A star Algorithm

- 8 – Connected Grid
- Cost for each move (g) = 1
- Heuristics (h) used – Manhattan Distance (Cost = 1 for x direction & 1 for y direction)
- Total cost (f) = g + h
- Cost represented in the bottom of each cell. Format: Total cost(parent cell)
- Visited cells marked by a ✓ on top right.

Team Vulcan

Visited Set – {START}

Current Cell – Start
Neighbor Cells – 33,32,41
Next Cell Chosen - 33

h(v) for x direction →

7	6	5	4	3	2	1	0	
0 INF	1 INF	2 INF	3 INF	4 INF	5 INF	6 INF	GOAL INF	0
8	9	10	11	12 INF	13	14 INF	15 INF	1
16	17	18	19	20 INF	21 INF	22 INF	23	2
24 INF	25 INF	26 INF	27 INF	28 INF	29 INF	30	31 INF	3
32 1 + (7+4) = 12	33 1 + (6+4) = 11	34	35	36	37	38 INF	39 INF	4
START ✓ 0 + (7+5) = 12	41 1 + (6+5) = 12	42 INF	43 INF	44 INF	45 INF	46 INF	47 INF	5

h(v) for y direction ↑

Visited Set – {START,33,32,41}

Last Cells - Start
Current Cell – 33
Neighbor Cells – 24,25,26,42
Next Cell Chosen - 26

h(v) for x direction →

7	6	5	4	3	2	1	0	
0 INF	1 INF	2 INF	3 INF	4 INF	5 INF	6 INF	GOAL INF	0
8	9	10	11	12 INF	13	14 INF	15 INF	1
16	17	18	19	20 INF	21 INF	22 INF	23	2
24 2 + (7+3) = 12(33)	25 2 + (6+3) = 11(33)	26 2 + (5+3) = 10(33)	27 INF	28 INF	29 INF	30	31 INF	3
32 ✓ 1 + (7+4) = 12(S)	33 ✓ 1 + (6+4) = 11(S)	34	35	36	37	38 INF	39 INF	4
START ✓ 0 + (7+5) = 12	41 ✓ 1 + (6+5) = 12(S)	42 2 + (5+5) = 12(33)	43 INF	44 INF	45 INF	46 INF	47 INF	5

h(v) for y direction ↑

Visited Set – {START,33,32,41,24,25,26,42}

Last Cells – Start,33
Current Cell – 26
Neighbor Cells – 27
Next Cell Chosen - 27

h(v) for x direction →

7	6	5	4	3	2	1	0	
0 INF	1 INF	2 INF	3 INF	4 INF	5 INF	6 INF	GOAL INF	0
8	9	10	11	12 INF	13	14 INF	15 INF	1
16	17	18	19	20 INF	21 INF	22 INF	23	2
24 ✓ 2 + (7+3) = 12(33)	25 ✓ 2 + (6+3) = 11(33)	26 ✓ 2 + (5+3) = 10(33)	27 3 + (4+3) = 10(26)	28 INF	29 INF	30	31 INF	3
32 ✓ 1 + (7+4) = 12(S)	33 ✓ 1 + (6+4) = 11(S)	34	35	36	37	38 INF	39 INF	4
START ✓ 0 + (7+5) = 12	41 ✓ 1 + (6+5) = 12(S)	42 ✓ 2 + (5+5) = 12(33)	43 INF	44 INF	45 INF	46 INF	47 INF	5

h(v) for y direction ↑

Visited Set – {START,33,32,41,24,25,26,42,27}

Last Cells – Start,33,26
Current Cell – 27
Neighbor Cells – 20,28
Next Cell Chosen - 20

h(v) for x direction →

7	6	5	4	3	2	1	0	
0 INF	1 INF	2 INF	3 INF	4 INF	5 INF	6 INF	GOAL INF	0
8	9	10	11	12 INF	13	14 INF	15 INF	1
16	17	18	19	20 4 + (3+2) = 9(27)	21 INF	22 INF	23	2
24 ✓ 2 + (7+3) = 12(33)	25 ✓ 2 + (6+3) = 11(33)	26 ✓ 2 + (5+3) = 10(33)	27 ✓ 3 + (4+3) = 10(26)	28 4 + (3+3) = 10(27)	29 INF	30	31 INF	3
32 ✓ 1 + (7+4) = 12(S)	33 ✓ 1 + (6+4) = 11(S)	34	35	36	37	38 INF	39 INF	4
START ✓ 0 + (7+5) = 12	41 ✓ 1 + (6+5) = 12(S)	42 ✓ 2 + (5+5) = 12(33)	43 INF	44 INF	45 INF	46 INF	47 INF	5

h(v) for y direction ↑

Visited Set – {START,33,32,41,24,25,26,42,27,20,28}

Last Cells – Start,33,26,27
Current Cell – 20
Neighbor Cells – 12,21,29
Next Cell Chosen - 21

h(v) for x direction →

7	6	5	4	3	2	1	0	
0 INF	1 INF	2 INF	3 INF	4 INF	5 INF	6 INF	GOAL INF	0
8	9	10	11	12 5 + (3+1) = 9(20)	13	14 INF	15 INF	1
16	17	18	19	20 ✓ 4 + (3+2) = 9(27)	21 5 + (2+2) = 9(20)	22 INF	23	2
24 ✓ 2 + (7+3) = 12(33)	25 ✓ 2 + (6+3) = 11(33)	26 ✓ 2 + (5+3) = 10(33)	27 ✓ 3 + (4+3) = 10(26)	28 ✓ 4 + (3+3) = 10(27)	29 5 + (2+3) = 10(20)	30	31 INF	3
32 ✓ 1 + (7+4) = 12(S)	33 ✓ 1 + (6+4) = 11(S)	34	35	36	37	38 INF	39 INF	4
START ✓ 0 + (7+5) = 12	41 ✓ 1 + (6+5) = 12(S)	42 ✓ 2 + (5+5) = 12(33)	43 INF	44 INF	45 INF	46 INF	47 INF	5

h(v) for y direction ↑

NOTE: There is a tie in minimum cost for cell 12 and 21, their heuristics cost is also the same. Hence, we have to choose either 12 or 21 randomly at this step. Further steps are shown using the cell 21. But we will include the alternate path using 12 in the last slide.

Visited Set – {START,33,32,41,24,25,26,42,27,20,28,12,21,29}

Last Cells – Start,33,26,27,20
Current Cell – 21
Neighbor Cells – 14,22
Next Cell Chosen - 14

h(v) for x direction →

7	6	5	4	3	2	1	0	
0 INF	1 INF	2 INF	3 INF	4 INF	5 INF	6 INF	GOAL INF	0
8	9	10	11	12 ✓ 5 + (3+1) = 9(20)	13	14 6 + (1+1) = 8(21)	15 INF	1
16	17	18	19	20 ✓ 4 + (3+2) = 9(27)	21 ✓ 5 + (2+2) = 9(20)	22 6 + (1+2) = 9(21)	23	2
24 ✓ 2 + (7+3) = 12(33)	25 ✓ 2 + (6+3) = 11(33)	26 ✓ 2 + (5+3) = 10(33)	27 ✓ 3 + (4+3) = 10(26)	28 ✓ 4 + (3+3) = 10(27)	29 ✓ 5 + (2+3) = 10(20)	30	31 INF	3
32 ✓ 1 + (7+4) = 12(S)	33 ✓ 1 + (6+4) = 11(S)	34	35	36	37	38 INF	39 INF	4
START ✓ 0 + (7+5) = 12	41 ✓ 1 + (6+5) = 12(S)	42 ✓ 2 + (5+5) = 12(33)	43 INF	44 INF	45 INF	46 INF	47 INF	5

h(v) for y direction ↑

Visited Set – {START,33,32,41,24,25,26,42,27,20,28,12,21,29,14,22}

Last Cells – Start,33,26,27,20,21
Current Cell – 14
Neighbor Cells – 6,GOAL,15
Next Cell Chosen - GOAL

h(v) for x direction →

7	6	5	4	3	2	1	0	
0 INF	1 INF	2 INF	3 INF	4 INF	5 INF	6 7 + (1+0) = 8(14)	GOAL 7 + (0+0) = 7(14)	0
8	9	10	11	12 ✓ 5 + (3+1) = 9(20)	13	14 ✓ 6 + (1+1) = 8(21)	15 7 + (0+1) = 8(14)	1
16	17	18	19	20 ✓ 4 + (3+2) = 9(27)	21 ✓ 5 + (2+2) = 9(20)	22 ✓ 6 + (1+2) = 9(21)	23	2
24 ✓ 2 + (7+3) = 12(33)	25 ✓ 2 + (6+3) = 11(33)	26 ✓ 2 + (5+3) = 10(33)	27 ✓ 3 + (4+3) = 10(26)	28 ✓ 4 + (3+3) = 10(27)	29 ✓ 5 + (2+3) = 10(20)	30	31 INF	3
32 ✓ 1 + (7+4) = 12(S)	33 ✓ 1 + (6+4) = 11(S)	34	35	36	37	38 INF	39 INF	4
START ✓ 0 + (7+5) = 12	41 ✓ 1 + (6+5) = 12(S)	42 ✓ 2 + (5+5) = 12(33)	43 INF	44 INF	45 INF	46 INF	47 INF	5

h(v) for y direction ↑

Visited Set – {START,33,32,41,24,25,26,42,27,20,28,12,21,29,14,22,6,GOAL,15}

Path 1 – Start,33,26,27,20,21,14,GOAL
Total Cost = 7

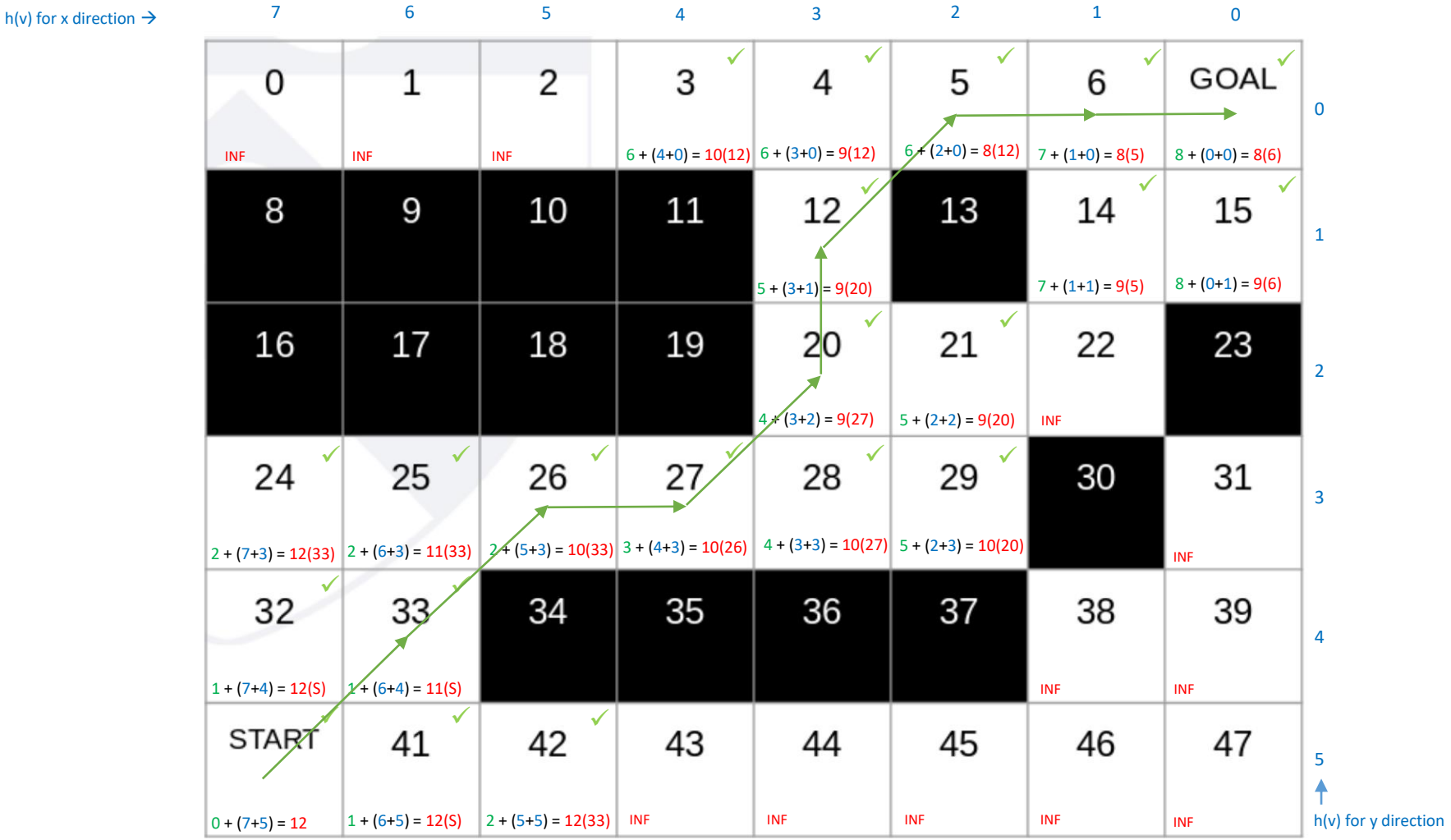
h(v) for x direction →

7	6	5	4	3	2	1	0	
0 INF	1 INF	2 INF	3 INF	4 INF	5 INF	6 ✓ 7 + (1+0) = 8(14)	GOAL ✓ 7 + (0+0) = 7(14)	0
8	9	10	11	12 ✓ 5 + (3+1) = 9(20)	13	14 ✓ 6 + (1+1) = 8(21)	15 ✓ 7 + (0+1) = 8(14)	1
16	17	18	19	20 ✓ 4 + (3+2) = 9(27)	21 ✓ 5 + (2+2) = 9(20)	22 ✓ 6 + (1+2) = 9(21)	23	2
24 ✓ 2 + (7+3) = 12(33)	25 ✓ 2 + (6+3) = 11(33)	26 ✓ 2 + (5+3) = 10(33)	27 ✓ 3 + (4+3) = 10(26)	28 ✓ 4 + (3+3) = 10(27)	29 ✓ 5 + (2+3) = 10(20)	30	31 INF	3
32 ✓ 1 + (7+4) = 12(S)	33 ✓ 1 + (6+4) = 11(S)	34	35	36	37	38 INF	39 INF	4
START 0 + (7+5) = 12	41 ✓ 1 + (6+5) = 12(S)	42 ✓ 2 + (5+5) = 12(33)	43 INF	44 INF	45 INF	46 INF	47 INF	5

h(v) for y direction ↑

Visited Set – {START,33,32,41,24,25,26,42,27,20,28,12,21,3,4,5,6,14,GOAL,15}

Path 2 – Start,33,26,27,20,12,5,6,GOAL
Total Cost = 8



NOTE: This would be the path if we had chosen block 12 in slide 6. The visited set has 20 elements as compared to the 19 for last path. The path is a little longer and has a higher cost. Hence, Manhattan Distance is not an Admissible Heuristic for this case as the path returned by A* may not be optimal.