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Group 16

CS4341 Assignment 1

Below are 5 tables, one per world, recording the score, number of actions, and number of nodes expanded for each of the heuristics. Heuristic #5 is calculated as:

Manhattan + (⅓)(minimum # turns)

The minimum turn cost is the minimum number of turns the robot would need to execute in order to reach the goal - it is calculated from the goal node's position, the robot's current node, and the direction the robot is facing on that node (which is calculated using the current node's parent node). This ranges from 0 - 2.

World 5x5:

Heuristic Number	**Score**	**Actions**	**Nodes Expanded**
#1: 0	471.33	6	7
#2: min(vert, horiz)	471.33	6	6
#3: max(vert, horiz)	471.33	6	6
#4: Manhatten	471.33	6	6
#5: Dominates #4	471.33	6	6
#6: #5 times 3	471.33	6	5

World 15x15:

Heuristic Number	**Score**	**Actions**	**Nodes Expanded**
#1: 0	437.33	19	170
#2: min(vert, horiz)	437.33	19	166
#3: max(vert, horiz)	437.33	19	150
#4: Manhatten	437.33	19	140
#5: Dominates #4	437.33	19	139
#6: #5 times 3	437.33	19	57

World 20x20:

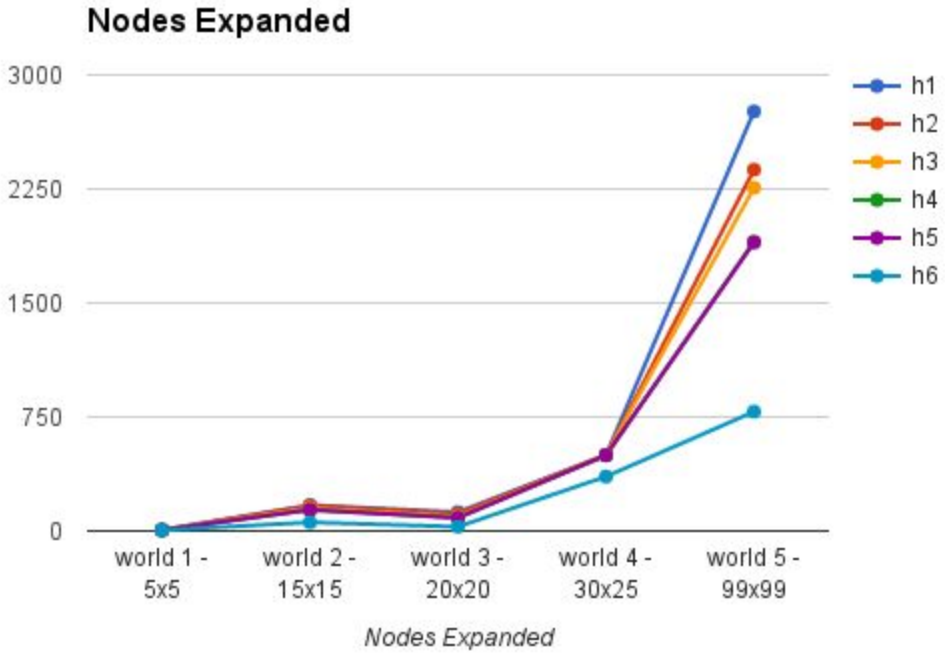
Heuristic Number	Score	Actions	Nodes Expanded
#1: 0	444	9	124
#2: min(vert, horiz)	444	9	114
#3: max(vert, horiz)	444	9	95
#4: Manhatten	444	9	88
#5: Dominates #4	444	9	86
#6: #5 times 3	444	9	28

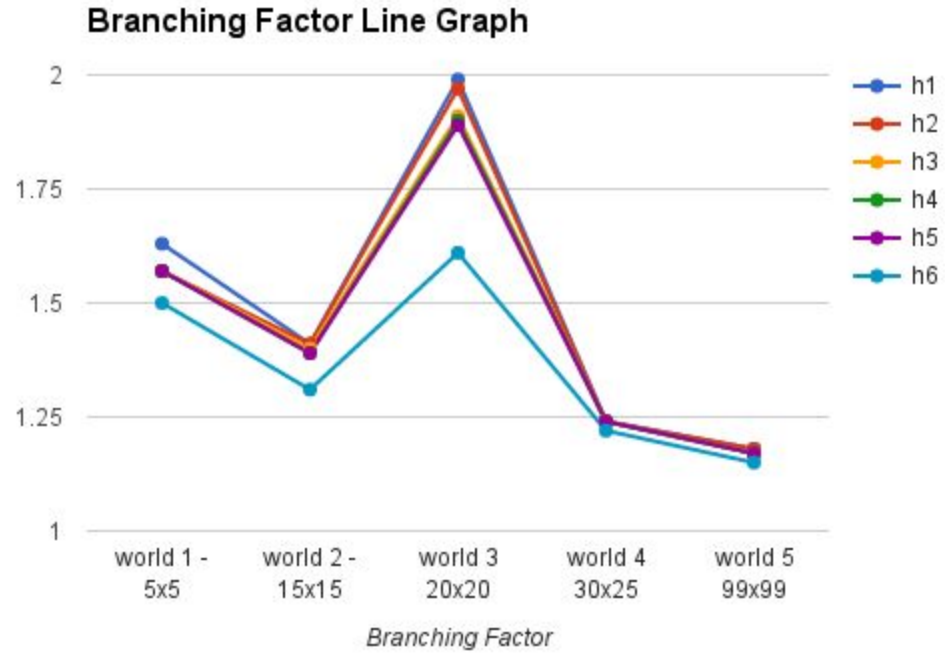
World 30x25:

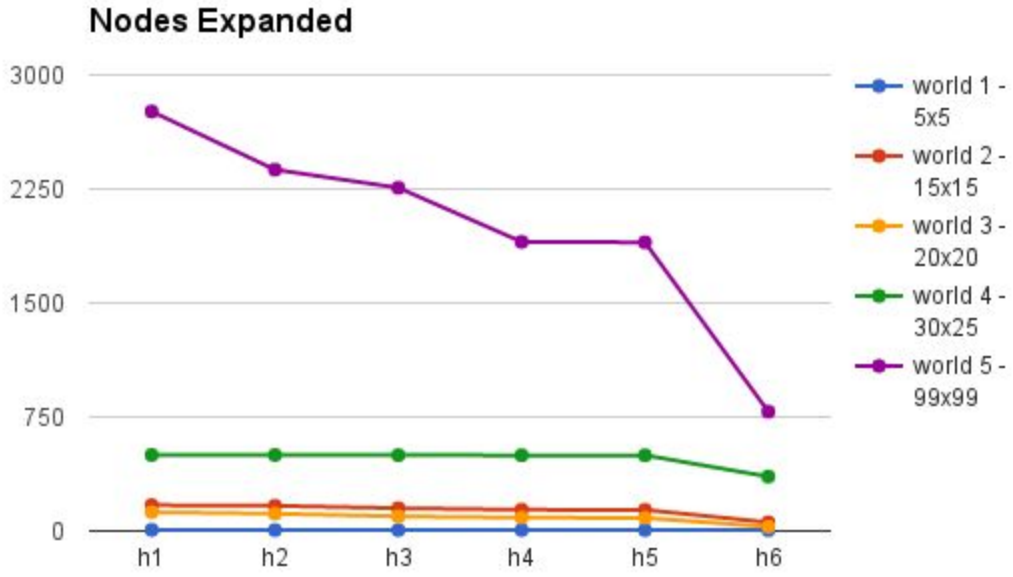
Heuristic Number	Score	Actions	Nodes Expanded
#1: 0	322.33	40	500
#2: min(vert, horiz)	322.33	40	500
#3: max(vert, horiz)	322.33	40	499
#4: Manhatten	322.33	40	498
#5: Dominates #4	322.33	40	498
#6: #5 times 3	322.33	40	358

World 99x99:

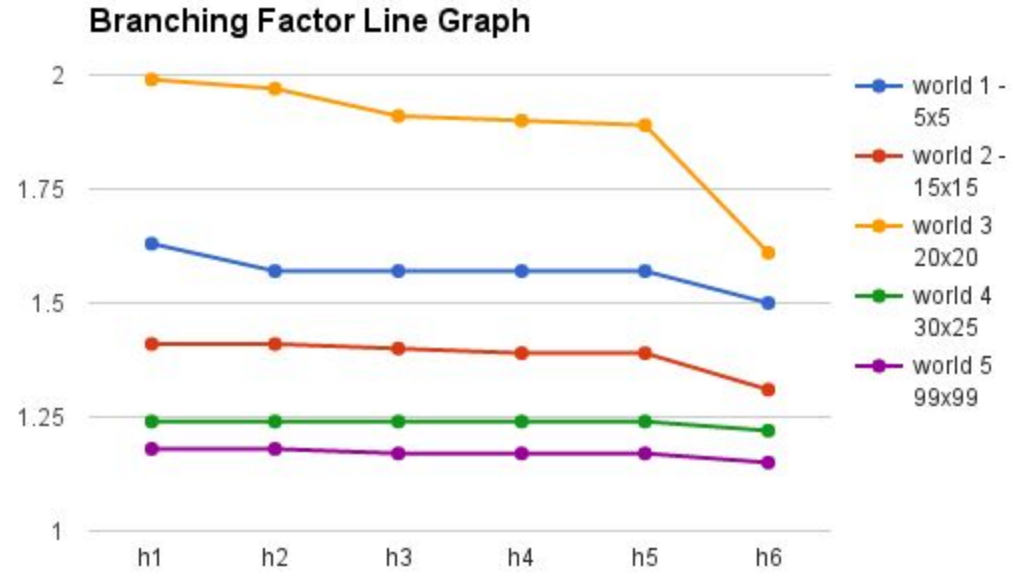
Heuristic Number	Score	Actions	Nodes Expanded
#1: 0	153.66	57	2760
#2: min(vert, horiz)	153.66	57	2377
#3: max(vert, horiz)	153.66	57	2258
#4: Manhatten	153.66	57	1902
#5: Dominates #4	153.66	57	1899
#6: #5 times 3	153.66	57	785


Nodes Expanded
3000
2250
1500
750
0
world 1 - 5x5
world 2 - 15x15
world 3 - 20x20
world 4 - 30x25
world 5 - 99x99
h1
h2
h3
h4
h5
h6
Nodes Expanded


Branching Factor Line Graph
2
1.75
1.5
1.25
1
world 1 - 5x5
world 2 - 15x15
world 3 20x20
world 4 30x25
world 5 99x99
h1
h2
h3
h4
h5
h6
Branching Factor



Nodes Expanded



Branching Factor

How do the 5 heuristics vary in effectiveness? How much gain is there to using any heuristic (#1 vs. #2)? Is #5 noticeably more effective than the other heuristics?
The effectiveness of the heuristics increase as they dominate each other. Heuristic 1 is least effective in reducing the number of nodes while heuristic 5 is the best. For heuristic 5 there was a markable difference compared to heuristic 1 which does generate a heuristic value. Heuristic 5 had around 31% fewer nodes expanded compared to heuristic 1. Heuristic 2 shows a slight gain compared to heuristic 1 but not by much.

For heuristic #6: how does its solution quality compare with #5? Is it performing noticeably worse? How much more efficient is it?
Heuristic 6, since it is not admissible will expand less nodes. With such a large emphasis on the heuristic, it often has more leap actions that do not consider the cost. It merely tries to reach the goal quicker. This means the overall cost of the path will often increase. Though this did not show up in our data, when we multiplied heuristic 5 by 10 instead of a factor of 3, we noticed that the score decreased, meaning the resulting path was non-optimal.