

CMPT310 ASSIGNMENT-1 (RITIKA GOYAL) (301401516)

The following table shows the result of 10 random puzzles generated and records the time, solution-length, number of nodes expanded for each heuristic.

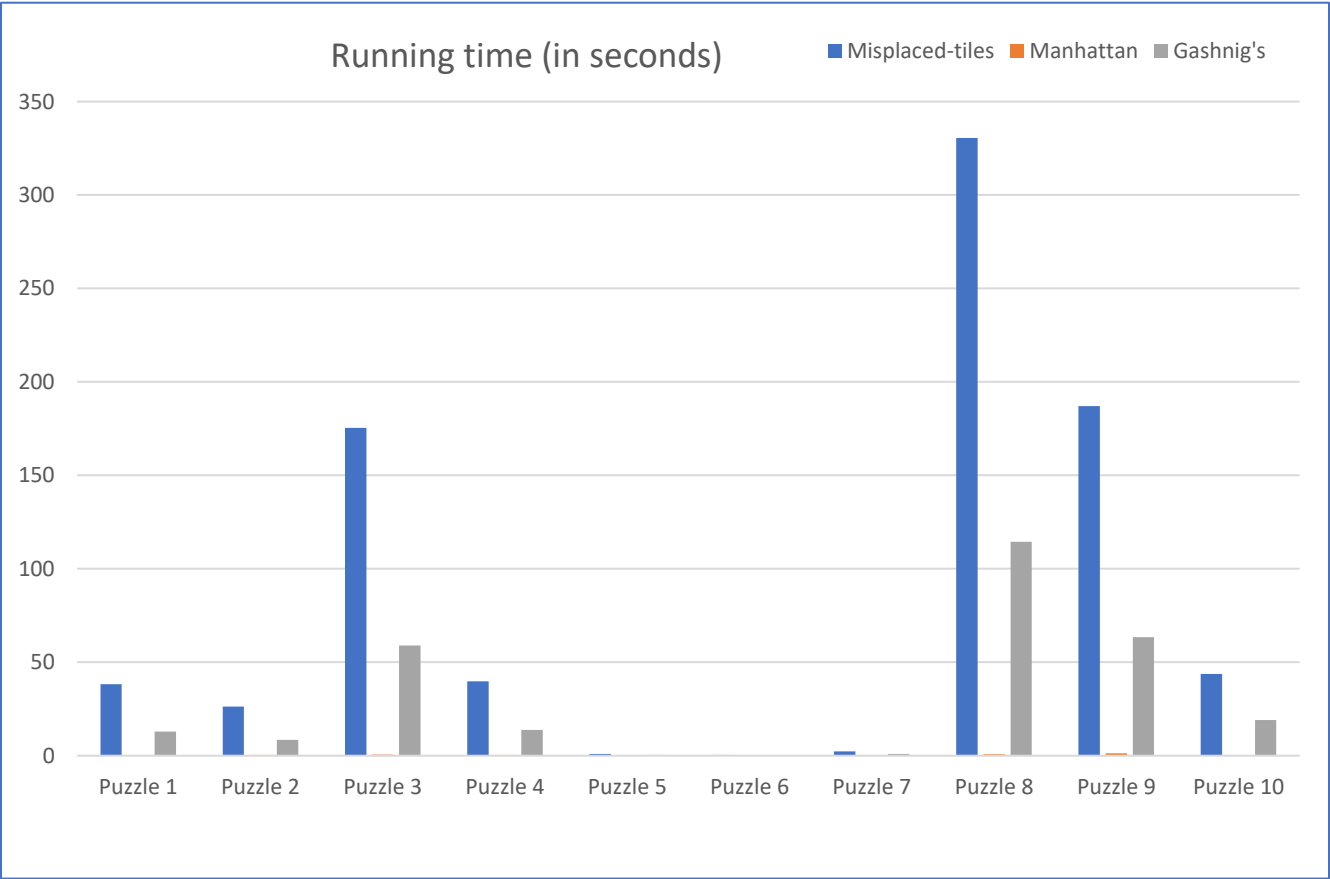
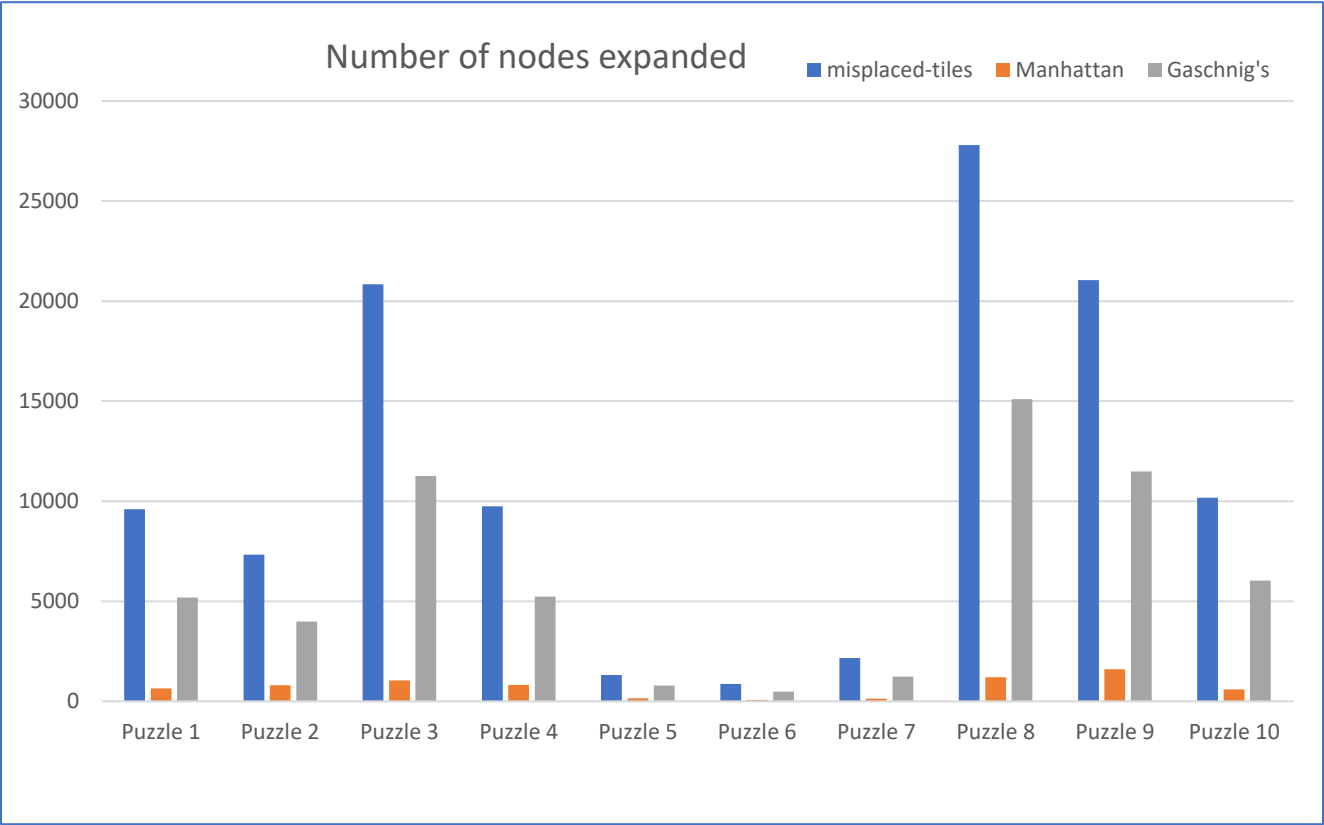
	MISPLACED-TILES			MANHATTAN			GASCHNIG's		
	Time(sec)	Solution-length	Nodes-expanded	Time(sec)	Solution-length	Nodes-expanded	Time(sec)	Solution-length	Nodes-expanded
Puzzle 1	38.2258970	23	9594	0.23062896	23	638	12.9810650	23	5193
Puzzle 2	26.2220447	22	7329	0.37026858	22	803	8.45787119	22	3982
Puzzle 3	175.394987	25	20839	0.58179140	25	1041	58.9165627	25	11258
Puzzle 4	39.8697571	23	9746	0.36788916	23	820	13.7734425	23	5227
Puzzle 5	0.89487314	18	1311	0.02015042	18	146	0.43713927	18	794
Puzzle 6	0.41955947	18	874	0.00528907	18	61	0.18477320	18	488
Puzzle 7	2.25082015	20	2157	0.01664376	20	136	0.85672330	20	1230
Puzzle 8	330.560495	26	27808	0.75929188	26	1197	114.395275	26	15097
Puzzle 9	186.978873	25	21050	1.27577185	25	1600	63.4104428	25	11490
Puzzle 10	43.7349312	23	10180	0.25952172	23	602	19.1182219	23	6032

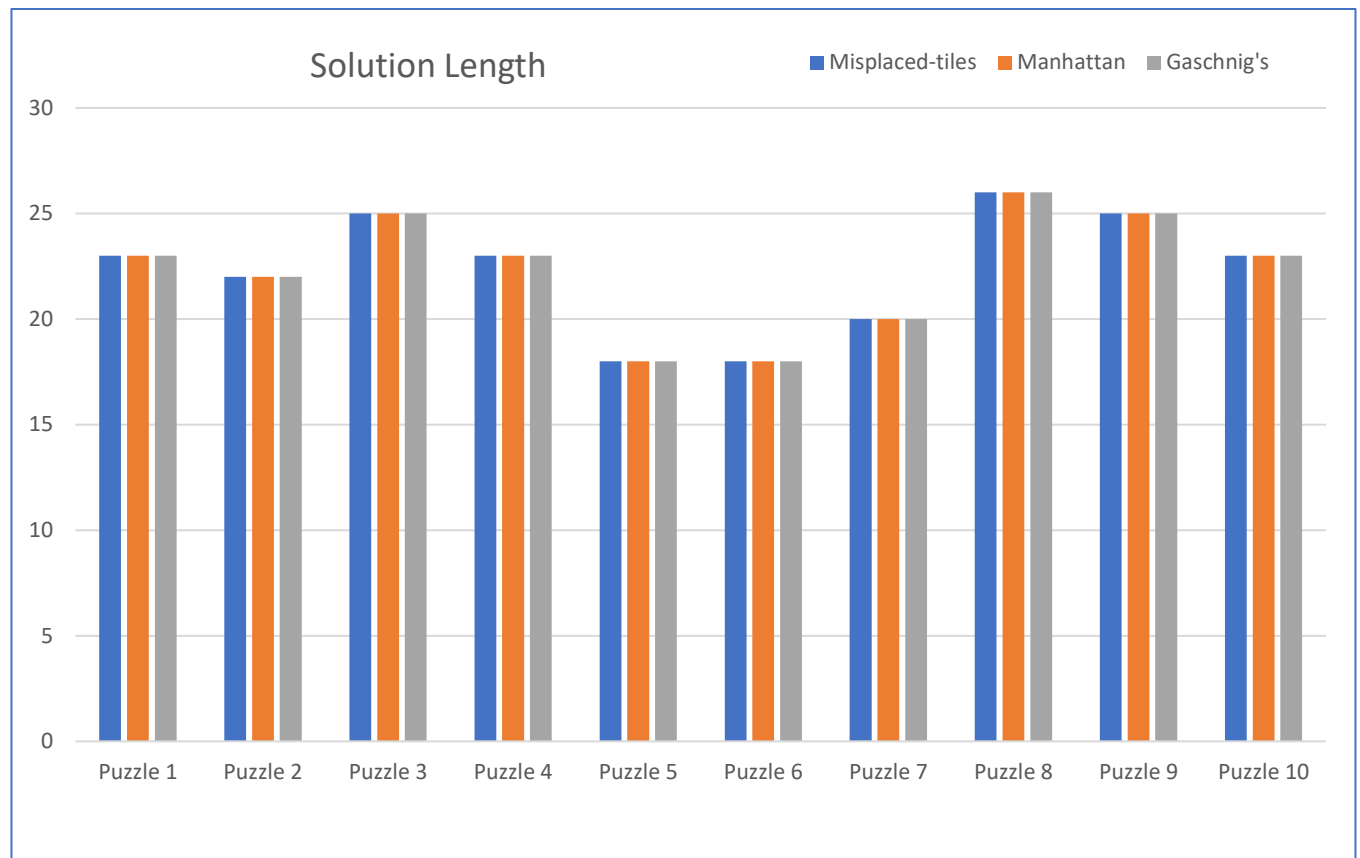
The solution length is same for all the heuristics in each puzzle and thus it is not compared in the table.

The following table shows the comparison between minimum and maximum time and nodes expanded in different algorithms.

Misplaced-tiles = (MT), Manhattan = (M), Gaschnig's = (G)

	Time		Nodes-Expanded		Average of Number of nodes expanded (all 3 heuristics)
	Min	Max	Min	Max	
Puzzle1	0.23062896 (M)	38.2258970 (MT)	638 (M)	9594 (MT)	(9594+638+5193)/3 = 5141
Puzzle2	0.37026858 (M)	26.2220447 (MT)	803 (M)	7329 (MT)	(7329+803+3982)/3= 4038
Puzzle3	0.58179140 (M)	175.394987 (MT)	1041 (M)	20839 (MT)	(20839+1041+11258)/3= 11046
Puzzle4	0.36788916 (M)	39.8697571 (MT)	820 (M)	9746 (MT)	(9746+820+5227)/3= 5264
Puzzle5	0.02015042 (M)	0.89487314 (MT)	146 (M)	1311 (MT)	(1311+146+794)/3= 750
Puzzle6	0.00528907 (M)	0.41955947 (MT)	61 (M)	874 (MT)	(874+61+488)/3= 474
Puzzle7	0.01664376 (M)	2.25082015 (MT)	136 (M)	2157 (MT)	(2157+136+1230)/3= 1174
Puzzle8	0.75929188 (M)	330.560495 (MT)	1197 (M)	27808 (MT)	(27808+1197+15097)/3= 14700
Puzzle9	1.27577185 (M)	186.978873 (MT)	1600 (M)	21050 (MT)	(21050+1600+11490)/3= 11380
Puzzle10	0.25952172 (M)	43.7349312 (MT)	602 (M)	10180 (MT)	(10180+602+6032)/3= 5604





ANSWERS TO THE QUESTIONS:

1. The best algorithm (according to data) is Manhattan since it takes minimum time to solve and expands minimum number of nodes to get the solution in each puzzle and is quicker than others.
2. The misplaced-tiles heuristic checks whether a tile is misplaced or not, but it does not check that how far away that tile is from being correct. The tile which is closer to the goal is treated the same to the tile which is farther from it.
 Instead of treating each tile equal like Misplaced-tile, the Manhattan heuristics checks whether the tile is closer to the goal and how much close it is,
 In Gaschnig's Heuristics the tile is swapped with the gap instead of just sliding them around.
 The heuristic that should be ruled out is Misplaced-tile due to reason That it does not used any distance estimation to solve the puzzle. As it is known that and admissible heuristic h_1 is at least as accurate as another admissible heuristic h_2 iff for every n $h_1(n) \geq h_2(n)$. Here h value of misplaced tile is less than Manhattan heuristics which justifies it being ruled out.
3. The heuristics that is always at least as accurate as all 3 heuristic functions is pattern database.
 In pattern databases, some of the tiles are replaced with a wild card like '*' and compute exact solution for each pattern and use that value as heuristic. In case of more than one pattern, it uses maximum value. The h value of pattern database is greater than that of misplaced-tile, Manhattan and gaschnig's heuristics.