Run	Score	Max Tile	Time (ms)	Run	Score	Max Tile	Time (ms)
Run 1	Score 10448	Max Tile 1024	Time (ms) 230	Run 1	Score 3556	Max Tile 256	Time (ms) 90
1	10448	1024	230	1	3556	256	90
1 2	10448 6692	1024 512	230 160	1 2	3556 3044	256 256	90 90
1 2 3 4 5	10448 6692 3160	1024 512 256 256 512	230 160 90	1 2 3 4 5	3556 3044 7500	256 256 512	90 90 180
1 2 3 4	10448 6692 3160 6212	1024 512 256 256	230 160 90 140	1 2 3 4	3556 3044 7500 1644	256 256 512 128	90 90 180 50
1 2 3 4 5 6 7	10448 6692 3160 6212 7020 6408 5304	1024 512 256 256 512 512	230 160 90 140 160 150	1 2 3 4 5	3556 3044 7500 1644 4492 4768 1832	256 256 512 128 256 256 128	90 90 180 50 110 130 60
1 2 3 4 5 6 7 8	10448 6692 3160 6212 7020 6408 5304 6360	1024 512 256 256 512 512	230 160 90 140 160 150 130	1 2 3 4 5 6 7 8	3556 3044 7500 1644 4492 4768 1832 1800	256 256 512 128 256 256 128	90 90 180 50 110 130
1 2 3 4 5 6 7 8	10448 6692 3160 6212 7020 6408 5304 6360 2976	1024 512 256 256 512 512 512 512 256	230 160 90 140 160 150 130 150 80	1 2 3 4 5 6 7 8 9	3556 3044 7500 1644 4492 4768 1832 1800 1804	256 256 512 128 256 256 128 128	90 90 180 50 110 130 60 60
1 2 3 4 5 6 7 8 9	10448 6692 3160 6212 7020 6408 5304 6360 2976 6884	1024 512 256 256 512 512 512 512 256 512	230 160 90 140 160 150 130 150 80 160	1 2 3 4 5 6 7 8 9	3556 3044 7500 1644 4492 4768 1832 1800 1804 5560	256 256 512 128 256 256 128 128 128 512	90 90 180 50 110 130 60 60 60
1 2 3 4 5 6 7 8	10448 6692 3160 6212 7020 6408 5304 6360 2976	1024 512 256 256 512 512 512 512 256	230 160 90 140 160 150 130 150 80	1 2 3 4 5 6 7 8 9	3556 3044 7500 1644 4492 4768 1832 1800 1804	256 256 512 128 256 256 128 128	90 90 180 50 110 130 60 60
1 2 3 4 5 6 7 8 9	10448 6692 3160 6212 7020 6408 5304 6360 2976 6884	1024 512 256 256 512 512 512 512 256 512	230 160 90 140 160 150 130 150 80 160	1 2 3 4 5 6 7 8 9	3556 3044 7500 1644 4492 4768 1832 1800 1804 5560	256 256 512 128 256 256 128 128 128 512	90 90 180 50 110 130 60 60 60
1 2 3 4 5 6 7 8 9 10 Average	10448 6692 3160 6212 7020 6408 5304 6360 2976 6884 6146.4	1024 512 256 256 512 512 512 256 512 486.4	230 160 90 140 160 150 130 150 80 160 145	1 2 3 4 5 6 7 8 9 10 Average	3556 3044 7500 1644 4492 4768 1832 1800 1804 5560 3600	256 256 512 128 256 256 128 128 128 512 256	90 90 180 50 110 130 60 60 140
1 2 3 4 5 6 7 8 9 10 Average	10448 6692 3160 6212 7020 6408 5304 6360 2976 6884 6146.4	1024 512 256 256 512 512 512 256 512 486.4 Propagation	230 160 90 140 160 150 130 150 80 160 145	1 2 3 4 5 6 7 8 9 10 Average	3556 3044 7500 1644 4492 4768 1832 1800 1804 5560 3600	256 256 512 128 256 256 128 128 128 128 512 256 Propagation	90 90 180 50 110 130 60 60 140 97
1 2 3 4 5 6 7 8 9 10 Average Depth Run	10448 6692 3160 6212 7020 6408 5304 6360 2976 6884 6146.4 6 Score	1024 512 256 256 512 512 512 256 512 486.4 Propagation Max Tile	230 160 90 140 160 150 130 150 80 160 145 Max Time (ms)	1 2 3 4 5 6 7 8 9 10 Average Depth Run	3556 3044 7500 1644 4492 4768 1832 1800 1804 5560 3600	256 256 512 128 256 256 128 128 128 512 256 Propagation Max Tile	90 90 180 50 110 130 60 60 140 97 Average Time (ms)
1 2 3 4 5 6 7 8 9 10 Average Depth Run 1	10448 6692 3160 6212 7020 6408 5304 6360 2976 6884 6146.4 6 Score 5048	1024 512 256 256 512 512 512 512 486.4 Propagation Max Tile 512	230 160 90 140 160 150 130 150 80 160 145 Max Time (ms)	1 2 3 4 5 6 7 8 9 10 Average Depth Run 1	3556 3044 7500 1644 4492 4768 1832 1800 1804 5560 3600 6 Score 2980	256 256 512 128 256 256 128 128 128 512 256 Propagation Max Tile 256	90 90 180 50 110 130 60 60 140 97 Average Time (ms)
1 2 3 4 5 6 7 8 9 10 Average Depth Run 1 2	10448 6692 3160 6212 7020 6408 5304 6360 2976 6884 6146.4 6 Score 5048 2900	1024 512 256 256 512 512 512 256 512 486.4 Propagation Max Tile 512 256	230 160 90 140 160 150 130 150 80 160 145 Max Time (ms) 310 200	1 2 3 4 5 6 7 8 9 10 Average Depth Run 1 2	3556 3044 7500 1644 4492 4768 1832 1800 1804 5560 3600 6 Score 2980 1916	256 256 512 128 256 256 128 128 128 512 256 Propagation Max Tile 256 128	90 90 180 50 110 130 60 60 140 97 Average Time (ms) 200 150
1 2 3 4 5 6 7 8 9 10 Average Depth Run 1 2 3	10448 6692 3160 6212 7020 6408 5304 6360 2976 6884 6146.4 6 Score 5048 2900 5308	1024 512 256 256 512 512 512 512 486.4 Propagation Max Tile 512 256 512	230 160 90 140 160 150 130 150 80 160 145 Max Time (ms) 310 200 330	1 2 3 4 5 6 7 8 9 10 Average Depth Run 1 2	3556 3044 7500 1644 4492 4768 1832 1800 1804 5560 3600 6 Score 2980 1916 3236	256 256 512 128 256 256 128 128 512 256 Propagation Max Tile 256 128 256	90 90 180 50 110 130 60 60 140 97 Average Time (ms) 200 150 220
1 2 3 4 5 6 7 8 9 10 Average Depth Run 1 2 3 4	10448 6692 3160 6212 7020 6408 5304 6360 2976 6884 6146.4 6 Score 5048 2900 5308 7024	1024 512 256 256 512 512 512 256 512 486.4 Propagation Max Tile 512 256 512 512	230 160 90 140 160 150 130 150 80 160 145 Max Time (ms) 310 200 330 410	1 2 3 4 5 6 7 8 9 10 Average Depth Run 1 2 3	3556 3044 7500 1644 4492 4768 1832 1800 1804 5560 3600 6 Score 2980 1916 3236 6612	256 256 512 128 256 256 128 128 128 512 256 Propagation Max Tile 256 128 256 512	90 90 180 50 110 130 60 60 140 97 Average Time (ms) 200 150 220 380
1 2 3 4 5 6 7 8 9 10 Average Depth Run 1 2 3 4 5	10448 6692 3160 6212 7020 6408 5304 6360 2976 6884 6146.4 6 Score 5048 2900 5308 7024 3776	1024 512 256 256 512 512 512 512 486.4 Propagation Max Tile 512 256 512 256 512 256 512 256	230 160 90 140 160 150 130 150 80 160 145 Max Time (ms) 310 200 330 410 260	1 2 3 4 5 6 7 8 9 10 Average Depth Run 1 2 3 4 5 5	3556 3044 7500 1644 4492 4768 1832 1800 1804 5560 3600 6 Score 2980 1916 3236 6612 2508	256 256 512 128 256 256 128 128 128 512 256 Propagation Max Tile 256 128 256 512 256	90 90 180 50 110 130 60 60 140 97 Average Time (ms) 200 150 220 380 160

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Α	verage	5169.2	435.2	319	Average	3197.2	256	207
	10	5476	512	330	10	3428	256	210
	9	7064	512	440	9	6948	512	400

Graph



Summary

The purpose of this assignment was to implement a variation of Dijkstra's algorithm with an underlying max heap data structure to find a path to the highest scoring game state in 2048.

There are two propagation techniques that can be chosen from for the game intelligence – maximum and average. Propagation refers to the first action being updated with the scores of its children. Score is used as a heuristic to rank moves.

Through experimentation it was discovered that using maximum propagation yields much higher scores than average propagation for all depths.

Depth 3 with max propagation returned the highest average score, with depth 1 returning the lowest average scores for both average and max propagation.

With increase in depth, the run time of the program increases as more nodes are being generated and expanded.