

Evaluation:

Paths used for evaluation

(20,1) to (1,20)

(1,1) to (20,20)

(1,10) to (20,10)

(10,1) to (10,20)

(13,6) to (7,6)

Q. Which algorithm is the fastest?

A. For all 5 cases Greedy best first is the fastest, i.e. it has the least iteration count for all 5 cases

Q. Which is the most memory efficient?

A. Breadth first search is the most memory efficient among DFS, Greedy best first and BFS, as it takes least memory in all 5 cases. When A-star is also put into comparison, BFS still is most memory efficient except for the path 13,6 to 7,6 where size of frontier of A-star is 1 less than that of BFS

Q. Which visits fewest vertices?

A. Greedy Best first visits the fewest vertices in all 5 cases

Q. Which generates the shortest path length?

A. Breadth first search always gives the shortest path

Q. Are the performance differences what you expected based on the theoretical complexity analysis?

A. The worst case space complexity of dfs is  $O(b.m)$ , for bfs is  $O(b^d)$ , for greedybfs is  $O(b^m)$  which can be reduced considerably using a good heuristic. The worst case time complexity of dfs is  $O(b^m)$ , for bfs is  $O(b^d)$  and for greedy bfs is  $O(b^m)$  which can be reduced using a good heuristic. Here in the implementation of the given graph we get time complexity as  $BFS > DFS > Greedy\ best\ first$ . For the space complexity we get performance as  $DFS > Greedy\ Best\ first > BFS$  i.e. DFS has maximum frontier size compared with other two and the BFS takes maximum iterations to run. Here  $b$  is branching factor,  $d$  is depth of goal node and  $m$  is the maximum possible depth of graph.

Q. Does BFS always find the shortest path? Does GBFS always go "straight" to the goal, or are there cases where it gets side-tracked?

A. Yes BFS always finds the shortest path. GBFS tries to take the path straight to the goal (which the heuristic assumes would be the path) but it gets side-tracked when that path does not have a direct link to the goal (when the path assumed by heuristic is not the correct path then it gets side tracked)

Path : 20,1 to 1,20

	BFS	DFS	Greedy-Best First	A-Star
Iteration Count	271	219	35	133
Max Frontier Size	22	88	51	42
Vertices Visited	271	271	85	167
Path Length	33	55	35	33

Path 1,1 to 20,20

	BFS	DFS	Greedy-Best First	A-Star
Iteration Count	264	43	31	94
Max Frontier Size	21	44	37	46
Vertices Visited	271	86	67	139
Path Length	28	40	31	30

Path 1,10 to 20,10

	BFS	DFS	Greedy-Best First	A-Star
Iteration Count	244	164	53	129
Max Frontier Size	25	94	43	34
Vertices Visited	258	223	95	161
Path Length	25	52	34	25

Path 10,1 to 10,20

	BFS	DFS	Greedy-Best First	A-Star
Iteration Count	264	170	35	106
Max Frontier Size	24	88	44	37
Vertices Visited	271	239	78	142
Path Length	26	53	26	26

Path 13,6 to 7,6

	BFS	DFS	Greedy-Best First	A-Star
Iteration Count	247	157	40	126
Max Frontier Size	22	92	35	21
Vertices Visited	263	232	74	146
Path Length	28	68	28	28

Traces for BFS for all 5 Paths:

[20, 1] to [1, 20]

iter= 0 len\_frontier= 0 popped= 255 [20, 1] depth= 0

pushed 256 [20, 2]

pushed 237 [19, 1]

iter= 1 len\_frontier= 1 popped= 256 [20, 2] depth= 1

pushed 255 [20, 1]

pushed 257 [20, 3]  
pushed 238 [19, 2]  
iter= 2 len\_frontier= 3 popped= 237 [19, 1] depth= 1  
pushed 223 [18, 1]  
iter= 3 len\_frontier= 3 popped= 255 [20, 1] depth= 2  
iter= 4 len\_frontier= 2 popped= 257 [20, 3] depth= 2  
pushed 258 [20, 4]  
pushed 239 [19, 3]  
iter= 5 len\_frontier= 3 popped= 238 [19, 2] depth= 2  
pushed 224 [18, 2]  
iter= 6 len\_frontier= 3 popped= 223 [18, 1] depth= 2  
pushed 211 [17, 1]  
iter= 7 len\_frontier= 3 popped= 258 [20, 4] depth= 3  
pushed 259 [20, 5]  
pushed 240 [19, 4]  
iter= 8 len\_frontier= 4 popped= 239 [19, 3] depth= 3  
pushed 225 [18, 3]  
iter= 9 len\_frontier= 4 popped= 224 [18, 2] depth= 3  
pushed 212 [17, 2]  
iter= 10 len\_frontier= 4 popped= 211 [17, 1] depth= 3  
pushed 198 [16, 1]  
iter= 11 len\_frontier= 4 popped= 259 [20, 5] depth= 4  
pushed 260 [20, 6]  
pushed 241 [19, 5]  
iter= 12 len\_frontier= 5 popped= 240 [19, 4] depth= 4  
pushed 226 [18, 4]  
iter= 13 len\_frontier= 5 popped= 225 [18, 3] depth= 4  
pushed 213 [17, 3]  
iter= 14 len\_frontier= 5 popped= 212 [17, 2] depth= 4  
pushed 199 [16, 2]  
iter= 15 len\_frontier= 5 popped= 198 [16, 1] depth= 4  
pushed 185 [15, 1]  
iter= 16 len\_frontier= 5 popped= 260 [20, 6] depth= 5  
pushed 261 [20, 7]  
pushed 242 [19, 6]  
iter= 17 len\_frontier= 6 popped= 241 [19, 5] depth= 5  
pushed 227 [18, 5]  
iter= 18 len\_frontier= 6 popped= 226 [18, 4] depth= 5  
iter= 19 len\_frontier= 5 popped= 213 [17, 3] depth= 5  
pushed 200 [16, 3]  
iter= 20 len\_frontier= 5 popped= 199 [16, 2] depth= 5  
pushed 186 [15, 2]  
iter= 21 len\_frontier= 5 popped= 185 [15, 1] depth= 5  
pushed 173 [14, 1]  
iter= 22 len\_frontier= 5 popped= 261 [20, 7] depth= 6  
pushed 262 [20, 8]  
pushed 243 [19, 7]  
iter= 23 len\_frontier= 6 popped= 242 [19, 6] depth= 6  
pushed 228 [18, 6]

iter= 24 len\_frontier= 6 popped= 227 [18, 5] depth= 6  
pushed 214 [17, 8]  
iter= 25 len\_frontier= 6 popped= 200 [16, 3] depth= 6  
pushed 187 [15, 3]  
iter= 26 len\_frontier= 6 popped= 186 [15, 2] depth= 6  
pushed 174 [14, 2]  
iter= 27 len\_frontier= 6 popped= 173 [14, 1] depth= 6  
pushed 160 [13, 1]  
iter= 28 len\_frontier= 6 popped= 262 [20, 8] depth= 7  
pushed 263 [20, 9]  
pushed 244 [19, 8]  
iter= 29 len\_frontier= 7 popped= 243 [19, 7] depth= 7  
pushed 229 [18, 7]  
iter= 30 len\_frontier= 7 popped= 228 [18, 6] depth= 7  
iter= 31 len\_frontier= 6 popped= 214 [17, 8] depth= 7  
pushed 201 [16, 8]  
pushed 230 [18, 8]  
pushed 202 [16, 9]  
pushed 203 [16, 10]  
iter= 32 len\_frontier= 9 popped= 187 [15, 3] depth= 7  
pushed 175 [14, 3]  
iter= 33 len\_frontier= 9 popped= 174 [14, 2] depth= 7  
pushed 161 [13, 2]  
iter= 34 len\_frontier= 9 popped= 160 [13, 1] depth= 7  
pushed 155 [12, 1]  
iter= 35 len\_frontier= 9 popped= 263 [20, 9] depth= 8  
pushed 264 [20, 10]  
pushed 245 [19, 10]  
iter= 36 len\_frontier= 10 popped= 244 [19, 8] depth= 8  
iter= 37 len\_frontier= 9 popped= 229 [18, 7] depth= 8  
iter= 38 len\_frontier= 8 popped= 201 [16, 8] depth= 8  
pushed 188 [15, 8]  
pushed 177 [14, 7]  
iter= 39 len\_frontier= 9 popped= 230 [18, 8] depth= 8  
iter= 40 len\_frontier= 8 popped= 202 [16, 9] depth= 8  
iter= 41 len\_frontier= 7 popped= 203 [16, 10] depth= 8  
iter= 42 len\_frontier= 6 popped= 175 [14, 3] depth= 8  
pushed 162 [13, 3]  
iter= 43 len\_frontier= 6 popped= 161 [13, 2] depth= 8  
pushed 156 [12, 2]  
iter= 44 len\_frontier= 6 popped= 155 [12, 1] depth= 8  
pushed 150 [11, 1]  
iter= 45 len\_frontier= 6 popped= 264 [20, 10] depth= 9  
pushed 265 [20, 11]  
iter= 46 len\_frontier= 6 popped= 245 [19, 10] depth= 9  
pushed 246 [19, 11]  
iter= 47 len\_frontier= 6 popped= 188 [15, 8] depth= 9  
pushed 178 [14, 8]  
iter= 48 len\_frontier= 6 popped= 177 [14, 7] depth= 9

pushed 176 [14, 6]  
pushed 164 [13, 7]  
pushed 163 [13, 6]  
iter= 49 len\_frontier= 8 popped= 162 [13, 3] depth= 9  
pushed 157 [12, 3]  
iter= 50 len\_frontier= 8 popped= 156 [12, 2] depth= 9  
pushed 151 [11, 2]  
iter= 51 len\_frontier= 8 popped= 150 [11, 1] depth= 9  
pushed 145 [10, 1]  
iter= 52 len\_frontier= 8 popped= 265 [20, 11] depth= 10  
pushed 266 [20, 12]  
iter= 53 len\_frontier= 8 popped= 246 [19, 11] depth= 10  
pushed 247 [19, 12]  
iter= 54 len\_frontier= 8 popped= 178 [14, 8] depth= 10  
pushed 165 [13, 8]  
iter= 55 len\_frontier= 8 popped= 176 [14, 6] depth= 10  
iter= 56 len\_frontier= 7 popped= 164 [13, 7] depth= 10  
iter= 57 len\_frontier= 6 popped= 163 [13, 6] depth= 10  
iter= 58 len\_frontier= 5 popped= 157 [12, 3] depth= 10  
pushed 152 [11, 3]  
iter= 59 len\_frontier= 5 popped= 151 [11, 2] depth= 10  
pushed 146 [10, 2]  
iter= 60 len\_frontier= 5 popped= 145 [10, 1] depth= 10  
pushed 130 [9, 1]  
iter= 61 len\_frontier= 5 popped= 266 [20, 12] depth= 11  
pushed 267 [20, 13]  
iter= 62 len\_frontier= 5 popped= 247 [19, 12] depth= 11  
pushed 248 [19, 13]  
iter= 63 len\_frontier= 5 popped= 165 [13, 8] depth= 11  
iter= 64 len\_frontier= 4 popped= 152 [11, 3] depth= 11  
pushed 147 [10, 3]  
iter= 65 len\_frontier= 4 popped= 146 [10, 2] depth= 11  
pushed 131 [9, 2]  
iter= 66 len\_frontier= 4 popped= 130 [9, 1] depth= 11  
pushed 113 [8, 1]  
iter= 67 len\_frontier= 4 popped= 267 [20, 13] depth= 12  
pushed 268 [20, 14]  
iter= 68 len\_frontier= 4 popped= 248 [19, 13] depth= 12  
iter= 69 len\_frontier= 3 popped= 147 [10, 3] depth= 12  
pushed 132 [9, 3]  
iter= 70 len\_frontier= 3 popped= 131 [9, 2] depth= 12  
pushed 114 [8, 2]  
iter= 71 len\_frontier= 3 popped= 113 [8, 1] depth= 12  
pushed 99 [7, 1]  
iter= 72 len\_frontier= 3 popped= 268 [20, 14] depth= 13  
pushed 269 [20, 15]  
pushed 249 [19, 15]  
pushed 231 [18, 15]  
iter= 73 len\_frontier= 5 popped= 132 [9, 3] depth= 13

pushed 115 [8, 3]  
iter= 74 len\_frontier= 5 popped= 114 [8, 2] depth= 13  
pushed 100 [7, 2]  
iter= 75 len\_frontier= 5 popped= 99 [7, 1] depth= 13  
pushed 87 [6, 1]  
iter= 76 len\_frontier= 5 popped= 269 [20, 15] depth= 14  
pushed 270 [20, 16]  
iter= 77 len\_frontier= 5 popped= 249 [19, 15] depth= 14  
pushed 250 [19, 16]  
iter= 78 len\_frontier= 5 popped= 231 [18, 15] depth= 14  
pushed 232 [18, 16]  
pushed 217 [17, 15]  
pushed 204 [16, 14]  
iter= 79 len\_frontier= 7 popped= 115 [8, 3] depth= 14  
pushed 101 [7, 3]  
iter= 80 len\_frontier= 7 popped= 100 [7, 2] depth= 14  
pushed 88 [6, 2]  
iter= 81 len\_frontier= 7 popped= 87 [6, 1] depth= 14  
pushed 75 [5, 1]  
iter= 82 len\_frontier= 7 popped= 270 [20, 16] depth= 15  
pushed 271 [20, 17]  
iter= 83 len\_frontier= 7 popped= 250 [19, 16] depth= 15  
pushed 251 [19, 17]  
iter= 84 len\_frontier= 7 popped= 232 [18, 16] depth= 15  
pushed 233 [18, 17]  
pushed 218 [17, 16]  
iter= 85 len\_frontier= 8 popped= 217 [17, 15] depth= 15  
pushed 205 [16, 15]  
iter= 86 len\_frontier= 8 popped= 204 [16, 14] depth= 15  
pushed 191 [15, 14]  
pushed 190 [15, 13]  
pushed 216 [17, 13]  
pushed 215 [17, 12]  
iter= 87 len\_frontier= 11 popped= 101 [7, 3] depth= 15  
pushed 89 [6, 3]  
iter= 88 len\_frontier= 11 popped= 88 [6, 2] depth= 15  
pushed 76 [5, 2]  
iter= 89 len\_frontier= 11 popped= 75 [5, 1] depth= 15  
pushed 59 [4, 1]  
iter= 90 len\_frontier= 11 popped= 271 [20, 17] depth= 16  
pushed 272 [20, 18]  
iter= 91 len\_frontier= 11 popped= 251 [19, 17] depth= 16  
pushed 252 [19, 18]  
iter= 92 len\_frontier= 11 popped= 233 [18, 17] depth= 16  
pushed 234 [18, 18]  
pushed 219 [17, 17]  
iter= 93 len\_frontier= 12 popped= 218 [17, 16] depth= 16  
pushed 206 [16, 16]  
iter= 94 len\_frontier= 12 popped= 205 [16, 15] depth= 16

pushed 192 [15, 15]  
iter= 95 len\_frontier= 12 popped= 191 [15, 14] depth= 16  
iter= 96 len\_frontier= 11 popped= 190 [15, 13] depth= 16  
pushed 189 [15, 12]  
iter= 97 len\_frontier= 11 popped= 216 [17, 13] depth= 16  
iter= 98 len\_frontier= 10 popped= 215 [17, 12] depth= 16  
iter= 99 len\_frontier= 9 popped= 89 [6, 3] depth= 16  
pushed 77 [5, 3]  
iter= 100 len\_frontier= 9 popped= 76 [5, 2] depth= 16  
pushed 60 [4, 2]  
iter= 101 len\_frontier= 9 popped= 59 [4, 1] depth= 16  
pushed 40 [3, 1]  
iter= 102 len\_frontier= 9 popped= 272 [20, 18] depth= 17  
pushed 273 [20, 19]  
iter= 103 len\_frontier= 9 popped= 252 [19, 18] depth= 17  
pushed 253 [19, 19]  
iter= 104 len\_frontier= 9 popped= 234 [18, 18] depth= 17  
pushed 235 [18, 19]  
pushed 220 [17, 18]  
iter= 105 len\_frontier= 10 popped= 219 [17, 17] depth= 17  
pushed 207 [16, 17]  
iter= 106 len\_frontier= 10 popped= 206 [16, 16] depth= 17  
pushed 193 [15, 16]  
iter= 107 len\_frontier= 10 popped= 192 [15, 15] depth= 17  
pushed 179 [14, 15]  
iter= 108 len\_frontier= 10 popped= 189 [15, 12] depth= 17  
iter= 109 len\_frontier= 9 popped= 77 [5, 3] depth= 17  
pushed 61 [4, 3]  
iter= 110 len\_frontier= 9 popped= 60 [4, 2] depth= 17  
pushed 41 [3, 2]  
iter= 111 len\_frontier= 9 popped= 40 [3, 1] depth= 17  
pushed 20 [2, 1]  
iter= 112 len\_frontier= 9 popped= 273 [20, 19] depth= 18  
pushed 274 [20, 20]  
iter= 113 len\_frontier= 9 popped= 253 [19, 19] depth= 18  
pushed 254 [19, 20]  
iter= 114 len\_frontier= 9 popped= 235 [18, 19] depth= 18  
pushed 236 [18, 20]  
pushed 221 [17, 19]  
iter= 115 len\_frontier= 10 popped= 220 [17, 18] depth= 18  
pushed 208 [16, 18]  
iter= 116 len\_frontier= 10 popped= 207 [16, 17] depth= 18  
pushed 194 [15, 17]  
iter= 117 len\_frontier= 10 popped= 193 [15, 16] depth= 18  
pushed 180 [14, 16]  
iter= 118 len\_frontier= 10 popped= 179 [14, 15] depth= 18  
pushed 170 [13, 15]  
iter= 119 len\_frontier= 10 popped= 61 [4, 3] depth= 18  
pushed 62 [4, 4]

pushed 42 [3, 3]  
iter= 120 len\_frontier= 11 popped= 41 [3, 2] depth= 18  
pushed 21 [2, 2]  
iter= 121 len\_frontier= 11 popped= 20 [2, 1] depth= 18  
pushed 0 [1, 1]  
iter= 122 len\_frontier= 11 popped= 274 [20, 20] depth= 19  
iter= 123 len\_frontier= 10 popped= 254 [19, 20] depth= 19  
iter= 124 len\_frontier= 9 popped= 236 [18, 20] depth= 19  
pushed 222 [17, 20]  
iter= 125 len\_frontier= 9 popped= 221 [17, 19] depth= 19  
pushed 209 [16, 19]  
iter= 126 len\_frontier= 9 popped= 208 [16, 18] depth= 19  
pushed 195 [15, 18]  
iter= 127 len\_frontier= 9 popped= 194 [15, 17] depth= 19  
pushed 181 [14, 17]  
iter= 128 len\_frontier= 9 popped= 180 [14, 16] depth= 19  
iter= 129 len\_frontier= 8 popped= 170 [13, 15] depth= 19  
iter= 130 len\_frontier= 7 popped= 62 [4, 4] depth= 19  
pushed 63 [4, 5]  
pushed 43 [3, 4]  
iter= 131 len\_frontier= 8 popped= 42 [3, 3] depth= 19  
pushed 22 [2, 3]  
iter= 132 len\_frontier= 8 popped= 21 [2, 2] depth= 19  
pushed 1 [1, 2]  
iter= 133 len\_frontier= 8 popped= 0 [1, 1] depth= 19  
iter= 134 len\_frontier= 7 popped= 222 [17, 20] depth= 20  
pushed 210 [16, 20]  
iter= 135 len\_frontier= 7 popped= 209 [16, 19] depth= 20  
pushed 196 [15, 19]  
iter= 136 len\_frontier= 7 popped= 195 [15, 18] depth= 20  
pushed 182 [14, 18]  
iter= 137 len\_frontier= 7 popped= 181 [14, 17] depth= 20  
pushed 171 [13, 19]  
iter= 138 len\_frontier= 7 popped= 63 [4, 5] depth= 20  
pushed 64 [4, 6]  
pushed 44 [3, 5]  
iter= 139 len\_frontier= 8 popped= 43 [3, 4] depth= 20  
pushed 23 [2, 4]  
iter= 140 len\_frontier= 8 popped= 22 [2, 3] depth= 20  
pushed 2 [1, 3]  
iter= 141 len\_frontier= 8 popped= 1 [1, 2] depth= 20  
iter= 142 len\_frontier= 7 popped= 210 [16, 20] depth= 21  
pushed 197 [15, 20]  
iter= 143 len\_frontier= 7 popped= 196 [15, 19] depth= 21  
pushed 183 [14, 19]  
iter= 144 len\_frontier= 7 popped= 182 [14, 18] depth= 21  
iter= 145 len\_frontier= 6 popped= 171 [13, 19] depth= 21  
pushed 172 [13, 20]  
pushed 158 [12, 19]



pushed 184 [14, 20]  
iter= 146 len\_frontier= 8 popped= 64 [4, 6] depth= 21  
pushed 65 [4, 7]  
pushed 45 [3, 6]  
iter= 147 len\_frontier= 9 popped= 44 [3, 5] depth= 21  
pushed 24 [2, 5]  
iter= 148 len\_frontier= 9 popped= 23 [2, 4] depth= 21  
pushed 3 [1, 4]  
iter= 149 len\_frontier= 9 popped= 2 [1, 3] depth= 21  
iter= 150 len\_frontier= 8 popped= 197 [15, 20] depth= 22  
iter= 151 len\_frontier= 7 popped= 183 [14, 19] depth= 22  
iter= 152 len\_frontier= 6 popped= 172 [13, 20] depth= 22  
pushed 159 [12, 20]  
iter= 153 len\_frontier= 6 popped= 158 [12, 19] depth= 22  
pushed 153 [11, 19]  
iter= 154 len\_frontier= 6 popped= 184 [14, 20] depth= 22  
iter= 155 len\_frontier= 5 popped= 65 [4, 7] depth= 22  
pushed 66 [4, 8]  
pushed 46 [3, 7]  
iter= 156 len\_frontier= 6 popped= 45 [3, 6] depth= 22  
pushed 25 [2, 6]  
iter= 157 len\_frontier= 6 popped= 24 [2, 5] depth= 22  
pushed 4 [1, 5]  
iter= 158 len\_frontier= 6 popped= 3 [1, 4] depth= 22  
iter= 159 len\_frontier= 5 popped= 159 [12, 20] depth= 23  
pushed 154 [11, 20]  
iter= 160 len\_frontier= 5 popped= 153 [11, 19] depth= 23  
pushed 148 [10, 19]  
pushed 127 [8, 18]  
iter= 161 len\_frontier= 6 popped= 66 [4, 8] depth= 23  
pushed 67 [4, 9]  
pushed 78 [5, 8]  
pushed 47 [3, 8]  
iter= 162 len\_frontier= 8 popped= 46 [3, 7] depth= 23  
pushed 26 [2, 7]  
iter= 163 len\_frontier= 8 popped= 25 [2, 6] depth= 23  
pushed 5 [1, 6]  
iter= 164 len\_frontier= 8 popped= 4 [1, 5] depth= 23  
iter= 165 len\_frontier= 7 popped= 154 [11, 20] depth= 24  
pushed 149 [10, 20]  
iter= 166 len\_frontier= 7 popped= 148 [10, 19] depth= 24  
pushed 143 [9, 19]  
iter= 167 len\_frontier= 7 popped= 127 [8, 18] depth= 24  
pushed 128 [8, 19]  
pushed 126 [8, 17]  
pushed 110 [7, 18]  
pushed 109 [7, 17]  
iter= 168 len\_frontier= 10 popped= 67 [4, 9] depth= 24  
pushed 68 [4, 10]

pushed 48 [3, 9]  
iter= 169 len\_frontier= 11 popped= 78 [5, 8] depth= 24  
pushed 90 [6, 8]  
iter= 170 len\_frontier= 11 popped= 47 [3, 8] depth= 24  
pushed 27 [2, 8]  
iter= 171 len\_frontier= 11 popped= 26 [2, 7] depth= 24  
pushed 6 [1, 7]  
iter= 172 len\_frontier= 11 popped= 5 [1, 6] depth= 24  
iter= 173 len\_frontier= 10 popped= 149 [10, 20] depth= 25  
pushed 144 [9, 20]  
iter= 174 len\_frontier= 10 popped= 143 [9, 19] depth= 25  
iter= 175 len\_frontier= 9 popped= 128 [8, 19] depth= 25  
pushed 129 [8, 20]  
pushed 111 [7, 19]  
iter= 176 len\_frontier= 10 popped= 126 [8, 17] depth= 25  
pushed 125 [8, 16]  
pushed 108 [7, 16]  
iter= 177 len\_frontier= 11 popped= 110 [7, 18] depth= 25  
pushed 96 [6, 18]  
pushed 95 [6, 17]  
iter= 178 len\_frontier= 12 popped= 109 [7, 17] depth= 25  
pushed 94 [6, 16]  
iter= 179 len\_frontier= 12 popped= 68 [4, 10] depth= 25  
pushed 49 [3, 10]  
pushed 50 [3, 11]  
pushed 51 [3, 12]  
pushed 52 [3, 13]  
iter= 180 len\_frontier= 15 popped= 48 [3, 9] depth= 25  
pushed 28 [2, 9]  
iter= 181 len\_frontier= 15 popped= 90 [6, 8] depth= 25  
pushed 104 [7, 8]  
iter= 182 len\_frontier= 15 popped= 27 [2, 8] depth= 25  
pushed 7 [1, 8]  
iter= 183 len\_frontier= 15 popped= 6 [1, 7] depth= 25  
iter= 184 len\_frontier= 14 popped= 144 [9, 20] depth= 26  
iter= 185 len\_frontier= 13 popped= 129 [8, 20] depth= 26  
pushed 112 [7, 20]  
iter= 186 len\_frontier= 13 popped= 111 [7, 19] depth= 26  
pushed 97 [6, 19]  
iter= 187 len\_frontier= 13 popped= 125 [8, 16] depth= 26  
pushed 124 [8, 15]  
pushed 107 [7, 15]  
iter= 188 len\_frontier= 14 popped= 108 [7, 16] depth= 26  
pushed 93 [6, 15]  
iter= 189 len\_frontier= 14 popped= 96 [6, 18] depth= 26  
pushed 84 [5, 18]  
pushed 83 [5, 17]  
iter= 190 len\_frontier= 15 popped= 95 [6, 17] depth= 26  
pushed 82 [5, 16]

iter= 191 len\_frontier= 15 popped= 94 [6, 16] depth= 26  
pushed 81 [5, 15]  
iter= 192 len\_frontier= 15 popped= 49 [3, 10] depth= 26  
pushed 29 [2, 10]  
iter= 193 len\_frontier= 15 popped= 50 [3, 11] depth= 26  
pushed 30 [2, 11]  
iter= 194 len\_frontier= 15 popped= 51 [3, 12] depth= 26  
pushed 31 [2, 12]  
iter= 195 len\_frontier= 15 popped= 52 [3, 13] depth= 26  
pushed 32 [2, 13]  
iter= 196 len\_frontier= 15 popped= 28 [2, 9] depth= 26  
pushed 8 [1, 9]  
iter= 197 len\_frontier= 15 popped= 104 [7, 8] depth= 26  
pushed 103 [7, 7]  
pushed 105 [7, 9]  
pushed 118 [8, 8]  
pushed 119 [8, 9]  
iter= 198 len\_frontier= 18 popped= 7 [1, 8] depth= 26  
iter= 199 len\_frontier= 17 popped= 112 [7, 20] depth= 27  
pushed 98 [6, 20]  
iter= 200 len\_frontier= 17 popped= 97 [6, 19] depth= 27  
pushed 85 [5, 19]  
iter= 201 len\_frontier= 17 popped= 124 [8, 15] depth= 27  
pushed 142 [9, 15]  
iter= 202 len\_frontier= 17 popped= 107 [7, 15] depth= 27  
pushed 92 [6, 14]  
iter= 203 len\_frontier= 17 popped= 93 [6, 15] depth= 27  
pushed 80 [5, 14]  
iter= 204 len\_frontier= 17 popped= 84 [5, 18] depth= 27  
pushed 72 [4, 18]  
pushed 71 [4, 17]  
iter= 205 len\_frontier= 18 popped= 83 [5, 17] depth= 27  
pushed 70 [4, 16]  
iter= 206 len\_frontier= 18 popped= 82 [5, 16] depth= 27  
pushed 69 [4, 15]  
iter= 207 len\_frontier= 18 popped= 81 [5, 15] depth= 27  
iter= 208 len\_frontier= 17 popped= 29 [2, 10] depth= 27  
pushed 9 [1, 10]  
iter= 209 len\_frontier= 17 popped= 30 [2, 11] depth= 27  
pushed 10 [1, 11]  
iter= 210 len\_frontier= 17 popped= 31 [2, 12] depth= 27  
pushed 11 [1, 12]  
iter= 211 len\_frontier= 17 popped= 32 [2, 13] depth= 27  
pushed 33 [2, 14]  
pushed 12 [1, 13]  
iter= 212 len\_frontier= 18 popped= 8 [1, 9] depth= 27  
iter= 213 len\_frontier= 17 popped= 103 [7, 7] depth= 27  
pushed 102 [7, 6]  
pushed 117 [8, 7]

iter= 214 len\_frontier= 18 popped= 105 [7, 9] depth= 27  
pushed 106 [7, 10]  
pushed 120 [8, 10]  
iter= 215 len\_frontier= 19 popped= 118 [8, 8] depth= 27  
pushed 135 [9, 8]  
pushed 136 [9, 9]  
iter= 216 len\_frontier= 20 popped= 119 [8, 9] depth= 27  
pushed 137 [9, 10]  
iter= 217 len\_frontier= 20 popped= 98 [6, 20] depth= 28  
pushed 86 [5, 20]  
iter= 218 len\_frontier= 20 popped= 85 [5, 19] depth= 28  
pushed 73 [4, 19]  
iter= 219 len\_frontier= 20 popped= 142 [9, 15] depth= 28  
pushed 141 [9, 14]  
iter= 220 len\_frontier= 20 popped= 92 [6, 14] depth= 28  
pushed 91 [6, 13]  
pushed 79 [5, 13]  
iter= 221 len\_frontier= 21 popped= 80 [5, 14] depth= 28  
iter= 222 len\_frontier= 20 popped= 72 [4, 18] depth= 28  
pushed 56 [3, 18]  
pushed 55 [3, 17]  
iter= 223 len\_frontier= 21 popped= 71 [4, 17] depth= 28  
pushed 54 [3, 16]  
iter= 224 len\_frontier= 21 popped= 70 [4, 16] depth= 28  
pushed 53 [3, 15]  
iter= 225 len\_frontier= 21 popped= 69 [4, 15] depth= 28  
iter= 226 len\_frontier= 20 popped= 9 [1, 10] depth= 28  
iter= 227 len\_frontier= 19 popped= 10 [1, 11] depth= 28  
iter= 228 len\_frontier= 18 popped= 11 [1, 12] depth= 28  
iter= 229 len\_frontier= 17 popped= 33 [2, 14] depth= 28  
pushed 34 [2, 15]  
pushed 13 [1, 14]  
iter= 230 len\_frontier= 18 popped= 12 [1, 13] depth= 28  
iter= 231 len\_frontier= 17 popped= 102 [7, 6] depth= 28  
pushed 116 [8, 6]  
iter= 232 len\_frontier= 17 popped= 117 [8, 7] depth= 28  
pushed 134 [9, 7]  
iter= 233 len\_frontier= 17 popped= 106 [7, 10] depth= 28  
pushed 121 [8, 11]  
pushed 122 [8, 12]  
iter= 234 len\_frontier= 18 popped= 120 [8, 10] depth= 28  
pushed 138 [9, 11]  
iter= 235 len\_frontier= 18 popped= 135 [9, 8] depth= 28  
iter= 236 len\_frontier= 17 popped= 136 [9, 9] depth= 28  
iter= 237 len\_frontier= 16 popped= 137 [9, 10] depth= 28  
iter= 238 len\_frontier= 15 popped= 86 [5, 20] depth= 29  
pushed 74 [4, 20]  
iter= 239 len\_frontier= 15 popped= 73 [4, 19] depth= 29  
pushed 57 [3, 19]

iter= 240 len\_frontier= 15 popped= 141 [9, 14] depth= 29  
pushed 140 [9, 13]  
iter= 241 len\_frontier= 15 popped= 91 [6, 13] depth= 29  
iter= 242 len\_frontier= 14 popped= 79 [5, 13] depth= 29  
iter= 243 len\_frontier= 13 popped= 56 [3, 18] depth= 29  
pushed 37 [2, 18]  
pushed 36 [2, 17]  
iter= 244 len\_frontier= 14 popped= 55 [3, 17] depth= 29  
pushed 35 [2, 16]  
iter= 245 len\_frontier= 14 popped= 54 [3, 16] depth= 29  
iter= 246 len\_frontier= 13 popped= 53 [3, 15] depth= 29  
iter= 247 len\_frontier= 12 popped= 34 [2, 15] depth= 29  
pushed 14 [1, 15]  
iter= 248 len\_frontier= 12 popped= 13 [1, 14] depth= 29  
iter= 249 len\_frontier= 11 popped= 116 [8, 6] depth= 29  
pushed 133 [9, 6]  
iter= 250 len\_frontier= 11 popped= 134 [9, 7] depth= 29  
iter= 251 len\_frontier= 10 popped= 121 [8, 11] depth= 29  
pushed 139 [9, 12]  
iter= 252 len\_frontier= 10 popped= 122 [8, 12] depth= 29  
pushed 123 [8, 13]  
iter= 253 len\_frontier= 10 popped= 138 [9, 11] depth= 29  
iter= 254 len\_frontier= 9 popped= 74 [4, 20] depth= 30  
pushed 58 [3, 20]  
iter= 255 len\_frontier= 9 popped= 57 [3, 19] depth= 30  
pushed 38 [2, 19]  
iter= 256 len\_frontier= 9 popped= 140 [9, 13] depth= 30  
iter= 257 len\_frontier= 8 popped= 37 [2, 18] depth= 30  
pushed 17 [1, 18]  
pushed 16 [1, 17]  
iter= 258 len\_frontier= 9 popped= 36 [2, 17] depth= 30  
pushed 15 [1, 16]  
iter= 259 len\_frontier= 9 popped= 35 [2, 16] depth= 30  
iter= 260 len\_frontier= 8 popped= 14 [1, 15] depth= 30  
iter= 261 len\_frontier= 7 popped= 133 [9, 6] depth= 30  
iter= 262 len\_frontier= 6 popped= 139 [9, 12] depth= 30  
iter= 263 len\_frontier= 5 popped= 123 [8, 13] depth= 30  
iter= 264 len\_frontier= 4 popped= 58 [3, 20] depth= 31  
pushed 39 [2, 20]  
iter= 265 len\_frontier= 4 popped= 38 [2, 19] depth= 31  
pushed 18 [1, 19]  
iter= 266 len\_frontier= 4 popped= 17 [1, 18] depth= 31  
iter= 267 len\_frontier= 3 popped= 16 [1, 17] depth= 31  
iter= 268 len\_frontier= 2 popped= 15 [1, 16] depth= 31  
iter= 269 len\_frontier= 1 popped= 39 [2, 20] depth= 32  
pushed 19 [1, 20]  
iter= 270 len\_frontier= 1 popped= 18 [1, 19] depth= 32  
iter= 271 len\_frontier= 0 popped= 19 [1, 20] depth= 33  
solution\_path:

vertex 19 (1, 20)  
vertex 39 (2, 20)  
vertex 58 (3, 20)  
vertex 74 (4, 20)  
vertex 86 (5, 20)  
vertex 98 (6, 20)  
vertex 112 (7, 20)  
vertex 129 (8, 20)  
vertex 128 (8, 19)  
vertex 127 (8, 18)  
vertex 153 (11, 19)  
vertex 158 (12, 19)  
vertex 171 (13, 19)  
vertex 181 (14, 17)  
vertex 194 (15, 17)  
vertex 207 (16, 17)  
vertex 219 (17, 17)  
vertex 233 (18, 17)  
vertex 232 (18, 16)  
vertex 231 (18, 15)  
vertex 268 (20, 14)  
vertex 267 (20, 13)  
vertex 266 (20, 12)  
vertex 265 (20, 11)  
vertex 264 (20, 10)  
vertex 263 (20, 9)  
vertex 262 (20, 8)  
vertex 261 (20, 7)  
vertex 260 (20, 6)  
vertex 259 (20, 5)  
vertex 258 (20, 4)  
vertex 257 (20, 3)  
vertex 256 (20, 2)  
vertex 255 (20, 1)

Some statistics:

=====

Search algorithm: BFS

Iteration Count: 271

max frontier size: 22

vertices visited: 271/275

Path length: 33

-----Completed Execution-----

[1, 1] to [20, 20]

iter= 0 len\_frontier= 0 popped= 0 [1, 1] depth= 0

pushed 1 [1, 2]

pushed 20 [2, 1]

pushed 21 [2, 2]

```
iter= 1 len_frontier= 2 popped= 1 [1, 2] depth= 1
pushed 0 [1, 1]
pushed 2 [1, 3]
pushed 22 [2, 3]
iter= 2 len_frontier= 4 popped= 20 [2, 1] depth= 1
pushed 40 [3, 1]
pushed 41 [3, 2]
iter= 3 len_frontier= 5 popped= 21 [2, 2] depth= 1
pushed 42 [3, 3]
iter= 4 len_frontier= 5 popped= 0 [1, 1] depth= 2
iter= 5 len_frontier= 4 popped= 2 [1, 3] depth= 2
pushed 3 [1, 4]
pushed 23 [2, 4]
iter= 6 len_frontier= 5 popped= 22 [2, 3] depth= 2
pushed 43 [3, 4]
iter= 7 len_frontier= 5 popped= 40 [3, 1] depth= 2
pushed 59 [4, 1]
pushed 60 [4, 2]
iter= 8 len_frontier= 6 popped= 41 [3, 2] depth= 2
pushed 61 [4, 3]
iter= 9 len_frontier= 6 popped= 42 [3, 3] depth= 2
pushed 62 [4, 4]
iter= 10 len_frontier= 6 popped= 3 [1, 4] depth= 3
pushed 4 [1, 5]
pushed 24 [2, 5]
iter= 11 len_frontier= 7 popped= 23 [2, 4] depth= 3
pushed 44 [3, 5]
iter= 12 len_frontier= 7 popped= 43 [3, 4] depth= 3
pushed 63 [4, 5]
iter= 13 len_frontier= 7 popped= 59 [4, 1] depth= 3
pushed 75 [5, 1]
pushed 76 [5, 2]
iter= 14 len_frontier= 8 popped= 60 [4, 2] depth= 3
pushed 77 [5, 3]
iter= 15 len_frontier= 8 popped= 61 [4, 3] depth= 3
iter= 16 len_frontier= 7 popped= 62 [4, 4] depth= 3
iter= 17 len_frontier= 6 popped= 4 [1, 5] depth= 4
pushed 5 [1, 6]
pushed 25 [2, 6]
iter= 18 len_frontier= 7 popped= 24 [2, 5] depth= 4
pushed 45 [3, 6]
iter= 19 len_frontier= 7 popped= 44 [3, 5] depth= 4
pushed 64 [4, 6]
iter= 20 len_frontier= 7 popped= 63 [4, 5] depth= 4
iter= 21 len_frontier= 6 popped= 75 [5, 1] depth= 4
pushed 87 [6, 1]
pushed 88 [6, 2]
iter= 22 len_frontier= 7 popped= 76 [5, 2] depth= 4
pushed 89 [6, 3]
```

iter= 23 len\_frontier= 7 popped= 77 [5, 3] depth= 4  
iter= 24 len\_frontier= 6 popped= 5 [1, 6] depth= 5  
pushed 6 [1, 7]  
pushed 26 [2, 7]  
iter= 25 len\_frontier= 7 popped= 25 [2, 6] depth= 5  
pushed 46 [3, 7]  
iter= 26 len\_frontier= 7 popped= 45 [3, 6] depth= 5  
pushed 65 [4, 7]  
iter= 27 len\_frontier= 7 popped= 64 [4, 6] depth= 5  
iter= 28 len\_frontier= 6 popped= 87 [6, 1] depth= 5  
pushed 99 [7, 1]  
pushed 100 [7, 2]  
iter= 29 len\_frontier= 7 popped= 88 [6, 2] depth= 5  
pushed 101 [7, 3]  
iter= 30 len\_frontier= 7 popped= 89 [6, 3] depth= 5  
iter= 31 len\_frontier= 6 popped= 6 [1, 7] depth= 6  
pushed 7 [1, 8]  
pushed 27 [2, 8]  
iter= 32 len\_frontier= 7 popped= 26 [2, 7] depth= 6  
pushed 47 [3, 8]  
iter= 33 len\_frontier= 7 popped= 46 [3, 7] depth= 6  
pushed 66 [4, 8]  
iter= 34 len\_frontier= 7 popped= 65 [4, 7] depth= 6  
iter= 35 len\_frontier= 6 popped= 99 [7, 1] depth= 6  
pushed 113 [8, 1]  
pushed 114 [8, 2]  
iter= 36 len\_frontier= 7 popped= 100 [7, 2] depth= 6  
pushed 115 [8, 3]  
iter= 37 len\_frontier= 7 popped= 101 [7, 3] depth= 6  
iter= 38 len\_frontier= 6 popped= 7 [1, 8] depth= 7  
pushed 8 [1, 9]  
pushed 28 [2, 9]  
iter= 39 len\_frontier= 7 popped= 27 [2, 8] depth= 7  
pushed 48 [3, 9]  
iter= 40 len\_frontier= 7 popped= 47 [3, 8] depth= 7  
pushed 67 [4, 9]  
iter= 41 len\_frontier= 7 popped= 66 [4, 8] depth= 7  
pushed 78 [5, 8]  
iter= 42 len\_frontier= 7 popped= 113 [8, 1] depth= 7  
pushed 130 [9, 1]  
pushed 131 [9, 2]  
iter= 43 len\_frontier= 8 popped= 114 [8, 2] depth= 7  
pushed 132 [9, 3]  
iter= 44 len\_frontier= 8 popped= 115 [8, 3] depth= 7  
iter= 45 len\_frontier= 7 popped= 8 [1, 9] depth= 8  
pushed 9 [1, 10]  
pushed 29 [2, 10]  
iter= 46 len\_frontier= 8 popped= 28 [2, 9] depth= 8  
pushed 49 [3, 10]



iter= 47 len\_frontier= 8 popped= 48 [3, 9] depth= 8  
pushed 68 [4, 10]  
iter= 48 len\_frontier= 8 popped= 67 [4, 9] depth= 8  
iter= 49 len\_frontier= 7 popped= 78 [5, 8] depth= 8  
pushed 90 [6, 8]  
iter= 50 len\_frontier= 7 popped= 130 [9, 1] depth= 8  
pushed 145 [10, 1]  
pushed 146 [10, 2]  
iter= 51 len\_frontier= 8 popped= 131 [9, 2] depth= 8  
pushed 147 [10, 3]  
iter= 52 len\_frontier= 8 popped= 132 [9, 3] depth= 8  
iter= 53 len\_frontier= 7 popped= 9 [1, 10] depth= 9  
pushed 10 [1, 11]  
pushed 30 [2, 11]  
iter= 54 len\_frontier= 8 popped= 29 [2, 10] depth= 9  
pushed 50 [3, 11]  
iter= 55 len\_frontier= 8 popped= 49 [3, 10] depth= 9  
iter= 56 len\_frontier= 7 popped= 68 [4, 10] depth= 9  
pushed 51 [3, 12]  
pushed 52 [3, 13]  
iter= 57 len\_frontier= 8 popped= 90 [6, 8] depth= 9  
pushed 104 [7, 8]  
iter= 58 len\_frontier= 8 popped= 145 [10, 1] depth= 9  
pushed 150 [11, 1]  
pushed 151 [11, 2]  
iter= 59 len\_frontier= 9 popped= 146 [10, 2] depth= 9  
pushed 152 [11, 3]  
iter= 60 len\_frontier= 9 popped= 147 [10, 3] depth= 9  
iter= 61 len\_frontier= 8 popped= 10 [1, 11] depth= 10  
pushed 11 [1, 12]  
pushed 31 [2, 12]  
iter= 62 len\_frontier= 9 popped= 30 [2, 11] depth= 10  
iter= 63 len\_frontier= 8 popped= 50 [3, 11] depth= 10  
iter= 64 len\_frontier= 7 popped= 51 [3, 12] depth= 10  
iter= 65 len\_frontier= 6 popped= 52 [3, 13] depth= 10  
pushed 32 [2, 13]  
iter= 66 len\_frontier= 6 popped= 104 [7, 8] depth= 10  
pushed 103 [7, 7]  
pushed 105 [7, 9]  
pushed 118 [8, 8]  
pushed 119 [8, 9]  
iter= 67 len\_frontier= 9 popped= 150 [11, 1] depth= 10  
pushed 155 [12, 1]  
pushed 156 [12, 2]  
iter= 68 len\_frontier= 10 popped= 151 [11, 2] depth= 10  
pushed 157 [12, 3]  
iter= 69 len\_frontier= 10 popped= 152 [11, 3] depth= 10  
iter= 70 len\_frontier= 9 popped= 11 [1, 12] depth= 11  
pushed 12 [1, 13]

iter= 71 len\_frontier= 9 popped= 31 [2, 12] depth= 11  
iter= 72 len\_frontier= 8 popped= 32 [2, 13] depth= 11  
pushed 33 [2, 14]  
iter= 73 len\_frontier= 8 popped= 103 [7, 7] depth= 11  
pushed 102 [7, 6]  
pushed 117 [8, 7]  
iter= 74 len\_frontier= 9 popped= 105 [7, 9] depth= 11  
pushed 106 [7, 10]  
pushed 120 [8, 10]  
iter= 75 len\_frontier= 10 popped= 118 [8, 8] depth= 11  
pushed 135 [9, 8]  
pushed 136 [9, 9]  
iter= 76 len\_frontier= 11 popped= 119 [8, 9] depth= 11  
pushed 137 [9, 10]  
iter= 77 len\_frontier= 11 popped= 155 [12, 1] depth= 11  
pushed 160 [13, 1]  
pushed 161 [13, 2]  
iter= 78 len\_frontier= 12 popped= 156 [12, 2] depth= 11  
pushed 162 [13, 3]  
iter= 79 len\_frontier= 12 popped= 157 [12, 3] depth= 11  
iter= 80 len\_frontier= 11 popped= 12 [1, 13] depth= 12  
pushed 13 [1, 14]  
iter= 81 len\_frontier= 11 popped= 33 [2, 14] depth= 12  
pushed 34 [2, 15]  
pushed 53 [3, 15]  
iter= 82 len\_frontier= 12 popped= 102 [7, 6] depth= 12  
pushed 116 [8, 6]  
iter= 83 len\_frontier= 12 popped= 117 [8, 7] depth= 12  
pushed 134 [9, 7]  
iter= 84 len\_frontier= 12 popped= 106 [7, 10] depth= 12  
pushed 121 [8, 11]  
pushed 122 [8, 12]  
iter= 85 len\_frontier= 13 popped= 120 [8, 10] depth= 12  
pushed 138 [9, 11]  
iter= 86 len\_frontier= 13 popped= 135 [9, 8] depth= 12  
iter= 87 len\_frontier= 12 popped= 136 [9, 9] depth= 12  
iter= 88 len\_frontier= 11 popped= 137 [9, 10] depth= 12  
iter= 89 len\_frontier= 10 popped= 160 [13, 1] depth= 12  
pushed 173 [14, 1]  
pushed 174 [14, 2]  
iter= 90 len\_frontier= 11 popped= 161 [13, 2] depth= 12  
pushed 175 [14, 3]  
iter= 91 len\_frontier= 11 popped= 162 [13, 3] depth= 12  
iter= 92 len\_frontier= 10 popped= 13 [1, 14] depth= 13  
pushed 14 [1, 15]  
iter= 93 len\_frontier= 10 popped= 34 [2, 15] depth= 13  
pushed 35 [2, 16]  
pushed 54 [3, 16]  
iter= 94 len\_frontier= 11 popped= 53 [3, 15] depth= 13

pushed 69 [4, 15]  
pushed 70 [4, 16]  
iter= 95 len\_frontier= 12 popped= 116 [8, 6] depth= 13  
pushed 133 [9, 6]  
iter= 96 len\_frontier= 12 popped= 134 [9, 7] depth= 13  
iter= 97 len\_frontier= 11 popped= 121 [8, 11] depth= 13  
pushed 139 [9, 12]  
iter= 98 len\_frontier= 11 popped= 122 [8, 12] depth= 13  
pushed 123 [8, 13]  
pushed 140 [9, 13]  
iter= 99 len\_frontier= 12 popped= 138 [9, 11] depth= 13  
iter= 100 len\_frontier= 11 popped= 173 [14, 1] depth= 13  
pushed 185 [15, 1]  
pushed 186 [15, 2]  
iter= 101 len\_frontier= 12 popped= 174 [14, 2] depth= 13  
pushed 187 [15, 3]  
iter= 102 len\_frontier= 12 popped= 175 [14, 3] depth= 13  
iter= 103 len\_frontier= 11 popped= 14 [1, 15] depth= 14  
pushed 15 [1, 16]  
iter= 104 len\_frontier= 11 popped= 35 [2, 16] depth= 14  
pushed 36 [2, 17]  
pushed 55 [3, 17]  
iter= 105 len\_frontier= 12 popped= 54 [3, 16] depth= 14  
pushed 71 [4, 17]  
iter= 106 len\_frontier= 12 popped= 69 [4, 15] depth= 14  
pushed 81 [5, 15]  
pushed 82 [5, 16]  
iter= 107 len\_frontier= 13 popped= 70 [4, 16] depth= 14  
pushed 83 [5, 17]  
iter= 108 len\_frontier= 13 popped= 133 [9, 6] depth= 14  
iter= 109 len\_frontier= 12 popped= 139 [9, 12] depth= 14  
iter= 110 len\_frontier= 11 popped= 123 [8, 13] depth= 14  
iter= 111 len\_frontier= 10 popped= 140 [9, 13] depth= 14  
pushed 141 [9, 14]  
iter= 112 len\_frontier= 10 popped= 185 [15, 1] depth= 14  
pushed 198 [16, 1]  
pushed 199 [16, 2]  
iter= 113 len\_frontier= 11 popped= 186 [15, 2] depth= 14  
pushed 200 [16, 3]  
iter= 114 len\_frontier= 11 popped= 187 [15, 3] depth= 14  
iter= 115 len\_frontier= 10 popped= 15 [1, 16] depth= 15  
pushed 16 [1, 17]  
iter= 116 len\_frontier= 10 popped= 36 [2, 17] depth= 15  
pushed 37 [2, 18]  
pushed 56 [3, 18]  
iter= 117 len\_frontier= 11 popped= 55 [3, 17] depth= 15  
pushed 72 [4, 18]  
iter= 118 len\_frontier= 11 popped= 71 [4, 17] depth= 15  
pushed 84 [5, 18]

iter= 119 len\_frontier= 11 popped= 81 [5, 15] depth= 15  
pushed 80 [5, 14]  
pushed 93 [6, 15]  
pushed 94 [6, 16]  
iter= 120 len\_frontier= 13 popped= 82 [5, 16] depth= 15  
pushed 95 [6, 17]  
iter= 121 len\_frontier= 13 popped= 83 [5, 17] depth= 15  
pushed 96 [6, 18]  
iter= 122 len\_frontier= 13 popped= 141 [9, 14] depth= 15  
pushed 142 [9, 15]  
iter= 123 len\_frontier= 13 popped= 198 [16, 1] depth= 15  
pushed 211 [17, 1]  
pushed 212 [17, 2]  
iter= 124 len\_frontier= 14 popped= 199 [16, 2] depth= 15  
pushed 213 [17, 3]  
iter= 125 len\_frontier= 14 popped= 200 [16, 3] depth= 15  
iter= 126 len\_frontier= 13 popped= 16 [1, 17] depth= 16  
pushed 17 [1, 18]  
iter= 127 len\_frontier= 13 popped= 37 [2, 18] depth= 16  
pushed 38 [2, 19]  
pushed 57 [3, 19]  
iter= 128 len\_frontier= 14 popped= 56 [3, 18] depth= 16  
pushed 73 [4, 19]  
iter= 129 len\_frontier= 14 popped= 72 [4, 18] depth= 16  
pushed 85 [5, 19]  
iter= 130 len\_frontier= 14 popped= 84 [5, 18] depth= 16  
pushed 97 [6, 19]  
iter= 131 len\_frontier= 14 popped= 80 [5, 14] depth= 16  
pushed 79 [5, 13]  
pushed 92 [6, 14]  
iter= 132 len\_frontier= 15 popped= 93 [6, 15] depth= 16  
pushed 107 [7, 15]  
pushed 108 [7, 16]  
iter= 133 len\_frontier= 16 popped= 94 [6, 16] depth= 16  
pushed 109 [7, 17]  
iter= 134 len\_frontier= 16 popped= 95 [6, 17] depth= 16  
pushed 110 [7, 18]  
iter= 135 len\_frontier= 16 popped= 96 [6, 18] depth= 16  
pushed 111 [7, 19]  
iter= 136 len\_frontier= 16 popped= 142 [9, 15] depth= 16  
pushed 124 [8, 15]  
iter= 137 len\_frontier= 16 popped= 211 [17, 1] depth= 16  
pushed 223 [18, 1]  
pushed 224 [18, 2]  
iter= 138 len\_frontier= 17 popped= 212 [17, 2] depth= 16  
pushed 225 [18, 3]  
iter= 139 len\_frontier= 17 popped= 213 [17, 3] depth= 16  
pushed 226 [18, 4]  
pushed 227 [18, 5]

iter= 140 len\_frontier= 18 popped= 17 [1, 18] depth= 17  
pushed 18 [1, 19]  
iter= 141 len\_frontier= 18 popped= 38 [2, 19] depth= 17  
pushed 39 [2, 20]  
pushed 58 [3, 20]  
iter= 142 len\_frontier= 19 popped= 57 [3, 19] depth= 17  
pushed 74 [4, 20]  
iter= 143 len\_frontier= 19 popped= 73 [4, 19] depth= 17  
pushed 86 [5, 20]  
iter= 144 len\_frontier= 19 popped= 85 [5, 19] depth= 17  
pushed 98 [6, 20]  
iter= 145 len\_frontier= 19 popped= 97 [6, 19] depth= 17  
pushed 112 [7, 20]  
iter= 146 len\_frontier= 19 popped= 79 [5, 13] depth= 17  
pushed 91 [6, 13]  
iter= 147 len\_frontier= 19 popped= 92 [6, 14] depth= 17  
iter= 148 len\_frontier= 18 popped= 107 [7, 15] depth= 17  
pushed 125 [8, 16]  
iter= 149 len\_frontier= 18 popped= 108 [7, 16] depth= 17  
pushed 126 [8, 17]  
iter= 150 len\_frontier= 18 popped= 109 [7, 17] depth= 17  
pushed 127 [8, 18]  
iter= 151 len\_frontier= 18 popped= 110 [7, 18] depth= 17  
pushed 128 [8, 19]  
iter= 152 len\_frontier= 18 popped= 111 [7, 19] depth= 17  
pushed 129 [8, 20]  
iter= 153 len\_frontier= 18 popped= 124 [8, 15] depth= 17  
iter= 154 len\_frontier= 17 popped= 223 [18, 1] depth= 17  
pushed 237 [19, 1]  
pushed 238 [19, 2]  
iter= 155 len\_frontier= 18 popped= 224 [18, 2] depth= 17  
pushed 239 [19, 3]  
iter= 156 len\_frontier= 18 popped= 225 [18, 3] depth= 17  
pushed 240 [19, 4]  
iter= 157 len\_frontier= 18 popped= 226 [18, 4] depth= 17  
pushed 241 [19, 5]  
iter= 158 len\_frontier= 18 popped= 227 [18, 5] depth= 17  
pushed 228 [18, 6]  
pushed 242 [19, 6]  
pushed 214 [17, 8]  
iter= 159 len\_frontier= 20 popped= 18 [1, 19] depth= 18  
pushed 19 [1, 20]  
iter= 160 len\_frontier= 20 popped= 39 [2, 20] depth= 18  
iter= 161 len\_frontier= 19 popped= 58 [3, 20] depth= 18  
iter= 162 len\_frontier= 18 popped= 74 [4, 20] depth= 18  
iter= 163 len\_frontier= 17 popped= 86 [5, 20] depth= 18  
iter= 164 len\_frontier= 16 popped= 98 [6, 20] depth= 18  
iter= 165 len\_frontier= 15 popped= 112 [7, 20] depth= 18  
iter= 166 len\_frontier= 14 popped= 91 [6, 13] depth= 18

iter= 167 len\_frontier= 13 popped= 125 [8, 16] depth= 18  
iter= 168 len\_frontier= 12 popped= 126 [8, 17] depth= 18  
iter= 169 len\_frontier= 11 popped= 127 [8, 18] depth= 18  
pushed 143 [9, 19]  
pushed 148 [10, 19]  
pushed 153 [11, 19]  
iter= 170 len\_frontier= 13 popped= 128 [8, 19] depth= 18  
pushed 144 [9, 20]  
iter= 171 len\_frontier= 13 popped= 129 [8, 20] depth= 18  
iter= 172 len\_frontier= 12 popped= 237 [19, 1] depth= 18  
pushed 255 [20, 1]  
pushed 256 [20, 2]  
iter= 173 len\_frontier= 13 popped= 238 [19, 2] depth= 18  
pushed 257 [20, 3]  
iter= 174 len\_frontier= 13 popped= 239 [19, 3] depth= 18  
pushed 258 [20, 4]  
iter= 175 len\_frontier= 13 popped= 240 [19, 4] depth= 18  
pushed 259 [20, 5]  
iter= 176 len\_frontier= 13 popped= 241 [19, 5] depth= 18  
pushed 260 [20, 6]  
iter= 177 len\_frontier= 13 popped= 228 [18, 6] depth= 18  
pushed 229 [18, 7]  
pushed 243 [19, 7]  
iter= 178 len\_frontier= 14 popped= 242 [19, 6] depth= 18  
pushed 261 [20, 7]  
iter= 179 len\_frontier= 14 popped= 214 [17, 8] depth= 18  
pushed 201 [16, 8]  
pushed 230 [18, 8]  
pushed 202 [16, 9]  
pushed 203 [16, 10]  
iter= 180 len\_frontier= 17 popped= 19 [1, 20] depth= 19  
iter= 181 len\_frontier= 16 popped= 143 [9, 19] depth= 19  
pushed 149 [10, 20]  
iter= 182 len\_frontier= 16 popped= 148 [10, 19] depth= 19  
pushed 154 [11, 20]  
iter= 183 len\_frontier= 16 popped= 153 [11, 19] depth= 19  
pushed 158 [12, 19]  
pushed 159 [12, 20]  
iter= 184 len\_frontier= 17 popped= 144 [9, 20] depth= 19  
iter= 185 len\_frontier= 16 popped= 255 [20, 1] depth= 19  
iter= 186 len\_frontier= 15 popped= 256 [20, 2] depth= 19  
iter= 187 len\_frontier= 14 popped= 257 [20, 3] depth= 19  
iter= 188 len\_frontier= 13 popped= 258 [20, 4] depth= 19  
iter= 189 len\_frontier= 12 popped= 259 [20, 5] depth= 19  
iter= 190 len\_frontier= 11 popped= 260 [20, 6] depth= 19  
iter= 191 len\_frontier= 10 popped= 229 [18, 7] depth= 19  
pushed 244 [19, 8]  
iter= 192 len\_frontier= 10 popped= 243 [19, 7] depth= 19  
pushed 262 [20, 8]

iter= 193 len\_frontier= 10 popped= 261 [20, 7] depth= 19  
iter= 194 len\_frontier= 9 popped= 201 [16, 8] depth= 19  
pushed 188 [15, 8]  
pushed 177 [14, 7]  
iter= 195 len\_frontier= 10 popped= 230 [18, 8] depth= 19  
iter= 196 len\_frontier= 9 popped= 202 [16, 9] depth= 19  
iter= 197 len\_frontier= 8 popped= 203 [16, 10] depth= 19  
iter= 198 len\_frontier= 7 popped= 149 [10, 20] depth= 20  
iter= 199 len\_frontier= 6 popped= 154 [11, 20] depth= 20  
iter= 200 len\_frontier= 5 popped= 158 [12, 19] depth= 20  
pushed 171 [13, 19]  
pushed 172 [13, 20]  
iter= 201 len\_frontier= 6 popped= 159 [12, 20] depth= 20  
iter= 202 len\_frontier= 5 popped= 244 [19, 8] depth= 20  
pushed 263 [20, 9]  
iter= 203 len\_frontier= 5 popped= 262 [20, 8] depth= 20  
iter= 204 len\_frontier= 4 popped= 188 [15, 8] depth= 20  
pushed 178 [14, 8]  
iter= 205 len\_frontier= 4 popped= 177 [14, 7] depth= 20  
pushed 176 [14, 6]  
pushed 164 [13, 7]  
pushed 163 [13, 6]  
iter= 206 len\_frontier= 6 popped= 171 [13, 19] depth= 21  
pushed 183 [14, 19]  
pushed 182 [14, 18]  
pushed 184 [14, 20]  
pushed 181 [14, 17]  
iter= 207 len\_frontier= 9 popped= 172 [13, 20] depth= 21  
iter= 208 len\_frontier= 8 popped= 263 [20, 9] depth= 21  
pushed 264 [20, 10]  
pushed 245 [19, 10]  
iter= 209 len\_frontier= 9 popped= 178 [14, 8] depth= 21  
pushed 165 [13, 8]  
iter= 210 len\_frontier= 9 popped= 176 [14, 6] depth= 21  
iter= 211 len\_frontier= 8 popped= 164 [13, 7] depth= 21  
iter= 212 len\_frontier= 7 popped= 163 [13, 6] depth= 21  
iter= 213 len\_frontier= 6 popped= 183 [14, 19] depth= 22  
pushed 196 [15, 19]  
pushed 197 [15, 20]  
iter= 214 len\_frontier= 7 popped= 182 [14, 18] depth= 22  
pushed 195 [15, 18]  
iter= 215 len\_frontier= 7 popped= 184 [14, 20] depth= 22  
iter= 216 len\_frontier= 6 popped= 181 [14, 17] depth= 22  
pushed 180 [14, 16]  
pushed 194 [15, 17]  
iter= 217 len\_frontier= 7 popped= 264 [20, 10] depth= 22  
pushed 265 [20, 11]  
iter= 218 len\_frontier= 7 popped= 245 [19, 10] depth= 22  
pushed 246 [19, 11]

iter= 219 len\_frontier= 7 popped= 165 [13, 8] depth= 22  
iter= 220 len\_frontier= 6 popped= 196 [15, 19] depth= 23  
pushed 209 [16, 19]  
pushed 210 [16, 20]  
iter= 221 len\_frontier= 7 popped= 197 [15, 20] depth= 23  
iter= 222 len\_frontier= 6 popped= 195 [15, 18] depth= 23  
pushed 208 [16, 18]  
iter= 223 len\_frontier= 6 popped= 180 [14, 16] depth= 23  
pushed 179 [14, 15]  
pushed 193 [15, 16]  
iter= 224 len\_frontier= 7 popped= 194 [15, 17] depth= 23  
pushed 207 [16, 17]  
iter= 225 len\_frontier= 7 popped= 265 [20, 11] depth= 23  
pushed 266 [20, 12]  
iter= 226 len\_frontier= 7 popped= 246 [19, 11] depth= 23  
pushed 247 [19, 12]  
iter= 227 len\_frontier= 7 popped= 209 [16, 19] depth= 24  
pushed 221 [17, 19]  
pushed 222 [17, 20]  
iter= 228 len\_frontier= 8 popped= 210 [16, 20] depth= 24  
iter= 229 len\_frontier= 7 popped= 208 [16, 18] depth= 24  
pushed 220 [17, 18]  
iter= 230 len\_frontier= 7 popped= 179 [14, 15] depth= 24  
pushed 170 [13, 15]  
pushed 192 [15, 15]  
iter= 231 len\_frontier= 8 popped= 193 [15, 16] depth= 24  
pushed 206 [16, 16]  
iter= 232 len\_frontier= 8 popped= 207 [16, 17] depth= 24  
pushed 219 [17, 17]  
iter= 233 len\_frontier= 8 popped= 266 [20, 12] depth= 24  
pushed 267 [20, 13]  
iter= 234 len\_frontier= 8 popped= 247 [19, 12] depth= 24  
pushed 248 [19, 13]  
iter= 235 len\_frontier= 8 popped= 221 [17, 19] depth= 25  
pushed 235 [18, 19]  
pushed 236 [18, 20]  
iter= 236 len\_frontier= 9 popped= 222 [17, 20] depth= 25  
iter= 237 len\_frontier= 8 popped= 220 [17, 18] depth= 25  
pushed 234 [18, 18]  
iter= 238 len\_frontier= 8 popped= 170 [13, 15] depth= 25  
iter= 239 len\_frontier= 7 popped= 192 [15, 15] depth= 25  
pushed 191 [15, 14]  
pushed 205 [16, 15]  
iter= 240 len\_frontier= 8 popped= 206 [16, 16] depth= 25  
pushed 218 [17, 16]  
iter= 241 len\_frontier= 8 popped= 219 [17, 17] depth= 25  
pushed 233 [18, 17]  
iter= 242 len\_frontier= 8 popped= 267 [20, 13] depth= 25  
pushed 268 [20, 14]



```
iter= 243 len_frontier= 8 popped= 248 [19, 13] depth= 25
iter= 244 len_frontier= 7 popped= 235 [18, 19] depth= 26
pushed 253 [19, 19]
pushed 254 [19, 20]
iter= 245 len_frontier= 8 popped= 236 [18, 20] depth= 26
iter= 246 len_frontier= 7 popped= 234 [18, 18] depth= 26
pushed 252 [19, 18]
iter= 247 len_frontier= 7 popped= 191 [15, 14] depth= 26
pushed 190 [15, 13]
pushed 204 [16, 14]
iter= 248 len_frontier= 8 popped= 205 [16, 15] depth= 26
pushed 217 [17, 15]
iter= 249 len_frontier= 8 popped= 218 [17, 16] depth= 26
pushed 232 [18, 16]
iter= 250 len_frontier= 8 popped= 233 [18, 17] depth= 26
pushed 251 [19, 17]
iter= 251 len_frontier= 8 popped= 268 [20, 14] depth= 26
pushed 269 [20, 15]
pushed 249 [19, 15]
pushed 231 [18, 15]
iter= 252 len_frontier= 10 popped= 253 [19, 19] depth= 27
pushed 273 [20, 19]
pushed 274 [20, 20]
iter= 253 len_frontier= 11 popped= 254 [19, 20] depth= 27
iter= 254 len_frontier= 10 popped= 252 [19, 18] depth= 27
pushed 272 [20, 18]
iter= 255 len_frontier= 10 popped= 190 [15, 13] depth= 27
pushed 189 [15, 12]
iter= 256 len_frontier= 10 popped= 204 [16, 14] depth= 27
pushed 216 [17, 13]
pushed 215 [17, 12]
iter= 257 len_frontier= 11 popped= 217 [17, 15] depth= 27
iter= 258 len_frontier= 10 popped= 232 [18, 16] depth= 27
pushed 250 [19, 16]
iter= 259 len_frontier= 10 popped= 251 [19, 17] depth= 27
pushed 271 [20, 17]
iter= 260 len_frontier= 10 popped= 269 [20, 15] depth= 27
pushed 270 [20, 16]
iter= 261 len_frontier= 10 popped= 249 [19, 15] depth= 27
iter= 262 len_frontier= 9 popped= 231 [18, 15] depth= 27
iter= 263 len_frontier= 8 popped= 273 [20, 19] depth= 28
iter= 264 len_frontier= 7 popped= 274 [20, 20] depth= 28
solution_path:
vertex 274 (20, 20)
vertex 253 (19, 19)
vertex 235 (18, 19)
vertex 221 (17, 19)
vertex 209 (16, 19)
vertex 196 (15, 19)
```

vertex 183 (14, 19)  
vertex 171 (13, 19)  
vertex 158 (12, 19)  
vertex 153 (11, 19)  
vertex 127 (8, 18)  
vertex 109 (7, 17)  
vertex 94 (6, 16)  
vertex 81 (5, 15)  
vertex 69 (4, 15)  
vertex 53 (3, 15)  
vertex 33 (2, 14)  
vertex 32 (2, 13)  
vertex 52 (3, 13)  
vertex 68 (4, 10)  
vertex 48 (3, 9)  
vertex 27 (2, 8)  
vertex 6 (1, 7)  
vertex 5 (1, 6)  
vertex 4 (1, 5)  
vertex 3 (1, 4)  
vertex 2 (1, 3)  
vertex 1 (1, 2)  
vertex 0 (1, 1)

Some statistics:

=====

Search algorithm: BFS

Iteration Count: 264

max frontier size: 21

vertices visited: 271/275

Path length: 28

-----Completed Execution-----

[1, 10] to [20, 10]

iter= 0 len\_frontier= 0 popped= 9 [1, 10] depth= 0

pushed 8 [1, 9]

pushed 10 [1, 11]

pushed 29 [2, 10]

pushed 30 [2, 11]

iter= 1 len\_frontier= 3 popped= 8 [1, 9] depth= 1

pushed 9 [1, 10]

pushed 7 [1, 8]

pushed 28 [2, 9]

iter= 2 len\_frontier= 5 popped= 10 [1, 11] depth= 1

pushed 11 [1, 12]

pushed 31 [2, 12]

iter= 3 len\_frontier= 6 popped= 29 [2, 10] depth= 1

pushed 49 [3, 10]

pushed 50 [3, 11]

iter= 4 len\_frontier= 7 popped= 30 [2, 11] depth= 1  
pushed 51 [3, 12]  
iter= 5 len\_frontier= 7 popped= 9 [1, 10] depth= 2  
iter= 6 len\_frontier= 6 popped= 7 [1, 8] depth= 2  
pushed 6 [1, 7]  
pushed 27 [2, 8]  
iter= 7 len\_frontier= 7 popped= 28 [2, 9] depth= 2  
pushed 48 [3, 9]  
iter= 8 len\_frontier= 7 popped= 11 [1, 12] depth= 2  
pushed 12 [1, 13]  
pushed 32 [2, 13]  
iter= 9 len\_frontier= 8 popped= 31 [2, 12] depth= 2  
pushed 52 [3, 13]  
iter= 10 len\_frontier= 8 popped= 49 [3, 10] depth= 2  
pushed 68 [4, 10]  
iter= 11 len\_frontier= 8 popped= 50 [3, 11] depth= 2  
iter= 12 len\_frontier= 7 popped= 51 [3, 12] depth= 2  
iter= 13 len\_frontier= 6 popped= 6 [1, 7] depth= 3  
pushed 5 [1, 6]  
pushed 26 [2, 7]  
iter= 14 len\_frontier= 7 popped= 27 [2, 8] depth= 3  
pushed 47 [3, 8]  
iter= 15 len\_frontier= 7 popped= 48 [3, 9] depth= 3  
pushed 67 [4, 9]  
iter= 16 len\_frontier= 7 popped= 12 [1, 13] depth= 3  
pushed 13 [1, 14]  
pushed 33 [2, 14]  
iter= 17 len\_frontier= 8 popped= 32 [2, 13] depth= 3  
iter= 18 len\_frontier= 7 popped= 52 [3, 13] depth= 3  
iter= 19 len\_frontier= 6 popped= 68 [4, 10] depth= 3  
iter= 20 len\_frontier= 5 popped= 5 [1, 6] depth= 4  
pushed 4 [1, 5]  
pushed 25 [2, 6]  
iter= 21 len\_frontier= 6 popped= 26 [2, 7] depth= 4  
pushed 46 [3, 7]  
iter= 22 len\_frontier= 6 popped= 47 [3, 8] depth= 4  
pushed 66 [4, 8]  
iter= 23 len\_frontier= 6 popped= 67 [4, 9] depth= 4  
iter= 24 len\_frontier= 5 popped= 13 [1, 14] depth= 4  
pushed 14 [1, 15]  
pushed 34 [2, 15]  
iter= 25 len\_frontier= 6 popped= 33 [2, 14] depth= 4  
pushed 53 [3, 15]  
iter= 26 len\_frontier= 6 popped= 4 [1, 5] depth= 5  
pushed 3 [1, 4]  
pushed 24 [2, 5]  
iter= 27 len\_frontier= 7 popped= 25 [2, 6] depth= 5  
pushed 45 [3, 6]  
iter= 28 len\_frontier= 7 popped= 46 [3, 7] depth= 5

pushed 65 [4, 7]  
iter= 29 len\_frontier= 7 popped= 66 [4, 8] depth= 5  
pushed 78 [5, 8]  
iter= 30 len\_frontier= 7 popped= 14 [1, 15] depth= 5  
pushed 15 [1, 16]  
pushed 35 [2, 16]  
iter= 31 len\_frontier= 8 popped= 34 [2, 15] depth= 5  
pushed 54 [3, 16]  
iter= 32 len\_frontier= 8 popped= 53 [3, 15] depth= 5  
pushed 69 [4, 15]  
pushed 70 [4, 16]  
iter= 33 len\_frontier= 9 popped= 3 [1, 4] depth= 6  
pushed 2 [1, 3]  
pushed 23 [2, 4]  
iter= 34 len\_frontier= 10 popped= 24 [2, 5] depth= 6  
pushed 44 [3, 5]  
iter= 35 len\_frontier= 10 popped= 45 [3, 6] depth= 6  
pushed 64 [4, 6]  
iter= 36 len\_frontier= 10 popped= 65 [4, 7] depth= 6  
iter= 37 len\_frontier= 9 popped= 78 [5, 8] depth= 6  
pushed 90 [6, 8]  
iter= 38 len\_frontier= 9 popped= 15 [1, 16] depth= 6  
pushed 16 [1, 17]  
pushed 36 [2, 17]  
iter= 39 len\_frontier= 10 popped= 35 [2, 16] depth= 6  
pushed 55 [3, 17]  
iter= 40 len\_frontier= 10 popped= 54 [3, 16] depth= 6  
pushed 71 [4, 17]  
iter= 41 len\_frontier= 10 popped= 69 [4, 15] depth= 6  
pushed 81 [5, 15]  
pushed 82 [5, 16]  
iter= 42 len\_frontier= 11 popped= 70 [4, 16] depth= 6  
pushed 83 [5, 17]  
iter= 43 len\_frontier= 11 popped= 2 [1, 3] depth= 7  
pushed 1 [1, 2]  
pushed 22 [2, 3]  
iter= 44 len\_frontier= 12 popped= 23 [2, 4] depth= 7  
pushed 43 [3, 4]  
iter= 45 len\_frontier= 12 popped= 44 [3, 5] depth= 7  
pushed 63 [4, 5]  
iter= 46 len\_frontier= 12 popped= 64 [4, 6] depth= 7  
iter= 47 len\_frontier= 11 popped= 90 [6, 8] depth= 7  
pushed 104 [7, 8]  
iter= 48 len\_frontier= 11 popped= 16 [1, 17] depth= 7  
pushed 17 [1, 18]  
pushed 37 [2, 18]  
iter= 49 len\_frontier= 12 popped= 36 [2, 17] depth= 7  
pushed 56 [3, 18]  
iter= 50 len\_frontier= 12 popped= 55 [3, 17] depth= 7

pushed 72 [4, 18]  
iter= 51 len\_frontier= 12 popped= 71 [4, 17] depth= 7  
pushed 84 [5, 18]  
iter= 52 len\_frontier= 12 popped= 81 [5, 15] depth= 7  
pushed 80 [5, 14]  
pushed 93 [6, 15]  
pushed 94 [6, 16]  
iter= 53 len\_frontier= 14 popped= 82 [5, 16] depth= 7  
pushed 95 [6, 17]  
iter= 54 len\_frontier= 14 popped= 83 [5, 17] depth= 7  
pushed 96 [6, 18]  
iter= 55 len\_frontier= 14 popped= 1 [1, 2] depth= 8  
pushed 0 [1, 1]  
pushed 21 [2, 2]  
iter= 56 len\_frontier= 15 popped= 22 [2, 3] depth= 8  
pushed 42 [3, 3]  
iter= 57 len\_frontier= 15 popped= 43 [3, 4] depth= 8  
pushed 62 [4, 4]  
iter= 58 len\_frontier= 15 popped= 63 [4, 5] depth= 8  
iter= 59 len\_frontier= 14 popped= 104 [7, 8] depth= 8  
pushed 103 [7, 7]  
pushed 105 [7, 9]  
pushed 118 [8, 8]  
pushed 119 [8, 9]  
iter= 60 len\_frontier= 17 popped= 17 [1, 18] depth= 8  
pushed 18 [1, 19]  
pushed 38 [2, 19]  
iter= 61 len\_frontier= 18 popped= 37 [2, 18] depth= 8  
pushed 57 [3, 19]  
iter= 62 len\_frontier= 18 popped= 56 [3, 18] depth= 8  
pushed 73 [4, 19]  
iter= 63 len\_frontier= 18 popped= 72 [4, 18] depth= 8  
pushed 85 [5, 19]  
iter= 64 len\_frontier= 18 popped= 84 [5, 18] depth= 8  
pushed 97 [6, 19]  
iter= 65 len\_frontier= 18 popped= 80 [5, 14] depth= 8  
pushed 79 [5, 13]  
pushed 92 [6, 14]  
iter= 66 len\_frontier= 19 popped= 93 [6, 15] depth= 8  
pushed 107 [7, 15]  
pushed 108 [7, 16]  
iter= 67 len\_frontier= 20 popped= 94 [6, 16] depth= 8  
pushed 109 [7, 17]  
iter= 68 len\_frontier= 20 popped= 95 [6, 17] depth= 8  
pushed 110 [7, 18]  
iter= 69 len\_frontier= 20 popped= 96 [6, 18] depth= 8  
pushed 111 [7, 19]  
iter= 70 len\_frontier= 20 popped= 0 [1, 1] depth= 9  
pushed 20 [2, 1]

iter= 71 len\_frontier= 20 popped= 21 [2, 2] depth= 9  
pushed 41 [3, 2]  
iter= 72 len\_frontier= 20 popped= 42 [3, 3] depth= 9  
pushed 61 [4, 3]  
iter= 73 len\_frontier= 20 popped= 62 [4, 4] depth= 9  
iter= 74 len\_frontier= 19 popped= 103 [7, 7] depth= 9  
pushed 102 [7, 6]  
pushed 117 [8, 7]  
iter= 75 len\_frontier= 20 popped= 105 [7, 9] depth= 9  
pushed 106 [7, 10]  
pushed 120 [8, 10]  
iter= 76 len\_frontier= 21 popped= 118 [8, 8] depth= 9  
pushed 135 [9, 8]  
pushed 136 [9, 9]  
iter= 77 len\_frontier= 22 popped= 119 [8, 9] depth= 9  
pushed 137 [9, 10]  
iter= 78 len\_frontier= 22 popped= 18 [1, 19] depth= 9  
pushed 19 [1, 20]  
pushed 39 [2, 20]  
iter= 79 len\_frontier= 23 popped= 38 [2, 19] depth= 9  
pushed 58 [3, 20]  
iter= 80 len\_frontier= 23 popped= 57 [3, 19] depth= 9  
pushed 74 [4, 20]  
iter= 81 len\_frontier= 23 popped= 73 [4, 19] depth= 9  
pushed 86 [5, 20]  
iter= 82 len\_frontier= 23 popped= 85 [5, 19] depth= 9  
pushed 98 [6, 20]  
iter= 83 len\_frontier= 23 popped= 97 [6, 19] depth= 9  
pushed 112 [7, 20]  
iter= 84 len\_frontier= 23 popped= 79 [5, 13] depth= 9  
pushed 91 [6, 13]  
iter= 85 len\_frontier= 23 popped= 92 [6, 14] depth= 9  
iter= 86 len\_frontier= 22 popped= 107 [7, 15] depth= 9  
pushed 124 [8, 15]  
pushed 125 [8, 16]  
iter= 87 len\_frontier= 23 popped= 108 [7, 16] depth= 9  
pushed 126 [8, 17]  
iter= 88 len\_frontier= 23 popped= 109 [7, 17] depth= 9  
pushed 127 [8, 18]  
iter= 89 len\_frontier= 23 popped= 110 [7, 18] depth= 9  
pushed 128 [8, 19]  
iter= 90 len\_frontier= 23 popped= 111 [7, 19] depth= 9  
pushed 129 [8, 20]  
iter= 91 len\_frontier= 23 popped= 20 [2, 1] depth= 10  
pushed 40 [3, 1]  
iter= 92 len\_frontier= 23 popped= 41 [3, 2] depth= 10  
pushed 60 [4, 2]  
iter= 93 len\_frontier= 23 popped= 61 [4, 3] depth= 10  
pushed 77 [5, 3]

iter= 94 len\_frontier= 23 popped= 102 [7, 6] depth= 10  
pushed 116 [8, 6]  
iter= 95 len\_frontier= 23 popped= 117 [8, 7] depth= 10  
pushed 134 [9, 7]  
iter= 96 len\_frontier= 23 popped= 106 [7, 10] depth= 10  
pushed 121 [8, 11]  
pushed 122 [8, 12]  
iter= 97 len\_frontier= 24 popped= 120 [8, 10] depth= 10  
pushed 138 [9, 11]  
iter= 98 len\_frontier= 24 popped= 135 [9, 8] depth= 10  
iter= 99 len\_frontier= 23 popped= 136 [9, 9] depth= 10  
iter= 100 len\_frontier= 22 popped= 137 [9, 10] depth= 10  
iter= 101 len\_frontier= 21 popped= 19 [1, 20] depth= 10  
iter= 102 len\_frontier= 20 popped= 39 [2, 20] depth= 10  
iter= 103 len\_frontier= 19 popped= 58 [3, 20] depth= 10  
iter= 104 len\_frontier= 18 popped= 74 [4, 20] depth= 10  
iter= 105 len\_frontier= 17 popped= 86 [5, 20] depth= 10  
iter= 106 len\_frontier= 16 popped= 98 [6, 20] depth= 10  
iter= 107 len\_frontier= 15 popped= 112 [7, 20] depth= 10  
iter= 108 len\_frontier= 14 popped= 91 [6, 13] depth= 10  
iter= 109 len\_frontier= 13 popped= 124 [8, 15] depth= 10  
pushed 142 [9, 15]  
iter= 110 len\_frontier= 13 popped= 125 [8, 16] depth= 10  
iter= 111 len\_frontier= 12 popped= 126 [8, 17] depth= 10  
iter= 112 len\_frontier= 11 popped= 127 [8, 18] depth= 10  
pushed 143 [9, 19]  
pushed 148 [10, 19]  
pushed 153 [11, 19]  
iter= 113 len\_frontier= 13 popped= 128 [8, 19] depth= 10  
pushed 144 [9, 20]  
iter= 114 len\_frontier= 13 popped= 129 [8, 20] depth= 10  
iter= 115 len\_frontier= 12 popped= 40 [3, 1] depth= 11  
pushed 59 [4, 1]  
iter= 116 len\_frontier= 12 popped= 60 [4, 2] depth= 11  
pushed 76 [5, 2]  
iter= 117 len\_frontier= 12 popped= 77 [5, 3] depth= 11  
pushed 89 [6, 3]  
iter= 118 len\_frontier= 12 popped= 116 [8, 6] depth= 11  
pushed 133 [9, 6]  
iter= 119 len\_frontier= 12 popped= 134 [9, 7] depth= 11  
iter= 120 len\_frontier= 11 popped= 121 [8, 11] depth= 11  
pushed 139 [9, 12]  
iter= 121 len\_frontier= 11 popped= 122 [8, 12] depth= 11  
pushed 123 [8, 13]  
pushed 140 [9, 13]  
iter= 122 len\_frontier= 12 popped= 138 [9, 11] depth= 11  
iter= 123 len\_frontier= 11 popped= 142 [9, 15] depth= 11  
pushed 141 [9, 14]  
iter= 124 len\_frontier= 11 popped= 143 [9, 19] depth= 11

pushed 149 [10, 20]  
iter= 125 len\_frontier= 11 popped= 148 [10, 19] depth= 11  
pushed 154 [11, 20]  
iter= 126 len\_frontier= 11 popped= 153 [11, 19] depth= 11  
pushed 158 [12, 19]  
pushed 159 [12, 20]  
iter= 127 len\_frontier= 12 popped= 144 [9, 20] depth= 11  
iter= 128 len\_frontier= 11 popped= 59 [4, 1] depth= 12  
pushed 75 [5, 1]  
iter= 129 len\_frontier= 11 popped= 76 [5, 2] depth= 12  
pushed 88 [6, 2]  
iter= 130 len\_frontier= 11 popped= 89 [6, 3] depth= 12  
pushed 101 [7, 3]  
iter= 131 len\_frontier= 11 popped= 133 [9, 6] depth= 12  
iter= 132 len\_frontier= 10 popped= 139 [9, 12] depth= 12  
iter= 133 len\_frontier= 9 popped= 123 [8, 13] depth= 12  
iter= 134 len\_frontier= 8 popped= 140 [9, 13] depth= 12  
iter= 135 len\_frontier= 7 popped= 141 [9, 14] depth= 12  
iter= 136 len\_frontier= 6 popped= 149 [10, 20] depth= 12  
iter= 137 len\_frontier= 5 popped= 154 [11, 20] depth= 12  
iter= 138 len\_frontier= 4 popped= 158 [12, 19] depth= 12  
pushed 171 [13, 19]  
pushed 172 [13, 20]  
iter= 139 len\_frontier= 5 popped= 159 [12, 20] depth= 12  
iter= 140 len\_frontier= 4 popped= 75 [5, 1] depth= 13  
pushed 87 [6, 1]  
iter= 141 len\_frontier= 4 popped= 88 [6, 2] depth= 13  
pushed 100 [7, 2]  
iter= 142 len\_frontier= 4 popped= 101 [7, 3] depth= 13  
pushed 115 [8, 3]  
iter= 143 len\_frontier= 4 popped= 171 [13, 19] depth= 13  
pushed 183 [14, 19]  
pushed 182 [14, 18]  
pushed 184 [14, 20]  
pushed 181 [14, 17]  
iter= 144 len\_frontier= 7 popped= 172 [13, 20] depth= 13  
iter= 145 len\_frontier= 6 popped= 87 [6, 1] depth= 14  
pushed 99 [7, 1]  
iter= 146 len\_frontier= 6 popped= 100 [7, 2] depth= 14  
pushed 114 [8, 2]  
iter= 147 len\_frontier= 6 popped= 115 [8, 3] depth= 14  
pushed 132 [9, 3]  
iter= 148 len\_frontier= 6 popped= 183 [14, 19] depth= 14  
pushed 196 [15, 19]  
pushed 197 [15, 20]  
iter= 149 len\_frontier= 7 popped= 182 [14, 18] depth= 14  
pushed 195 [15, 18]  
iter= 150 len\_frontier= 7 popped= 184 [14, 20] depth= 14  
iter= 151 len\_frontier= 6 popped= 181 [14, 17] depth= 14



pushed 180 [14, 16]  
pushed 194 [15, 17]  
iter= 152 len\_frontier= 7 popped= 99 [7, 1] depth= 15  
pushed 113 [8, 1]  
iter= 153 len\_frontier= 7 popped= 114 [8, 2] depth= 15  
pushed 131 [9, 2]  
iter= 154 len\_frontier= 7 popped= 132 [9, 3] depth= 15  
pushed 147 [10, 3]  
iter= 155 len\_frontier= 7 popped= 196 [15, 19] depth= 15  
pushed 209 [16, 19]  
pushed 210 [16, 20]  
iter= 156 len\_frontier= 8 popped= 197 [15, 20] depth= 15  
iter= 157 len\_frontier= 7 popped= 195 [15, 18] depth= 15  
pushed 208 [16, 18]  
iter= 158 len\_frontier= 7 popped= 180 [14, 16] depth= 15  
pushed 179 [14, 15]  
pushed 193 [15, 16]  
iter= 159 len\_frontier= 8 popped= 194 [15, 17] depth= 15  
pushed 207 [16, 17]  
iter= 160 len\_frontier= 8 popped= 113 [8, 1] depth= 16  
pushed 130 [9, 1]  
iter= 161 len\_frontier= 8 popped= 131 [9, 2] depth= 16  
pushed 146 [10, 2]  
iter= 162 len\_frontier= 8 popped= 147 [10, 3] depth= 16  
pushed 152 [11, 3]  
iter= 163 len\_frontier= 8 popped= 209 [16, 19] depth= 16  
pushed 221 [17, 19]  
pushed 222 [17, 20]  
iter= 164 len\_frontier= 9 popped= 210 [16, 20] depth= 16  
iter= 165 len\_frontier= 8 popped= 208 [16, 18] depth= 16  
pushed 220 [17, 18]  
iter= 166 len\_frontier= 8 popped= 179 [14, 15] depth= 16  
pushed 170 [13, 15]  
pushed 192 [15, 15]  
iter= 167 len\_frontier= 9 popped= 193 [15, 16] depth= 16  
pushed 206 [16, 16]  
iter= 168 len\_frontier= 9 popped= 207 [16, 17] depth= 16  
pushed 219 [17, 17]  
iter= 169 len\_frontier= 9 popped= 130 [9, 1] depth= 17  
pushed 145 [10, 1]  
iter= 170 len\_frontier= 9 popped= 146 [10, 2] depth= 17  
pushed 151 [11, 2]  
iter= 171 len\_frontier= 9 popped= 152 [11, 3] depth= 17  
pushed 157 [12, 3]  
iter= 172 len\_frontier= 9 popped= 221 [17, 19] depth= 17  
pushed 235 [18, 19]  
pushed 236 [18, 20]  
iter= 173 len\_frontier= 10 popped= 222 [17, 20] depth= 17  
iter= 174 len\_frontier= 9 popped= 220 [17, 18] depth= 17

pushed 234 [18, 18]  
iter= 175 len\_frontier= 9 popped= 170 [13, 15] depth= 17  
iter= 176 len\_frontier= 8 popped= 192 [15, 15] depth= 17  
pushed 191 [15, 14]  
pushed 205 [16, 15]  
iter= 177 len\_frontier= 9 popped= 206 [16, 16] depth= 17  
pushed 218 [17, 16]  
iter= 178 len\_frontier= 9 popped= 219 [17, 17] depth= 17  
pushed 233 [18, 17]  
iter= 179 len\_frontier= 9 popped= 145 [10, 1] depth= 18  
pushed 150 [11, 1]  
iter= 180 len\_frontier= 9 popped= 151 [11, 2] depth= 18  
pushed 156 [12, 2]  
iter= 181 len\_frontier= 9 popped= 157 [12, 3] depth= 18  
pushed 162 [13, 3]  
iter= 182 len\_frontier= 9 popped= 235 [18, 19] depth= 18  
pushed 253 [19, 19]  
pushed 254 [19, 20]  
iter= 183 len\_frontier= 10 popped= 236 [18, 20] depth= 18  
iter= 184 len\_frontier= 9 popped= 234 [18, 18] depth= 18  
pushed 252 [19, 18]  
iter= 185 len\_frontier= 9 popped= 191 [15, 14] depth= 18  
pushed 190 [15, 13]  
pushed 204 [16, 14]  
iter= 186 len\_frontier= 10 popped= 205 [16, 15] depth= 18  
pushed 217 [17, 15]  
iter= 187 len\_frontier= 10 popped= 218 [17, 16] depth= 18  
pushed 232 [18, 16]  
iter= 188 len\_frontier= 10 popped= 233 [18, 17] depth= 18  
pushed 251 [19, 17]  
iter= 189 len\_frontier= 10 popped= 150 [11, 1] depth= 19  
pushed 155 [12, 1]  
iter= 190 len\_frontier= 10 popped= 156 [12, 2] depth= 19  
pushed 161 [13, 2]  
iter= 191 len\_frontier= 10 popped= 162 [13, 3] depth= 19  
pushed 175 [14, 3]  
iter= 192 len\_frontier= 10 popped= 253 [19, 19] depth= 19  
pushed 273 [20, 19]  
pushed 274 [20, 20]  
iter= 193 len\_frontier= 11 popped= 254 [19, 20] depth= 19  
iter= 194 len\_frontier= 10 popped= 252 [19, 18] depth= 19  
pushed 272 [20, 18]  
iter= 195 len\_frontier= 10 popped= 190 [15, 13] depth= 19  
pushed 189 [15, 12]  
iter= 196 len\_frontier= 10 popped= 204 [16, 14] depth= 19  
pushed 216 [17, 13]  
pushed 215 [17, 12]  
pushed 231 [18, 15]  
iter= 197 len\_frontier= 12 popped= 217 [17, 15] depth= 19

iter= 198 len\_frontier= 11 popped= 232 [18, 16] depth= 19  
pushed 250 [19, 16]  
iter= 199 len\_frontier= 11 popped= 251 [19, 17] depth= 19  
pushed 271 [20, 17]  
iter= 200 len\_frontier= 11 popped= 155 [12, 1] depth= 20  
pushed 160 [13, 1]  
iter= 201 len\_frontier= 11 popped= 161 [13, 2] depth= 20  
pushed 174 [14, 2]  
iter= 202 len\_frontier= 11 popped= 175 [14, 3] depth= 20  
pushed 187 [15, 3]  
iter= 203 len\_frontier= 11 popped= 273 [20, 19] depth= 20  
iter= 204 len\_frontier= 10 popped= 274 [20, 20] depth= 20  
iter= 205 len\_frontier= 9 popped= 272 [20, 18] depth= 20  
iter= 206 len\_frontier= 8 popped= 189 [15, 12] depth= 20  
iter= 207 len\_frontier= 7 popped= 216 [17, 13] depth= 20  
iter= 208 len\_frontier= 6 popped= 215 [17, 12] depth= 20  
iter= 209 len\_frontier= 5 popped= 231 [18, 15] depth= 20  
pushed 249 [19, 15]  
pushed 268 [20, 14]  
iter= 210 len\_frontier= 6 popped= 250 [19, 16] depth= 20  
pushed 270 [20, 16]  
iter= 211 len\_frontier= 6 popped= 271 [20, 17] depth= 20  
iter= 212 len\_frontier= 5 popped= 160 [13, 1] depth= 21  
pushed 173 [14, 1]  
iter= 213 len\_frontier= 5 popped= 174 [14, 2] depth= 21  
pushed 186 [15, 2]  
iter= 214 len\_frontier= 5 popped= 187 [15, 3] depth= 21  
pushed 200 [16, 3]  
iter= 215 len\_frontier= 5 popped= 249 [19, 15] depth= 21  
pushed 269 [20, 15]  
iter= 216 len\_frontier= 5 popped= 268 [20, 14] depth= 21  
pushed 267 [20, 13]  
pushed 248 [19, 13]  
iter= 217 len\_frontier= 6 popped= 270 [20, 16] depth= 21  
iter= 218 len\_frontier= 5 popped= 173 [14, 1] depth= 22  
pushed 185 [15, 1]  
iter= 219 len\_frontier= 5 popped= 186 [15, 2] depth= 22  
pushed 199 [16, 2]  
iter= 220 len\_frontier= 5 popped= 200 [16, 3] depth= 22  
pushed 213 [17, 3]  
iter= 221 len\_frontier= 5 popped= 269 [20, 15] depth= 22  
iter= 222 len\_frontier= 4 popped= 267 [20, 13] depth= 22  
pushed 266 [20, 12]  
pushed 247 [19, 12]  
iter= 223 len\_frontier= 5 popped= 248 [19, 13] depth= 22  
iter= 224 len\_frontier= 4 popped= 185 [15, 1] depth= 23  
pushed 198 [16, 1]  
iter= 225 len\_frontier= 4 popped= 199 [16, 2] depth= 23  
pushed 212 [17, 2]

```
iter= 226 len_frontier= 4 popped= 213 [17, 3] depth= 23
pushed 225 [18, 3]
pushed 226 [18, 4]
pushed 227 [18, 5]
iter= 227 len_frontier= 6 popped= 266 [20, 12] depth= 23
pushed 265 [20, 11]
pushed 246 [19, 11]
iter= 228 len_frontier= 7 popped= 247 [19, 12] depth= 23
iter= 229 len_frontier= 6 popped= 198 [16, 1] depth= 24
pushed 211 [17, 1]
iter= 230 len_frontier= 6 popped= 212 [17, 2] depth= 24
pushed 224 [18, 2]
iter= 231 len_frontier= 6 popped= 225 [18, 3] depth= 24
pushed 239 [19, 3]
pushed 240 [19, 4]
iter= 232 len_frontier= 7 popped= 226 [18, 4] depth= 24
pushed 241 [19, 5]
iter= 233 len_frontier= 7 popped= 227 [18, 5] depth= 24
pushed 228 [18, 6]
pushed 242 [19, 6]
pushed 214 [17, 8]
iter= 234 len_frontier= 9 popped= 265 [20, 11] depth= 24
pushed 264 [20, 10]
pushed 245 [19, 10]
iter= 235 len_frontier= 10 popped= 246 [19, 11] depth= 24
iter= 236 len_frontier= 9 popped= 211 [17, 1] depth= 25
pushed 223 [18, 1]
iter= 237 len_frontier= 9 popped= 224 [18, 2] depth= 25
pushed 238 [19, 2]
iter= 238 len_frontier= 9 popped= 239 [19, 3] depth= 25
pushed 257 [20, 3]
pushed 258 [20, 4]
iter= 239 len_frontier= 10 popped= 240 [19, 4] depth= 25
pushed 259 [20, 5]
iter= 240 len_frontier= 10 popped= 241 [19, 5] depth= 25
pushed 260 [20, 6]
iter= 241 len_frontier= 10 popped= 228 [18, 6] depth= 25
pushed 229 [18, 7]
pushed 243 [19, 7]
iter= 242 len_frontier= 11 popped= 242 [19, 6] depth= 25
pushed 261 [20, 7]
iter= 243 len_frontier= 11 popped= 214 [17, 8] depth= 25
pushed 201 [16, 8]
pushed 230 [18, 8]
pushed 202 [16, 9]
pushed 203 [16, 10]
iter= 244 len_frontier= 14 popped= 264 [20, 10] depth= 25
solution_path:
vertex 264 (20, 10)
```

vertex 265 (20, 11)  
vertex 266 (20, 12)  
vertex 267 (20, 13)  
vertex 268 (20, 14)  
vertex 231 (18, 15)  
vertex 204 (16, 14)  
vertex 191 (15, 14)  
vertex 192 (15, 15)  
vertex 179 (14, 15)  
vertex 180 (14, 16)  
vertex 181 (14, 17)  
vertex 171 (13, 19)  
vertex 158 (12, 19)  
vertex 153 (11, 19)  
vertex 127 (8, 18)  
vertex 109 (7, 17)  
vertex 94 (6, 16)  
vertex 81 (5, 15)  
vertex 69 (4, 15)  
vertex 53 (3, 15)  
vertex 33 (2, 14)  
vertex 12 (1, 13)  
vertex 11 (1, 12)  
vertex 10 (1, 11)  
vertex 9 (1, 10)

Some statistics:

=====

Search algorithm: BFS

Iteration Count: 244

max frontier size: 25

vertices visited: 258/275

Path length: 25

-----Completed Execution-----

[10, 1] to [10, 20]

iter= 0 len\_frontier= 0 popped= 145 [10, 1] depth= 0

pushed 146 [10, 2]

pushed 130 [9, 1]

pushed 150 [11, 1]

pushed 151 [11, 2]

iter= 1 len\_frontier= 3 popped= 146 [10, 2] depth= 1

pushed 145 [10, 1]

pushed 147 [10, 3]

pushed 131 [9, 2]

pushed 152 [11, 3]

iter= 2 len\_frontier= 6 popped= 130 [9, 1] depth= 1

pushed 113 [8, 1]

iter= 3 len\_frontier= 6 popped= 150 [11, 1] depth= 1

pushed 155 [12, 1]  
pushed 156 [12, 2]  
iter= 4 len\_frontier= 7 popped= 151 [11, 2] depth= 1  
pushed 157 [12, 3]  
iter= 5 len\_frontier= 7 popped= 145 [10, 1] depth= 2  
iter= 6 len\_frontier= 6 popped= 147 [10, 3] depth= 2  
pushed 132 [9, 3]  
iter= 7 len\_frontier= 6 popped= 131 [9, 2] depth= 2  
pushed 114 [8, 2]  
iter= 8 len\_frontier= 6 popped= 152 [11, 3] depth= 2  
iter= 9 len\_frontier= 5 popped= 113 [8, 1] depth= 2  
pushed 99 [7, 1]  
iter= 10 len\_frontier= 5 popped= 155 [12, 1] depth= 2  
pushed 160 [13, 1]  
pushed 161 [13, 2]  
iter= 11 len\_frontier= 6 popped= 156 [12, 2] depth= 2  
pushed 162 [13, 3]  
iter= 12 len\_frontier= 6 popped= 157 [12, 3] depth= 2  
iter= 13 len\_frontier= 5 popped= 132 [9, 3] depth= 3  
pushed 115 [8, 3]  
iter= 14 len\_frontier= 5 popped= 114 [8, 2] depth= 3  
pushed 100 [7, 2]  
iter= 15 len\_frontier= 5 popped= 99 [7, 1] depth= 3  
pushed 87 [6, 1]  
iter= 16 len\_frontier= 5 popped= 160 [13, 1] depth= 3  
pushed 173 [14, 1]  
pushed 174 [14, 2]  
iter= 17 len\_frontier= 6 popped= 161 [13, 2] depth= 3  
pushed 175 [14, 3]  
iter= 18 len\_frontier= 6 popped= 162 [13, 3] depth= 3  
iter= 19 len\_frontier= 5 popped= 115 [8, 3] depth= 4  
pushed 101 [7, 3]  
iter= 20 len\_frontier= 5 popped= 100 [7, 2] depth= 4  
pushed 88 [6, 2]  
iter= 21 len\_frontier= 5 popped= 87 [6, 1] depth= 4  
pushed 75 [5, 1]  
iter= 22 len\_frontier= 5 popped= 173 [14, 1] depth= 4  
pushed 185 [15, 1]  
pushed 186 [15, 2]  
iter= 23 len\_frontier= 6 popped= 174 [14, 2] depth= 4  
pushed 187 [15, 3]  
iter= 24 len\_frontier= 6 popped= 175 [14, 3] depth= 4  
iter= 25 len\_frontier= 5 popped= 101 [7, 3] depth= 5  
pushed 89 [6, 3]  
iter= 26 len\_frontier= 5 popped= 88 [6, 2] depth= 5  
pushed 76 [5, 2]  
iter= 27 len\_frontier= 5 popped= 75 [5, 1] depth= 5  
pushed 59 [4, 1]  
iter= 28 len\_frontier= 5 popped= 185 [15, 1] depth= 5

pushed 198 [16, 1]  
pushed 199 [16, 2]  
iter= 29 len\_frontier= 6 popped= 186 [15, 2] depth= 5  
pushed 200 [16, 3]  
iter= 30 len\_frontier= 6 popped= 187 [15, 3] depth= 5  
iter= 31 len\_frontier= 5 popped= 89 [6, 3] depth= 6  
pushed 77 [5, 3]  
iter= 32 len\_frontier= 5 popped= 76 [5, 2] depth= 6  
pushed 60 [4, 2]  
iter= 33 len\_frontier= 5 popped= 59 [4, 1] depth= 6  
pushed 40 [3, 1]  
iter= 34 len\_frontier= 5 popped= 198 [16, 1] depth= 6  
pushed 211 [17, 1]  
pushed 212 [17, 2]  
iter= 35 len\_frontier= 6 popped= 199 [16, 2] depth= 6  
pushed 213 [17, 3]  
iter= 36 len\_frontier= 6 popped= 200 [16, 3] depth= 6  
iter= 37 len\_frontier= 5 popped= 77 [5, 3] depth= 7  
pushed 61 [4, 3]  
iter= 38 len\_frontier= 5 popped= 60 [4, 2] depth= 7  
pushed 41 [3, 2]  
iter= 39 len\_frontier= 5 popped= 40 [3, 1] depth= 7  
pushed 20 [2, 1]  
iter= 40 len\_frontier= 5 popped= 211 [17, 1] depth= 7  
pushed 223 [18, 1]  
pushed 224 [18, 2]  
iter= 41 len\_frontier= 6 popped= 212 [17, 2] depth= 7  
pushed 225 [18, 3]  
iter= 42 len\_frontier= 6 popped= 213 [17, 3] depth= 7  
pushed 226 [18, 4]  
pushed 227 [18, 5]  
iter= 43 len\_frontier= 7 popped= 61 [4, 3] depth= 8  
pushed 62 [4, 4]  
pushed 42 [3, 3]  
iter= 44 len\_frontier= 8 popped= 41 [3, 2] depth= 8  
pushed 21 [2, 2]  
iter= 45 len\_frontier= 8 popped= 20 [2, 1] depth= 8  
pushed 0 [1, 1]  
iter= 46 len\_frontier= 8 popped= 223 [18, 1] depth= 8  
pushed 237 [19, 1]  
pushed 238 [19, 2]  
iter= 47 len\_frontier= 9 popped= 224 [18, 2] depth= 8  
pushed 239 [19, 3]  
iter= 48 len\_frontier= 9 popped= 225 [18, 3] depth= 8  
pushed 240 [19, 4]  
iter= 49 len\_frontier= 9 popped= 226 [18, 4] depth= 8  
pushed 241 [19, 5]  
iter= 50 len\_frontier= 9 popped= 227 [18, 5] depth= 8  
pushed 228 [18, 6]

pushed 242 [19, 6]  
pushed 214 [17, 8]  
iter= 51 len\_frontier= 11 popped= 62 [4, 4] depth= 9  
pushed 63 [4, 5]  
pushed 43 [3, 4]  
iter= 52 len\_frontier= 12 popped= 42 [3, 3] depth= 9  
pushed 22 [2, 3]  
iter= 53 len\_frontier= 12 popped= 21 [2, 2] depth= 9  
pushed 1 [1, 2]  
iter= 54 len\_frontier= 12 popped= 0 [1, 1] depth= 9  
iter= 55 len\_frontier= 11 popped= 237 [19, 1] depth= 9  
pushed 255 [20, 1]  
pushed 256 [20, 2]  
iter= 56 len\_frontier= 12 popped= 238 [19, 2] depth= 9  
pushed 257 [20, 3]  
iter= 57 len\_frontier= 12 popped= 239 [19, 3] depth= 9  
pushed 258 [20, 4]  
iter= 58 len\_frontier= 12 popped= 240 [19, 4] depth= 9  
pushed 259 [20, 5]  
iter= 59 len\_frontier= 12 popped= 241 [19, 5] depth= 9  
pushed 260 [20, 6]  
iter= 60 len\_frontier= 12 popped= 228 [18, 6] depth= 9  
pushed 229 [18, 7]  
pushed 243 [19, 7]  
iter= 61 len\_frontier= 13 popped= 242 [19, 6] depth= 9  
pushed 261 [20, 7]  
iter= 62 len\_frontier= 13 popped= 214 [17, 8] depth= 9  
pushed 201 [16, 8]  
pushed 230 [18, 8]  
pushed 202 [16, 9]  
pushed 203 [16, 10]  
iter= 63 len\_frontier= 16 popped= 63 [4, 5] depth= 10  
pushed 64 [4, 6]  
pushed 44 [3, 5]  
iter= 64 len\_frontier= 17 popped= 43 [3, 4] depth= 10  
pushed 23 [2, 4]  
iter= 65 len\_frontier= 17 popped= 22 [2, 3] depth= 10  
pushed 2 [1, 3]  
iter= 66 len\_frontier= 17 popped= 1 [1, 2] depth= 10  
iter= 67 len\_frontier= 16 popped= 255 [20, 1] depth= 10  
iter= 68 len\_frontier= 15 popped= 256 [20, 2] depth= 10  
iter= 69 len\_frontier= 14 popped= 257 [20, 3] depth= 10  
iter= 70 len\_frontier= 13 popped= 258 [20, 4] depth= 10  
iter= 71 len\_frontier= 12 popped= 259 [20, 5] depth= 10  
iter= 72 len\_frontier= 11 popped= 260 [20, 6] depth= 10  
iter= 73 len\_frontier= 10 popped= 229 [18, 7] depth= 10  
pushed 244 [19, 8]  
iter= 74 len\_frontier= 10 popped= 243 [19, 7] depth= 10  
pushed 262 [20, 8]



iter= 75 len\_frontier= 10 popped= 261 [20, 7] depth= 10  
iter= 76 len\_frontier= 9 popped= 201 [16, 8] depth= 10  
pushed 188 [15, 8]  
pushed 177 [14, 7]  
iter= 77 len\_frontier= 10 popped= 230 [18, 8] depth= 10  
iter= 78 len\_frontier= 9 popped= 202 [16, 9] depth= 10  
iter= 79 len\_frontier= 8 popped= 203 [16, 10] depth= 10  
iter= 80 len\_frontier= 7 popped= 64 [4, 6] depth= 11  
pushed 65 [4, 7]  
pushed 45 [3, 6]  
iter= 81 len\_frontier= 8 popped= 44 [3, 5] depth= 11  
pushed 24 [2, 5]  
iter= 82 len\_frontier= 8 popped= 23 [2, 4] depth= 11  
pushed 3 [1, 4]  
iter= 83 len\_frontier= 8 popped= 2 [1, 3] depth= 11  
iter= 84 len\_frontier= 7 popped= 244 [19, 8] depth= 11  
pushed 263 [20, 9]  
iter= 85 len\_frontier= 7 popped= 262 [20, 8] depth= 11  
iter= 86 len\_frontier= 6 popped= 188 [15, 8] depth= 11  
pushed 178 [14, 8]  
iter= 87 len\_frontier= 6 popped= 177 [14, 7] depth= 11  
pushed 176 [14, 6]  
pushed 164 [13, 7]  
pushed 163 [13, 6]  
iter= 88 len\_frontier= 8 popped= 65 [4, 7] depth= 12  
pushed 66 [4, 8]  
pushed 46 [3, 7]  
iter= 89 len\_frontier= 9 popped= 45 [3, 6] depth= 12  
pushed 25 [2, 6]  
iter= 90 len\_frontier= 9 popped= 24 [2, 5] depth= 12  
pushed 4 [1, 5]  
iter= 91 len\_frontier= 9 popped= 3 [1, 4] depth= 12  
iter= 92 len\_frontier= 8 popped= 263 [20, 9] depth= 12  
pushed 264 [20, 10]  
pushed 245 [19, 10]  
iter= 93 len\_frontier= 9 popped= 178 [14, 8] depth= 12  
pushed 165 [13, 8]  
iter= 94 len\_frontier= 9 popped= 176 [14, 6] depth= 12  
iter= 95 len\_frontier= 8 popped= 164 [13, 7] depth= 12  
iter= 96 len\_frontier= 7 popped= 163 [13, 6] depth= 12  
iter= 97 len\_frontier= 6 popped= 66 [4, 8] depth= 13  
pushed 67 [4, 9]  
pushed 78 [5, 8]  
pushed 47 [3, 8]  
iter= 98 len\_frontier= 8 popped= 46 [3, 7] depth= 13  
pushed 26 [2, 7]  
iter= 99 len\_frontier= 8 popped= 25 [2, 6] depth= 13  
pushed 5 [1, 6]  
iter= 100 len\_frontier= 8 popped= 4 [1, 5] depth= 13

iter= 101 len\_frontier= 7 popped= 264 [20, 10] depth= 13  
pushed 265 [20, 11]  
iter= 102 len\_frontier= 7 popped= 245 [19, 10] depth= 13  
pushed 246 [19, 11]  
iter= 103 len\_frontier= 7 popped= 165 [13, 8] depth= 13  
iter= 104 len\_frontier= 6 popped= 67 [4, 9] depth= 14  
pushed 68 [4, 10]  
pushed 48 [3, 9]  
iter= 105 len\_frontier= 7 popped= 78 [5, 8] depth= 14  
pushed 90 [6, 8]  
iter= 106 len\_frontier= 7 popped= 47 [3, 8] depth= 14  
pushed 27 [2, 8]  
iter= 107 len\_frontier= 7 popped= 26 [2, 7] depth= 14  
pushed 6 [1, 7]  
iter= 108 len\_frontier= 7 popped= 5 [1, 6] depth= 14  
iter= 109 len\_frontier= 6 popped= 265 [20, 11] depth= 14  
pushed 266 [20, 12]  
iter= 110 len\_frontier= 6 popped= 246 [19, 11] depth= 14  
pushed 247 [19, 12]  
iter= 111 len\_frontier= 6 popped= 68 [4, 10] depth= 15  
pushed 49 [3, 10]  
pushed 50 [3, 11]  
pushed 51 [3, 12]  
pushed 52 [3, 13]  
iter= 112 len\_frontier= 9 popped= 48 [3, 9] depth= 15  
pushed 28 [2, 9]  
iter= 113 len\_frontier= 9 popped= 90 [6, 8] depth= 15  
pushed 104 [7, 8]  
iter= 114 len\_frontier= 9 popped= 27 [2, 8] depth= 15  
pushed 7 [1, 8]  
iter= 115 len\_frontier= 9 popped= 6 [1, 7] depth= 15  
iter= 116 len\_frontier= 8 popped= 266 [20, 12] depth= 15  
pushed 267 [20, 13]  
iter= 117 len\_frontier= 8 popped= 247 [19, 12] depth= 15  
pushed 248 [19, 13]  
iter= 118 len\_frontier= 8 popped= 49 [3, 10] depth= 16  
pushed 29 [2, 10]  
iter= 119 len\_frontier= 8 popped= 50 [3, 11] depth= 16  
pushed 30 [2, 11]  
iter= 120 len\_frontier= 8 popped= 51 [3, 12] depth= 16  
pushed 31 [2, 12]  
iter= 121 len\_frontier= 8 popped= 52 [3, 13] depth= 16  
pushed 32 [2, 13]  
iter= 122 len\_frontier= 8 popped= 28 [2, 9] depth= 16  
pushed 8 [1, 9]  
iter= 123 len\_frontier= 8 popped= 104 [7, 8] depth= 16  
pushed 103 [7, 7]  
pushed 105 [7, 9]  
pushed 118 [8, 8]

pushed 119 [8, 9]  
iter= 124 len\_frontier= 11 popped= 7 [1, 8] depth= 16  
iter= 125 len\_frontier= 10 popped= 267 [20, 13] depth= 16  
pushed 268 [20, 14]  
iter= 126 len\_frontier= 10 popped= 248 [19, 13] depth= 16  
iter= 127 len\_frontier= 9 popped= 29 [2, 10] depth= 17  
pushed 9 [1, 10]  
iter= 128 len\_frontier= 9 popped= 30 [2, 11] depth= 17  
pushed 10 [1, 11]  
iter= 129 len\_frontier= 9 popped= 31 [2, 12] depth= 17  
pushed 11 [1, 12]  
iter= 130 len\_frontier= 9 popped= 32 [2, 13] depth= 17  
pushed 33 [2, 14]  
pushed 12 [1, 13]  
iter= 131 len\_frontier= 10 popped= 8 [1, 9] depth= 17  
iter= 132 len\_frontier= 9 popped= 103 [7, 7] depth= 17  
pushed 102 [7, 6]  
pushed 117 [8, 7]  
iter= 133 len\_frontier= 10 popped= 105 [7, 9] depth= 17  
pushed 106 [7, 10]  
pushed 120 [8, 10]  
iter= 134 len\_frontier= 11 popped= 118 [8, 8] depth= 17  
pushed 135 [9, 8]  
pushed 136 [9, 9]  
iter= 135 len\_frontier= 12 popped= 119 [8, 9] depth= 17  
pushed 137 [9, 10]  
iter= 136 len\_frontier= 12 popped= 268 [20, 14] depth= 17  
pushed 269 [20, 15]  
pushed 249 [19, 15]  
pushed 231 [18, 15]  
iter= 137 len\_frontier= 14 popped= 9 [1, 10] depth= 18  
iter= 138 len\_frontier= 13 popped= 10 [1, 11] depth= 18  
iter= 139 len\_frontier= 12 popped= 11 [1, 12] depth= 18  
iter= 140 len\_frontier= 11 popped= 33 [2, 14] depth= 18  
pushed 34 [2, 15]  
pushed 13 [1, 14]  
pushed 53 [3, 15]  
iter= 141 len\_frontier= 13 popped= 12 [1, 13] depth= 18  
iter= 142 len\_frontier= 12 popped= 102 [7, 6] depth= 18  
pushed 116 [8, 6]  
iter= 143 len\_frontier= 12 popped= 117 [8, 7] depth= 18  
pushed 134 [9, 7]  
iter= 144 len\_frontier= 12 popped= 106 [7, 10] depth= 18  
pushed 121 [8, 11]  
pushed 122 [8, 12]  
iter= 145 len\_frontier= 13 popped= 120 [8, 10] depth= 18  
pushed 138 [9, 11]  
iter= 146 len\_frontier= 13 popped= 135 [9, 8] depth= 18  
iter= 147 len\_frontier= 12 popped= 136 [9, 9] depth= 18

iter= 148 len\_frontier= 11 popped= 137 [9, 10] depth= 18  
iter= 149 len\_frontier= 10 popped= 269 [20, 15] depth= 18  
pushed 270 [20, 16]  
iter= 150 len\_frontier= 10 popped= 249 [19, 15] depth= 18  
pushed 250 [19, 16]  
iter= 151 len\_frontier= 10 popped= 231 [18, 15] depth= 18  
pushed 232 [18, 16]  
pushed 217 [17, 15]  
pushed 204 [16, 14]  
iter= 152 len\_frontier= 12 popped= 34 [2, 15] depth= 19  
pushed 35 [2, 16]  
pushed 14 [1, 15]  
pushed 54 [3, 16]  
iter= 153 len\_frontier= 14 popped= 13 [1, 14] depth= 19  
iter= 154 len\_frontier= 13 popped= 53 [3, 15] depth= 19  
pushed 69 [4, 15]  
pushed 70 [4, 16]  
iter= 155 len\_frontier= 14 popped= 116 [8, 6] depth= 19  
pushed 133 [9, 6]  
iter= 156 len\_frontier= 14 popped= 134 [9, 7] depth= 19  
iter= 157 len\_frontier= 13 popped= 121 [8, 11] depth= 19  
pushed 139 [9, 12]  
iter= 158 len\_frontier= 13 popped= 122 [8, 12] depth= 19  
pushed 123 [8, 13]  
pushed 140 [9, 13]  
iter= 159 len\_frontier= 14 popped= 138 [9, 11] depth= 19  
iter= 160 len\_frontier= 13 popped= 270 [20, 16] depth= 19  
pushed 271 [20, 17]  
iter= 161 len\_frontier= 13 popped= 250 [19, 16] depth= 19  
pushed 251 [19, 17]  
iter= 162 len\_frontier= 13 popped= 232 [18, 16] depth= 19  
pushed 233 [18, 17]  
pushed 218 [17, 16]  
iter= 163 len\_frontier= 14 popped= 217 [17, 15] depth= 19  
pushed 205 [16, 15]  
iter= 164 len\_frontier= 14 popped= 204 [16, 14] depth= 19  
pushed 191 [15, 14]  
pushed 190 [15, 13]  
pushed 216 [17, 13]  
pushed 215 [17, 12]  
iter= 165 len\_frontier= 17 popped= 35 [2, 16] depth= 20  
pushed 36 [2, 17]  
pushed 15 [1, 16]  
pushed 55 [3, 17]  
iter= 166 len\_frontier= 19 popped= 14 [1, 15] depth= 20  
iter= 167 len\_frontier= 18 popped= 54 [3, 16] depth= 20  
pushed 71 [4, 17]  
iter= 168 len\_frontier= 18 popped= 69 [4, 15] depth= 20  
pushed 81 [5, 15]

pushed 82 [5, 16]  
iter= 169 len\_frontier= 19 popped= 70 [4, 16] depth= 20  
pushed 83 [5, 17]  
iter= 170 len\_frontier= 19 popped= 133 [9, 6] depth= 20  
iter= 171 len\_frontier= 18 popped= 139 [9, 12] depth= 20  
iter= 172 len\_frontier= 17 popped= 123 [8, 13] depth= 20  
iter= 173 len\_frontier= 16 popped= 140 [9, 13] depth= 20  
pushed 141 [9, 14]  
iter= 174 len\_frontier= 16 popped= 271 [20, 17] depth= 20  
pushed 272 [20, 18]  
iter= 175 len\_frontier= 16 popped= 251 [19, 17] depth= 20  
pushed 252 [19, 18]  
iter= 176 len\_frontier= 16 popped= 233 [18, 17] depth= 20  
pushed 234 [18, 18]  
pushed 219 [17, 17]  
iter= 177 len\_frontier= 17 popped= 218 [17, 16] depth= 20  
pushed 206 [16, 16]  
iter= 178 len\_frontier= 17 popped= 205 [16, 15] depth= 20  
pushed 192 [15, 15]  
iter= 179 len\_frontier= 17 popped= 191 [15, 14] depth= 20  
iter= 180 len\_frontier= 16 popped= 190 [15, 13] depth= 20  
pushed 189 [15, 12]  
iter= 181 len\_frontier= 16 popped= 216 [17, 13] depth= 20  
iter= 182 len\_frontier= 15 popped= 215 [17, 12] depth= 20  
iter= 183 len\_frontier= 14 popped= 36 [2, 17] depth= 21  
pushed 37 [2, 18]  
pushed 16 [1, 17]  
pushed 56 [3, 18]  
iter= 184 len\_frontier= 16 popped= 15 [1, 16] depth= 21  
iter= 185 len\_frontier= 15 popped= 55 [3, 17] depth= 21  
pushed 72 [4, 18]  
iter= 186 len\_frontier= 15 popped= 71 [4, 17] depth= 21  
pushed 84 [5, 18]  
iter= 187 len\_frontier= 15 popped= 81 [5, 15] depth= 21  
pushed 80 [5, 14]  
pushed 93 [6, 15]  
pushed 94 [6, 16]  
iter= 188 len\_frontier= 17 popped= 82 [5, 16] depth= 21  
pushed 95 [6, 17]  
iter= 189 len\_frontier= 17 popped= 83 [5, 17] depth= 21  
pushed 96 [6, 18]  
iter= 190 len\_frontier= 17 popped= 141 [9, 14] depth= 21  
pushed 142 [9, 15]  
iter= 191 len\_frontier= 17 popped= 272 [20, 18] depth= 21  
pushed 273 [20, 19]  
iter= 192 len\_frontier= 17 popped= 252 [19, 18] depth= 21  
pushed 253 [19, 19]  
iter= 193 len\_frontier= 17 popped= 234 [18, 18] depth= 21  
pushed 235 [18, 19]

pushed 220 [17, 18]  
iter= 194 len\_frontier= 18 popped= 219 [17, 17] depth= 21  
pushed 207 [16, 17]  
iter= 195 len\_frontier= 18 popped= 206 [16, 16] depth= 21  
pushed 193 [15, 16]  
iter= 196 len\_frontier= 18 popped= 192 [15, 15] depth= 21  
pushed 179 [14, 15]  
iter= 197 len\_frontier= 18 popped= 189 [15, 12] depth= 21  
iter= 198 len\_frontier= 17 popped= 37 [2, 18] depth= 22  
pushed 38 [2, 19]  
pushed 17 [1, 18]  
pushed 57 [3, 19]  
iter= 199 len\_frontier= 19 popped= 16 [1, 17] depth= 22  
iter= 200 len\_frontier= 18 popped= 56 [3, 18] depth= 22  
pushed 73 [4, 19]  
iter= 201 len\_frontier= 18 popped= 72 [4, 18] depth= 22  
pushed 85 [5, 19]  
iter= 202 len\_frontier= 18 popped= 84 [5, 18] depth= 22  
pushed 97 [6, 19]  
iter= 203 len\_frontier= 18 popped= 80 [5, 14] depth= 22  
pushed 79 [5, 13]  
pushed 92 [6, 14]  
iter= 204 len\_frontier= 19 popped= 93 [6, 15] depth= 22  
pushed 107 [7, 15]  
pushed 108 [7, 16]  
iter= 205 len\_frontier= 20 popped= 94 [6, 16] depth= 22  
pushed 109 [7, 17]  
iter= 206 len\_frontier= 20 popped= 95 [6, 17] depth= 22  
pushed 110 [7, 18]  
iter= 207 len\_frontier= 20 popped= 96 [6, 18] depth= 22  
pushed 111 [7, 19]  
iter= 208 len\_frontier= 20 popped= 142 [9, 15] depth= 22  
pushed 124 [8, 15]  
iter= 209 len\_frontier= 20 popped= 273 [20, 19] depth= 22  
pushed 274 [20, 20]  
iter= 210 len\_frontier= 20 popped= 253 [19, 19] depth= 22  
pushed 254 [19, 20]  
iter= 211 len\_frontier= 20 popped= 235 [18, 19] depth= 22  
pushed 236 [18, 20]  
pushed 221 [17, 19]  
iter= 212 len\_frontier= 21 popped= 220 [17, 18] depth= 22  
pushed 208 [16, 18]  
iter= 213 len\_frontier= 21 popped= 207 [16, 17] depth= 22  
pushed 194 [15, 17]  
iter= 214 len\_frontier= 21 popped= 193 [15, 16] depth= 22  
pushed 180 [14, 16]  
iter= 215 len\_frontier= 21 popped= 179 [14, 15] depth= 22  
pushed 170 [13, 15]  
iter= 216 len\_frontier= 21 popped= 38 [2, 19] depth= 23

pushed 39 [2, 20]  
pushed 18 [1, 19]  
pushed 58 [3, 20]  
iter= 217 len\_frontier= 23 popped= 17 [1, 18] depth= 23  
iter= 218 len\_frontier= 22 popped= 57 [3, 19] depth= 23  
pushed 74 [4, 20]  
iter= 219 len\_frontier= 22 popped= 73 [4, 19] depth= 23  
pushed 86 [5, 20]  
iter= 220 len\_frontier= 22 popped= 85 [5, 19] depth= 23  
pushed 98 [6, 20]  
iter= 221 len\_frontier= 22 popped= 97 [6, 19] depth= 23  
pushed 112 [7, 20]  
iter= 222 len\_frontier= 22 popped= 79 [5, 13] depth= 23  
pushed 91 [6, 13]  
iter= 223 len\_frontier= 22 popped= 92 [6, 14] depth= 23  
iter= 224 len\_frontier= 21 popped= 107 [7, 15] depth= 23  
pushed 125 [8, 16]  
iter= 225 len\_frontier= 21 popped= 108 [7, 16] depth= 23  
pushed 126 [8, 17]  
iter= 226 len\_frontier= 21 popped= 109 [7, 17] depth= 23  
pushed 127 [8, 18]  
iter= 227 len\_frontier= 21 popped= 110 [7, 18] depth= 23  
pushed 128 [8, 19]  
iter= 228 len\_frontier= 21 popped= 111 [7, 19] depth= 23  
pushed 129 [8, 20]  
iter= 229 len\_frontier= 21 popped= 124 [8, 15] depth= 23  
iter= 230 len\_frontier= 20 popped= 274 [20, 20] depth= 23  
iter= 231 len\_frontier= 19 popped= 254 [19, 20] depth= 23  
iter= 232 len\_frontier= 18 popped= 236 [18, 20] depth= 23  
pushed 222 [17, 20]  
iter= 233 len\_frontier= 18 popped= 221 [17, 19] depth= 23  
pushed 209 [16, 19]  
iter= 234 len\_frontier= 18 popped= 208 [16, 18] depth= 23  
pushed 195 [15, 18]  
iter= 235 len\_frontier= 18 popped= 194 [15, 17] depth= 23  
pushed 181 [14, 17]  
iter= 236 len\_frontier= 18 popped= 180 [14, 16] depth= 23  
iter= 237 len\_frontier= 17 popped= 170 [13, 15] depth= 23  
iter= 238 len\_frontier= 16 popped= 39 [2, 20] depth= 24  
pushed 19 [1, 20]  
iter= 239 len\_frontier= 16 popped= 18 [1, 19] depth= 24  
iter= 240 len\_frontier= 15 popped= 58 [3, 20] depth= 24  
iter= 241 len\_frontier= 14 popped= 74 [4, 20] depth= 24  
iter= 242 len\_frontier= 13 popped= 86 [5, 20] depth= 24  
iter= 243 len\_frontier= 12 popped= 98 [6, 20] depth= 24  
iter= 244 len\_frontier= 11 popped= 112 [7, 20] depth= 24  
iter= 245 len\_frontier= 10 popped= 91 [6, 13] depth= 24  
iter= 246 len\_frontier= 9 popped= 125 [8, 16] depth= 24  
iter= 247 len\_frontier= 8 popped= 126 [8, 17] depth= 24

```
iter= 248 len_frontier= 7 popped= 127 [8, 18] depth= 24
pushed 143 [9, 19]
pushed 148 [10, 19]
pushed 153 [11, 19]
iter= 249 len_frontier= 9 popped= 128 [8, 19] depth= 24
pushed 144 [9, 20]
iter= 250 len_frontier= 9 popped= 129 [8, 20] depth= 24
iter= 251 len_frontier= 8 popped= 222 [17, 20] depth= 24
pushed 210 [16, 20]
iter= 252 len_frontier= 8 popped= 209 [16, 19] depth= 24
pushed 196 [15, 19]
iter= 253 len_frontier= 8 popped= 195 [15, 18] depth= 24
pushed 182 [14, 18]
iter= 254 len_frontier= 8 popped= 181 [14, 17] depth= 24
pushed 171 [13, 19]
iter= 255 len_frontier= 8 popped= 19 [1, 20] depth= 25
iter= 256 len_frontier= 7 popped= 143 [9, 19] depth= 25
pushed 149 [10, 20]
iter= 257 len_frontier= 7 popped= 148 [10, 19] depth= 25
pushed 154 [11, 20]
iter= 258 len_frontier= 7 popped= 153 [11, 19] depth= 25
pushed 158 [12, 19]
pushed 159 [12, 20]
iter= 259 len_frontier= 8 popped= 144 [9, 20] depth= 25
iter= 260 len_frontier= 7 popped= 210 [16, 20] depth= 25
pushed 197 [15, 20]
iter= 261 len_frontier= 7 popped= 196 [15, 19] depth= 25
pushed 183 [14, 19]
iter= 262 len_frontier= 7 popped= 182 [14, 18] depth= 25
iter= 263 len_frontier= 6 popped= 171 [13, 19] depth= 25
pushed 172 [13, 20]
pushed 184 [14, 20]
iter= 264 len_frontier= 7 popped= 149 [10, 20] depth= 26
solution_path:
vertex 149 (10, 20)
vertex 143 (9, 19)
vertex 127 (8, 18)
vertex 109 (7, 17)
vertex 94 (6, 16)
vertex 81 (5, 15)
vertex 69 (4, 15)
vertex 53 (3, 15)
vertex 33 (2, 14)
vertex 32 (2, 13)
vertex 52 (3, 13)
vertex 68 (4, 10)
vertex 67 (4, 9)
vertex 66 (4, 8)
vertex 65 (4, 7)
```



vertex 64 (4, 6)  
vertex 63 (4, 5)  
vertex 62 (4, 4)  
vertex 61 (4, 3)  
vertex 77 (5, 3)  
vertex 89 (6, 3)  
vertex 101 (7, 3)  
vertex 115 (8, 3)  
vertex 132 (9, 3)  
vertex 147 (10, 3)  
vertex 146 (10, 2)  
vertex 145 (10, 1)

Some statistics:

=====

Search algorithm: BFS

Iteration Count: 264

max frontier size: 24

vertices visited: 271/275

Path length: 26

-----Completed Execution-----

[13, 6] to [7, 6]

iter= 0 len\_frontier= 0 popped= 163 [13, 6] depth= 0

pushed 164 [13, 7]

pushed 176 [14, 6]

pushed 177 [14, 7]

iter= 1 len\_frontier= 2 popped= 164 [13, 7] depth= 1

pushed 163 [13, 6]

pushed 165 [13, 8]

pushed 178 [14, 8]

iter= 2 len\_frontier= 4 popped= 176 [14, 6] depth= 1

iter= 3 len\_frontier= 3 popped= 177 [14, 7] depth= 1

pushed 188 [15, 8]

pushed 201 [16, 8]

iter= 4 len\_frontier= 4 popped= 163 [13, 6] depth= 2

iter= 5 len\_frontier= 3 popped= 165 [13, 8] depth= 2

iter= 6 len\_frontier= 2 popped= 178 [14, 8] depth= 2

iter= 7 len\_frontier= 1 popped= 188 [15, 8] depth= 2

pushed 202 [16, 9]

pushed 203 [16, 10]

iter= 8 len\_frontier= 2 popped= 201 [16, 8] depth= 2

pushed 214 [17, 8]

iter= 9 len\_frontier= 2 popped= 202 [16, 9] depth= 3

iter= 10 len\_frontier= 1 popped= 203 [16, 10] depth= 3

iter= 11 len\_frontier= 0 popped= 214 [17, 8] depth= 3

pushed 230 [18, 8]

pushed 229 [18, 7]

pushed 228 [18, 6]

pushed 227 [18, 5]  
iter= 12 len\_frontier= 3 popped= 230 [18, 8] depth= 4  
pushed 244 [19, 8]  
iter= 13 len\_frontier= 3 popped= 229 [18, 7] depth= 4  
pushed 243 [19, 7]  
iter= 14 len\_frontier= 3 popped= 228 [18, 6] depth= 4  
pushed 242 [19, 6]  
iter= 15 len\_frontier= 3 popped= 227 [18, 5] depth= 4  
pushed 226 [18, 4]  
pushed 241 [19, 5]  
pushed 213 [17, 3]  
iter= 16 len\_frontier= 5 popped= 244 [19, 8] depth= 5  
pushed 262 [20, 8]  
pushed 263 [20, 9]  
iter= 17 len\_frontier= 6 popped= 243 [19, 7] depth= 5  
pushed 261 [20, 7]  
iter= 18 len\_frontier= 6 popped= 242 [19, 6] depth= 5  
pushed 260 [20, 6]  
iter= 19 len\_frontier= 6 popped= 226 [18, 4] depth= 5  
pushed 225 [18, 3]  
pushed 240 [19, 4]  
iter= 20 len\_frontier= 7 popped= 241 [19, 5] depth= 5  
pushed 259 [20, 5]  
iter= 21 len\_frontier= 7 popped= 213 [17, 3] depth= 5  
pushed 212 [17, 2]  
pushed 200 [16, 3]  
pushed 199 [16, 2]  
iter= 22 len\_frontier= 9 popped= 262 [20, 8] depth= 6  
iter= 23 len\_frontier= 8 popped= 263 [20, 9] depth= 6  
pushed 264 [20, 10]  
pushed 245 [19, 10]  
iter= 24 len\_frontier= 9 popped= 261 [20, 7] depth= 6  
iter= 25 len\_frontier= 8 popped= 260 [20, 6] depth= 6  
iter= 26 len\_frontier= 7 popped= 225 [18, 3] depth= 6  
pushed 224 [18, 2]  
pushed 239 [19, 3]  
iter= 27 len\_frontier= 8 popped= 240 [19, 4] depth= 6  
pushed 258 [20, 4]  
iter= 28 len\_frontier= 8 popped= 259 [20, 5] depth= 6  
iter= 29 len\_frontier= 7 popped= 212 [17, 2] depth= 6  
pushed 211 [17, 1]  
pushed 198 [16, 1]  
iter= 30 len\_frontier= 8 popped= 200 [16, 3] depth= 6  
pushed 187 [15, 3]  
pushed 186 [15, 2]  
iter= 31 len\_frontier= 9 popped= 199 [16, 2] depth= 6  
pushed 185 [15, 1]  
iter= 32 len\_frontier= 9 popped= 264 [20, 10] depth= 7  
pushed 265 [20, 11]

iter= 33 len\_frontier= 9 popped= 245 [19, 10] depth= 7  
pushed 246 [19, 11]  
iter= 34 len\_frontier= 9 popped= 224 [18, 2] depth= 7  
pushed 223 [18, 1]  
pushed 238 [19, 2]  
iter= 35 len\_frontier= 10 popped= 239 [19, 3] depth= 7  
pushed 257 [20, 3]  
iter= 36 len\_frontier= 10 popped= 258 [20, 4] depth= 7  
iter= 37 len\_frontier= 9 popped= 211 [17, 1] depth= 7  
iter= 38 len\_frontier= 8 popped= 198 [16, 1] depth= 7  
iter= 39 len\_frontier= 7 popped= 187 [15, 3] depth= 7  
pushed 175 [14, 3]  
pushed 174 [14, 2]  
iter= 40 len\_frontier= 8 popped= 186 [15, 2] depth= 7  
pushed 173 [14, 1]  
iter= 41 len\_frontier= 8 popped= 185 [15, 1] depth= 7  
iter= 42 len\_frontier= 7 popped= 265 [20, 11] depth= 8  
pushed 266 [20, 12]  
iter= 43 len\_frontier= 7 popped= 246 [19, 11] depth= 8  
pushed 247 [19, 12]  
iter= 44 len\_frontier= 7 popped= 223 [18, 1] depth= 8  
pushed 237 [19, 1]  
iter= 45 len\_frontier= 7 popped= 238 [19, 2] depth= 8  
pushed 256 [20, 2]  
iter= 46 len\_frontier= 7 popped= 257 [20, 3] depth= 8  
iter= 47 len\_frontier= 6 popped= 175 [14, 3] depth= 8  
pushed 162 [13, 3]  
pushed 161 [13, 2]  
iter= 48 len\_frontier= 7 popped= 174 [14, 2] depth= 8  
pushed 160 [13, 1]  
iter= 49 len\_frontier= 7 popped= 173 [14, 1] depth= 8  
iter= 50 len\_frontier= 6 popped= 266 [20, 12] depth= 9  
pushed 267 [20, 13]  
iter= 51 len\_frontier= 6 popped= 247 [19, 12] depth= 9  
pushed 248 [19, 13]  
iter= 52 len\_frontier= 6 popped= 237 [19, 1] depth= 9  
pushed 255 [20, 1]  
iter= 53 len\_frontier= 6 popped= 256 [20, 2] depth= 9  
iter= 54 len\_frontier= 5 popped= 162 [13, 3] depth= 9  
pushed 157 [12, 3]  
pushed 156 [12, 2]  
iter= 55 len\_frontier= 6 popped= 161 [13, 2] depth= 9  
pushed 155 [12, 1]  
iter= 56 len\_frontier= 6 popped= 160 [13, 1] depth= 9  
iter= 57 len\_frontier= 5 popped= 267 [20, 13] depth= 10  
pushed 268 [20, 14]  
iter= 58 len\_frontier= 5 popped= 248 [19, 13] depth= 10  
iter= 59 len\_frontier= 4 popped= 255 [20, 1] depth= 10  
iter= 60 len\_frontier= 3 popped= 157 [12, 3] depth= 10

pushed 152 [11, 3]  
pushed 151 [11, 2]  
iter= 61 len\_frontier= 4 popped= 156 [12, 2] depth= 10  
pushed 150 [11, 1]  
iter= 62 len\_frontier= 4 popped= 155 [12, 1] depth= 10  
iter= 63 len\_frontier= 3 popped= 268 [20, 14] depth= 11  
pushed 269 [20, 15]  
pushed 249 [19, 15]  
pushed 231 [18, 15]  
iter= 64 len\_frontier= 5 popped= 152 [11, 3] depth= 11  
pushed 147 [10, 3]  
pushed 146 [10, 2]  
iter= 65 len\_frontier= 6 popped= 151 [11, 2] depth= 11  
pushed 145 [10, 1]  
iter= 66 len\_frontier= 6 popped= 150 [11, 1] depth= 11  
iter= 67 len\_frontier= 5 popped= 269 [20, 15] depth= 12  
pushed 270 [20, 16]  
iter= 68 len\_frontier= 5 popped= 249 [19, 15] depth= 12  
pushed 250 [19, 16]  
iter= 69 len\_frontier= 5 popped= 231 [18, 15] depth= 12  
pushed 232 [18, 16]  
pushed 217 [17, 15]  
pushed 204 [16, 14]  
iter= 70 len\_frontier= 7 popped= 147 [10, 3] depth= 12  
pushed 132 [9, 3]  
pushed 131 [9, 2]  
iter= 71 len\_frontier= 8 popped= 146 [10, 2] depth= 12  
pushed 130 [9, 1]  
iter= 72 len\_frontier= 8 popped= 145 [10, 1] depth= 12  
iter= 73 len\_frontier= 7 popped= 270 [20, 16] depth= 13  
pushed 271 [20, 17]  
iter= 74 len\_frontier= 7 popped= 250 [19, 16] depth= 13  
pushed 251 [19, 17]  
iter= 75 len\_frontier= 7 popped= 232 [18, 16] depth= 13  
pushed 233 [18, 17]  
pushed 218 [17, 16]  
iter= 76 len\_frontier= 8 popped= 217 [17, 15] depth= 13  
pushed 205 [16, 15]  
iter= 77 len\_frontier= 8 popped= 204 [16, 14] depth= 13  
pushed 191 [15, 14]  
pushed 190 [15, 13]  
pushed 216 [17, 13]  
pushed 215 [17, 12]  
iter= 78 len\_frontier= 11 popped= 132 [9, 3] depth= 13  
pushed 115 [8, 3]  
pushed 114 [8, 2]  
iter= 79 len\_frontier= 12 popped= 131 [9, 2] depth= 13  
pushed 113 [8, 1]  
iter= 80 len\_frontier= 12 popped= 130 [9, 1] depth= 13

iter= 81 len\_frontier= 11 popped= 271 [20, 17] depth= 14  
pushed 272 [20, 18]  
iter= 82 len\_frontier= 11 popped= 251 [19, 17] depth= 14  
pushed 252 [19, 18]  
iter= 83 len\_frontier= 11 popped= 233 [18, 17] depth= 14  
pushed 234 [18, 18]  
pushed 219 [17, 17]  
iter= 84 len\_frontier= 12 popped= 218 [17, 16] depth= 14  
pushed 206 [16, 16]  
iter= 85 len\_frontier= 12 popped= 205 [16, 15] depth= 14  
pushed 192 [15, 15]  
iter= 86 len\_frontier= 12 popped= 191 [15, 14] depth= 14  
iter= 87 len\_frontier= 11 popped= 190 [15, 13] depth= 14  
pushed 189 [15, 12]  
iter= 88 len\_frontier= 11 popped= 216 [17, 13] depth= 14  
iter= 89 len\_frontier= 10 popped= 215 [17, 12] depth= 14  
iter= 90 len\_frontier= 9 popped= 115 [8, 3] depth= 14  
pushed 101 [7, 3]  
pushed 100 [7, 2]  
iter= 91 len\_frontier= 10 popped= 114 [8, 2] depth= 14  
pushed 99 [7, 1]  
iter= 92 len\_frontier= 10 popped= 113 [8, 1] depth= 14  
iter= 93 len\_frontier= 9 popped= 272 [20, 18] depth= 15  
pushed 273 [20, 19]  
iter= 94 len\_frontier= 9 popped= 252 [19, 18] depth= 15  
pushed 253 [19, 19]  
iter= 95 len\_frontier= 9 popped= 234 [18, 18] depth= 15  
pushed 235 [18, 19]  
pushed 220 [17, 18]  
iter= 96 len\_frontier= 10 popped= 219 [17, 17] depth= 15  
pushed 207 [16, 17]  
iter= 97 len\_frontier= 10 popped= 206 [16, 16] depth= 15  
pushed 193 [15, 16]  
iter= 98 len\_frontier= 10 popped= 192 [15, 15] depth= 15  
pushed 179 [14, 15]  
iter= 99 len\_frontier= 10 popped= 189 [15, 12] depth= 15  
iter= 100 len\_frontier= 9 popped= 101 [7, 3] depth= 15  
pushed 89 [6, 3]  
pushed 88 [6, 2]  
iter= 101 len\_frontier= 10 popped= 100 [7, 2] depth= 15  
pushed 87 [6, 1]  
iter= 102 len\_frontier= 10 popped= 99 [7, 1] depth= 15  
iter= 103 len\_frontier= 9 popped= 273 [20, 19] depth= 16  
pushed 274 [20, 20]  
iter= 104 len\_frontier= 9 popped= 253 [19, 19] depth= 16  
pushed 254 [19, 20]  
iter= 105 len\_frontier= 9 popped= 235 [18, 19] depth= 16  
pushed 236 [18, 20]  
pushed 221 [17, 19]

iter= 106 len\_frontier= 10 popped= 220 [17, 18] depth= 16  
pushed 208 [16, 18]  
iter= 107 len\_frontier= 10 popped= 207 [16, 17] depth= 16  
pushed 194 [15, 17]  
iter= 108 len\_frontier= 10 popped= 193 [15, 16] depth= 16  
pushed 180 [14, 16]  
iter= 109 len\_frontier= 10 popped= 179 [14, 15] depth= 16  
pushed 170 [13, 15]  
iter= 110 len\_frontier= 10 popped= 89 [6, 3] depth= 16  
pushed 77 [5, 3]  
pushed 76 [5, 2]  
iter= 111 len\_frontier= 11 popped= 88 [6, 2] depth= 16  
pushed 75 [5, 1]  
iter= 112 len\_frontier= 11 popped= 87 [6, 1] depth= 16  
iter= 113 len\_frontier= 10 popped= 274 [20, 20] depth= 17  
iter= 114 len\_frontier= 9 popped= 254 [19, 20] depth= 17  
iter= 115 len\_frontier= 8 popped= 236 [18, 20] depth= 17  
pushed 222 [17, 20]  
iter= 116 len\_frontier= 8 popped= 221 [17, 19] depth= 17  
pushed 209 [16, 19]  
iter= 117 len\_frontier= 8 popped= 208 [16, 18] depth= 17  
pushed 195 [15, 18]  
iter= 118 len\_frontier= 8 popped= 194 [15, 17] depth= 17  
pushed 181 [14, 17]  
iter= 119 len\_frontier= 8 popped= 180 [14, 16] depth= 17  
iter= 120 len\_frontier= 7 popped= 170 [13, 15] depth= 17  
iter= 121 len\_frontier= 6 popped= 77 [5, 3] depth= 17  
pushed 61 [4, 3]  
pushed 60 [4, 2]  
iter= 122 len\_frontier= 7 popped= 76 [5, 2] depth= 17  
pushed 59 [4, 1]  
iter= 123 len\_frontier= 7 popped= 75 [5, 1] depth= 17  
iter= 124 len\_frontier= 6 popped= 222 [17, 20] depth= 18  
pushed 210 [16, 20]  
iter= 125 len\_frontier= 6 popped= 209 [16, 19] depth= 18  
pushed 196 [15, 19]  
iter= 126 len\_frontier= 6 popped= 195 [15, 18] depth= 18  
pushed 182 [14, 18]  
iter= 127 len\_frontier= 6 popped= 181 [14, 17] depth= 18  
pushed 171 [13, 19]  
iter= 128 len\_frontier= 6 popped= 61 [4, 3] depth= 18  
pushed 62 [4, 4]  
pushed 42 [3, 3]  
pushed 41 [3, 2]  
iter= 129 len\_frontier= 8 popped= 60 [4, 2] depth= 18  
pushed 40 [3, 1]  
iter= 130 len\_frontier= 8 popped= 59 [4, 1] depth= 18  
iter= 131 len\_frontier= 7 popped= 210 [16, 20] depth= 19  
pushed 197 [15, 20]

iter= 132 len\_frontier= 7 popped= 196 [15, 19] depth= 19  
pushed 183 [14, 19]  
iter= 133 len\_frontier= 7 popped= 182 [14, 18] depth= 19  
iter= 134 len\_frontier= 6 popped= 171 [13, 19] depth= 19  
pushed 172 [13, 20]  
pushed 158 [12, 19]  
pushed 184 [14, 20]  
iter= 135 len\_frontier= 8 popped= 62 [4, 4] depth= 19  
pushed 63 [4, 5]  
pushed 43 [3, 4]  
iter= 136 len\_frontier= 9 popped= 42 [3, 3] depth= 19  
pushed 22 [2, 3]  
pushed 21 [2, 2]  
iter= 137 len\_frontier= 10 popped= 41 [3, 2] depth= 19  
pushed 20 [2, 1]  
iter= 138 len\_frontier= 10 popped= 40 [3, 1] depth= 19  
iter= 139 len\_frontier= 9 popped= 197 [15, 20] depth= 20  
iter= 140 len\_frontier= 8 popped= 183 [14, 19] depth= 20  
iter= 141 len\_frontier= 7 popped= 172 [13, 20] depth= 20  
pushed 159 [12, 20]  
iter= 142 len\_frontier= 7 popped= 158 [12, 19] depth= 20  
pushed 153 [11, 19]  
iter= 143 len\_frontier= 7 popped= 184 [14, 20] depth= 20  
iter= 144 len\_frontier= 6 popped= 63 [4, 5] depth= 20  
pushed 64 [4, 6]  
pushed 44 [3, 5]  
iter= 145 len\_frontier= 7 popped= 43 [3, 4] depth= 20  
pushed 23 [2, 4]  
iter= 146 len\_frontier= 7 popped= 22 [2, 3] depth= 20  
pushed 2 [1, 3]  
pushed 1 [1, 2]  
iter= 147 len\_frontier= 8 popped= 21 [2, 2] depth= 20  
pushed 0 [1, 1]  
iter= 148 len\_frontier= 8 popped= 20 [2, 1] depth= 20  
iter= 149 len\_frontier= 7 popped= 159 [12, 20] depth= 21  
pushed 154 [11, 20]  
iter= 150 len\_frontier= 7 popped= 153 [11, 19] depth= 21  
pushed 148 [10, 19]  
pushed 127 [8, 18]  
iter= 151 len\_frontier= 8 popped= 64 [4, 6] depth= 21  
pushed 65 [4, 7]  
pushed 45 [3, 6]  
iter= 152 len\_frontier= 9 popped= 44 [3, 5] depth= 21  
pushed 24 [2, 5]  
iter= 153 len\_frontier= 9 popped= 23 [2, 4] depth= 21  
pushed 3 [1, 4]  
iter= 154 len\_frontier= 9 popped= 2 [1, 3] depth= 21  
iter= 155 len\_frontier= 8 popped= 1 [1, 2] depth= 21  
iter= 156 len\_frontier= 7 popped= 0 [1, 1] depth= 21

iter= 157 len\_frontier= 6 popped= 154 [11, 20] depth= 22  
pushed 149 [10, 20]  
iter= 158 len\_frontier= 6 popped= 148 [10, 19] depth= 22  
pushed 143 [9, 19]  
iter= 159 len\_frontier= 6 popped= 127 [8, 18] depth= 22  
pushed 128 [8, 19]  
pushed 126 [8, 17]  
pushed 110 [7, 18]  
pushed 109 [7, 17]  
iter= 160 len\_frontier= 9 popped= 65 [4, 7] depth= 22  
pushed 66 [4, 8]  
pushed 46 [3, 7]  
iter= 161 len\_frontier= 10 popped= 45 [3, 6] depth= 22  
pushed 25 [2, 6]  
iter= 162 len\_frontier= 10 popped= 24 [2, 5] depth= 22  
pushed 4 [1, 5]  
iter= 163 len\_frontier= 10 popped= 3 [1, 4] depth= 22  
iter= 164 len\_frontier= 9 popped= 149 [10, 20] depth= 23  
pushed 144 [9, 20]  
iter= 165 len\_frontier= 9 popped= 143 [9, 19] depth= 23  
iter= 166 len\_frontier= 8 popped= 128 [8, 19] depth= 23  
pushed 129 [8, 20]  
pushed 111 [7, 19]  
iter= 167 len\_frontier= 9 popped= 126 [8, 17] depth= 23  
pushed 125 [8, 16]  
pushed 108 [7, 16]  
iter= 168 len\_frontier= 10 popped= 110 [7, 18] depth= 23  
pushed 96 [6, 18]  
pushed 95 [6, 17]  
iter= 169 len\_frontier= 11 popped= 109 [7, 17] depth= 23  
pushed 94 [6, 16]  
iter= 170 len\_frontier= 11 popped= 66 [4, 8] depth= 23  
pushed 67 [4, 9]  
pushed 78 [5, 8]  
pushed 47 [3, 8]  
iter= 171 len\_frontier= 13 popped= 46 [3, 7] depth= 23  
pushed 26 [2, 7]  
iter= 172 len\_frontier= 13 popped= 25 [2, 6] depth= 23  
pushed 5 [1, 6]  
iter= 173 len\_frontier= 13 popped= 4 [1, 5] depth= 23  
iter= 174 len\_frontier= 12 popped= 144 [9, 20] depth= 24  
iter= 175 len\_frontier= 11 popped= 129 [8, 20] depth= 24  
pushed 112 [7, 20]  
iter= 176 len\_frontier= 11 popped= 111 [7, 19] depth= 24  
pushed 97 [6, 19]  
iter= 177 len\_frontier= 11 popped= 125 [8, 16] depth= 24  
pushed 124 [8, 15]  
pushed 107 [7, 15]  
iter= 178 len\_frontier= 12 popped= 108 [7, 16] depth= 24



pushed 93 [6, 15]  
iter= 179 len\_frontier= 12 popped= 96 [6, 18] depth= 24  
pushed 84 [5, 18]  
pushed 83 [5, 17]  
iter= 180 len\_frontier= 13 popped= 95 [6, 17] depth= 24  
pushed 82 [5, 16]  
iter= 181 len\_frontier= 13 popped= 94 [6, 16] depth= 24  
pushed 81 [5, 15]  
iter= 182 len\_frontier= 13 popped= 67 [4, 9] depth= 24  
pushed 68 [4, 10]  
pushed 48 [3, 9]  
iter= 183 len\_frontier= 14 popped= 78 [5, 8] depth= 24  
pushed 90 [6, 8]  
iter= 184 len\_frontier= 14 popped= 47 [3, 8] depth= 24  
pushed 27 [2, 8]  
iter= 185 len\_frontier= 14 popped= 26 [2, 7] depth= 24  
pushed 6 [1, 7]  
iter= 186 len\_frontier= 14 popped= 5 [1, 6] depth= 24  
iter= 187 len\_frontier= 13 popped= 112 [7, 20] depth= 25  
pushed 98 [6, 20]  
iter= 188 len\_frontier= 13 popped= 97 [6, 19] depth= 25  
pushed 85 [5, 19]  
iter= 189 len\_frontier= 13 popped= 124 [8, 15] depth= 25  
pushed 142 [9, 15]  
iter= 190 len\_frontier= 13 popped= 107 [7, 15] depth= 25  
pushed 92 [6, 14]  
iter= 191 len\_frontier= 13 popped= 93 [6, 15] depth= 25  
pushed 80 [5, 14]  
iter= 192 len\_frontier= 13 popped= 84 [5, 18] depth= 25  
pushed 72 [4, 18]  
pushed 71 [4, 17]  
iter= 193 len\_frontier= 14 popped= 83 [5, 17] depth= 25  
pushed 70 [4, 16]  
iter= 194 len\_frontier= 14 popped= 82 [5, 16] depth= 25  
pushed 69 [4, 15]  
iter= 195 len\_frontier= 14 popped= 81 [5, 15] depth= 25  
iter= 196 len\_frontier= 13 popped= 68 [4, 10] depth= 25  
pushed 49 [3, 10]  
pushed 50 [3, 11]  
pushed 51 [3, 12]  
pushed 52 [3, 13]  
iter= 197 len\_frontier= 16 popped= 48 [3, 9] depth= 25  
pushed 28 [2, 9]  
iter= 198 len\_frontier= 16 popped= 90 [6, 8] depth= 25  
pushed 104 [7, 8]  
iter= 199 len\_frontier= 16 popped= 27 [2, 8] depth= 25  
pushed 7 [1, 8]  
iter= 200 len\_frontier= 16 popped= 6 [1, 7] depth= 25  
iter= 201 len\_frontier= 15 popped= 98 [6, 20] depth= 26

pushed 86 [5, 20]  
iter= 202 len\_frontier= 15 popped= 85 [5, 19] depth= 26  
pushed 73 [4, 19]  
iter= 203 len\_frontier= 15 popped= 142 [9, 15] depth= 26  
pushed 141 [9, 14]  
iter= 204 len\_frontier= 15 popped= 92 [6, 14] depth= 26  
pushed 91 [6, 13]  
pushed 79 [5, 13]  
iter= 205 len\_frontier= 16 popped= 80 [5, 14] depth= 26  
iter= 206 len\_frontier= 15 popped= 72 [4, 18] depth= 26  
pushed 56 [3, 18]  
pushed 55 [3, 17]  
iter= 207 len\_frontier= 16 popped= 71 [4, 17] depth= 26  
pushed 54 [3, 16]  
iter= 208 len\_frontier= 16 popped= 70 [4, 16] depth= 26  
pushed 53 [3, 15]  
iter= 209 len\_frontier= 16 popped= 69 [4, 15] depth= 26  
iter= 210 len\_frontier= 15 popped= 49 [3, 10] depth= 26  
pushed 29 [2, 10]  
iter= 211 len\_frontier= 15 popped= 50 [3, 11] depth= 26  
pushed 30 [2, 11]  
iter= 212 len\_frontier= 15 popped= 51 [3, 12] depth= 26  
pushed 31 [2, 12]  
iter= 213 len\_frontier= 15 popped= 52 [3, 13] depth= 26  
pushed 32 [2, 13]  
iter= 214 len\_frontier= 15 popped= 28 [2, 9] depth= 26  
pushed 8 [1, 9]  
iter= 215 len\_frontier= 15 popped= 104 [7, 8] depth= 26  
pushed 103 [7, 7]  
pushed 105 [7, 9]  
pushed 118 [8, 8]  
pushed 119 [8, 9]  
iter= 216 len\_frontier= 18 popped= 7 [1, 8] depth= 26  
iter= 217 len\_frontier= 17 popped= 86 [5, 20] depth= 27  
pushed 74 [4, 20]  
iter= 218 len\_frontier= 17 popped= 73 [4, 19] depth= 27  
pushed 57 [3, 19]  
iter= 219 len\_frontier= 17 popped= 141 [9, 14] depth= 27  
pushed 140 [9, 13]  
iter= 220 len\_frontier= 17 popped= 91 [6, 13] depth= 27  
iter= 221 len\_frontier= 16 popped= 79 [5, 13] depth= 27  
iter= 222 len\_frontier= 15 popped= 56 [3, 18] depth= 27  
pushed 37 [2, 18]  
pushed 36 [2, 17]  
iter= 223 len\_frontier= 16 popped= 55 [3, 17] depth= 27  
pushed 35 [2, 16]  
iter= 224 len\_frontier= 16 popped= 54 [3, 16] depth= 27  
pushed 34 [2, 15]  
iter= 225 len\_frontier= 16 popped= 53 [3, 15] depth= 27

```
pushed 33 [2, 14]
iter= 226 len_frontier= 16 popped= 29 [2, 10] depth= 27
pushed 9 [1, 10]
iter= 227 len_frontier= 16 popped= 30 [2, 11] depth= 27
pushed 10 [1, 11]
iter= 228 len_frontier= 16 popped= 31 [2, 12] depth= 27
pushed 11 [1, 12]
iter= 229 len_frontier= 16 popped= 32 [2, 13] depth= 27
pushed 12 [1, 13]
iter= 230 len_frontier= 16 popped= 8 [1, 9] depth= 27
iter= 231 len_frontier= 15 popped= 103 [7, 7] depth= 27
pushed 102 [7, 6]
pushed 117 [8, 7]
iter= 232 len_frontier= 16 popped= 105 [7, 9] depth= 27
pushed 106 [7, 10]
pushed 120 [8, 10]
iter= 233 len_frontier= 17 popped= 118 [8, 8] depth= 27
pushed 135 [9, 8]
pushed 136 [9, 9]
iter= 234 len_frontier= 18 popped= 119 [8, 9] depth= 27
pushed 137 [9, 10]
iter= 235 len_frontier= 18 popped= 74 [4, 20] depth= 28
pushed 58 [3, 20]
iter= 236 len_frontier= 18 popped= 57 [3, 19] depth= 28
pushed 38 [2, 19]
iter= 237 len_frontier= 18 popped= 140 [9, 13] depth= 28
pushed 139 [9, 12]
pushed 123 [8, 13]
pushed 122 [8, 12]
iter= 238 len_frontier= 20 popped= 37 [2, 18] depth= 28
pushed 17 [1, 18]
pushed 16 [1, 17]
iter= 239 len_frontier= 21 popped= 36 [2, 17] depth= 28
pushed 15 [1, 16]
iter= 240 len_frontier= 21 popped= 35 [2, 16] depth= 28
pushed 14 [1, 15]
iter= 241 len_frontier= 21 popped= 34 [2, 15] depth= 28
pushed 13 [1, 14]
iter= 242 len_frontier= 21 popped= 33 [2, 14] depth= 28
iter= 243 len_frontier= 20 popped= 9 [1, 10] depth= 28
iter= 244 len_frontier= 19 popped= 10 [1, 11] depth= 28
iter= 245 len_frontier= 18 popped= 11 [1, 12] depth= 28
iter= 246 len_frontier= 17 popped= 12 [1, 13] depth= 28
iter= 247 len_frontier= 16 popped= 102 [7, 6] depth= 28
solution_path:
vertex 102 (7, 6)
vertex 103 (7, 7)
vertex 104 (7, 8)
vertex 90 (6, 8)
```

vertex 78 (5, 8)  
vertex 66 (4, 8)  
vertex 65 (4, 7)  
vertex 64 (4, 6)  
vertex 63 (4, 5)  
vertex 62 (4, 4)  
vertex 61 (4, 3)  
vertex 77 (5, 3)  
vertex 89 (6, 3)  
vertex 101 (7, 3)  
vertex 115 (8, 3)  
vertex 132 (9, 3)  
vertex 147 (10, 3)  
vertex 152 (11, 3)  
vertex 157 (12, 3)  
vertex 162 (13, 3)  
vertex 175 (14, 3)  
vertex 187 (15, 3)  
vertex 200 (16, 3)  
vertex 213 (17, 3)  
vertex 227 (18, 5)  
vertex 214 (17, 8)  
vertex 201 (16, 8)  
vertex 177 (14, 7)  
vertex 163 (13, 6)

Some statistics:

=====

Search algorithm: BFS

Iteration Count: 247

max frontier size: 22

vertices visited: 263/275

Path length: 28

-----Completed Execution-----

Traces for DFS for all 5 Paths:

[20, 1] to [1, 20]

iter= 0 len\_frontier= 0 popped= 255 [20, 1] depth= 0

pushed 256 [20, 2]

pushed 237 [19, 1]

iter= 1 len\_frontier= 1 popped= 237 [19, 1] depth= 1

pushed 238 [19, 2]

pushed 223 [18, 1]

pushed 255 [20, 1]

iter= 2 len\_frontier= 3 popped= 255 [20, 1] depth= 2

```
iter= 3 len_frontier= 2 popped= 223 [18, 1] depth= 2
pushed 224 [18, 2]
pushed 211 [17, 1]
iter= 4 len_frontier= 3 popped= 211 [17, 1] depth= 3
pushed 212 [17, 2]
pushed 198 [16, 1]
iter= 5 len_frontier= 4 popped= 198 [16, 1] depth= 4
pushed 199 [16, 2]
pushed 185 [15, 1]
iter= 6 len_frontier= 5 popped= 185 [15, 1] depth= 5
pushed 186 [15, 2]
pushed 173 [14, 1]
iter= 7 len_frontier= 6 popped= 173 [14, 1] depth= 6
pushed 174 [14, 2]
pushed 160 [13, 1]
iter= 8 len_frontier= 7 popped= 160 [13, 1] depth= 7
pushed 161 [13, 2]
pushed 155 [12, 1]
iter= 9 len_frontier= 8 popped= 155 [12, 1] depth= 8
pushed 156 [12, 2]
pushed 150 [11, 1]
iter= 10 len_frontier= 9 popped= 150 [11, 1] depth= 9
pushed 151 [11, 2]
pushed 145 [10, 1]
iter= 11 len_frontier= 10 popped= 145 [10, 1] depth= 10
pushed 146 [10, 2]
pushed 130 [9, 1]
iter= 12 len_frontier= 11 popped= 130 [9, 1] depth= 11
pushed 131 [9, 2]
pushed 113 [8, 1]
iter= 13 len_frontier= 12 popped= 113 [8, 1] depth= 12
pushed 114 [8, 2]
pushed 99 [7, 1]
iter= 14 len_frontier= 13 popped= 99 [7, 1] depth= 13
pushed 100 [7, 2]
pushed 87 [6, 1]
iter= 15 len_frontier= 14 popped= 87 [6, 1] depth= 14
pushed 88 [6, 2]
pushed 75 [5, 1]
iter= 16 len_frontier= 15 popped= 75 [5, 1] depth= 15
pushed 76 [5, 2]
pushed 59 [4, 1]
iter= 17 len_frontier= 16 popped= 59 [4, 1] depth= 16
pushed 60 [4, 2]
pushed 40 [3, 1]
iter= 18 len_frontier= 17 popped= 40 [3, 1] depth= 17
pushed 41 [3, 2]
pushed 20 [2, 1]
iter= 19 len_frontier= 18 popped= 20 [2, 1] depth= 18
```

```
pushed 21 [2, 2]
pushed 0 [1, 1]
iter= 20 len_frontier= 19 popped= 0 [1, 1] depth= 19
pushed 1 [1, 2]
iter= 21 len_frontier= 19 popped= 1 [1, 2] depth= 20
pushed 2 [1, 3]
pushed 22 [2, 3]
iter= 22 len_frontier= 20 popped= 22 [2, 3] depth= 21
pushed 23 [2, 4]
pushed 42 [3, 3]
pushed 43 [3, 4]
iter= 23 len_frontier= 22 popped= 43 [3, 4] depth= 22
pushed 44 [3, 5]
pushed 62 [4, 4]
pushed 63 [4, 5]
iter= 24 len_frontier= 24 popped= 63 [4, 5] depth= 23
pushed 64 [4, 6]
iter= 25 len_frontier= 24 popped= 64 [4, 6] depth= 24
pushed 65 [4, 7]
pushed 45 [3, 6]
iter= 26 len_frontier= 25 popped= 45 [3, 6] depth= 25
pushed 46 [3, 7]
pushed 25 [2, 6]
pushed 24 [2, 5]
iter= 27 len_frontier= 27 popped= 24 [2, 5] depth= 26
pushed 4 [1, 5]
pushed 3 [1, 4]
iter= 28 len_frontier= 28 popped= 3 [1, 4] depth= 27
iter= 29 len_frontier= 27 popped= 4 [1, 5] depth= 27
pushed 5 [1, 6]
iter= 30 len_frontier= 27 popped= 5 [1, 6] depth= 28
pushed 6 [1, 7]
pushed 26 [2, 7]
iter= 31 len_frontier= 28 popped= 26 [2, 7] depth= 29
pushed 27 [2, 8]
pushed 47 [3, 8]
iter= 32 len_frontier= 29 popped= 47 [3, 8] depth= 30
pushed 48 [3, 9]
pushed 66 [4, 8]
pushed 67 [4, 9]
iter= 33 len_frontier= 31 popped= 67 [4, 9] depth= 31
pushed 68 [4, 10]
iter= 34 len_frontier= 31 popped= 68 [4, 10] depth= 32
pushed 49 [3, 10]
pushed 50 [3, 11]
pushed 51 [3, 12]
pushed 52 [3, 13]
iter= 35 len_frontier= 34 popped= 52 [3, 13] depth= 33
pushed 32 [2, 13]
```

```
pushed 31 [2, 12]
iter= 36 len_frontier= 35 popped= 31 [2, 12] depth= 34
pushed 30 [2, 11]
pushed 11 [1, 12]
pushed 10 [1, 11]
iter= 37 len_frontier= 37 popped= 10 [1, 11] depth= 35
pushed 9 [1, 10]
iter= 38 len_frontier= 37 popped= 9 [1, 10] depth= 36
pushed 8 [1, 9]
pushed 29 [2, 10]
iter= 39 len_frontier= 38 popped= 29 [2, 10] depth= 37
pushed 28 [2, 9]
iter= 40 len_frontier= 38 popped= 28 [2, 9] depth= 38
pushed 7 [1, 8]
iter= 41 len_frontier= 38 popped= 7 [1, 8] depth= 39
iter= 42 len_frontier= 37 popped= 8 [1, 9] depth= 37
iter= 43 len_frontier= 36 popped= 11 [1, 12] depth= 35
pushed 12 [1, 13]
iter= 44 len_frontier= 36 popped= 12 [1, 13] depth= 36
pushed 13 [1, 14]
pushed 33 [2, 14]
iter= 45 len_frontier= 37 popped= 33 [2, 14] depth= 37
pushed 34 [2, 15]
pushed 53 [3, 15]
iter= 46 len_frontier= 38 popped= 53 [3, 15] depth= 38
pushed 54 [3, 16]
pushed 69 [4, 15]
pushed 70 [4, 16]
iter= 47 len_frontier= 40 popped= 70 [4, 16] depth= 39
pushed 71 [4, 17]
pushed 82 [5, 16]
pushed 83 [5, 17]
iter= 48 len_frontier= 42 popped= 83 [5, 17] depth= 40
pushed 84 [5, 18]
pushed 95 [6, 17]
pushed 96 [6, 18]
iter= 49 len_frontier= 44 popped= 96 [6, 18] depth= 41
pushed 97 [6, 19]
pushed 110 [7, 18]
pushed 111 [7, 19]
iter= 50 len_frontier= 46 popped= 111 [7, 19] depth= 42
pushed 112 [7, 20]
pushed 128 [8, 19]
pushed 129 [8, 20]
iter= 51 len_frontier= 48 popped= 129 [8, 20] depth= 43
pushed 144 [9, 20]
iter= 52 len_frontier= 48 popped= 144 [9, 20] depth= 44
pushed 143 [9, 19]
pushed 149 [10, 20]
```

iter= 53 len\_frontier= 49 popped= 149 [10, 20] depth= 45  
pushed 148 [10, 19]  
pushed 154 [11, 20]  
iter= 54 len\_frontier= 50 popped= 154 [11, 20] depth= 46  
pushed 153 [11, 19]  
pushed 159 [12, 20]  
iter= 55 len\_frontier= 51 popped= 159 [12, 20] depth= 47  
pushed 158 [12, 19]  
pushed 172 [13, 20]  
iter= 56 len\_frontier= 52 popped= 172 [13, 20] depth= 48  
pushed 171 [13, 19]  
pushed 184 [14, 20]  
iter= 57 len\_frontier= 53 popped= 184 [14, 20] depth= 49  
pushed 183 [14, 19]  
pushed 197 [15, 20]  
iter= 58 len\_frontier= 54 popped= 197 [15, 20] depth= 50  
pushed 196 [15, 19]  
pushed 210 [16, 20]  
iter= 59 len\_frontier= 55 popped= 210 [16, 20] depth= 51  
pushed 209 [16, 19]  
pushed 222 [17, 20]  
iter= 60 len\_frontier= 56 popped= 222 [17, 20] depth= 52  
pushed 221 [17, 19]  
pushed 236 [18, 20]  
iter= 61 len\_frontier= 57 popped= 236 [18, 20] depth= 53  
pushed 235 [18, 19]  
pushed 254 [19, 20]  
iter= 62 len\_frontier= 58 popped= 254 [19, 20] depth= 54  
pushed 253 [19, 19]  
pushed 274 [20, 20]  
iter= 63 len\_frontier= 59 popped= 274 [20, 20] depth= 55  
pushed 273 [20, 19]  
iter= 64 len\_frontier= 59 popped= 273 [20, 19] depth= 56  
pushed 272 [20, 18]  
pushed 252 [19, 18]  
iter= 65 len\_frontier= 60 popped= 252 [19, 18] depth= 57  
pushed 251 [19, 17]  
pushed 234 [18, 18]  
pushed 233 [18, 17]  
iter= 66 len\_frontier= 62 popped= 233 [18, 17] depth= 58  
pushed 232 [18, 16]  
pushed 219 [17, 17]  
pushed 218 [17, 16]  
iter= 67 len\_frontier= 64 popped= 218 [17, 16] depth= 59  
pushed 217 [17, 15]  
pushed 206 [16, 16]  
pushed 205 [16, 15]  
iter= 68 len\_frontier= 66 popped= 205 [16, 15] depth= 60  
pushed 204 [16, 14]



pushed 192 [15, 15]  
pushed 191 [15, 14]  
iter= 69 len\_frontier= 68 popped= 191 [15, 14] depth= 61  
pushed 190 [15, 13]  
iter= 70 len\_frontier= 68 popped= 190 [15, 13] depth= 62  
pushed 189 [15, 12]  
iter= 71 len\_frontier= 68 popped= 189 [15, 12] depth= 63  
iter= 72 len\_frontier= 67 popped= 192 [15, 15] depth= 61  
pushed 193 [15, 16]  
pushed 179 [14, 15]  
iter= 73 len\_frontier= 68 popped= 179 [14, 15] depth= 62  
pushed 180 [14, 16]  
pushed 170 [13, 15]  
iter= 74 len\_frontier= 69 popped= 170 [13, 15] depth= 63  
iter= 75 len\_frontier= 68 popped= 180 [14, 16] depth= 63  
pushed 181 [14, 17]  
pushed 194 [15, 17]  
iter= 76 len\_frontier= 69 popped= 194 [15, 17] depth= 64  
pushed 195 [15, 18]  
pushed 207 [16, 17]  
pushed 208 [16, 18]  
iter= 77 len\_frontier= 71 popped= 208 [16, 18] depth= 65  
pushed 220 [17, 18]  
iter= 78 len\_frontier= 71 popped= 220 [17, 18] depth= 66  
iter= 79 len\_frontier= 70 popped= 207 [16, 17] depth= 65  
iter= 80 len\_frontier= 69 popped= 195 [15, 18] depth= 65  
pushed 182 [14, 18]  
iter= 81 len\_frontier= 69 popped= 182 [14, 18] depth= 66  
iter= 82 len\_frontier= 68 popped= 181 [14, 17] depth= 64  
iter= 83 len\_frontier= 67 popped= 193 [15, 16] depth= 62  
iter= 84 len\_frontier= 66 popped= 204 [16, 14] depth= 61  
pushed 216 [17, 13]  
pushed 215 [17, 12]  
pushed 231 [18, 15]  
iter= 85 len\_frontier= 68 popped= 231 [18, 15] depth= 62  
pushed 249 [19, 15]  
pushed 250 [19, 16]  
pushed 268 [20, 14]  
iter= 86 len\_frontier= 70 popped= 268 [20, 14] depth= 63  
pushed 269 [20, 15]  
pushed 267 [20, 13]  
pushed 248 [19, 13]  
iter= 87 len\_frontier= 72 popped= 248 [19, 13] depth= 64  
pushed 247 [19, 12]  
iter= 88 len\_frontier= 72 popped= 247 [19, 12] depth= 65  
pushed 246 [19, 11]  
pushed 266 [20, 12]  
iter= 89 len\_frontier= 73 popped= 266 [20, 12] depth= 66  
pushed 265 [20, 11]

iter= 90 len\_frontier= 73 popped= 265 [20, 11] depth= 67  
pushed 264 [20, 10]  
pushed 245 [19, 10]  
iter= 91 len\_frontier= 74 popped= 245 [19, 10] depth= 68  
pushed 263 [20, 9]  
iter= 92 len\_frontier= 74 popped= 263 [20, 9] depth= 69  
pushed 262 [20, 8]  
pushed 244 [19, 8]  
iter= 93 len\_frontier= 75 popped= 244 [19, 8] depth= 70  
pushed 243 [19, 7]  
pushed 230 [18, 8]  
pushed 229 [18, 7]  
iter= 94 len\_frontier= 77 popped= 229 [18, 7] depth= 71  
pushed 228 [18, 6]  
pushed 214 [17, 8]  
iter= 95 len\_frontier= 78 popped= 214 [17, 8] depth= 72  
pushed 201 [16, 8]  
pushed 202 [16, 9]  
pushed 203 [16, 10]  
pushed 227 [18, 5]  
iter= 96 len\_frontier= 81 popped= 227 [18, 5] depth= 73  
pushed 226 [18, 4]  
pushed 241 [19, 5]  
pushed 242 [19, 6]  
pushed 213 [17, 3]  
iter= 97 len\_frontier= 84 popped= 213 [17, 3] depth= 74  
pushed 200 [16, 3]  
pushed 225 [18, 3]  
iter= 98 len\_frontier= 85 popped= 225 [18, 3] depth= 75  
pushed 239 [19, 3]  
pushed 240 [19, 4]  
iter= 99 len\_frontier= 86 popped= 240 [19, 4] depth= 76  
pushed 258 [20, 4]  
pushed 259 [20, 5]  
iter= 100 len\_frontier= 87 popped= 259 [20, 5] depth= 77  
pushed 260 [20, 6]  
iter= 101 len\_frontier= 87 popped= 260 [20, 6] depth= 78  
pushed 261 [20, 7]  
iter= 102 len\_frontier= 87 popped= 261 [20, 7] depth= 79  
iter= 103 len\_frontier= 86 popped= 258 [20, 4] depth= 77  
pushed 257 [20, 3]  
iter= 104 len\_frontier= 86 popped= 257 [20, 3] depth= 78  
iter= 105 len\_frontier= 85 popped= 239 [19, 3] depth= 76  
iter= 106 len\_frontier= 84 popped= 200 [16, 3] depth= 75  
pushed 187 [15, 3]  
iter= 107 len\_frontier= 84 popped= 187 [15, 3] depth= 76  
pushed 175 [14, 3]  
iter= 108 len\_frontier= 84 popped= 175 [14, 3] depth= 77  
pushed 162 [13, 3]

iter= 109 len\_frontier= 84 popped= 162 [13, 3] depth= 78  
pushed 157 [12, 3]  
iter= 110 len\_frontier= 84 popped= 157 [12, 3] depth= 79  
pushed 152 [11, 3]  
iter= 111 len\_frontier= 84 popped= 152 [11, 3] depth= 80  
pushed 147 [10, 3]  
iter= 112 len\_frontier= 84 popped= 147 [10, 3] depth= 81  
pushed 132 [9, 3]  
iter= 113 len\_frontier= 84 popped= 132 [9, 3] depth= 82  
pushed 115 [8, 3]  
iter= 114 len\_frontier= 84 popped= 115 [8, 3] depth= 83  
pushed 101 [7, 3]  
iter= 115 len\_frontier= 84 popped= 101 [7, 3] depth= 84  
pushed 89 [6, 3]  
iter= 116 len\_frontier= 84 popped= 89 [6, 3] depth= 85  
pushed 77 [5, 3]  
iter= 117 len\_frontier= 84 popped= 77 [5, 3] depth= 86  
pushed 61 [4, 3]  
iter= 118 len\_frontier= 84 popped= 61 [4, 3] depth= 87  
iter= 119 len\_frontier= 83 popped= 242 [19, 6] depth= 74  
iter= 120 len\_frontier= 82 popped= 241 [19, 5] depth= 74  
iter= 121 len\_frontier= 81 popped= 226 [18, 4] depth= 74  
iter= 122 len\_frontier= 80 popped= 203 [16, 10] depth= 73  
pushed 188 [15, 8]  
iter= 123 len\_frontier= 80 popped= 188 [15, 8] depth= 74  
pushed 178 [14, 8]  
pushed 177 [14, 7]  
iter= 124 len\_frontier= 81 popped= 177 [14, 7] depth= 75  
pushed 176 [14, 6]  
pushed 164 [13, 7]  
pushed 163 [13, 6]  
iter= 125 len\_frontier= 83 popped= 163 [13, 6] depth= 76  
iter= 126 len\_frontier= 82 popped= 164 [13, 7] depth= 76  
pushed 165 [13, 8]  
iter= 127 len\_frontier= 82 popped= 165 [13, 8] depth= 77  
iter= 128 len\_frontier= 81 popped= 176 [14, 6] depth= 76  
iter= 129 len\_frontier= 80 popped= 178 [14, 8] depth= 75  
iter= 130 len\_frontier= 79 popped= 202 [16, 9] depth= 73  
iter= 131 len\_frontier= 78 popped= 201 [16, 8] depth= 73  
iter= 132 len\_frontier= 77 popped= 228 [18, 6] depth= 72  
iter= 133 len\_frontier= 76 popped= 230 [18, 8] depth= 71  
iter= 134 len\_frontier= 75 popped= 243 [19, 7] depth= 71  
iter= 135 len\_frontier= 74 popped= 262 [20, 8] depth= 70  
iter= 136 len\_frontier= 73 popped= 264 [20, 10] depth= 68  
iter= 137 len\_frontier= 72 popped= 246 [19, 11] depth= 66  
iter= 138 len\_frontier= 71 popped= 267 [20, 13] depth= 64  
iter= 139 len\_frontier= 70 popped= 269 [20, 15] depth= 64  
pushed 270 [20, 16]  
iter= 140 len\_frontier= 70 popped= 270 [20, 16] depth= 65

pushed 271 [20, 17]  
iter= 141 len\_frontier= 70 popped= 271 [20, 17] depth= 66  
iter= 142 len\_frontier= 69 popped= 250 [19, 16] depth= 63  
iter= 143 len\_frontier= 68 popped= 249 [19, 15] depth= 63  
iter= 144 len\_frontier= 67 popped= 215 [17, 12] depth= 62  
iter= 145 len\_frontier= 66 popped= 216 [17, 13] depth= 62  
iter= 146 len\_frontier= 65 popped= 206 [16, 16] depth= 60  
iter= 147 len\_frontier= 64 popped= 217 [17, 15] depth= 60  
iter= 148 len\_frontier= 63 popped= 219 [17, 17] depth= 59  
iter= 149 len\_frontier= 62 popped= 232 [18, 16] depth= 59  
iter= 150 len\_frontier= 61 popped= 234 [18, 18] depth= 58  
iter= 151 len\_frontier= 60 popped= 251 [19, 17] depth= 58  
iter= 152 len\_frontier= 59 popped= 272 [20, 18] depth= 57  
iter= 153 len\_frontier= 58 popped= 253 [19, 19] depth= 55  
iter= 154 len\_frontier= 57 popped= 235 [18, 19] depth= 54  
iter= 155 len\_frontier= 56 popped= 221 [17, 19] depth= 53  
iter= 156 len\_frontier= 55 popped= 209 [16, 19] depth= 52  
iter= 157 len\_frontier= 54 popped= 196 [15, 19] depth= 51  
iter= 158 len\_frontier= 53 popped= 183 [14, 19] depth= 50  
iter= 159 len\_frontier= 52 popped= 171 [13, 19] depth= 49  
iter= 160 len\_frontier= 51 popped= 158 [12, 19] depth= 48  
iter= 161 len\_frontier= 50 popped= 153 [11, 19] depth= 47  
pushed 127 [8, 18]  
iter= 162 len\_frontier= 50 popped= 127 [8, 18] depth= 48  
pushed 126 [8, 17]  
pushed 109 [7, 17]  
iter= 163 len\_frontier= 51 popped= 109 [7, 17] depth= 49  
pushed 108 [7, 16]  
pushed 94 [6, 16]  
iter= 164 len\_frontier= 52 popped= 94 [6, 16] depth= 50  
pushed 93 [6, 15]  
pushed 81 [5, 15]  
iter= 165 len\_frontier= 53 popped= 81 [5, 15] depth= 51  
pushed 80 [5, 14]  
iter= 166 len\_frontier= 53 popped= 80 [5, 14] depth= 52  
pushed 79 [5, 13]  
pushed 92 [6, 14]  
iter= 167 len\_frontier= 54 popped= 92 [6, 14] depth= 53  
pushed 91 [6, 13]  
pushed 107 [7, 15]  
iter= 168 len\_frontier= 55 popped= 107 [7, 15] depth= 54  
pushed 124 [8, 15]  
pushed 125 [8, 16]  
iter= 169 len\_frontier= 56 popped= 125 [8, 16] depth= 55  
iter= 170 len\_frontier= 55 popped= 124 [8, 15] depth= 55  
pushed 142 [9, 15]  
iter= 171 len\_frontier= 55 popped= 142 [9, 15] depth= 56  
pushed 141 [9, 14]  
iter= 172 len\_frontier= 55 popped= 141 [9, 14] depth= 57

pushed 140 [9, 13]  
iter= 173 len\_frontier= 55 popped= 140 [9, 13] depth= 58  
pushed 139 [9, 12]  
pushed 123 [8, 13]  
pushed 122 [8, 12]  
iter= 174 len\_frontier= 57 popped= 122 [8, 12] depth= 59  
pushed 121 [8, 11]  
pushed 106 [7, 10]  
iter= 175 len\_frontier= 58 popped= 106 [7, 10] depth= 60  
pushed 105 [7, 9]  
pushed 120 [8, 10]  
iter= 176 len\_frontier= 59 popped= 120 [8, 10] depth= 61  
pushed 119 [8, 9]  
pushed 137 [9, 10]  
pushed 138 [9, 11]  
iter= 177 len\_frontier= 61 popped= 138 [9, 11] depth= 62  
iter= 178 len\_frontier= 60 popped= 137 [9, 10] depth= 62  
pushed 136 [9, 9]  
iter= 179 len\_frontier= 60 popped= 136 [9, 9] depth= 63  
pushed 135 [9, 8]  
pushed 118 [8, 8]  
iter= 180 len\_frontier= 61 popped= 118 [8, 8] depth= 64  
pushed 117 [8, 7]  
pushed 104 [7, 8]  
pushed 103 [7, 7]  
iter= 181 len\_frontier= 63 popped= 103 [7, 7] depth= 65  
pushed 102 [7, 6]  
iter= 182 len\_frontier= 63 popped= 102 [7, 6] depth= 66  
pushed 116 [8, 6]  
iter= 183 len\_frontier= 63 popped= 116 [8, 6] depth= 67  
pushed 133 [9, 6]  
pushed 134 [9, 7]  
iter= 184 len\_frontier= 64 popped= 134 [9, 7] depth= 68  
iter= 185 len\_frontier= 63 popped= 133 [9, 6] depth= 68  
iter= 186 len\_frontier= 62 popped= 104 [7, 8] depth= 65  
pushed 90 [6, 8]  
iter= 187 len\_frontier= 62 popped= 90 [6, 8] depth= 66  
pushed 78 [5, 8]  
iter= 188 len\_frontier= 62 popped= 78 [5, 8] depth= 67  
iter= 189 len\_frontier= 61 popped= 117 [8, 7] depth= 65  
iter= 190 len\_frontier= 60 popped= 135 [9, 8] depth= 64  
iter= 191 len\_frontier= 59 popped= 119 [8, 9] depth= 62  
iter= 192 len\_frontier= 58 popped= 105 [7, 9] depth= 61  
iter= 193 len\_frontier= 57 popped= 121 [8, 11] depth= 60  
iter= 194 len\_frontier= 56 popped= 123 [8, 13] depth= 59  
iter= 195 len\_frontier= 55 popped= 139 [9, 12] depth= 59  
iter= 196 len\_frontier= 54 popped= 91 [6, 13] depth= 54  
iter= 197 len\_frontier= 53 popped= 79 [5, 13] depth= 53  
iter= 198 len\_frontier= 52 popped= 93 [6, 15] depth= 51

```
iter= 199 len_frontier= 51 popped= 108 [7, 16] depth= 50
iter= 200 len_frontier= 50 popped= 126 [8, 17] depth= 49
iter= 201 len_frontier= 49 popped= 148 [10, 19] depth= 46
iter= 202 len_frontier= 48 popped= 143 [9, 19] depth= 45
iter= 203 len_frontier= 47 popped= 128 [8, 19] depth= 43
iter= 204 len_frontier= 46 popped= 112 [7, 20] depth= 43
pushed 98 [6, 20]
iter= 205 len_frontier= 46 popped= 98 [6, 20] depth= 44
pushed 86 [5, 20]
pushed 85 [5, 19]
iter= 206 len_frontier= 47 popped= 85 [5, 19] depth= 45
pushed 73 [4, 19]
pushed 72 [4, 18]
iter= 207 len_frontier= 48 popped= 72 [4, 18] depth= 46
pushed 56 [3, 18]
pushed 55 [3, 17]
iter= 208 len_frontier= 49 popped= 55 [3, 17] depth= 47
pushed 36 [2, 17]
pushed 35 [2, 16]
iter= 209 len_frontier= 50 popped= 35 [2, 16] depth= 48
pushed 15 [1, 16]
pushed 14 [1, 15]
iter= 210 len_frontier= 51 popped= 14 [1, 15] depth= 49
iter= 211 len_frontier= 50 popped= 15 [1, 16] depth= 49
pushed 16 [1, 17]
iter= 212 len_frontier= 50 popped= 16 [1, 17] depth= 50
pushed 17 [1, 18]
pushed 37 [2, 18]
iter= 213 len_frontier= 51 popped= 37 [2, 18] depth= 51
pushed 38 [2, 19]
pushed 57 [3, 19]
iter= 214 len_frontier= 52 popped= 57 [3, 19] depth= 52
pushed 58 [3, 20]
pushed 74 [4, 20]
iter= 215 len_frontier= 53 popped= 74 [4, 20] depth= 53
iter= 216 len_frontier= 52 popped= 58 [3, 20] depth= 53
pushed 39 [2, 20]
iter= 217 len_frontier= 52 popped= 39 [2, 20] depth= 54
pushed 19 [1, 20]
pushed 18 [1, 19]
iter= 218 len_frontier= 53 popped= 18 [1, 19] depth= 55
iter= 219 len_frontier= 52 popped= 19 [1, 20] depth= 55
solution_path:
vertex 19 (1, 20)
vertex 39 (2, 20)
vertex 58 (3, 20)
vertex 57 (3, 19)
vertex 37 (2, 18)
vertex 16 (1, 17)
```

vertex 15 (1, 16)  
vertex 35 (2, 16)  
vertex 55 (3, 17)  
vertex 72 (4, 18)  
vertex 85 (5, 19)  
vertex 98 (6, 20)  
vertex 112 (7, 20)  
vertex 111 (7, 19)  
vertex 96 (6, 18)  
vertex 83 (5, 17)  
vertex 70 (4, 16)  
vertex 53 (3, 15)  
vertex 33 (2, 14)  
vertex 12 (1, 13)  
vertex 11 (1, 12)  
vertex 31 (2, 12)  
vertex 52 (3, 13)  
vertex 68 (4, 10)  
vertex 67 (4, 9)  
vertex 47 (3, 8)  
vertex 26 (2, 7)  
vertex 5 (1, 6)  
vertex 4 (1, 5)  
vertex 24 (2, 5)  
vertex 45 (3, 6)  
vertex 64 (4, 6)  
vertex 63 (4, 5)  
vertex 43 (3, 4)  
vertex 22 (2, 3)  
vertex 1 (1, 2)  
vertex 0 (1, 1)  
vertex 20 (2, 1)  
vertex 40 (3, 1)  
vertex 59 (4, 1)  
vertex 75 (5, 1)  
vertex 87 (6, 1)  
vertex 99 (7, 1)  
vertex 113 (8, 1)  
vertex 130 (9, 1)  
vertex 145 (10, 1)  
vertex 150 (11, 1)  
vertex 155 (12, 1)  
vertex 160 (13, 1)  
vertex 173 (14, 1)  
vertex 185 (15, 1)  
vertex 198 (16, 1)  
vertex 211 (17, 1)  
vertex 223 (18, 1)  
vertex 237 (19, 1)

vertex 255 (20, 1)

Some statistics:

=====

Search algorithm: DFS

Iteration Count: 219

max frontier size: 88

vertices visited: 271/275

Path length: 55

-----Completed Execution-----

[1, 1] to [20, 20]

iter= 0 len\_frontier= 0 popped= 0 [1, 1] depth= 0

pushed 1 [1, 2]

pushed 20 [2, 1]

pushed 21 [2, 2]

iter= 1 len\_frontier= 2 popped= 21 [2, 2] depth= 1

pushed 22 [2, 3]

pushed 41 [3, 2]

pushed 0 [1, 1]

pushed 42 [3, 3]

iter= 2 len\_frontier= 5 popped= 42 [3, 3] depth= 2

pushed 43 [3, 4]

pushed 61 [4, 3]

pushed 62 [4, 4]

iter= 3 len\_frontier= 7 popped= 62 [4, 4] depth= 3

pushed 63 [4, 5]

iter= 4 len\_frontier= 7 popped= 63 [4, 5] depth= 4

pushed 64 [4, 6]

pushed 44 [3, 5]

iter= 5 len\_frontier= 8 popped= 44 [3, 5] depth= 5

pushed 45 [3, 6]

pushed 24 [2, 5]

pushed 23 [2, 4]

iter= 6 len\_frontier= 10 popped= 23 [2, 4] depth= 6

pushed 3 [1, 4]

pushed 2 [1, 3]

iter= 7 len\_frontier= 11 popped= 2 [1, 3] depth= 7

iter= 8 len\_frontier= 10 popped= 3 [1, 4] depth= 7

pushed 4 [1, 5]

iter= 9 len\_frontier= 10 popped= 4 [1, 5] depth= 8

pushed 5 [1, 6]

pushed 25 [2, 6]

iter= 10 len\_frontier= 11 popped= 25 [2, 6] depth= 9

pushed 26 [2, 7]

pushed 46 [3, 7]

iter= 11 len\_frontier= 12 popped= 46 [3, 7] depth= 10

pushed 47 [3, 8]

pushed 65 [4, 7]



pushed 66 [4, 8]  
iter= 12 len\_frontier= 14 popped= 66 [4, 8] depth= 11  
pushed 67 [4, 9]  
pushed 78 [5, 8]  
iter= 13 len\_frontier= 15 popped= 78 [5, 8] depth= 12  
pushed 90 [6, 8]  
iter= 14 len\_frontier= 15 popped= 90 [6, 8] depth= 13  
pushed 104 [7, 8]  
iter= 15 len\_frontier= 15 popped= 104 [7, 8] depth= 14  
pushed 103 [7, 7]  
pushed 105 [7, 9]  
pushed 118 [8, 8]  
pushed 119 [8, 9]  
iter= 16 len\_frontier= 18 popped= 119 [8, 9] depth= 15  
pushed 120 [8, 10]  
pushed 136 [9, 9]  
pushed 137 [9, 10]  
iter= 17 len\_frontier= 20 popped= 137 [9, 10] depth= 16  
pushed 138 [9, 11]  
iter= 18 len\_frontier= 20 popped= 138 [9, 11] depth= 17  
pushed 139 [9, 12]  
pushed 121 [8, 11]  
iter= 19 len\_frontier= 21 popped= 121 [8, 11] depth= 18  
pushed 122 [8, 12]  
pushed 106 [7, 10]  
iter= 20 len\_frontier= 22 popped= 106 [7, 10] depth= 19  
iter= 21 len\_frontier= 21 popped= 122 [8, 12] depth= 19  
pushed 123 [8, 13]  
pushed 140 [9, 13]  
iter= 22 len\_frontier= 22 popped= 140 [9, 13] depth= 20  
pushed 141 [9, 14]  
iter= 23 len\_frontier= 22 popped= 141 [9, 14] depth= 21  
pushed 142 [9, 15]  
iter= 24 len\_frontier= 22 popped= 142 [9, 15] depth= 22  
pushed 124 [8, 15]  
iter= 25 len\_frontier= 22 popped= 124 [8, 15] depth= 23  
pushed 125 [8, 16]  
pushed 107 [7, 15]  
iter= 26 len\_frontier= 23 popped= 107 [7, 15] depth= 24  
pushed 108 [7, 16]  
pushed 93 [6, 15]  
pushed 92 [6, 14]  
iter= 27 len\_frontier= 25 popped= 92 [6, 14] depth= 25  
pushed 91 [6, 13]  
pushed 80 [5, 14]  
pushed 79 [5, 13]  
iter= 28 len\_frontier= 27 popped= 79 [5, 13] depth= 26  
iter= 29 len\_frontier= 26 popped= 80 [5, 14] depth= 26  
pushed 81 [5, 15]

```
iter= 30 len_frontier= 26 popped= 81 [5, 15] depth= 27
pushed 82 [5, 16]
pushed 69 [4, 15]
pushed 94 [6, 16]
iter= 31 len_frontier= 28 popped= 94 [6, 16] depth= 28
pushed 95 [6, 17]
pushed 109 [7, 17]
iter= 32 len_frontier= 29 popped= 109 [7, 17] depth= 29
pushed 110 [7, 18]
pushed 126 [8, 17]
pushed 127 [8, 18]
iter= 33 len_frontier= 31 popped= 127 [8, 18] depth= 30
pushed 128 [8, 19]
pushed 143 [9, 19]
pushed 148 [10, 19]
pushed 153 [11, 19]
iter= 34 len_frontier= 34 popped= 153 [11, 19] depth= 31
pushed 154 [11, 20]
pushed 158 [12, 19]
pushed 159 [12, 20]
iter= 35 len_frontier= 36 popped= 159 [12, 20] depth= 32
pushed 172 [13, 20]
iter= 36 len_frontier= 36 popped= 172 [13, 20] depth= 33
pushed 171 [13, 19]
pushed 184 [14, 20]
iter= 37 len_frontier= 37 popped= 184 [14, 20] depth= 34
pushed 183 [14, 19]
pushed 197 [15, 20]
iter= 38 len_frontier= 38 popped= 197 [15, 20] depth= 35
pushed 196 [15, 19]
pushed 210 [16, 20]
iter= 39 len_frontier= 39 popped= 210 [16, 20] depth= 36
pushed 209 [16, 19]
pushed 222 [17, 20]
iter= 40 len_frontier= 40 popped= 222 [17, 20] depth= 37
pushed 221 [17, 19]
pushed 236 [18, 20]
iter= 41 len_frontier= 41 popped= 236 [18, 20] depth= 38
pushed 235 [18, 19]
pushed 254 [19, 20]
iter= 42 len_frontier= 42 popped= 254 [19, 20] depth= 39
pushed 253 [19, 19]
pushed 274 [20, 20]
iter= 43 len_frontier= 43 popped= 274 [20, 20] depth= 40
solution_path:
vertex 274 (20, 20)
vertex 254 (19, 20)
vertex 236 (18, 20)
vertex 222 (17, 20)
```

vertex 210 (16, 20)  
vertex 197 (15, 20)  
vertex 184 (14, 20)  
vertex 172 (13, 20)  
vertex 159 (12, 20)  
vertex 153 (11, 19)  
vertex 127 (8, 18)  
vertex 109 (7, 17)  
vertex 94 (6, 16)  
vertex 81 (5, 15)  
vertex 80 (5, 14)  
vertex 92 (6, 14)  
vertex 107 (7, 15)  
vertex 124 (8, 15)  
vertex 142 (9, 15)  
vertex 141 (9, 14)  
vertex 140 (9, 13)  
vertex 122 (8, 12)  
vertex 121 (8, 11)  
vertex 138 (9, 11)  
vertex 137 (9, 10)  
vertex 119 (8, 9)  
vertex 104 (7, 8)  
vertex 90 (6, 8)  
vertex 78 (5, 8)  
vertex 66 (4, 8)  
vertex 46 (3, 7)  
vertex 25 (2, 6)  
vertex 4 (1, 5)  
vertex 3 (1, 4)  
vertex 23 (2, 4)  
vertex 44 (3, 5)  
vertex 63 (4, 5)  
vertex 62 (4, 4)  
vertex 42 (3, 3)  
vertex 21 (2, 2)  
vertex 0 (1, 1)

Some statistics:

=====

Search algorithm: DFS

Iteration Count: 43

max frontier size: 44

vertices visited: 86/275

Path length: 40

-----Completed Execution-----

[1, 10] to [20, 10]

iter= 0 len\_frontier= 0 popped= 9 [1, 10] depth= 0

```
pushed 8 [1, 9]
pushed 10 [1, 11]
pushed 29 [2, 10]
pushed 30 [2, 11]
iter= 1 len_frontier= 3 popped= 30 [2, 11] depth= 1
pushed 31 [2, 12]
pushed 50 [3, 11]
pushed 9 [1, 10]
pushed 51 [3, 12]
iter= 2 len_frontier= 6 popped= 51 [3, 12] depth= 2
pushed 52 [3, 13]
pushed 68 [4, 10]
iter= 3 len_frontier= 7 popped= 68 [4, 10] depth= 3
pushed 67 [4, 9]
pushed 49 [3, 10]
pushed 48 [3, 9]
iter= 4 len_frontier= 9 popped= 48 [3, 9] depth= 4
pushed 47 [3, 8]
pushed 28 [2, 9]
pushed 27 [2, 8]
iter= 5 len_frontier= 11 popped= 27 [2, 8] depth= 5
pushed 26 [2, 7]
pushed 7 [1, 8]
pushed 6 [1, 7]
iter= 6 len_frontier= 13 popped= 6 [1, 7] depth= 6
pushed 5 [1, 6]
iter= 7 len_frontier= 13 popped= 5 [1, 6] depth= 7
pushed 4 [1, 5]
pushed 25 [2, 6]
iter= 8 len_frontier= 14 popped= 25 [2, 6] depth= 8
pushed 24 [2, 5]
pushed 45 [3, 6]
pushed 46 [3, 7]
iter= 9 len_frontier= 16 popped= 46 [3, 7] depth= 9
pushed 65 [4, 7]
pushed 66 [4, 8]
iter= 10 len_frontier= 17 popped= 66 [4, 8] depth= 10
pushed 78 [5, 8]
iter= 11 len_frontier= 17 popped= 78 [5, 8] depth= 11
pushed 90 [6, 8]
iter= 12 len_frontier= 17 popped= 90 [6, 8] depth= 12
pushed 104 [7, 8]
iter= 13 len_frontier= 17 popped= 104 [7, 8] depth= 13
pushed 103 [7, 7]
pushed 105 [7, 9]
pushed 118 [8, 8]
pushed 119 [8, 9]
iter= 14 len_frontier= 20 popped= 119 [8, 9] depth= 14
pushed 120 [8, 10]
```

pushed 136 [9, 9]  
pushed 137 [9, 10]  
iter= 15 len\_frontier= 22 popped= 137 [9, 10] depth= 15  
pushed 138 [9, 11]  
iter= 16 len\_frontier= 22 popped= 138 [9, 11] depth= 16  
pushed 139 [9, 12]  
pushed 121 [8, 11]  
iter= 17 len\_frontier= 23 popped= 121 [8, 11] depth= 17  
pushed 122 [8, 12]  
pushed 106 [7, 10]  
iter= 18 len\_frontier= 24 popped= 106 [7, 10] depth= 18  
iter= 19 len\_frontier= 23 popped= 122 [8, 12] depth= 18  
pushed 123 [8, 13]  
pushed 140 [9, 13]  
iter= 20 len\_frontier= 24 popped= 140 [9, 13] depth= 19  
pushed 141 [9, 14]  
iter= 21 len\_frontier= 24 popped= 141 [9, 14] depth= 20  
pushed 142 [9, 15]  
iter= 22 len\_frontier= 24 popped= 142 [9, 15] depth= 21  
pushed 124 [8, 15]  
iter= 23 len\_frontier= 24 popped= 124 [8, 15] depth= 22  
pushed 125 [8, 16]  
pushed 107 [7, 15]  
iter= 24 len\_frontier= 25 popped= 107 [7, 15] depth= 23  
pushed 108 [7, 16]  
pushed 93 [6, 15]  
pushed 92 [6, 14]  
iter= 25 len\_frontier= 27 popped= 92 [6, 14] depth= 24  
pushed 91 [6, 13]  
pushed 80 [5, 14]  
pushed 79 [5, 13]  
iter= 26 len\_frontier= 29 popped= 79 [5, 13] depth= 25  
iter= 27 len\_frontier= 28 popped= 80 [5, 14] depth= 25  
pushed 81 [5, 15]  
iter= 28 len\_frontier= 28 popped= 81 [5, 15] depth= 26  
pushed 82 [5, 16]  
pushed 69 [4, 15]  
pushed 94 [6, 16]  
iter= 29 len\_frontier= 30 popped= 94 [6, 16] depth= 27  
pushed 95 [6, 17]  
pushed 109 [7, 17]  
iter= 30 len\_frontier= 31 popped= 109 [7, 17] depth= 28  
pushed 110 [7, 18]  
pushed 126 [8, 17]  
pushed 127 [8, 18]  
iter= 31 len\_frontier= 33 popped= 127 [8, 18] depth= 29  
pushed 128 [8, 19]  
pushed 143 [9, 19]  
pushed 148 [10, 19]

pushed 153 [11, 19]  
iter= 32 len\_frontier= 36 popped= 153 [11, 19] depth= 30  
pushed 154 [11, 20]  
pushed 158 [12, 19]  
pushed 159 [12, 20]  
iter= 33 len\_frontier= 38 popped= 159 [12, 20] depth= 31  
pushed 172 [13, 20]  
iter= 34 len\_frontier= 38 popped= 172 [13, 20] depth= 32  
pushed 171 [13, 19]  
pushed 184 [14, 20]  
iter= 35 len\_frontier= 39 popped= 184 [14, 20] depth= 33  
pushed 183 [14, 19]  
pushed 197 [15, 20]  
iter= 36 len\_frontier= 40 popped= 197 [15, 20] depth= 34  
pushed 196 [15, 19]  
pushed 210 [16, 20]  
iter= 37 len\_frontier= 41 popped= 210 [16, 20] depth= 35  
pushed 209 [16, 19]  
pushed 222 [17, 20]  
iter= 38 len\_frontier= 42 popped= 222 [17, 20] depth= 36  
pushed 221 [17, 19]  
pushed 236 [18, 20]  
iter= 39 len\_frontier= 43 popped= 236 [18, 20] depth= 37  
pushed 235 [18, 19]  
pushed 254 [19, 20]  
iter= 40 len\_frontier= 44 popped= 254 [19, 20] depth= 38  
pushed 253 [19, 19]  
pushed 274 [20, 20]  
iter= 41 len\_frontier= 45 popped= 274 [20, 20] depth= 39  
pushed 273 [20, 19]  
iter= 42 len\_frontier= 45 popped= 273 [20, 19] depth= 40  
pushed 272 [20, 18]  
pushed 252 [19, 18]  
iter= 43 len\_frontier= 46 popped= 252 [19, 18] depth= 41  
pushed 251 [19, 17]  
pushed 234 [18, 18]  
pushed 233 [18, 17]  
iter= 44 len\_frontier= 48 popped= 233 [18, 17] depth= 42  
pushed 232 [18, 16]  
pushed 219 [17, 17]  
pushed 218 [17, 16]  
iter= 45 len\_frontier= 50 popped= 218 [17, 16] depth= 43  
pushed 217 [17, 15]  
pushed 206 [16, 16]  
pushed 205 [16, 15]  
iter= 46 len\_frontier= 52 popped= 205 [16, 15] depth= 44  
pushed 204 [16, 14]  
pushed 192 [15, 15]  
pushed 191 [15, 14]

iter= 47 len\_frontier= 54 popped= 191 [15, 14] depth= 45  
pushed 190 [15, 13]  
iter= 48 len\_frontier= 54 popped= 190 [15, 13] depth= 46  
pushed 189 [15, 12]  
iter= 49 len\_frontier= 54 popped= 189 [15, 12] depth= 47  
iter= 50 len\_frontier= 53 popped= 192 [15, 15] depth= 45  
pushed 193 [15, 16]  
pushed 179 [14, 15]  
iter= 51 len\_frontier= 54 popped= 179 [14, 15] depth= 46  
pushed 180 [14, 16]  
pushed 170 [13, 15]  
iter= 52 len\_frontier= 55 popped= 170 [13, 15] depth= 47  
iter= 53 len\_frontier= 54 popped= 180 [14, 16] depth= 47  
pushed 181 [14, 17]  
pushed 194 [15, 17]  
iter= 54 len\_frontier= 55 popped= 194 [15, 17] depth= 48  
pushed 195 [15, 18]  
pushed 207 [16, 17]  
pushed 208 [16, 18]  
iter= 55 len\_frontier= 57 popped= 208 [16, 18] depth= 49  
pushed 220 [17, 18]  
iter= 56 len\_frontier= 57 popped= 220 [17, 18] depth= 50  
iter= 57 len\_frontier= 56 popped= 207 [16, 17] depth= 49  
iter= 58 len\_frontier= 55 popped= 195 [15, 18] depth= 49  
pushed 182 [14, 18]  
iter= 59 len\_frontier= 55 popped= 182 [14, 18] depth= 50  
iter= 60 len\_frontier= 54 popped= 181 [14, 17] depth= 48  
iter= 61 len\_frontier= 53 popped= 193 [15, 16] depth= 46  
iter= 62 len\_frontier= 52 popped= 204 [16, 14] depth= 45  
pushed 216 [17, 13]  
pushed 215 [17, 12]  
pushed 231 [18, 15]  
iter= 63 len\_frontier= 54 popped= 231 [18, 15] depth= 46  
pushed 249 [19, 15]  
pushed 250 [19, 16]  
pushed 268 [20, 14]  
iter= 64 len\_frontier= 56 popped= 268 [20, 14] depth= 47  
pushed 269 [20, 15]  
pushed 267 [20, 13]  
pushed 248 [19, 13]  
iter= 65 len\_frontier= 58 popped= 248 [19, 13] depth= 48  
pushed 247 [19, 12]  
iter= 66 len\_frontier= 58 popped= 247 [19, 12] depth= 49  
pushed 246 [19, 11]  
pushed 266 [20, 12]  
iter= 67 len\_frontier= 59 popped= 266 [20, 12] depth= 50  
pushed 265 [20, 11]  
iter= 68 len\_frontier= 59 popped= 265 [20, 11] depth= 51  
pushed 264 [20, 10]

pushed 245 [19, 10]  
iter= 69 len\_frontier= 60 popped= 245 [19, 10] depth= 52  
pushed 263 [20, 9]  
iter= 70 len\_frontier= 60 popped= 263 [20, 9] depth= 53  
pushed 262 [20, 8]  
pushed 244 [19, 8]  
iter= 71 len\_frontier= 61 popped= 244 [19, 8] depth= 54  
pushed 243 [19, 7]  
pushed 230 [18, 8]  
pushed 229 [18, 7]  
iter= 72 len\_frontier= 63 popped= 229 [18, 7] depth= 55  
pushed 228 [18, 6]  
pushed 214 [17, 8]  
iter= 73 len\_frontier= 64 popped= 214 [17, 8] depth= 56  
pushed 201 [16, 8]  
pushed 202 [16, 9]  
pushed 203 [16, 10]  
pushed 227 [18, 5]  
iter= 74 len\_frontier= 67 popped= 227 [18, 5] depth= 57  
pushed 226 [18, 4]  
pushed 241 [19, 5]  
pushed 242 [19, 6]  
pushed 213 [17, 3]  
iter= 75 len\_frontier= 70 popped= 213 [17, 3] depth= 58  
pushed 212 [17, 2]  
pushed 200 [16, 3]  
pushed 225 [18, 3]  
pushed 199 [16, 2]  
iter= 76 len\_frontier= 73 popped= 199 [16, 2] depth= 59  
pushed 198 [16, 1]  
pushed 186 [15, 2]  
pushed 185 [15, 1]  
iter= 77 len\_frontier= 75 popped= 185 [15, 1] depth= 60  
pushed 173 [14, 1]  
iter= 78 len\_frontier= 75 popped= 173 [14, 1] depth= 61  
pushed 174 [14, 2]  
pushed 160 [13, 1]  
iter= 79 len\_frontier= 76 popped= 160 [13, 1] depth= 62  
pushed 161 [13, 2]  
pushed 155 [12, 1]  
iter= 80 len\_frontier= 77 popped= 155 [12, 1] depth= 63  
pushed 156 [12, 2]  
pushed 150 [11, 1]  
iter= 81 len\_frontier= 78 popped= 150 [11, 1] depth= 64  
pushed 151 [11, 2]  
pushed 145 [10, 1]  
iter= 82 len\_frontier= 79 popped= 145 [10, 1] depth= 65  
pushed 146 [10, 2]  
pushed 130 [9, 1]



iter= 83 len\_frontier= 80 popped= 130 [9, 1] depth= 66  
pushed 131 [9, 2]  
pushed 113 [8, 1]  
iter= 84 len\_frontier= 81 popped= 113 [8, 1] depth= 67  
pushed 114 [8, 2]  
pushed 99 [7, 1]  
iter= 85 len\_frontier= 82 popped= 99 [7, 1] depth= 68  
pushed 100 [7, 2]  
pushed 87 [6, 1]  
iter= 86 len\_frontier= 83 popped= 87 [6, 1] depth= 69  
pushed 88 [6, 2]  
pushed 75 [5, 1]  
iter= 87 len\_frontier= 84 popped= 75 [5, 1] depth= 70  
pushed 76 [5, 2]  
pushed 59 [4, 1]  
iter= 88 len\_frontier= 85 popped= 59 [4, 1] depth= 71  
pushed 60 [4, 2]  
pushed 40 [3, 1]  
iter= 89 len\_frontier= 86 popped= 40 [3, 1] depth= 72  
pushed 41 [3, 2]  
pushed 20 [2, 1]  
iter= 90 len\_frontier= 87 popped= 20 [2, 1] depth= 73  
pushed 21 [2, 2]  
pushed 0 [1, 1]  
iter= 91 len\_frontier= 88 popped= 0 [1, 1] depth= 74  
pushed 1 [1, 2]  
iter= 92 len\_frontier= 88 popped= 1 [1, 2] depth= 75  
pushed 2 [1, 3]  
pushed 22 [2, 3]  
iter= 93 len\_frontier= 89 popped= 22 [2, 3] depth= 76  
pushed 23 [2, 4]  
pushed 42 [3, 3]  
pushed 43 [3, 4]  
iter= 94 len\_frontier= 91 popped= 43 [3, 4] depth= 77  
pushed 44 [3, 5]  
pushed 62 [4, 4]  
pushed 63 [4, 5]  
iter= 95 len\_frontier= 93 popped= 63 [4, 5] depth= 78  
pushed 64 [4, 6]  
iter= 96 len\_frontier= 93 popped= 64 [4, 6] depth= 79  
iter= 97 len\_frontier= 92 popped= 62 [4, 4] depth= 78  
pushed 61 [4, 3]  
iter= 98 len\_frontier= 92 popped= 61 [4, 3] depth= 79  
pushed 77 [5, 3]  
iter= 99 len\_frontier= 92 popped= 77 [5, 3] depth= 80  
pushed 89 [6, 3]  
iter= 100 len\_frontier= 92 popped= 89 [6, 3] depth= 81  
pushed 101 [7, 3]  
iter= 101 len\_frontier= 92 popped= 101 [7, 3] depth= 82

pushed 115 [8, 3]  
iter= 102 len\_frontier= 92 popped= 115 [8, 3] depth= 83  
pushed 132 [9, 3]  
iter= 103 len\_frontier= 92 popped= 132 [9, 3] depth= 84  
pushed 147 [10, 3]  
iter= 104 len\_frontier= 92 popped= 147 [10, 3] depth= 85  
pushed 152 [11, 3]  
iter= 105 len\_frontier= 92 popped= 152 [11, 3] depth= 86  
pushed 157 [12, 3]  
iter= 106 len\_frontier= 92 popped= 157 [12, 3] depth= 87  
pushed 162 [13, 3]  
iter= 107 len\_frontier= 92 popped= 162 [13, 3] depth= 88  
pushed 175 [14, 3]  
iter= 108 len\_frontier= 92 popped= 175 [14, 3] depth= 89  
pushed 187 [15, 3]  
iter= 109 len\_frontier= 92 popped= 187 [15, 3] depth= 90  
iter= 110 len\_frontier= 91 popped= 44 [3, 5] depth= 78  
iter= 111 len\_frontier= 90 popped= 42 [3, 3] depth= 77  
iter= 112 len\_frontier= 89 popped= 23 [2, 4] depth= 77  
pushed 3 [1, 4]  
iter= 113 len\_frontier= 89 popped= 3 [1, 4] depth= 78  
iter= 114 len\_frontier= 88 popped= 2 [1, 3] depth= 76  
iter= 115 len\_frontier= 87 popped= 21 [2, 2] depth= 74  
iter= 116 len\_frontier= 86 popped= 41 [3, 2] depth= 73  
iter= 117 len\_frontier= 85 popped= 60 [4, 2] depth= 72  
iter= 118 len\_frontier= 84 popped= 76 [5, 2] depth= 71  
iter= 119 len\_frontier= 83 popped= 88 [6, 2] depth= 70  
iter= 120 len\_frontier= 82 popped= 100 [7, 2] depth= 69  
iter= 121 len\_frontier= 81 popped= 114 [8, 2] depth= 68  
iter= 122 len\_frontier= 80 popped= 131 [9, 2] depth= 67  
iter= 123 len\_frontier= 79 popped= 146 [10, 2] depth= 66  
iter= 124 len\_frontier= 78 popped= 151 [11, 2] depth= 65  
iter= 125 len\_frontier= 77 popped= 156 [12, 2] depth= 64  
iter= 126 len\_frontier= 76 popped= 161 [13, 2] depth= 63  
iter= 127 len\_frontier= 75 popped= 174 [14, 2] depth= 62  
iter= 128 len\_frontier= 74 popped= 186 [15, 2] depth= 60  
iter= 129 len\_frontier= 73 popped= 198 [16, 1] depth= 60  
pushed 211 [17, 1]  
iter= 130 len\_frontier= 73 popped= 211 [17, 1] depth= 61  
pushed 223 [18, 1]  
pushed 224 [18, 2]  
iter= 131 len\_frontier= 74 popped= 224 [18, 2] depth= 62  
pushed 238 [19, 2]  
pushed 239 [19, 3]  
iter= 132 len\_frontier= 75 popped= 239 [19, 3] depth= 63  
pushed 240 [19, 4]  
pushed 257 [20, 3]  
pushed 258 [20, 4]  
iter= 133 len\_frontier= 77 popped= 258 [20, 4] depth= 64

pushed 259 [20, 5]  
iter= 134 len\_frontier= 77 popped= 259 [20, 5] depth= 65  
pushed 260 [20, 6]  
iter= 135 len\_frontier= 77 popped= 260 [20, 6] depth= 66  
pushed 261 [20, 7]  
iter= 136 len\_frontier= 77 popped= 261 [20, 7] depth= 67  
iter= 137 len\_frontier= 76 popped= 257 [20, 3] depth= 64  
pushed 256 [20, 2]  
iter= 138 len\_frontier= 76 popped= 256 [20, 2] depth= 65  
pushed 255 [20, 1]  
pushed 237 [19, 1]  
iter= 139 len\_frontier= 77 popped= 237 [19, 1] depth= 66  
iter= 140 len\_frontier= 76 popped= 255 [20, 1] depth= 66  
iter= 141 len\_frontier= 75 popped= 240 [19, 4] depth= 64  
iter= 142 len\_frontier= 74 popped= 238 [19, 2] depth= 63  
iter= 143 len\_frontier= 73 popped= 223 [18, 1] depth= 62  
iter= 144 len\_frontier= 72 popped= 225 [18, 3] depth= 59  
iter= 145 len\_frontier= 71 popped= 200 [16, 3] depth= 59  
iter= 146 len\_frontier= 70 popped= 212 [17, 2] depth= 59  
iter= 147 len\_frontier= 69 popped= 242 [19, 6] depth= 58  
iter= 148 len\_frontier= 68 popped= 241 [19, 5] depth= 58  
iter= 149 len\_frontier= 67 popped= 226 [18, 4] depth= 58  
iter= 150 len\_frontier= 66 popped= 203 [16, 10] depth= 57  
pushed 188 [15, 8]  
iter= 151 len\_frontier= 66 popped= 188 [15, 8] depth= 58  
pushed 178 [14, 8]  
pushed 177 [14, 7]  
iter= 152 len\_frontier= 67 popped= 177 [14, 7] depth= 59  
pushed 176 [14, 6]  
pushed 164 [13, 7]  
pushed 163 [13, 6]  
iter= 153 len\_frontier= 69 popped= 163 [13, 6] depth= 60  
iter= 154 len\_frontier= 68 popped= 164 [13, 7] depth= 60  
pushed 165 [13, 8]  
iter= 155 len\_frontier= 68 popped= 165 [13, 8] depth= 61  
iter= 156 len\_frontier= 67 popped= 176 [14, 6] depth= 60  
iter= 157 len\_frontier= 66 popped= 178 [14, 8] depth= 59  
iter= 158 len\_frontier= 65 popped= 202 [16, 9] depth= 57  
iter= 159 len\_frontier= 64 popped= 201 [16, 8] depth= 57  
iter= 160 len\_frontier= 63 popped= 228 [18, 6] depth= 56  
iter= 161 len\_frontier= 62 popped= 230 [18, 8] depth= 55  
iter= 162 len\_frontier= 61 popped= 243 [19, 7] depth= 55  
iter= 163 len\_frontier= 60 popped= 262 [20, 8] depth= 54  
iter= 164 len\_frontier= 59 popped= 264 [20, 10] depth= 52  
solution\_path:  
vertex 264 (20, 10)  
vertex 265 (20, 11)  
vertex 266 (20, 12)  
vertex 247 (19, 12)

vertex 248 (19, 13)  
vertex 268 (20, 14)  
vertex 231 (18, 15)  
vertex 204 (16, 14)  
vertex 205 (16, 15)  
vertex 218 (17, 16)  
vertex 233 (18, 17)  
vertex 252 (19, 18)  
vertex 273 (20, 19)  
vertex 274 (20, 20)  
vertex 254 (19, 20)  
vertex 236 (18, 20)  
vertex 222 (17, 20)  
vertex 210 (16, 20)  
vertex 197 (15, 20)  
vertex 184 (14, 20)  
vertex 172 (13, 20)  
vertex 159 (12, 20)  
vertex 153 (11, 19)  
vertex 127 (8, 18)  
vertex 109 (7, 17)  
vertex 94 (6, 16)  
vertex 81 (5, 15)  
vertex 80 (5, 14)  
vertex 92 (6, 14)  
vertex 107 (7, 15)  
vertex 124 (8, 15)  
vertex 142 (9, 15)  
vertex 141 (9, 14)  
vertex 140 (9, 13)  
vertex 122 (8, 12)  
vertex 121 (8, 11)  
vertex 138 (9, 11)  
vertex 137 (9, 10)  
vertex 119 (8, 9)  
vertex 104 (7, 8)  
vertex 90 (6, 8)  
vertex 78 (5, 8)  
vertex 66 (4, 8)  
vertex 46 (3, 7)  
vertex 25 (2, 6)  
vertex 5 (1, 6)  
vertex 6 (1, 7)  
vertex 27 (2, 8)  
vertex 48 (3, 9)  
vertex 68 (4, 10)  
vertex 51 (3, 12)  
vertex 30 (2, 11)  
vertex 9 (1, 10)

Some statistics:

=====

Search algorithm: DFS

Iteration Count: 164

max frontier size: 94

vertices visited: 223/275

Path length: 52

-----Completed Execution-----

[10, 1] to [10, 20]

iter= 0 len\_frontier= 0 popped= 145 [10, 1] depth= 0

pushed 146 [10, 2]

pushed 130 [9, 1]

pushed 150 [11, 1]

pushed 151 [11, 2]

iter= 1 len\_frontier= 3 popped= 151 [11, 2] depth= 1

pushed 152 [11, 3]

pushed 156 [12, 2]

pushed 145 [10, 1]

pushed 157 [12, 3]

iter= 2 len\_frontier= 6 popped= 157 [12, 3] depth= 2

pushed 162 [13, 3]

iter= 3 len\_frontier= 6 popped= 162 [13, 3] depth= 3

pushed 161 [13, 2]

pushed 175 [14, 3]

iter= 4 len\_frontier= 7 popped= 175 [14, 3] depth= 4

pushed 174 [14, 2]

pushed 187 [15, 3]

iter= 5 len\_frontier= 8 popped= 187 [15, 3] depth= 5

pushed 186 [15, 2]

pushed 200 [16, 3]

iter= 6 len\_frontier= 9 popped= 200 [16, 3] depth= 6

pushed 199 [16, 2]

pushed 213 [17, 3]

iter= 7 len\_frontier= 10 popped= 213 [17, 3] depth= 7

pushed 212 [17, 2]

pushed 225 [18, 3]

pushed 226 [18, 4]

pushed 227 [18, 5]

iter= 8 len\_frontier= 13 popped= 227 [18, 5] depth= 8

pushed 228 [18, 6]

pushed 241 [19, 5]

pushed 242 [19, 6]

pushed 214 [17, 8]

iter= 9 len\_frontier= 16 popped= 214 [17, 8] depth= 9

pushed 201 [16, 8]

pushed 230 [18, 8]

pushed 202 [16, 9]

pushed 229 [18, 7]  
pushed 203 [16, 10]  
iter= 10 len\_frontier= 20 popped= 203 [16, 10] depth= 10  
pushed 188 [15, 8]  
iter= 11 len\_frontier= 20 popped= 188 [15, 8] depth= 11  
pushed 178 [14, 8]  
pushed 177 [14, 7]  
iter= 12 len\_frontier= 21 popped= 177 [14, 7] depth= 12  
pushed 176 [14, 6]  
pushed 164 [13, 7]  
pushed 163 [13, 6]  
iter= 13 len\_frontier= 23 popped= 163 [13, 6] depth= 13  
iter= 14 len\_frontier= 22 popped= 164 [13, 7] depth= 13  
pushed 165 [13, 8]  
iter= 15 len\_frontier= 22 popped= 165 [13, 8] depth= 14  
iter= 16 len\_frontier= 21 popped= 176 [14, 6] depth= 13  
iter= 17 len\_frontier= 20 popped= 178 [14, 8] depth= 12  
iter= 18 len\_frontier= 19 popped= 229 [18, 7] depth= 10  
pushed 243 [19, 7]  
pushed 244 [19, 8]  
iter= 19 len\_frontier= 20 popped= 244 [19, 8] depth= 11  
pushed 262 [20, 8]  
pushed 263 [20, 9]  
iter= 20 len\_frontier= 21 popped= 263 [20, 9] depth= 12  
pushed 264 [20, 10]  
pushed 245 [19, 10]  
iter= 21 len\_frontier= 22 popped= 245 [19, 10] depth= 13  
pushed 246 [19, 11]  
pushed 265 [20, 11]  
iter= 22 len\_frontier= 23 popped= 265 [20, 11] depth= 14  
pushed 266 [20, 12]  
iter= 23 len\_frontier= 23 popped= 266 [20, 12] depth= 15  
pushed 267 [20, 13]  
pushed 247 [19, 12]  
iter= 24 len\_frontier= 24 popped= 247 [19, 12] depth= 16  
pushed 248 [19, 13]  
iter= 25 len\_frontier= 24 popped= 248 [19, 13] depth= 17  
pushed 268 [20, 14]  
iter= 26 len\_frontier= 24 popped= 268 [20, 14] depth= 18  
pushed 269 [20, 15]  
pushed 249 [19, 15]  
pushed 231 [18, 15]  
iter= 27 len\_frontier= 26 popped= 231 [18, 15] depth= 19  
pushed 232 [18, 16]  
pushed 217 [17, 15]  
pushed 250 [19, 16]  
pushed 204 [16, 14]  
iter= 28 len\_frontier= 29 popped= 204 [16, 14] depth= 20  
pushed 205 [16, 15]

pushed 191 [15, 14]  
pushed 190 [15, 13]  
pushed 216 [17, 13]  
pushed 215 [17, 12]  
iter= 29 len\_frontier= 33 popped= 215 [17, 12] depth= 21  
iter= 30 len\_frontier= 32 popped= 216 [17, 13] depth= 21  
iter= 31 len\_frontier= 31 popped= 190 [15, 13] depth= 21  
pushed 189 [15, 12]  
iter= 32 len\_frontier= 31 popped= 189 [15, 12] depth= 22  
iter= 33 len\_frontier= 30 popped= 191 [15, 14] depth= 21  
pushed 192 [15, 15]  
iter= 34 len\_frontier= 30 popped= 192 [15, 15] depth= 22  
pushed 193 [15, 16]  
pushed 179 [14, 15]  
pushed 206 [16, 16]  
iter= 35 len\_frontier= 32 popped= 206 [16, 16] depth= 23  
pushed 207 [16, 17]  
pushed 218 [17, 16]  
pushed 219 [17, 17]  
iter= 36 len\_frontier= 34 popped= 219 [17, 17] depth= 24  
pushed 220 [17, 18]  
pushed 233 [18, 17]  
pushed 234 [18, 18]  
iter= 37 len\_frontier= 36 popped= 234 [18, 18] depth= 25  
pushed 235 [18, 19]  
pushed 252 [19, 18]  
pushed 253 [19, 19]  
iter= 38 len\_frontier= 38 popped= 253 [19, 19] depth= 26  
pushed 254 [19, 20]  
pushed 273 [20, 19]  
pushed 274 [20, 20]  
iter= 39 len\_frontier= 40 popped= 274 [20, 20] depth= 27  
iter= 40 len\_frontier= 39 popped= 273 [20, 19] depth= 27  
pushed 272 [20, 18]  
iter= 41 len\_frontier= 39 popped= 272 [20, 18] depth= 28  
pushed 271 [20, 17]  
pushed 251 [19, 17]  
iter= 42 len\_frontier= 40 popped= 251 [19, 17] depth= 29  
iter= 43 len\_frontier= 39 popped= 271 [20, 17] depth= 29  
pushed 270 [20, 16]  
iter= 44 len\_frontier= 39 popped= 270 [20, 16] depth= 30  
iter= 45 len\_frontier= 38 popped= 254 [19, 20] depth= 27  
pushed 236 [18, 20]  
iter= 46 len\_frontier= 38 popped= 236 [18, 20] depth= 28  
pushed 222 [17, 20]  
pushed 221 [17, 19]  
iter= 47 len\_frontier= 39 popped= 221 [17, 19] depth= 29  
pushed 209 [16, 19]  
pushed 208 [16, 18]

iter= 48 len\_frontier= 40 popped= 208 [16, 18] depth= 30  
pushed 195 [15, 18]  
pushed 194 [15, 17]  
iter= 49 len\_frontier= 41 popped= 194 [15, 17] depth= 31  
pushed 181 [14, 17]  
pushed 180 [14, 16]  
iter= 50 len\_frontier= 42 popped= 180 [14, 16] depth= 32  
iter= 51 len\_frontier= 41 popped= 181 [14, 17] depth= 32  
pushed 182 [14, 18]  
pushed 171 [13, 19]  
iter= 52 len\_frontier= 42 popped= 171 [13, 19] depth= 33  
pushed 172 [13, 20]  
pushed 183 [14, 19]  
pushed 158 [12, 19]  
pushed 184 [14, 20]  
iter= 53 len\_frontier= 45 popped= 184 [14, 20] depth= 34  
pushed 197 [15, 20]  
iter= 54 len\_frontier= 45 popped= 197 [15, 20] depth= 35  
pushed 196 [15, 19]  
pushed 210 [16, 20]  
iter= 55 len\_frontier= 46 popped= 210 [16, 20] depth= 36  
iter= 56 len\_frontier= 45 popped= 196 [15, 19] depth= 36  
iter= 57 len\_frontier= 44 popped= 158 [12, 19] depth= 34  
pushed 159 [12, 20]  
pushed 153 [11, 19]  
iter= 58 len\_frontier= 45 popped= 153 [11, 19] depth= 35  
pushed 154 [11, 20]  
pushed 148 [10, 19]  
pushed 127 [8, 18]  
iter= 59 len\_frontier= 47 popped= 127 [8, 18] depth= 36  
pushed 128 [8, 19]  
pushed 126 [8, 17]  
pushed 110 [7, 18]  
pushed 143 [9, 19]  
pushed 109 [7, 17]  
iter= 60 len\_frontier= 51 popped= 109 [7, 17] depth= 37  
pushed 108 [7, 16]  
pushed 95 [6, 17]  
pushed 94 [6, 16]  
iter= 61 len\_frontier= 53 popped= 94 [6, 16] depth= 38  
pushed 93 [6, 15]  
pushed 82 [5, 16]  
pushed 81 [5, 15]  
iter= 62 len\_frontier= 55 popped= 81 [5, 15] depth= 39  
pushed 80 [5, 14]  
pushed 69 [4, 15]  
iter= 63 len\_frontier= 56 popped= 69 [4, 15] depth= 40  
pushed 70 [4, 16]  
pushed 53 [3, 15]



```
iter= 64 len_frontier= 57 popped= 53 [3, 15] depth= 41
pushed 54 [3, 16]
pushed 34 [2, 15]
pushed 33 [2, 14]
iter= 65 len_frontier= 59 popped= 33 [2, 14] depth= 42
pushed 32 [2, 13]
pushed 13 [1, 14]
pushed 12 [1, 13]
iter= 66 len_frontier= 61 popped= 12 [1, 13] depth= 43
pushed 11 [1, 12]
iter= 67 len_frontier= 61 popped= 11 [1, 12] depth= 44
pushed 10 [1, 11]
pushed 31 [2, 12]
iter= 68 len_frontier= 62 popped= 31 [2, 12] depth= 45
pushed 30 [2, 11]
pushed 51 [3, 12]
pushed 52 [3, 13]
iter= 69 len_frontier= 64 popped= 52 [3, 13] depth= 46
pushed 68 [4, 10]
iter= 70 len_frontier= 64 popped= 68 [4, 10] depth= 47
pushed 67 [4, 9]
pushed 49 [3, 10]
pushed 48 [3, 9]
pushed 50 [3, 11]
iter= 71 len_frontier= 67 popped= 50 [3, 11] depth= 48
pushed 29 [2, 10]
iter= 72 len_frontier= 67 popped= 29 [2, 10] depth= 49
pushed 28 [2, 9]
pushed 9 [1, 10]
pushed 8 [1, 9]
iter= 73 len_frontier= 69 popped= 8 [1, 9] depth= 50
pushed 7 [1, 8]
iter= 74 len_frontier= 69 popped= 7 [1, 8] depth= 51
pushed 6 [1, 7]
pushed 27 [2, 8]
iter= 75 len_frontier= 70 popped= 27 [2, 8] depth= 52
pushed 26 [2, 7]
pushed 47 [3, 8]
iter= 76 len_frontier= 71 popped= 47 [3, 8] depth= 53
pushed 46 [3, 7]
pushed 66 [4, 8]
iter= 77 len_frontier= 72 popped= 66 [4, 8] depth= 54
pushed 65 [4, 7]
pushed 78 [5, 8]
iter= 78 len_frontier= 73 popped= 78 [5, 8] depth= 55
pushed 90 [6, 8]
iter= 79 len_frontier= 73 popped= 90 [6, 8] depth= 56
pushed 104 [7, 8]
iter= 80 len_frontier= 73 popped= 104 [7, 8] depth= 57
```

pushed 103 [7, 7]  
pushed 105 [7, 9]  
pushed 118 [8, 8]  
pushed 119 [8, 9]  
iter= 81 len\_frontier= 76 popped= 119 [8, 9] depth= 58  
pushed 120 [8, 10]  
pushed 136 [9, 9]  
pushed 137 [9, 10]  
iter= 82 len\_frontier= 78 popped= 137 [9, 10] depth= 59  
pushed 138 [9, 11]  
iter= 83 len\_frontier= 78 popped= 138 [9, 11] depth= 60  
pushed 139 [9, 12]  
pushed 121 [8, 11]  
iter= 84 len\_frontier= 79 popped= 121 [8, 11] depth= 61  
pushed 122 [8, 12]  
pushed 106 [7, 10]  
iter= 85 len\_frontier= 80 popped= 106 [7, 10] depth= 62  
iter= 86 len\_frontier= 79 popped= 122 [8, 12] depth= 62  
pushed 123 [8, 13]  
pushed 140 [9, 13]  
iter= 87 len\_frontier= 80 popped= 140 [9, 13] depth= 63  
pushed 141 [9, 14]  
iter= 88 len\_frontier= 80 popped= 141 [9, 14] depth= 64  
pushed 142 [9, 15]  
iter= 89 len\_frontier= 80 popped= 142 [9, 15] depth= 65  
pushed 124 [8, 15]  
iter= 90 len\_frontier= 80 popped= 124 [8, 15] depth= 66  
pushed 125 [8, 16]  
pushed 107 [7, 15]  
iter= 91 len\_frontier= 81 popped= 107 [7, 15] depth= 67  
pushed 92 [6, 14]  
iter= 92 len\_frontier= 81 popped= 92 [6, 14] depth= 68  
pushed 91 [6, 13]  
pushed 79 [5, 13]  
iter= 93 len\_frontier= 82 popped= 79 [5, 13] depth= 69  
iter= 94 len\_frontier= 81 popped= 91 [6, 13] depth= 69  
iter= 95 len\_frontier= 80 popped= 125 [8, 16] depth= 67  
iter= 96 len\_frontier= 79 popped= 123 [8, 13] depth= 63  
iter= 97 len\_frontier= 78 popped= 139 [9, 12] depth= 61  
iter= 98 len\_frontier= 77 popped= 136 [9, 9] depth= 59  
pushed 135 [9, 8]  
iter= 99 len\_frontier= 77 popped= 135 [9, 8] depth= 60  
pushed 134 [9, 7]  
pushed 117 [8, 7]  
iter= 100 len\_frontier= 78 popped= 117 [8, 7] depth= 61  
pushed 116 [8, 6]  
pushed 102 [7, 6]  
iter= 101 len\_frontier= 79 popped= 102 [7, 6] depth= 62  
iter= 102 len\_frontier= 78 popped= 116 [8, 6] depth= 62

pushed 133 [9, 6]  
iter= 103 len\_frontier= 78 popped= 133 [9, 6] depth= 63  
iter= 104 len\_frontier= 77 popped= 134 [9, 7] depth= 61  
iter= 105 len\_frontier= 76 popped= 120 [8, 10] depth= 59  
iter= 106 len\_frontier= 75 popped= 118 [8, 8] depth= 58  
iter= 107 len\_frontier= 74 popped= 105 [7, 9] depth= 58  
iter= 108 len\_frontier= 73 popped= 103 [7, 7] depth= 58  
iter= 109 len\_frontier= 72 popped= 65 [4, 7] depth= 55  
pushed 64 [4, 6]  
pushed 45 [3, 6]  
iter= 110 len\_frontier= 73 popped= 45 [3, 6] depth= 56  
pushed 44 [3, 5]  
pushed 25 [2, 6]  
pushed 24 [2, 5]  
iter= 111 len\_frontier= 75 popped= 24 [2, 5] depth= 57  
pushed 23 [2, 4]  
pushed 4 [1, 5]  
pushed 3 [1, 4]  
iter= 112 len\_frontier= 77 popped= 3 [1, 4] depth= 58  
pushed 2 [1, 3]  
iter= 113 len\_frontier= 77 popped= 2 [1, 3] depth= 59  
pushed 1 [1, 2]  
pushed 22 [2, 3]  
iter= 114 len\_frontier= 78 popped= 22 [2, 3] depth= 60  
pushed 21 [2, 2]  
pushed 42 [3, 3]  
pushed 43 [3, 4]  
iter= 115 len\_frontier= 80 popped= 43 [3, 4] depth= 61  
pushed 62 [4, 4]  
pushed 63 [4, 5]  
iter= 116 len\_frontier= 81 popped= 63 [4, 5] depth= 62  
iter= 117 len\_frontier= 80 popped= 62 [4, 4] depth= 62  
pushed 61 [4, 3]  
iter= 118 len\_frontier= 80 popped= 61 [4, 3] depth= 63  
pushed 60 [4, 2]  
pushed 77 [5, 3]  
pushed 41 [3, 2]  
iter= 119 len\_frontier= 82 popped= 41 [3, 2] depth= 64  
pushed 40 [3, 1]  
pushed 20 [2, 1]  
iter= 120 len\_frontier= 83 popped= 20 [2, 1] depth= 65  
pushed 0 [1, 1]  
iter= 121 len\_frontier= 83 popped= 0 [1, 1] depth= 66  
iter= 122 len\_frontier= 82 popped= 40 [3, 1] depth= 65  
pushed 59 [4, 1]  
iter= 123 len\_frontier= 82 popped= 59 [4, 1] depth= 66  
pushed 75 [5, 1]  
pushed 76 [5, 2]  
iter= 124 len\_frontier= 83 popped= 76 [5, 2] depth= 67

pushed 88 [6, 2]  
pushed 89 [6, 3]  
iter= 125 len\_frontier= 84 popped= 89 [6, 3] depth= 68  
pushed 101 [7, 3]  
iter= 126 len\_frontier= 84 popped= 101 [7, 3] depth= 69  
pushed 100 [7, 2]  
pushed 115 [8, 3]  
iter= 127 len\_frontier= 85 popped= 115 [8, 3] depth= 70  
pushed 114 [8, 2]  
pushed 132 [9, 3]  
iter= 128 len\_frontier= 86 popped= 132 [9, 3] depth= 71  
pushed 131 [9, 2]  
pushed 147 [10, 3]  
iter= 129 len\_frontier= 87 popped= 147 [10, 3] depth= 72  
iter= 130 len\_frontier= 86 popped= 131 [9, 2] depth= 72  
pushed 113 [8, 1]  
iter= 131 len\_frontier= 86 popped= 113 [8, 1] depth= 73  
pushed 99 [7, 1]  
iter= 132 len\_frontier= 86 popped= 99 [7, 1] depth= 74  
pushed 87 [6, 1]  
iter= 133 len\_frontier= 86 popped= 87 [6, 1] depth= 75  
iter= 134 len\_frontier= 85 popped= 114 [8, 2] depth= 71  
iter= 135 len\_frontier= 84 popped= 100 [7, 2] depth= 70  
iter= 136 len\_frontier= 83 popped= 88 [6, 2] depth= 68  
iter= 137 len\_frontier= 82 popped= 75 [5, 1] depth= 67  
iter= 138 len\_frontier= 81 popped= 77 [5, 3] depth= 64  
iter= 139 len\_frontier= 80 popped= 60 [4, 2] depth= 64  
iter= 140 len\_frontier= 79 popped= 42 [3, 3] depth= 61  
iter= 141 len\_frontier= 78 popped= 21 [2, 2] depth= 61  
iter= 142 len\_frontier= 77 popped= 1 [1, 2] depth= 60  
iter= 143 len\_frontier= 76 popped= 4 [1, 5] depth= 58  
pushed 5 [1, 6]  
iter= 144 len\_frontier= 76 popped= 5 [1, 6] depth= 59  
iter= 145 len\_frontier= 75 popped= 23 [2, 4] depth= 58  
iter= 146 len\_frontier= 74 popped= 25 [2, 6] depth= 57  
iter= 147 len\_frontier= 73 popped= 44 [3, 5] depth= 57  
iter= 148 len\_frontier= 72 popped= 64 [4, 6] depth= 56  
iter= 149 len\_frontier= 71 popped= 46 [3, 7] depth= 54  
iter= 150 len\_frontier= 70 popped= 26 [2, 7] depth= 53  
iter= 151 len\_frontier= 69 popped= 6 [1, 7] depth= 52  
iter= 152 len\_frontier= 68 popped= 9 [1, 10] depth= 50  
iter= 153 len\_frontier= 67 popped= 28 [2, 9] depth= 50  
iter= 154 len\_frontier= 66 popped= 48 [3, 9] depth= 48  
iter= 155 len\_frontier= 65 popped= 49 [3, 10] depth= 48  
iter= 156 len\_frontier= 64 popped= 67 [4, 9] depth= 48  
iter= 157 len\_frontier= 63 popped= 51 [3, 12] depth= 46  
iter= 158 len\_frontier= 62 popped= 30 [2, 11] depth= 46  
iter= 159 len\_frontier= 61 popped= 10 [1, 11] depth= 45  
iter= 160 len\_frontier= 60 popped= 13 [1, 14] depth= 43

```
pushed 14 [1, 15]
iter= 161 len_frontier= 60 popped= 14 [1, 15] depth= 44
pushed 15 [1, 16]
pushed 35 [2, 16]
iter= 162 len_frontier= 61 popped= 35 [2, 16] depth= 45
pushed 36 [2, 17]
pushed 55 [3, 17]
iter= 163 len_frontier= 62 popped= 55 [3, 17] depth= 46
pushed 56 [3, 18]
pushed 71 [4, 17]
pushed 72 [4, 18]
iter= 164 len_frontier= 64 popped= 72 [4, 18] depth= 47
pushed 73 [4, 19]
pushed 84 [5, 18]
pushed 85 [5, 19]
iter= 165 len_frontier= 66 popped= 85 [5, 19] depth= 48
pushed 86 [5, 20]
pushed 97 [6, 19]
pushed 98 [6, 20]
iter= 166 len_frontier= 68 popped= 98 [6, 20] depth= 49
pushed 112 [7, 20]
iter= 167 len_frontier= 68 popped= 112 [7, 20] depth= 50
pushed 111 [7, 19]
pushed 129 [8, 20]
iter= 168 len_frontier= 69 popped= 129 [8, 20] depth= 51
pushed 144 [9, 20]
iter= 169 len_frontier= 69 popped= 144 [9, 20] depth= 52
pushed 149 [10, 20]
iter= 170 len_frontier= 69 popped= 149 [10, 20] depth= 53
solution_path:
vertex 149 (10, 20)
vertex 144 (9, 20)
vertex 129 (8, 20)
vertex 112 (7, 20)
vertex 98 (6, 20)
vertex 85 (5, 19)
vertex 72 (4, 18)
vertex 55 (3, 17)
vertex 35 (2, 16)
vertex 14 (1, 15)
vertex 13 (1, 14)
vertex 33 (2, 14)
vertex 53 (3, 15)
vertex 69 (4, 15)
vertex 81 (5, 15)
vertex 94 (6, 16)
vertex 109 (7, 17)
vertex 127 (8, 18)
vertex 153 (11, 19)
```

vertex 158 (12, 19)  
vertex 171 (13, 19)  
vertex 181 (14, 17)  
vertex 194 (15, 17)  
vertex 208 (16, 18)  
vertex 221 (17, 19)  
vertex 236 (18, 20)  
vertex 254 (19, 20)  
vertex 253 (19, 19)  
vertex 234 (18, 18)  
vertex 219 (17, 17)  
vertex 206 (16, 16)  
vertex 192 (15, 15)  
vertex 191 (15, 14)  
vertex 204 (16, 14)  
vertex 231 (18, 15)  
vertex 268 (20, 14)  
vertex 248 (19, 13)  
vertex 247 (19, 12)  
vertex 266 (20, 12)  
vertex 265 (20, 11)  
vertex 245 (19, 10)  
vertex 263 (20, 9)  
vertex 244 (19, 8)  
vertex 229 (18, 7)  
vertex 214 (17, 8)  
vertex 227 (18, 5)  
vertex 213 (17, 3)  
vertex 200 (16, 3)  
vertex 187 (15, 3)  
vertex 175 (14, 3)  
vertex 162 (13, 3)  
vertex 157 (12, 3)  
vertex 151 (11, 2)  
vertex 145 (10, 1)

Some statistics:

=====

Search algorithm: DFS

Iteration Count: 170

max frontier size: 88

vertices visited: 239/275

Path length: 53

-----Completed Execution-----

[13, 6] to [7, 6]

iter= 0 len\_frontier= 0 popped= 163 [13, 6] depth= 0

pushed 164 [13, 7]

pushed 176 [14, 6]

```
pushed 177 [14, 7]
iter= 1 len_frontier= 2 popped= 177 [14, 7] depth= 1
pushed 178 [14, 8]
pushed 163 [13, 6]
pushed 188 [15, 8]
pushed 201 [16, 8]
iter= 2 len_frontier= 5 popped= 201 [16, 8] depth= 2
pushed 202 [16, 9]
pushed 214 [17, 8]
iter= 3 len_frontier= 6 popped= 214 [17, 8] depth= 3
pushed 230 [18, 8]
pushed 229 [18, 7]
pushed 203 [16, 10]
pushed 228 [18, 6]
pushed 227 [18, 5]
iter= 4 len_frontier= 10 popped= 227 [18, 5] depth= 4
pushed 226 [18, 4]
pushed 241 [19, 5]
pushed 242 [19, 6]
pushed 213 [17, 3]
iter= 5 len_frontier= 13 popped= 213 [17, 3] depth= 5
pushed 212 [17, 2]
pushed 200 [16, 3]
pushed 225 [18, 3]
pushed 199 [16, 2]
iter= 6 len_frontier= 16 popped= 199 [16, 2] depth= 6
pushed 198 [16, 1]
pushed 186 [15, 2]
pushed 185 [15, 1]
iter= 7 len_frontier= 18 popped= 185 [15, 1] depth= 7
pushed 173 [14, 1]
iter= 8 len_frontier= 18 popped= 173 [14, 1] depth= 8
pushed 174 [14, 2]
pushed 160 [13, 1]
iter= 9 len_frontier= 19 popped= 160 [13, 1] depth= 9
pushed 161 [13, 2]
pushed 155 [12, 1]
iter= 10 len_frontier= 20 popped= 155 [12, 1] depth= 10
pushed 156 [12, 2]
pushed 150 [11, 1]
iter= 11 len_frontier= 21 popped= 150 [11, 1] depth= 11
pushed 151 [11, 2]
pushed 145 [10, 1]
iter= 12 len_frontier= 22 popped= 145 [10, 1] depth= 12
pushed 146 [10, 2]
pushed 130 [9, 1]
iter= 13 len_frontier= 23 popped= 130 [9, 1] depth= 13
pushed 131 [9, 2]
pushed 113 [8, 1]
```

```
iter= 14 len_frontier= 24 popped= 113 [8, 1] depth= 14
pushed 114 [8, 2]
pushed 99 [7, 1]
iter= 15 len_frontier= 25 popped= 99 [7, 1] depth= 15
pushed 100 [7, 2]
pushed 87 [6, 1]
iter= 16 len_frontier= 26 popped= 87 [6, 1] depth= 16
pushed 88 [6, 2]
pushed 75 [5, 1]
iter= 17 len_frontier= 27 popped= 75 [5, 1] depth= 17
pushed 76 [5, 2]
pushed 59 [4, 1]
iter= 18 len_frontier= 28 popped= 59 [4, 1] depth= 18
pushed 60 [4, 2]
pushed 40 [3, 1]
iter= 19 len_frontier= 29 popped= 40 [3, 1] depth= 19
pushed 41 [3, 2]
pushed 20 [2, 1]
iter= 20 len_frontier= 30 popped= 20 [2, 1] depth= 20
pushed 21 [2, 2]
pushed 0 [1, 1]
iter= 21 len_frontier= 31 popped= 0 [1, 1] depth= 21
pushed 1 [1, 2]
iter= 22 len_frontier= 31 popped= 1 [1, 2] depth= 22
pushed 2 [1, 3]
pushed 22 [2, 3]
iter= 23 len_frontier= 32 popped= 22 [2, 3] depth= 23
pushed 23 [2, 4]
pushed 42 [3, 3]
pushed 43 [3, 4]
iter= 24 len_frontier= 34 popped= 43 [3, 4] depth= 24
pushed 44 [3, 5]
pushed 62 [4, 4]
pushed 63 [4, 5]
iter= 25 len_frontier= 36 popped= 63 [4, 5] depth= 25
pushed 64 [4, 6]
iter= 26 len_frontier= 36 popped= 64 [4, 6] depth= 26
pushed 65 [4, 7]
pushed 45 [3, 6]
iter= 27 len_frontier= 37 popped= 45 [3, 6] depth= 27
pushed 46 [3, 7]
pushed 25 [2, 6]
pushed 24 [2, 5]
iter= 28 len_frontier= 39 popped= 24 [2, 5] depth= 28
pushed 4 [1, 5]
pushed 3 [1, 4]
iter= 29 len_frontier= 40 popped= 3 [1, 4] depth= 29
iter= 30 len_frontier= 39 popped= 4 [1, 5] depth= 29
pushed 5 [1, 6]
```



iter= 31 len\_frontier= 39 popped= 5 [1, 6] depth= 30  
pushed 6 [1, 7]  
pushed 26 [2, 7]  
iter= 32 len\_frontier= 40 popped= 26 [2, 7] depth= 31  
pushed 27 [2, 8]  
pushed 47 [3, 8]  
iter= 33 len\_frontier= 41 popped= 47 [3, 8] depth= 32  
pushed 48 [3, 9]  
pushed 66 [4, 8]  
pushed 67 [4, 9]  
iter= 34 len\_frontier= 43 popped= 67 [4, 9] depth= 33  
pushed 68 [4, 10]  
iter= 35 len\_frontier= 43 popped= 68 [4, 10] depth= 34  
pushed 49 [3, 10]  
pushed 50 [3, 11]  
pushed 51 [3, 12]  
pushed 52 [3, 13]  
iter= 36 len\_frontier= 46 popped= 52 [3, 13] depth= 35  
pushed 32 [2, 13]  
pushed 31 [2, 12]  
iter= 37 len\_frontier= 47 popped= 31 [2, 12] depth= 36  
pushed 30 [2, 11]  
pushed 11 [1, 12]  
pushed 10 [1, 11]  
iter= 38 len\_frontier= 49 popped= 10 [1, 11] depth= 37  
pushed 9 [1, 10]  
iter= 39 len\_frontier= 49 popped= 9 [1, 10] depth= 38  
pushed 8 [1, 9]  
pushed 29 [2, 10]  
iter= 40 len\_frontier= 50 popped= 29 [2, 10] depth= 39  
pushed 28 [2, 9]  
iter= 41 len\_frontier= 50 popped= 28 [2, 9] depth= 40  
pushed 7 [1, 8]  
iter= 42 len\_frontier= 50 popped= 7 [1, 8] depth= 41  
iter= 43 len\_frontier= 49 popped= 8 [1, 9] depth= 39  
iter= 44 len\_frontier= 48 popped= 11 [1, 12] depth= 37  
pushed 12 [1, 13]  
iter= 45 len\_frontier= 48 popped= 12 [1, 13] depth= 38  
pushed 13 [1, 14]  
pushed 33 [2, 14]  
iter= 46 len\_frontier= 49 popped= 33 [2, 14] depth= 39  
pushed 34 [2, 15]  
pushed 53 [3, 15]  
iter= 47 len\_frontier= 50 popped= 53 [3, 15] depth= 40  
pushed 54 [3, 16]  
pushed 69 [4, 15]  
pushed 70 [4, 16]  
iter= 48 len\_frontier= 52 popped= 70 [4, 16] depth= 41  
pushed 71 [4, 17]

pushed 82 [5, 16]  
pushed 83 [5, 17]  
iter= 49 len\_frontier= 54 popped= 83 [5, 17] depth= 42  
pushed 84 [5, 18]  
pushed 95 [6, 17]  
pushed 96 [6, 18]  
iter= 50 len\_frontier= 56 popped= 96 [6, 18] depth= 43  
pushed 97 [6, 19]  
pushed 110 [7, 18]  
pushed 111 [7, 19]  
iter= 51 len\_frontier= 58 popped= 111 [7, 19] depth= 44  
pushed 112 [7, 20]  
pushed 128 [8, 19]  
pushed 129 [8, 20]  
iter= 52 len\_frontier= 60 popped= 129 [8, 20] depth= 45  
pushed 144 [9, 20]  
iter= 53 len\_frontier= 60 popped= 144 [9, 20] depth= 46  
pushed 143 [9, 19]  
pushed 149 [10, 20]  
iter= 54 len\_frontier= 61 popped= 149 [10, 20] depth= 47  
pushed 148 [10, 19]  
pushed 154 [11, 20]  
iter= 55 len\_frontier= 62 popped= 154 [11, 20] depth= 48  
pushed 153 [11, 19]  
pushed 159 [12, 20]  
iter= 56 len\_frontier= 63 popped= 159 [12, 20] depth= 49  
pushed 158 [12, 19]  
pushed 172 [13, 20]  
iter= 57 len\_frontier= 64 popped= 172 [13, 20] depth= 50  
pushed 171 [13, 19]  
pushed 184 [14, 20]  
iter= 58 len\_frontier= 65 popped= 184 [14, 20] depth= 51  
pushed 183 [14, 19]  
pushed 197 [15, 20]  
iter= 59 len\_frontier= 66 popped= 197 [15, 20] depth= 52  
pushed 196 [15, 19]  
pushed 210 [16, 20]  
iter= 60 len\_frontier= 67 popped= 210 [16, 20] depth= 53  
pushed 209 [16, 19]  
pushed 222 [17, 20]  
iter= 61 len\_frontier= 68 popped= 222 [17, 20] depth= 54  
pushed 221 [17, 19]  
pushed 236 [18, 20]  
iter= 62 len\_frontier= 69 popped= 236 [18, 20] depth= 55  
pushed 235 [18, 19]  
pushed 254 [19, 20]  
iter= 63 len\_frontier= 70 popped= 254 [19, 20] depth= 56  
pushed 253 [19, 19]  
pushed 274 [20, 20]

iter= 64 len\_frontier= 71 popped= 274 [20, 20] depth= 57  
pushed 273 [20, 19]  
iter= 65 len\_frontier= 71 popped= 273 [20, 19] depth= 58  
pushed 272 [20, 18]  
pushed 252 [19, 18]  
iter= 66 len\_frontier= 72 popped= 252 [19, 18] depth= 59  
pushed 251 [19, 17]  
pushed 234 [18, 18]  
pushed 233 [18, 17]  
iter= 67 len\_frontier= 74 popped= 233 [18, 17] depth= 60  
pushed 232 [18, 16]  
pushed 219 [17, 17]  
pushed 218 [17, 16]  
iter= 68 len\_frontier= 76 popped= 218 [17, 16] depth= 61  
pushed 217 [17, 15]  
pushed 206 [16, 16]  
pushed 205 [16, 15]  
iter= 69 len\_frontier= 78 popped= 205 [16, 15] depth= 62  
pushed 204 [16, 14]  
pushed 192 [15, 15]  
pushed 191 [15, 14]  
iter= 70 len\_frontier= 80 popped= 191 [15, 14] depth= 63  
pushed 190 [15, 13]  
iter= 71 len\_frontier= 80 popped= 190 [15, 13] depth= 64  
pushed 189 [15, 12]  
iter= 72 len\_frontier= 80 popped= 189 [15, 12] depth= 65  
iter= 73 len\_frontier= 79 popped= 192 [15, 15] depth= 63  
pushed 193 [15, 16]  
pushed 179 [14, 15]  
iter= 74 len\_frontier= 80 popped= 179 [14, 15] depth= 64  
pushed 180 [14, 16]  
pushed 170 [13, 15]  
iter= 75 len\_frontier= 81 popped= 170 [13, 15] depth= 65  
iter= 76 len\_frontier= 80 popped= 180 [14, 16] depth= 65  
pushed 181 [14, 17]  
pushed 194 [15, 17]  
iter= 77 len\_frontier= 81 popped= 194 [15, 17] depth= 66  
pushed 195 [15, 18]  
pushed 207 [16, 17]  
pushed 208 [16, 18]  
iter= 78 len\_frontier= 83 popped= 208 [16, 18] depth= 67  
pushed 220 [17, 18]  
iter= 79 len\_frontier= 83 popped= 220 [17, 18] depth= 68  
iter= 80 len\_frontier= 82 popped= 207 [16, 17] depth= 67  
iter= 81 len\_frontier= 81 popped= 195 [15, 18] depth= 67  
pushed 182 [14, 18]  
iter= 82 len\_frontier= 81 popped= 182 [14, 18] depth= 68  
iter= 83 len\_frontier= 80 popped= 181 [14, 17] depth= 66  
iter= 84 len\_frontier= 79 popped= 193 [15, 16] depth= 64

iter= 85 len\_frontier= 78 popped= 204 [16, 14] depth= 63  
pushed 216 [17, 13]  
pushed 215 [17, 12]  
pushed 231 [18, 15]  
iter= 86 len\_frontier= 80 popped= 231 [18, 15] depth= 64  
pushed 249 [19, 15]  
pushed 250 [19, 16]  
pushed 268 [20, 14]  
iter= 87 len\_frontier= 82 popped= 268 [20, 14] depth= 65  
pushed 269 [20, 15]  
pushed 267 [20, 13]  
pushed 248 [19, 13]  
iter= 88 len\_frontier= 84 popped= 248 [19, 13] depth= 66  
pushed 247 [19, 12]  
iter= 89 len\_frontier= 84 popped= 247 [19, 12] depth= 67  
pushed 246 [19, 11]  
pushed 266 [20, 12]  
iter= 90 len\_frontier= 85 popped= 266 [20, 12] depth= 68  
pushed 265 [20, 11]  
iter= 91 len\_frontier= 85 popped= 265 [20, 11] depth= 69  
pushed 264 [20, 10]  
pushed 245 [19, 10]  
iter= 92 len\_frontier= 86 popped= 245 [19, 10] depth= 70  
pushed 263 [20, 9]  
iter= 93 len\_frontier= 86 popped= 263 [20, 9] depth= 71  
pushed 262 [20, 8]  
pushed 244 [19, 8]  
iter= 94 len\_frontier= 87 popped= 244 [19, 8] depth= 72  
pushed 243 [19, 7]  
iter= 95 len\_frontier= 87 popped= 243 [19, 7] depth= 73  
pushed 261 [20, 7]  
iter= 96 len\_frontier= 87 popped= 261 [20, 7] depth= 74  
pushed 260 [20, 6]  
iter= 97 len\_frontier= 87 popped= 260 [20, 6] depth= 75  
pushed 259 [20, 5]  
iter= 98 len\_frontier= 87 popped= 259 [20, 5] depth= 76  
pushed 258 [20, 4]  
pushed 240 [19, 4]  
iter= 99 len\_frontier= 88 popped= 240 [19, 4] depth= 77  
pushed 239 [19, 3]  
iter= 100 len\_frontier= 88 popped= 239 [19, 3] depth= 78  
pushed 238 [19, 2]  
pushed 257 [20, 3]  
pushed 224 [18, 2]  
iter= 101 len\_frontier= 90 popped= 224 [18, 2] depth= 79  
pushed 223 [18, 1]  
pushed 211 [17, 1]  
iter= 102 len\_frontier= 91 popped= 211 [17, 1] depth= 80  
iter= 103 len\_frontier= 90 popped= 223 [18, 1] depth= 80

pushed 237 [19, 1]  
iter= 104 len\_frontier= 90 popped= 237 [19, 1] depth= 81  
pushed 255 [20, 1]  
pushed 256 [20, 2]  
iter= 105 len\_frontier= 91 popped= 256 [20, 2] depth= 82  
iter= 106 len\_frontier= 90 popped= 255 [20, 1] depth= 82  
iter= 107 len\_frontier= 89 popped= 257 [20, 3] depth= 79  
iter= 108 len\_frontier= 88 popped= 238 [19, 2] depth= 79  
iter= 109 len\_frontier= 87 popped= 258 [20, 4] depth= 77  
iter= 110 len\_frontier= 86 popped= 262 [20, 8] depth= 72  
iter= 111 len\_frontier= 85 popped= 264 [20, 10] depth= 70  
iter= 112 len\_frontier= 84 popped= 246 [19, 11] depth= 68  
iter= 113 len\_frontier= 83 popped= 267 [20, 13] depth= 66  
iter= 114 len\_frontier= 82 popped= 269 [20, 15] depth= 66  
pushed 270 [20, 16]  
iter= 115 len\_frontier= 82 popped= 270 [20, 16] depth= 67  
pushed 271 [20, 17]  
iter= 116 len\_frontier= 82 popped= 271 [20, 17] depth= 68  
iter= 117 len\_frontier= 81 popped= 250 [19, 16] depth= 65  
iter= 118 len\_frontier= 80 popped= 249 [19, 15] depth= 65  
iter= 119 len\_frontier= 79 popped= 215 [17, 12] depth= 64  
iter= 120 len\_frontier= 78 popped= 216 [17, 13] depth= 64  
iter= 121 len\_frontier= 77 popped= 206 [16, 16] depth= 62  
iter= 122 len\_frontier= 76 popped= 217 [17, 15] depth= 62  
iter= 123 len\_frontier= 75 popped= 219 [17, 17] depth= 61  
iter= 124 len\_frontier= 74 popped= 232 [18, 16] depth= 61  
iter= 125 len\_frontier= 73 popped= 234 [18, 18] depth= 60  
iter= 126 len\_frontier= 72 popped= 251 [19, 17] depth= 60  
iter= 127 len\_frontier= 71 popped= 272 [20, 18] depth= 59  
iter= 128 len\_frontier= 70 popped= 253 [19, 19] depth= 57  
iter= 129 len\_frontier= 69 popped= 235 [18, 19] depth= 56  
iter= 130 len\_frontier= 68 popped= 221 [17, 19] depth= 55  
iter= 131 len\_frontier= 67 popped= 209 [16, 19] depth= 54  
iter= 132 len\_frontier= 66 popped= 196 [15, 19] depth= 53  
iter= 133 len\_frontier= 65 popped= 183 [14, 19] depth= 52  
iter= 134 len\_frontier= 64 popped= 171 [13, 19] depth= 51  
iter= 135 len\_frontier= 63 popped= 158 [12, 19] depth= 50  
iter= 136 len\_frontier= 62 popped= 153 [11, 19] depth= 49  
pushed 127 [8, 18]  
iter= 137 len\_frontier= 62 popped= 127 [8, 18] depth= 50  
pushed 126 [8, 17]  
pushed 109 [7, 17]  
iter= 138 len\_frontier= 63 popped= 109 [7, 17] depth= 51  
pushed 108 [7, 16]  
pushed 94 [6, 16]  
iter= 139 len\_frontier= 64 popped= 94 [6, 16] depth= 52  
pushed 93 [6, 15]  
pushed 81 [5, 15]  
iter= 140 len\_frontier= 65 popped= 81 [5, 15] depth= 53

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pushed 80 [5, 14]
iter= 141 len_frontier= 65 popped= 80 [5, 14] depth= 54
pushed 79 [5, 13]
pushed 92 [6, 14]
iter= 142 len_frontier= 66 popped= 92 [6, 14] depth= 55
pushed 91 [6, 13]
pushed 107 [7, 15]
iter= 143 len_frontier= 67 popped= 107 [7, 15] depth= 56
pushed 124 [8, 15]
pushed 125 [8, 16]
iter= 144 len_frontier= 68 popped= 125 [8, 16] depth= 57
iter= 145 len_frontier= 67 popped= 124 [8, 15] depth= 57
pushed 142 [9, 15]
iter= 146 len_frontier= 67 popped= 142 [9, 15] depth= 58
pushed 141 [9, 14]
iter= 147 len_frontier= 67 popped= 141 [9, 14] depth= 59
pushed 140 [9, 13]
iter= 148 len_frontier= 67 popped= 140 [9, 13] depth= 60
pushed 139 [9, 12]
pushed 123 [8, 13]
pushed 122 [8, 12]
iter= 149 len_frontier= 69 popped= 122 [8, 12] depth= 61
pushed 121 [8, 11]
pushed 106 [7, 10]
iter= 150 len_frontier= 70 popped= 106 [7, 10] depth= 62
pushed 105 [7, 9]
pushed 120 [8, 10]
iter= 151 len_frontier= 71 popped= 120 [8, 10] depth= 63
pushed 119 [8, 9]
pushed 137 [9, 10]
pushed 138 [9, 11]
iter= 152 len_frontier= 73 popped= 138 [9, 11] depth= 64
iter= 153 len_frontier= 72 popped= 137 [9, 10] depth= 64
pushed 136 [9, 9]
iter= 154 len_frontier= 72 popped= 136 [9, 9] depth= 65
pushed 135 [9, 8]
pushed 118 [8, 8]
iter= 155 len_frontier= 73 popped= 118 [8, 8] depth= 66
pushed 117 [8, 7]
pushed 104 [7, 8]
pushed 103 [7, 7]
iter= 156 len_frontier= 75 popped= 103 [7, 7] depth= 67
pushed 102 [7, 6]
iter= 157 len_frontier= 75 popped= 102 [7, 6] depth= 68
solution_path:
vertex 102 (7, 6)
vertex 103 (7, 7)
vertex 118 (8, 8)
vertex 136 (9, 9)
```

vertex 137 (9, 10)  
vertex 120 (8, 10)  
vertex 106 (7, 10)  
vertex 122 (8, 12)  
vertex 140 (9, 13)  
vertex 141 (9, 14)  
vertex 142 (9, 15)  
vertex 124 (8, 15)  
vertex 107 (7, 15)  
vertex 92 (6, 14)  
vertex 80 (5, 14)  
vertex 81 (5, 15)  
vertex 94 (6, 16)  
vertex 109 (7, 17)  
vertex 127 (8, 18)  
vertex 153 (11, 19)  
vertex 154 (11, 20)  
vertex 149 (10, 20)  
vertex 144 (9, 20)  
vertex 129 (8, 20)  
vertex 111 (7, 19)  
vertex 96 (6, 18)  
vertex 83 (5, 17)  
vertex 70 (4, 16)  
vertex 53 (3, 15)  
vertex 33 (2, 14)  
vertex 12 (1, 13)  
vertex 11 (1, 12)  
vertex 31 (2, 12)  
vertex 52 (3, 13)  
vertex 68 (4, 10)  
vertex 67 (4, 9)  
vertex 47 (3, 8)  
vertex 26 (2, 7)  
vertex 5 (1, 6)  
vertex 4 (1, 5)  
vertex 24 (2, 5)  
vertex 45 (3, 6)  
vertex 64 (4, 6)  
vertex 63 (4, 5)  
vertex 43 (3, 4)  
vertex 22 (2, 3)  
vertex 1 (1, 2)  
vertex 0 (1, 1)  
vertex 20 (2, 1)  
vertex 40 (3, 1)  
vertex 59 (4, 1)  
vertex 75 (5, 1)  
vertex 87 (6, 1)

vertex 99 (7, 1)  
vertex 113 (8, 1)  
vertex 130 (9, 1)  
vertex 145 (10, 1)  
vertex 150 (11, 1)  
vertex 155 (12, 1)  
vertex 160 (13, 1)  
vertex 173 (14, 1)  
vertex 185 (15, 1)  
vertex 199 (16, 2)  
vertex 213 (17, 3)  
vertex 227 (18, 5)  
vertex 214 (17, 8)  
vertex 201 (16, 8)  
vertex 177 (14, 7)  
vertex 163 (13, 6)

Some statistics:

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Search algorithm: DFS

Iteration Count: 157

max frontier size: 92

vertices visited: 232/275

Path length: 68

-----Completed Execution-----

Traces for Greedy-Best First for all 5 paths:

[20, 1] to [1, 20]

iter= 0 len\_frontier= 1 popped= 255 [20, 1] depth= 0 dist2goal= 26.8700576851

pushed 256 [20, 2]

pushed 237 [19, 1]

iter= 1 len\_frontier= 2 popped= 256 [20, 2] depth= 1 dist2goal= 26.1725046566

pushed 255 [20, 1]

pushed 257 [20, 3]

pushed 238 [19, 2]

iter= 2 len\_frontier= 4 popped= 238 [19, 2] depth= 2 dist2goal= 25.4558441227

pushed 239 [19, 3]

pushed 224 [18, 2]

pushed 223 [18, 1]

iter= 3 len\_frontier= 6 popped= 239 [19, 3] depth= 3 dist2goal= 24.7588368063

pushed 240 [19, 4]

pushed 225 [18, 3]

pushed 258 [20, 4]

iter= 4 len\_frontier= 8 popped= 225 [18, 3] depth= 4 dist2goal= 24.0416305603

pushed 226 [18, 4]

pushed 213 [17, 3]

pushed 212 [17, 2]



iter= 5 len\_frontier= 10 popped= 226 [18, 4] depth= 5 dist2goal= 23.3452350599  
pushed 227 [18, 5]  
pushed 241 [19, 5]  
iter= 6 len\_frontier= 11 popped= 227 [18, 5] depth= 6 dist2goal= 22.6715680975  
pushed 228 [18, 6]  
pushed 242 [19, 6]  
pushed 214 [17, 8]  
iter= 7 len\_frontier= 13 popped= 214 [17, 8] depth= 7 dist2goal= 20.0  
pushed 201 [16, 8]  
pushed 230 [18, 8]  
pushed 202 [16, 9]  
pushed 229 [18, 7]  
pushed 203 [16, 10]  
iter= 8 len\_frontier= 17 popped= 203 [16, 10] depth= 8 dist2goal= 18.0277563773  
pushed 188 [15, 8]  
iter= 9 len\_frontier= 17 popped= 188 [15, 8] depth= 9 dist2goal= 18.4390889146  
pushed 178 [14, 8]  
pushed 177 [14, 7]  
iter= 10 len\_frontier= 18 popped= 178 [14, 8] depth= 10 dist2goal= 17.691806013  
pushed 165 [13, 8]  
pushed 164 [13, 7]  
iter= 11 len\_frontier= 19 popped= 165 [13, 8] depth= 11 dist2goal= 16.9705627485  
iter= 12 len\_frontier= 18 popped= 164 [13, 7] depth= 11 dist2goal= 17.691806013  
pushed 163 [13, 6]  
iter= 13 len\_frontier= 18 popped= 177 [14, 7] depth= 10 dist2goal= 18.3847763109  
pushed 176 [14, 6]  
iter= 14 len\_frontier= 18 popped= 163 [13, 6] depth= 12 dist2goal= 18.4390889146  
iter= 15 len\_frontier= 17 popped= 202 [16, 9] depth= 8 dist2goal= 18.6010752377  
iter= 16 len\_frontier= 16 popped= 176 [14, 6] depth= 11 dist2goal= 19.1049731745  
iter= 17 len\_frontier= 15 popped= 201 [16, 8] depth= 8 dist2goal= 19.2093727123  
iter= 18 len\_frontier= 14 popped= 230 [18, 8] depth= 8 dist2goal= 20.8086520467  
pushed 244 [19, 8]  
iter= 19 len\_frontier= 14 popped= 229 [18, 7] depth= 8 dist2goal= 21.400934559  
pushed 243 [19, 7]  
iter= 20 len\_frontier= 14 popped= 244 [19, 8] depth= 9 dist2goal= 21.6333076528  
pushed 262 [20, 8]  
pushed 263 [20, 9]  
iter= 21 len\_frontier= 15 popped= 263 [20, 9] depth= 10 dist2goal= 21.9544984001  
pushed 264 [20, 10]  
pushed 245 [19, 10]  
iter= 22 len\_frontier= 16 popped= 245 [19, 10] depth= 11 dist2goal= 20.591260282  
pushed 246 [19, 11]  
pushed 265 [20, 11]  
iter= 23 len\_frontier= 17 popped= 246 [19, 11] depth= 12 dist2goal= 20.1246117975  
pushed 247 [19, 12]  
pushed 266 [20, 12]  
iter= 24 len\_frontier= 18 popped= 247 [19, 12] depth= 13 dist2goal= 19.6977156036  
pushed 248 [19, 13]  
pushed 267 [20, 13]

iter= 25 len\_frontier= 19 popped= 248 [19, 13] depth= 14 dist2goal= 19.3132079158  
pushed 268 [20, 14]  
iter= 26 len\_frontier= 19 popped= 268 [20, 14] depth= 15 dist2goal= 19.9248588452  
pushed 269 [20, 15]  
pushed 249 [19, 15]  
pushed 231 [18, 15]  
iter= 27 len\_frontier= 21 popped= 231 [18, 15] depth= 16 dist2goal= 17.7200451467  
pushed 232 [18, 16]  
pushed 217 [17, 15]  
pushed 250 [19, 16]  
pushed 204 [16, 14]  
iter= 28 len\_frontier= 24 popped= 204 [16, 14] depth= 17 dist2goal= 16.1554944214  
pushed 205 [16, 15]  
pushed 191 [15, 14]  
pushed 190 [15, 13]  
pushed 216 [17, 13]  
pushed 215 [17, 12]  
iter= 29 len\_frontier= 28 popped= 191 [15, 14] depth= 18 dist2goal= 15.2315462117  
pushed 192 [15, 15]  
iter= 30 len\_frontier= 28 popped= 192 [15, 15] depth= 19 dist2goal= 14.8660687473  
pushed 193 [15, 16]  
pushed 179 [14, 15]  
pushed 206 [16, 16]  
iter= 31 len\_frontier= 30 popped= 179 [14, 15] depth= 20 dist2goal= 13.9283882772  
pushed 180 [14, 16]  
pushed 170 [13, 15]  
iter= 32 len\_frontier= 31 popped= 170 [13, 15] depth= 21 dist2goal= 13.0  
iter= 33 len\_frontier= 30 popped= 180 [14, 16] depth= 21 dist2goal= 13.6014705087  
pushed 181 [14, 17]  
pushed 194 [15, 17]  
iter= 34 len\_frontier= 31 popped= 181 [14, 17] depth= 22 dist2goal= 13.3416640641  
pushed 182 [14, 18]  
pushed 195 [15, 18]  
pushed 171 [13, 19]  
iter= 35 len\_frontier= 33 popped= 171 [13, 19] depth= 23 dist2goal= 12.0415945788  
pushed 172 [13, 20]  
pushed 183 [14, 19]  
pushed 158 [12, 19]  
pushed 184 [14, 20]  
iter= 36 len\_frontier= 36 popped= 158 [12, 19] depth= 24 dist2goal= 11.0453610172  
pushed 159 [12, 20]  
pushed 153 [11, 19]  
iter= 37 len\_frontier= 37 popped= 153 [11, 19] depth= 25 dist2goal= 10.0498756211  
pushed 154 [11, 20]  
pushed 148 [10, 19]  
pushed 127 [8, 18]  
iter= 38 len\_frontier= 39 popped= 127 [8, 18] depth= 26 dist2goal= 7.28010988928  
pushed 128 [8, 19]  
pushed 126 [8, 17]

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pushed 110 [7, 18]
pushed 143 [9, 19]
pushed 109 [7, 17]
iter= 39 len_frontier= 43 popped= 110 [7, 18] depth= 27 dist2goal= 6.32455532034
pushed 111 [7, 19]
pushed 96 [6, 18]
pushed 95 [6, 17]
iter= 40 len_frontier= 45 popped= 96 [6, 18] depth= 28 dist2goal= 5.38516480713
pushed 97 [6, 19]
pushed 84 [5, 18]
pushed 83 [5, 17]
iter= 41 len_frontier= 47 popped= 84 [5, 18] depth= 29 dist2goal= 4.472135955
pushed 85 [5, 19]
pushed 72 [4, 18]
pushed 71 [4, 17]
iter= 42 len_frontier= 49 popped= 72 [4, 18] depth= 30 dist2goal= 3.60555127546
pushed 73 [4, 19]
pushed 56 [3, 18]
pushed 55 [3, 17]
iter= 43 len_frontier= 51 popped= 56 [3, 18] depth= 31 dist2goal= 2.82842712475
pushed 57 [3, 19]
pushed 37 [2, 18]
pushed 36 [2, 17]
iter= 44 len_frontier= 53 popped= 37 [2, 18] depth= 32 dist2goal= 2.2360679775
pushed 38 [2, 19]
pushed 17 [1, 18]
pushed 16 [1, 17]
iter= 45 len_frontier= 55 popped= 38 [2, 19] depth= 33 dist2goal= 1.41421356237
pushed 39 [2, 20]
pushed 18 [1, 19]
pushed 58 [3, 20]
iter= 46 len_frontier= 57 popped= 18 [1, 19] depth= 34 dist2goal= 1.0
pushed 19 [1, 20]
iter= 47 len_frontier= 57 popped= 19 [1, 20] depth= 35 dist2goal= 0.0
solution_path:
vertex 19 (1, 20)
vertex 18 (1, 19)
vertex 38 (2, 19)
vertex 37 (2, 18)
vertex 56 (3, 18)
vertex 72 (4, 18)
vertex 84 (5, 18)
vertex 96 (6, 18)
vertex 110 (7, 18)
vertex 127 (8, 18)
vertex 153 (11, 19)
vertex 158 (12, 19)
vertex 171 (13, 19)
vertex 181 (14, 17)
```

vertex 180 (14, 16)  
vertex 179 (14, 15)  
vertex 192 (15, 15)  
vertex 191 (15, 14)  
vertex 204 (16, 14)  
vertex 231 (18, 15)  
vertex 268 (20, 14)  
vertex 248 (19, 13)  
vertex 247 (19, 12)  
vertex 246 (19, 11)  
vertex 245 (19, 10)  
vertex 263 (20, 9)  
vertex 244 (19, 8)  
vertex 230 (18, 8)  
vertex 214 (17, 8)  
vertex 227 (18, 5)  
vertex 226 (18, 4)  
vertex 225 (18, 3)  
vertex 239 (19, 3)  
vertex 238 (19, 2)  
vertex 256 (20, 2)  
vertex 255 (20, 1)

Some statistics:

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Search algorithm: GBFS

Iteration Count: 47

max frontier size: 57

vertices visited: 103/275

Path length: 35

-----Completed Execution-----

[1, 1] to [20, 20]

iter= 0 len\_frontier= 1 popped= 0 [1, 1] depth= 0 dist2goal= 26.8700576851

pushed 1 [1, 2]

pushed 20 [2, 1]

pushed 21 [2, 2]

iter= 1 len\_frontier= 3 popped= 21 [2, 2] depth= 1 dist2goal= 25.4558441227

pushed 22 [2, 3]

pushed 41 [3, 2]

pushed 0 [1, 1]

pushed 42 [3, 3]

iter= 2 len\_frontier= 6 popped= 42 [3, 3] depth= 2 dist2goal= 24.0416305603

pushed 43 [3, 4]

pushed 61 [4, 3]

pushed 62 [4, 4]

iter= 3 len\_frontier= 8 popped= 62 [4, 4] depth= 3 dist2goal= 22.627416998

pushed 63 [4, 5]

iter= 4 len\_frontier= 8 popped= 63 [4, 5] depth= 4 dist2goal= 21.9317121995

pushed 64 [4, 6]  
pushed 44 [3, 5]  
iter= 5 len\_frontier= 9 popped= 64 [4, 6] depth= 5 dist2goal= 21.2602916255  
pushed 65 [4, 7]  
pushed 45 [3, 6]  
iter= 6 len\_frontier= 10 popped= 65 [4, 7] depth= 6 dist2goal= 20.6155281281  
pushed 66 [4, 8]  
pushed 46 [3, 7]  
iter= 7 len\_frontier= 11 popped= 66 [4, 8] depth= 7 dist2goal= 20.0  
pushed 67 [4, 9]  
pushed 78 [5, 8]  
pushed 47 [3, 8]  
iter= 8 len\_frontier= 13 popped= 78 [5, 8] depth= 8 dist2goal= 19.2093727123  
pushed 90 [6, 8]  
iter= 9 len\_frontier= 13 popped= 90 [6, 8] depth= 9 dist2goal= 18.4390889146  
pushed 104 [7, 8]  
iter= 10 len\_frontier= 13 popped= 104 [7, 8] depth= 10 dist2goal= 17.691806013  
pushed 103 [7, 7]  
pushed 105 [7, 9]  
pushed 118 [8, 8]  
pushed 119 [8, 9]  
iter= 11 len\_frontier= 16 popped= 119 [8, 9] depth= 11 dist2goal= 16.2788205961  
pushed 120 [8, 10]  
pushed 136 [9, 9]  
pushed 137 [9, 10]  
iter= 12 len\_frontier= 18 popped= 137 [9, 10] depth= 12 dist2goal= 14.8660687473  
pushed 138 [9, 11]  
iter= 13 len\_frontier= 18 popped= 138 [9, 11] depth= 13 dist2goal= 14.2126704036  
pushed 139 [9, 12]  
pushed 121 [8, 11]  
iter= 14 len\_frontier= 19 popped= 139 [9, 12] depth= 14 dist2goal= 13.6014705087  
pushed 140 [9, 13]  
pushed 122 [8, 12]  
iter= 15 len\_frontier= 20 popped= 140 [9, 13] depth= 15 dist2goal= 13.0384048104  
pushed 141 [9, 14]  
pushed 123 [8, 13]  
iter= 16 len\_frontier= 21 popped= 141 [9, 14] depth= 16 dist2goal= 12.5299640861  
pushed 142 [9, 15]  
iter= 17 len\_frontier= 21 popped= 142 [9, 15] depth= 17 dist2goal= 12.0830459736  
pushed 124 [8, 15]  
iter= 18 len\_frontier= 21 popped= 124 [8, 15] depth= 18 dist2goal= 13.0  
pushed 125 [8, 16]  
pushed 107 [7, 15]  
iter= 19 len\_frontier= 22 popped= 125 [8, 16] depth= 19 dist2goal= 12.6491106407  
pushed 126 [8, 17]  
pushed 108 [7, 16]  
iter= 20 len\_frontier= 23 popped= 126 [8, 17] depth= 20 dist2goal= 12.3693168769  
pushed 127 [8, 18]  
pushed 109 [7, 17]

```
iter= 21 len_frontier= 24 popped= 127 [8, 18] depth= 21 dist2goal= 12.1655250606
pushed 128 [8, 19]
pushed 110 [7, 18]
pushed 143 [9, 19]
pushed 148 [10, 19]
pushed 153 [11, 19]
iter= 22 len_frontier= 28 popped= 153 [11, 19] depth= 22 dist2goal= 9.05538513814
pushed 154 [11, 20]
pushed 158 [12, 19]
pushed 159 [12, 20]
iter= 23 len_frontier= 30 popped= 159 [12, 20] depth= 23 dist2goal= 8.0
pushed 172 [13, 20]
iter= 24 len_frontier= 30 popped= 172 [13, 20] depth= 24 dist2goal= 7.0
pushed 171 [13, 19]
pushed 184 [14, 20]
iter= 25 len_frontier= 31 popped= 184 [14, 20] depth= 25 dist2goal= 6.0
pushed 183 [14, 19]
pushed 197 [15, 20]
iter= 26 len_frontier= 32 popped= 197 [15, 20] depth= 26 dist2goal= 5.0
pushed 196 [15, 19]
pushed 210 [16, 20]
iter= 27 len_frontier= 33 popped= 210 [16, 20] depth= 27 dist2goal= 4.0
pushed 209 [16, 19]
pushed 222 [17, 20]
iter= 28 len_frontier= 34 popped= 222 [17, 20] depth= 28 dist2goal= 3.0
pushed 221 [17, 19]
pushed 236 [18, 20]
iter= 29 len_frontier= 35 popped= 236 [18, 20] depth= 29 dist2goal= 2.0
pushed 235 [18, 19]
pushed 254 [19, 20]
iter= 30 len_frontier= 36 popped= 254 [19, 20] depth= 30 dist2goal= 1.0
pushed 253 [19, 19]
pushed 274 [20, 20]
iter= 31 len_frontier= 37 popped= 274 [20, 20] depth= 31 dist2goal= 0.0
solution_path:
vertex 274 (20, 20)
vertex 254 (19, 20)
vertex 236 (18, 20)
vertex 222 (17, 20)
vertex 210 (16, 20)
vertex 197 (15, 20)
vertex 184 (14, 20)
vertex 172 (13, 20)
vertex 159 (12, 20)
vertex 153 (11, 19)
vertex 127 (8, 18)
vertex 126 (8, 17)
vertex 125 (8, 16)
vertex 124 (8, 15)
```

vertex 142 (9, 15)  
vertex 141 (9, 14)  
vertex 140 (9, 13)  
vertex 139 (9, 12)  
vertex 138 (9, 11)  
vertex 137 (9, 10)  
vertex 119 (8, 9)  
vertex 104 (7, 8)  
vertex 90 (6, 8)  
vertex 78 (5, 8)  
vertex 66 (4, 8)  
vertex 65 (4, 7)  
vertex 64 (4, 6)  
vertex 63 (4, 5)  
vertex 62 (4, 4)  
vertex 42 (3, 3)  
vertex 21 (2, 2)  
vertex 0 (1, 1)

Some statistics:

=====

Search algorithm: GBFS

Iteration Count: 31

max frontier size: 37

vertices visited: 67/275

Path length: 31

-----Completed Execution-----

[1, 10] to [20, 10]

iter= 0 len\_frontier= 1 popped= 9 [1, 10] depth= 0 dist2goal= 19.0

pushed 8 [1, 9]

pushed 10 [1, 11]

pushed 29 [2, 10]

pushed 30 [2, 11]

iter= 1 len\_frontier= 4 popped= 29 [2, 10] depth= 1 dist2goal= 18.0

pushed 28 [2, 9]

pushed 9 [1, 10]

pushed 49 [3, 10]

pushed 50 [3, 11]

iter= 2 len\_frontier= 7 popped= 49 [3, 10] depth= 2 dist2goal= 17.0

pushed 48 [3, 9]

pushed 68 [4, 10]

iter= 3 len\_frontier= 8 popped= 68 [4, 10] depth= 3 dist2goal= 16.0

pushed 67 [4, 9]

pushed 51 [3, 12]

pushed 52 [3, 13]

iter= 4 len\_frontier= 10 popped= 67 [4, 9] depth= 4 dist2goal= 16.0312195419

pushed 66 [4, 8]

pushed 47 [3, 8]

iter= 5 len\_frontier= 11 popped= 66 [4, 8] depth= 5 dist2goal= 16.1245154966  
pushed 65 [4, 7]  
pushed 78 [5, 8]  
pushed 46 [3, 7]  
iter= 6 len\_frontier= 13 popped= 78 [5, 8] depth= 6 dist2goal= 15.1327459504  
pushed 90 [6, 8]  
iter= 7 len\_frontier= 13 popped= 90 [6, 8] depth= 7 dist2goal= 14.1421356237  
pushed 104 [7, 8]  
iter= 8 len\_frontier= 13 popped= 104 [7, 8] depth= 8 dist2goal= 13.152946438  
pushed 103 [7, 7]  
pushed 105 [7, 9]  
pushed 118 [8, 8]  
pushed 119 [8, 9]  
iter= 9 len\_frontier= 16 popped= 119 [8, 9] depth= 9 dist2goal= 12.0415945788  
pushed 120 [8, 10]  
pushed 136 [9, 9]  
pushed 137 [9, 10]  
iter= 10 len\_frontier= 18 popped= 137 [9, 10] depth= 10 dist2goal= 11.0  
pushed 138 [9, 11]  
iter= 11 len\_frontier= 18 popped= 136 [9, 9] depth= 10 dist2goal= 11.0453610172  
pushed 135 [9, 8]  
iter= 12 len\_frontier= 18 popped= 138 [9, 11] depth= 11 dist2goal= 11.0453610172  
pushed 139 [9, 12]  
pushed 121 [8, 11]  
iter= 13 len\_frontier= 19 popped= 135 [9, 8] depth= 11 dist2goal= 11.1803398875  
pushed 134 [9, 7]  
pushed 117 [8, 7]  
iter= 14 len\_frontier= 20 popped= 139 [9, 12] depth= 12 dist2goal= 11.1803398875  
pushed 140 [9, 13]  
pushed 122 [8, 12]  
iter= 15 len\_frontier= 21 popped= 134 [9, 7] depth= 12 dist2goal= 11.401754251  
pushed 133 [9, 6]  
pushed 116 [8, 6]  
iter= 16 len\_frontier= 22 popped= 140 [9, 13] depth= 13 dist2goal= 11.401754251  
pushed 141 [9, 14]  
pushed 123 [8, 13]  
iter= 17 len\_frontier= 23 popped= 133 [9, 6] depth= 13 dist2goal= 11.7046999107  
iter= 18 len\_frontier= 22 popped= 141 [9, 14] depth= 14 dist2goal= 11.7046999107  
pushed 142 [9, 15]  
iter= 19 len\_frontier= 22 popped= 120 [8, 10] depth= 10 dist2goal= 12.0  
pushed 106 [7, 10]  
iter= 20 len\_frontier= 22 popped= 121 [8, 11] depth= 12 dist2goal= 12.0415945788  
iter= 21 len\_frontier= 21 popped= 142 [9, 15] depth= 15 dist2goal= 12.0830459736  
pushed 124 [8, 15]  
iter= 22 len\_frontier= 21 popped= 122 [8, 12] depth= 13 dist2goal= 12.1655250606  
iter= 23 len\_frontier= 20 popped= 118 [8, 8] depth= 9 dist2goal= 12.1655250606  
iter= 24 len\_frontier= 19 popped= 117 [8, 7] depth= 12 dist2goal= 12.3693168769  
pushed 102 [7, 6]  
iter= 25 len\_frontier= 19 popped= 123 [8, 13] depth= 14 dist2goal= 12.3693168769



iter= 26 len\_frontier= 18 popped= 116 [8, 6] depth= 13 dist2goal= 12.6491106407  
iter= 27 len\_frontier= 17 popped= 124 [8, 15] depth= 16 dist2goal= 13.0  
pushed 125 [8, 16]  
pushed 107 [7, 15]  
iter= 28 len\_frontier= 18 popped= 106 [7, 10] depth= 11 dist2goal= 13.0  
iter= 29 len\_frontier= 17 popped= 105 [7, 9] depth= 9 dist2goal= 13.0384048104  
iter= 30 len\_frontier= 16 popped= 103 [7, 7] depth= 9 dist2goal= 13.3416640641  
iter= 31 len\_frontier= 15 popped= 125 [8, 16] depth= 17 dist2goal= 13.416407865  
pushed 126 [8, 17]  
pushed 108 [7, 16]  
iter= 32 len\_frontier= 16 popped= 102 [7, 6] depth= 13 dist2goal= 13.6014705087  
iter= 33 len\_frontier= 15 popped= 126 [8, 17] depth= 18 dist2goal= 13.8924439894  
pushed 127 [8, 18]  
pushed 109 [7, 17]  
iter= 34 len\_frontier= 16 popped= 107 [7, 15] depth= 17 dist2goal= 13.9283882772  
pushed 93 [6, 15]  
pushed 92 [6, 14]  
iter= 35 len\_frontier= 17 popped= 108 [7, 16] depth= 18 dist2goal= 14.3178210633  
pushed 94 [6, 16]  
iter= 36 len\_frontier= 17 popped= 127 [8, 18] depth= 19 dist2goal= 14.4222051019  
pushed 128 [8, 19]  
pushed 110 [7, 18]  
pushed 143 [9, 19]  
pushed 148 [10, 19]  
pushed 153 [11, 19]  
iter= 37 len\_frontier= 21 popped= 153 [11, 19] depth= 20 dist2goal= 12.7279220614  
pushed 154 [11, 20]  
pushed 158 [12, 19]  
pushed 159 [12, 20]  
iter= 38 len\_frontier= 23 popped= 158 [12, 19] depth= 21 dist2goal= 12.0415945788  
pushed 171 [13, 19]  
pushed 172 [13, 20]  
iter= 39 len\_frontier= 24 popped= 171 [13, 19] depth= 22 dist2goal= 11.401754251  
pushed 183 [14, 19]  
pushed 182 [14, 18]  
pushed 184 [14, 20]  
pushed 181 [14, 17]  
iter= 40 len\_frontier= 27 popped= 181 [14, 17] depth= 23 dist2goal= 9.21954445729  
pushed 180 [14, 16]  
pushed 194 [15, 17]  
pushed 195 [15, 18]  
iter= 41 len\_frontier= 29 popped= 180 [14, 16] depth= 24 dist2goal= 8.48528137424  
pushed 179 [14, 15]  
pushed 193 [15, 16]  
iter= 42 len\_frontier= 30 popped= 179 [14, 15] depth= 25 dist2goal= 7.81024967591  
pushed 170 [13, 15]  
pushed 192 [15, 15]  
iter= 43 len\_frontier= 31 popped= 192 [15, 15] depth= 26 dist2goal= 7.07106781187  
pushed 191 [15, 14]

```
pushed 205 [16, 15]
pushed 206 [16, 16]
iter= 44 len_frontier= 33 popped= 191 [15, 14] depth= 27 dist2goal= 6.40312423743
pushed 190 [15, 13]
pushed 204 [16, 14]
iter= 45 len_frontier= 34 popped= 204 [16, 14] depth= 28 dist2goal= 5.65685424949
pushed 217 [17, 15]
pushed 216 [17, 13]
pushed 215 [17, 12]
pushed 231 [18, 15]
iter= 46 len_frontier= 37 popped= 215 [17, 12] depth= 29 dist2goal= 3.60555127546
iter= 47 len_frontier= 36 popped= 216 [17, 13] depth= 29 dist2goal= 4.24264068712
iter= 48 len_frontier= 35 popped= 231 [18, 15] depth= 29 dist2goal= 5.38516480713
pushed 232 [18, 16]
pushed 249 [19, 15]
pushed 250 [19, 16]
pushed 268 [20, 14]
iter= 49 len_frontier= 38 popped= 268 [20, 14] depth= 30 dist2goal= 4.0
pushed 269 [20, 15]
pushed 267 [20, 13]
pushed 248 [19, 13]
iter= 50 len_frontier= 40 popped= 267 [20, 13] depth= 31 dist2goal= 3.0
pushed 266 [20, 12]
pushed 247 [19, 12]
iter= 51 len_frontier= 41 popped= 266 [20, 12] depth= 32 dist2goal= 2.0
pushed 265 [20, 11]
pushed 246 [19, 11]
iter= 52 len_frontier= 42 popped= 265 [20, 11] depth= 33 dist2goal= 1.0
pushed 264 [20, 10]
pushed 245 [19, 10]
iter= 53 len_frontier= 43 popped= 264 [20, 10] depth= 34 dist2goal= 0.0
solution_path:
vertex 264 (20, 10)
vertex 265 (20, 11)
vertex 266 (20, 12)
vertex 267 (20, 13)
vertex 268 (20, 14)
vertex 231 (18, 15)
vertex 204 (16, 14)
vertex 191 (15, 14)
vertex 192 (15, 15)
vertex 179 (14, 15)
vertex 180 (14, 16)
vertex 181 (14, 17)
vertex 171 (13, 19)
vertex 158 (12, 19)
vertex 153 (11, 19)
vertex 127 (8, 18)
vertex 126 (8, 17)
```

vertex 125 (8, 16)  
vertex 124 (8, 15)  
vertex 142 (9, 15)  
vertex 141 (9, 14)  
vertex 140 (9, 13)  
vertex 139 (9, 12)  
vertex 138 (9, 11)  
vertex 137 (9, 10)  
vertex 119 (8, 9)  
vertex 104 (7, 8)  
vertex 90 (6, 8)  
vertex 78 (5, 8)  
vertex 66 (4, 8)  
vertex 67 (4, 9)  
vertex 68 (4, 10)  
vertex 49 (3, 10)  
vertex 29 (2, 10)  
vertex 9 (1, 10)

Some statistics:

=====

Search algorithm: GBFS

Iteration Count: 53

max frontier size: 43

vertices visited: 95/275

Path length: 34

-----Completed Execution-----

[10, 1] to [10, 20]

iter= 0 len\_frontier= 1 popped= 145 [10, 1] depth= 0 dist2goal= 19.0

pushed 146 [10, 2]

pushed 130 [9, 1]

pushed 150 [11, 1]

pushed 151 [11, 2]

iter= 1 len\_frontier= 4 popped= 146 [10, 2] depth= 1 dist2goal= 18.0

pushed 145 [10, 1]

pushed 147 [10, 3]

pushed 131 [9, 2]

pushed 152 [11, 3]

iter= 2 len\_frontier= 7 popped= 147 [10, 3] depth= 2 dist2goal= 17.0

pushed 132 [9, 3]

iter= 3 len\_frontier= 7 popped= 152 [11, 3] depth= 2 dist2goal= 17.0293863659

pushed 157 [12, 3]

iter= 4 len\_frontier= 7 popped= 132 [9, 3] depth= 3 dist2goal= 17.0293863659

pushed 115 [8, 3]

pushed 114 [8, 2]

iter= 5 len\_frontier= 8 popped= 157 [12, 3] depth= 3 dist2goal= 17.1172427686

pushed 156 [12, 2]

pushed 162 [13, 3]

iter= 6 len\_frontier= 9 popped= 115 [8, 3] depth= 4 dist2goal= 17.1172427686  
pushed 101 [7, 3]  
pushed 100 [7, 2]  
iter= 7 len\_frontier= 10 popped= 162 [13, 3] depth= 4 dist2goal= 17.2626765016  
pushed 161 [13, 2]  
pushed 175 [14, 3]  
iter= 8 len\_frontier= 11 popped= 101 [7, 3] depth= 5 dist2goal= 17.2626765016  
pushed 89 [6, 3]  
pushed 88 [6, 2]  
iter= 9 len\_frontier= 12 popped= 89 [6, 3] depth= 6 dist2goal= 17.4642491966  
pushed 77 [5, 3]  
pushed 76 [5, 2]  
iter= 10 len\_frontier= 13 popped= 175 [14, 3] depth= 5 dist2goal= 17.4642491966  
pushed 174 [14, 2]  
pushed 187 [15, 3]  
iter= 11 len\_frontier= 14 popped= 77 [5, 3] depth= 7 dist2goal= 17.7200451467  
pushed 61 [4, 3]  
pushed 60 [4, 2]  
iter= 12 len\_frontier= 15 popped= 187 [15, 3] depth= 6 dist2goal= 17.7200451467  
pushed 186 [15, 2]  
pushed 200 [16, 3]  
iter= 13 len\_frontier= 16 popped= 151 [11, 2] depth= 1 dist2goal= 18.0277563773  
iter= 14 len\_frontier= 15 popped= 200 [16, 3] depth= 7 dist2goal= 18.0277563773  
pushed 199 [16, 2]  
pushed 213 [17, 3]  
iter= 15 len\_frontier= 16 popped= 131 [9, 2] depth= 2 dist2goal= 18.0277563773  
pushed 113 [8, 1]  
iter= 16 len\_frontier= 16 popped= 61 [4, 3] depth= 8 dist2goal= 18.0277563773  
pushed 62 [4, 4]  
pushed 42 [3, 3]  
pushed 41 [3, 2]  
iter= 17 len\_frontier= 18 popped= 62 [4, 4] depth= 9 dist2goal= 17.0880074906  
pushed 63 [4, 5]  
pushed 43 [3, 4]  
iter= 18 len\_frontier= 19 popped= 63 [4, 5] depth= 10 dist2goal= 16.1554944214  
pushed 64 [4, 6]  
pushed 44 [3, 5]  
iter= 19 len\_frontier= 20 popped= 64 [4, 6] depth= 11 dist2goal= 15.2315462117  
pushed 65 [4, 7]  
pushed 45 [3, 6]  
iter= 20 len\_frontier= 21 popped= 65 [4, 7] depth= 12 dist2goal= 14.3178210633  
pushed 66 [4, 8]  
pushed 46 [3, 7]  
iter= 21 len\_frontier= 22 popped= 66 [4, 8] depth= 13 dist2goal= 13.416407865  
pushed 67 [4, 9]  
pushed 78 [5, 8]  
pushed 47 [3, 8]  
iter= 22 len\_frontier= 24 popped= 67 [4, 9] depth= 14 dist2goal= 12.5299640861  
pushed 68 [4, 10]

```
pushed 48 [3, 9]
iter= 23 len_frontier= 25 popped= 68 [4, 10] depth= 15 dist2goal= 11.6619037897
pushed 49 [3, 10]
pushed 50 [3, 11]
pushed 51 [3, 12]
pushed 52 [3, 13]
iter= 24 len_frontier= 28 popped= 52 [3, 13] depth= 16 dist2goal= 9.89949493661
pushed 32 [2, 13]
pushed 31 [2, 12]
iter= 25 len_frontier= 29 popped= 51 [3, 12] depth= 16 dist2goal= 10.6301458127
pushed 30 [2, 11]
iter= 26 len_frontier= 29 popped= 32 [2, 13] depth= 17 dist2goal= 10.6301458127
pushed 33 [2, 14]
pushed 12 [1, 13]
pushed 11 [1, 12]
iter= 27 len_frontier= 31 popped= 33 [2, 14] depth= 18 dist2goal= 10.0
pushed 34 [2, 15]
pushed 13 [1, 14]
pushed 53 [3, 15]
iter= 28 len_frontier= 33 popped= 53 [3, 15] depth= 19 dist2goal= 8.60232526704
pushed 54 [3, 16]
pushed 69 [4, 15]
pushed 70 [4, 16]
iter= 29 len_frontier= 35 popped= 70 [4, 16] depth= 20 dist2goal= 7.21110255093
pushed 71 [4, 17]
pushed 82 [5, 16]
pushed 83 [5, 17]
iter= 30 len_frontier= 37 popped= 83 [5, 17] depth= 21 dist2goal= 5.83095189485
pushed 84 [5, 18]
pushed 95 [6, 17]
pushed 96 [6, 18]
iter= 31 len_frontier= 39 popped= 96 [6, 18] depth= 22 dist2goal= 4.472135955
pushed 97 [6, 19]
pushed 110 [7, 18]
pushed 111 [7, 19]
iter= 32 len_frontier= 41 popped= 111 [7, 19] depth= 23 dist2goal= 3.16227766017
pushed 112 [7, 20]
pushed 128 [8, 19]
pushed 129 [8, 20]
iter= 33 len_frontier= 43 popped= 129 [8, 20] depth= 24 dist2goal= 2.0
pushed 144 [9, 20]
iter= 34 len_frontier= 43 popped= 144 [9, 20] depth= 25 dist2goal= 1.0
pushed 143 [9, 19]
pushed 149 [10, 20]
iter= 35 len_frontier= 44 popped= 149 [10, 20] depth= 26 dist2goal= 0.0
solution_path:
vertex 149 (10, 20)
vertex 144 (9, 20)
vertex 129 (8, 20)
```

vertex 111 (7, 19)  
vertex 96 (6, 18)  
vertex 83 (5, 17)  
vertex 70 (4, 16)  
vertex 53 (3, 15)  
vertex 33 (2, 14)  
vertex 32 (2, 13)  
vertex 52 (3, 13)  
vertex 68 (4, 10)  
vertex 67 (4, 9)  
vertex 66 (4, 8)  
vertex 65 (4, 7)  
vertex 64 (4, 6)  
vertex 63 (4, 5)  
vertex 62 (4, 4)  
vertex 61 (4, 3)  
vertex 77 (5, 3)  
vertex 89 (6, 3)  
vertex 101 (7, 3)  
vertex 115 (8, 3)  
vertex 132 (9, 3)  
vertex 147 (10, 3)  
vertex 146 (10, 2)  
vertex 145 (10, 1)

Some statistics:

=====

Search algorithm: GBFS

Iteration Count: 35

max frontier size: 44

vertices visited: 78/275

Path length: 26

-----Completed Execution-----

[13, 6] to [7, 6]

iter= 0 len\_frontier= 1 popped= 163 [13, 6] depth= 0 dist2goal= 6.0

pushed 164 [13, 7]

pushed 176 [14, 6]

pushed 177 [14, 7]

iter= 1 len\_frontier= 3 popped= 164 [13, 7] depth= 1 dist2goal= 6.0827625303

pushed 163 [13, 6]

pushed 165 [13, 8]

pushed 178 [14, 8]

iter= 2 len\_frontier= 5 popped= 163 [13, 6] depth= 2 dist2goal= 6.0

iter= 3 len\_frontier= 4 popped= 165 [13, 8] depth= 2 dist2goal= 6.32455532034

iter= 4 len\_frontier= 3 popped= 176 [14, 6] depth= 1 dist2goal= 7.0

iter= 5 len\_frontier= 2 popped= 177 [14, 7] depth= 1 dist2goal= 7.07106781187

pushed 188 [15, 8]

pushed 201 [16, 8]

iter= 6 len\_frontier= 3 popped= 178 [14, 8] depth= 2 dist2goal= 7.28010988928  
iter= 7 len\_frontier= 2 popped= 188 [15, 8] depth= 2 dist2goal= 8.24621125124  
pushed 202 [16, 9]  
pushed 203 [16, 10]  
iter= 8 len\_frontier= 3 popped= 201 [16, 8] depth= 2 dist2goal= 9.21954445729  
pushed 214 [17, 8]  
iter= 9 len\_frontier= 3 popped= 202 [16, 9] depth= 3 dist2goal= 9.48683298051  
iter= 10 len\_frontier= 2 popped= 203 [16, 10] depth= 3 dist2goal= 9.8488578018  
iter= 11 len\_frontier= 1 popped= 214 [17, 8] depth= 3 dist2goal= 10.1980390272  
pushed 230 [18, 8]  
pushed 229 [18, 7]  
pushed 228 [18, 6]  
pushed 227 [18, 5]  
iter= 12 len\_frontier= 4 popped= 228 [18, 6] depth= 4 dist2goal= 11.0  
pushed 242 [19, 6]  
pushed 243 [19, 7]  
iter= 13 len\_frontier= 5 popped= 227 [18, 5] depth= 4 dist2goal= 11.0453610172  
pushed 226 [18, 4]  
pushed 241 [19, 5]  
pushed 213 [17, 3]  
iter= 14 len\_frontier= 7 popped= 213 [17, 3] depth= 5 dist2goal= 10.4403065089  
pushed 212 [17, 2]  
pushed 200 [16, 3]  
pushed 225 [18, 3]  
pushed 199 [16, 2]  
iter= 15 len\_frontier= 10 popped= 200 [16, 3] depth= 6 dist2goal= 9.48683298051  
pushed 187 [15, 3]  
pushed 186 [15, 2]  
iter= 16 len\_frontier= 11 popped= 187 [15, 3] depth= 7 dist2goal= 8.54400374532  
pushed 175 [14, 3]  
pushed 174 [14, 2]  
iter= 17 len\_frontier= 12 popped= 175 [14, 3] depth= 8 dist2goal= 7.61577310586  
pushed 162 [13, 3]  
pushed 161 [13, 2]  
iter= 18 len\_frontier= 13 popped= 162 [13, 3] depth= 9 dist2goal= 6.7082039325  
pushed 157 [12, 3]  
pushed 156 [12, 2]  
iter= 19 len\_frontier= 14 popped= 157 [12, 3] depth= 10 dist2goal= 5.83095189485  
pushed 152 [11, 3]  
pushed 151 [11, 2]  
iter= 20 len\_frontier= 15 popped= 152 [11, 3] depth= 11 dist2goal= 5.0  
pushed 147 [10, 3]  
pushed 146 [10, 2]  
iter= 21 len\_frontier= 16 popped= 147 [10, 3] depth= 12 dist2goal= 4.24264068712  
pushed 132 [9, 3]  
pushed 131 [9, 2]  
iter= 22 len\_frontier= 17 popped= 132 [9, 3] depth= 13 dist2goal= 3.60555127546  
pushed 115 [8, 3]  
pushed 114 [8, 2]

iter= 23 len\_frontier= 18 popped= 115 [8, 3] depth= 14 dist2goal= 3.16227766017  
pushed 101 [7, 3]  
pushed 100 [7, 2]  
iter= 24 len\_frontier= 19 popped= 101 [7, 3] depth= 15 dist2goal= 3.0  
pushed 89 [6, 3]  
pushed 88 [6, 2]  
iter= 25 len\_frontier= 20 popped= 89 [6, 3] depth= 16 dist2goal= 3.16227766017  
pushed 77 [5, 3]  
pushed 76 [5, 2]  
iter= 26 len\_frontier= 21 popped= 77 [5, 3] depth= 17 dist2goal= 3.60555127546  
pushed 61 [4, 3]  
pushed 60 [4, 2]  
iter= 27 len\_frontier= 22 popped= 100 [7, 2] depth= 15 dist2goal= 4.0  
pushed 99 [7, 1]  
pushed 87 [6, 1]  
iter= 28 len\_frontier= 23 popped= 114 [8, 2] depth= 14 dist2goal= 4.12310562562  
pushed 113 [8, 1]  
iter= 29 len\_frontier= 23 popped= 88 [6, 2] depth= 16 dist2goal= 4.12310562562  
pushed 75 [5, 1]  
iter= 30 len\_frontier= 23 popped= 61 [4, 3] depth= 18 dist2goal= 4.24264068712  
pushed 62 [4, 4]  
pushed 42 [3, 3]  
pushed 41 [3, 2]  
iter= 31 len\_frontier= 25 popped= 62 [4, 4] depth= 19 dist2goal= 3.60555127546  
pushed 63 [4, 5]  
pushed 43 [3, 4]  
iter= 32 len\_frontier= 26 popped= 63 [4, 5] depth= 20 dist2goal= 3.16227766017  
pushed 64 [4, 6]  
pushed 44 [3, 5]  
iter= 33 len\_frontier= 27 popped= 64 [4, 6] depth= 21 dist2goal= 3.0  
pushed 65 [4, 7]  
pushed 45 [3, 6]  
iter= 34 len\_frontier= 28 popped= 65 [4, 7] depth= 22 dist2goal= 3.16227766017  
pushed 66 [4, 8]  
pushed 46 [3, 7]  
iter= 35 len\_frontier= 29 popped= 66 [4, 8] depth= 23 dist2goal= 3.60555127546  
pushed 67 [4, 9]  
pushed 78 [5, 8]  
pushed 47 [3, 8]  
iter= 36 len\_frontier= 31 popped= 78 [5, 8] depth= 24 dist2goal= 2.82842712475  
pushed 90 [6, 8]  
iter= 37 len\_frontier= 31 popped= 90 [6, 8] depth= 25 dist2goal= 2.2360679775  
pushed 104 [7, 8]  
iter= 38 len\_frontier= 31 popped= 104 [7, 8] depth= 26 dist2goal= 2.0  
pushed 103 [7, 7]  
pushed 105 [7, 9]  
pushed 118 [8, 8]  
pushed 119 [8, 9]  
iter= 39 len\_frontier= 34 popped= 103 [7, 7] depth= 27 dist2goal= 1.0



```
pushed 102 [7, 6]
pushed 117 [8, 7]
iter= 40 len_frontier= 35 popped= 102 [7, 6] depth= 28 dist2goal= 0.0
solution_path:
vertex 102 (7, 6)
vertex 103 (7, 7)
vertex 104 (7, 8)
vertex 90 (6, 8)
vertex 78 (5, 8)
vertex 66 (4, 8)
vertex 65 (4, 7)
vertex 64 (4, 6)
vertex 63 (4, 5)
vertex 62 (4, 4)
vertex 61 (4, 3)
vertex 77 (5, 3)
vertex 89 (6, 3)
vertex 101 (7, 3)
vertex 115 (8, 3)
vertex 132 (9, 3)
vertex 147 (10, 3)
vertex 152 (11, 3)
vertex 157 (12, 3)
vertex 162 (13, 3)
vertex 175 (14, 3)
vertex 187 (15, 3)
vertex 200 (16, 3)
vertex 213 (17, 3)
vertex 227 (18, 5)
vertex 214 (17, 8)
vertex 201 (16, 8)
vertex 177 (14, 7)
vertex 163 (13, 6)
```

Some statistics:

=====

Search algorithm: GBFS

Iteration Count: 40

max frontier size: 35

vertices visited: 74/275

Path length: 28

-----Completed Execution-----

Traces for A-start for all 5 paths:

[20, 1] to [1, 20]

iter= 0 len\_frontier= 1 popped= 255 [20, 1] depth= 0 dist2goal= 26.8700576851

pushed 256 [20, 2]

pushed 237 [19, 1]  
iter= 1 len\_frontier= 2 popped= 256 [20, 2] depth= 1 dist2goal= 26.1725046566  
pushed 255 [20, 1]  
pushed 257 [20, 3]  
pushed 238 [19, 2]  
iter= 2 len\_frontier= 4 popped= 237 [19, 1] depth= 1 dist2goal= 26.1725046566  
pushed 223 [18, 1]  
iter= 3 len\_frontier= 4 popped= 238 [19, 2] depth= 2 dist2goal= 25.4558441227  
pushed 239 [19, 3]  
pushed 224 [18, 2]  
iter= 4 len\_frontier= 5 popped= 257 [20, 3] depth= 2 dist2goal= 25.495097568  
pushed 258 [20, 4]  
iter= 5 len\_frontier= 5 popped= 223 [18, 1] depth= 2 dist2goal= 25.495097568  
pushed 211 [17, 1]  
iter= 6 len\_frontier= 5 popped= 239 [19, 3] depth= 3 dist2goal= 24.7588368063  
pushed 240 [19, 4]  
pushed 225 [18, 3]  
iter= 7 len\_frontier= 6 popped= 224 [18, 2] depth= 3 dist2goal= 24.7588368063  
pushed 212 [17, 2]  
iter= 8 len\_frontier= 6 popped= 211 [17, 1] depth= 3 dist2goal= 24.8394846967  
pushed 198 [16, 1]  
iter= 9 len\_frontier= 6 popped= 258 [20, 4] depth= 3 dist2goal= 24.8394846967  
pushed 259 [20, 5]  
iter= 10 len\_frontier= 6 popped= 225 [18, 3] depth= 4 dist2goal= 24.0416305603  
pushed 226 [18, 4]  
pushed 213 [17, 3]  
iter= 11 len\_frontier= 7 popped= 212 [17, 2] depth= 4 dist2goal= 24.0831891576  
pushed 199 [16, 2]  
iter= 12 len\_frontier= 7 popped= 240 [19, 4] depth= 4 dist2goal= 24.0831891576  
pushed 241 [19, 5]  
iter= 13 len\_frontier= 7 popped= 198 [16, 1] depth= 4 dist2goal= 24.2074368738  
pushed 185 [15, 1]  
iter= 14 len\_frontier= 7 popped= 259 [20, 5] depth= 4 dist2goal= 24.2074368738  
pushed 260 [20, 6]  
iter= 15 len\_frontier= 7 popped= 226 [18, 4] depth= 5 dist2goal= 23.3452350599  
pushed 227 [18, 5]  
iter= 16 len\_frontier= 7 popped= 213 [17, 3] depth= 5 dist2goal= 23.3452350599  
pushed 200 [16, 3]  
iter= 17 len\_frontier= 7 popped= 241 [19, 5] depth= 5 dist2goal= 23.4307490277  
pushed 242 [19, 6]  
iter= 18 len\_frontier= 7 popped= 199 [16, 2] depth= 5 dist2goal= 23.4307490277  
pushed 186 [15, 2]  
iter= 19 len\_frontier= 7 popped= 185 [15, 1] depth= 5 dist2goal= 23.6008474424  
pushed 173 [14, 1]  
iter= 20 len\_frontier= 7 popped= 260 [20, 6] depth= 5 dist2goal= 23.6008474424  
pushed 261 [20, 7]  
iter= 21 len\_frontier= 7 popped= 227 [18, 5] depth= 6 dist2goal= 22.6715680975  
pushed 228 [18, 6]  
pushed 214 [17, 8]

iter= 22 len\_frontier= 8 popped= 214 [17, 8] depth= 7 dist2goal= 20.0  
pushed 201 [16, 8]  
pushed 230 [18, 8]  
pushed 202 [16, 9]  
pushed 229 [18, 7]  
pushed 203 [16, 10]  
iter= 23 len\_frontier= 12 popped= 203 [16, 10] depth= 8 dist2goal= 18.0277563773  
pushed 188 [15, 8]  
iter= 24 len\_frontier= 12 popped= 202 [16, 9] depth= 8 dist2goal= 18.6010752377  
iter= 25 len\_frontier= 11 popped= 201 [16, 8] depth= 8 dist2goal= 19.2093727123  
pushed 177 [14, 7]  
iter= 26 len\_frontier= 11 popped= 177 [14, 7] depth= 9 dist2goal= 18.3847763109  
pushed 176 [14, 6]  
pushed 178 [14, 8]  
pushed 164 [13, 7]  
pushed 163 [13, 6]  
iter= 27 len\_frontier= 14 popped= 188 [15, 8] depth= 9 dist2goal= 18.4390889146  
iter= 28 len\_frontier= 13 popped= 178 [14, 8] depth= 10 dist2goal= 17.691806013  
pushed 165 [13, 8]  
iter= 29 len\_frontier= 13 popped= 164 [13, 7] depth= 10 dist2goal= 17.691806013  
iter= 30 len\_frontier= 12 popped= 165 [13, 8] depth= 11 dist2goal= 16.9705627485  
iter= 31 len\_frontier= 11 popped= 163 [13, 6] depth= 10 dist2goal= 18.4390889146  
iter= 32 len\_frontier= 10 popped= 200 [16, 3] depth= 6 dist2goal= 22.6715680975  
pushed 187 [15, 3]  
iter= 33 len\_frontier= 10 popped= 242 [19, 6] depth= 6 dist2goal= 22.803508502  
pushed 243 [19, 7]  
iter= 34 len\_frontier= 10 popped= 186 [15, 2] depth= 6 dist2goal= 22.803508502  
pushed 174 [14, 2]  
iter= 35 len\_frontier= 10 popped= 230 [18, 8] depth= 8 dist2goal= 20.8086520467  
pushed 244 [19, 8]  
iter= 36 len\_frontier= 10 popped= 255 [20, 1] depth= 2 dist2goal= 26.8700576851  
iter= 37 len\_frontier= 9 popped= 173 [14, 1] depth= 6 dist2goal= 23.0217288664  
pushed 160 [13, 1]  
iter= 38 len\_frontier= 9 popped= 261 [20, 7] depth= 6 dist2goal= 23.0217288664  
pushed 262 [20, 8]  
iter= 39 len\_frontier= 9 popped= 228 [18, 6] depth= 7 dist2goal= 22.0227155455  
iter= 40 len\_frontier= 8 popped= 187 [15, 3] depth= 7 dist2goal= 22.0227155455  
pushed 175 [14, 3]  
iter= 41 len\_frontier= 8 popped= 176 [14, 6] depth= 10 dist2goal= 19.1049731745  
iter= 42 len\_frontier= 7 popped= 243 [19, 7] depth= 7 dist2goal= 22.2036033112  
iter= 43 len\_frontier= 6 popped= 174 [14, 2] depth= 7 dist2goal= 22.2036033112  
pushed 161 [13, 2]  
iter= 44 len\_frontier= 6 popped= 175 [14, 3] depth= 8 dist2goal= 21.400934559  
pushed 162 [13, 3]  
iter= 45 len\_frontier= 6 popped= 229 [18, 7] depth= 8 dist2goal= 21.400934559  
iter= 46 len\_frontier= 5 popped= 160 [13, 1] depth= 7 dist2goal= 22.4722050542  
pushed 155 [12, 1]  
iter= 47 len\_frontier= 5 popped= 262 [20, 8] depth= 7 dist2goal= 22.4722050542  
pushed 263 [20, 9]

iter= 48 len\_frontier= 5 popped= 161 [13, 2] depth= 8 dist2goal= 21.6333076528  
pushed 156 [12, 2]  
iter= 49 len\_frontier= 5 popped= 162 [13, 3] depth= 9 dist2goal= 20.8086520467  
pushed 157 [12, 3]  
iter= 50 len\_frontier= 5 popped= 155 [12, 1] depth= 8 dist2goal= 21.9544984001  
pushed 150 [11, 1]  
iter= 51 len\_frontier= 5 popped= 263 [20, 9] depth= 8 dist2goal= 21.9544984001  
pushed 264 [20, 10]  
pushed 245 [19, 10]  
iter= 52 len\_frontier= 6 popped= 245 [19, 10] depth= 9 dist2goal= 20.591260282  
pushed 246 [19, 11]  
pushed 265 [20, 11]  
iter= 53 len\_frontier= 7 popped= 156 [12, 2] depth= 9 dist2goal= 21.0950231097  
pushed 151 [11, 2]  
iter= 54 len\_frontier= 7 popped= 246 [19, 11] depth= 10 dist2goal= 20.1246117975  
pushed 247 [19, 12]  
pushed 266 [20, 12]  
iter= 55 len\_frontier= 8 popped= 157 [12, 3] depth= 10 dist2goal= 20.2484567313  
pushed 152 [11, 3]  
iter= 56 len\_frontier= 8 popped= 264 [20, 10] depth= 9 dist2goal= 21.4709105536  
iter= 57 len\_frontier= 7 popped= 150 [11, 1] depth= 9 dist2goal= 21.4709105536  
pushed 145 [10, 1]  
iter= 58 len\_frontier= 7 popped= 151 [11, 2] depth= 10 dist2goal= 20.591260282  
pushed 146 [10, 2]  
iter= 59 len\_frontier= 7 popped= 244 [19, 8] depth= 9 dist2goal= 21.6333076528  
iter= 60 len\_frontier= 6 popped= 247 [19, 12] depth= 11 dist2goal= 19.6977156036  
pushed 248 [19, 13]  
pushed 267 [20, 13]  
iter= 61 len\_frontier= 7 popped= 152 [11, 3] depth= 11 dist2goal= 19.7230829233  
pushed 147 [10, 3]  
iter= 62 len\_frontier= 7 popped= 265 [20, 11] depth= 10 dist2goal= 21.0237960416  
iter= 63 len\_frontier= 6 popped= 145 [10, 1] depth= 10 dist2goal= 21.0237960416  
pushed 130 [9, 1]  
iter= 64 len\_frontier= 6 popped= 146 [10, 2] depth= 11 dist2goal= 20.1246117975  
pushed 131 [9, 2]  
iter= 65 len\_frontier= 6 popped= 147 [10, 3] depth= 12 dist2goal= 19.2353840617  
pushed 132 [9, 3]  
iter= 66 len\_frontier= 6 popped= 248 [19, 13] depth= 12 dist2goal= 19.3132079158  
pushed 268 [20, 14]  
iter= 67 len\_frontier= 6 popped= 130 [9, 1] depth= 11 dist2goal= 20.6155281281  
pushed 113 [8, 1]  
iter= 68 len\_frontier= 6 popped= 266 [20, 12] depth= 11 dist2goal= 20.6155281281  
iter= 69 len\_frontier= 5 popped= 131 [9, 2] depth= 12 dist2goal= 19.6977156036  
pushed 114 [8, 2]  
iter= 70 len\_frontier= 5 popped= 132 [9, 3] depth= 13 dist2goal= 18.7882942281  
pushed 115 [8, 3]  
iter= 71 len\_frontier= 5 popped= 267 [20, 13] depth= 12 dist2goal= 20.2484567313  
iter= 72 len\_frontier= 4 popped= 113 [8, 1] depth= 12 dist2goal= 20.2484567313  
pushed 99 [7, 1]

iter= 73 len\_frontier= 4 popped= 114 [8, 2] depth= 13 dist2goal= 19.3132079158  
pushed 100 [7, 2]  
iter= 74 len\_frontier= 4 popped= 115 [8, 3] depth= 14 dist2goal= 18.3847763109  
pushed 101 [7, 3]  
iter= 75 len\_frontier= 4 popped= 99 [7, 1] depth= 13 dist2goal= 19.9248588452  
pushed 87 [6, 1]  
iter= 76 len\_frontier= 4 popped= 268 [20, 14] depth= 13 dist2goal= 19.9248588452  
pushed 269 [20, 15]  
pushed 249 [19, 15]  
pushed 231 [18, 15]  
iter= 77 len\_frontier= 6 popped= 231 [18, 15] depth= 14 dist2goal= 17.7200451467  
pushed 232 [18, 16]  
pushed 217 [17, 15]  
pushed 250 [19, 16]  
pushed 204 [16, 14]  
iter= 78 len\_frontier= 9 popped= 204 [16, 14] depth= 15 dist2goal= 16.1554944214  
pushed 205 [16, 15]  
pushed 191 [15, 14]  
pushed 190 [15, 13]  
pushed 216 [17, 13]  
pushed 215 [17, 12]  
iter= 79 len\_frontier= 13 popped= 191 [15, 14] depth= 16 dist2goal= 15.2315462117  
pushed 192 [15, 15]  
iter= 80 len\_frontier= 13 popped= 190 [15, 13] depth= 16 dist2goal= 15.6524758425  
pushed 189 [15, 12]  
iter= 81 len\_frontier= 13 popped= 217 [17, 15] depth= 15 dist2goal= 16.7630546142  
pushed 218 [17, 16]  
iter= 82 len\_frontier= 13 popped= 205 [16, 15] depth= 16 dist2goal= 15.8113883008  
pushed 206 [16, 16]  
iter= 83 len\_frontier= 13 popped= 192 [15, 15] depth= 17 dist2goal= 14.8660687473  
pushed 193 [15, 16]  
pushed 179 [14, 15]  
iter= 84 len\_frontier= 14 popped= 179 [14, 15] depth= 18 dist2goal= 13.9283882772  
pushed 180 [14, 16]  
pushed 170 [13, 15]  
iter= 85 len\_frontier= 15 popped= 170 [13, 15] depth= 19 dist2goal= 13.0  
iter= 86 len\_frontier= 14 popped= 232 [18, 16] depth= 15 dist2goal= 17.4642491966  
pushed 233 [18, 17]  
pushed 251 [19, 17]  
iter= 87 len\_frontier= 15 popped= 218 [17, 16] depth= 16 dist2goal= 16.4924225025  
pushed 219 [17, 17]  
iter= 88 len\_frontier= 15 popped= 206 [16, 16] depth= 17 dist2goal= 15.5241746963  
pushed 207 [16, 17]  
iter= 89 len\_frontier= 15 popped= 193 [15, 16] depth= 18 dist2goal= 14.5602197786  
pushed 194 [15, 17]  
iter= 90 len\_frontier= 15 popped= 180 [14, 16] depth= 19 dist2goal= 13.6014705087  
pushed 181 [14, 17]  
iter= 91 len\_frontier= 15 popped= 249 [19, 15] depth= 14 dist2goal= 18.6815416923  
pushed 270 [20, 16]

iter= 92 len\_frontier= 15 popped= 100 [7, 2] depth= 14 dist2goal= 18.973665961  
pushed 88 [6, 2]  
iter= 93 len\_frontier= 15 popped= 101 [7, 3] depth= 15 dist2goal= 18.0277563773  
pushed 89 [6, 3]  
iter= 94 len\_frontier= 15 popped= 189 [15, 12] depth= 17 dist2goal= 16.1245154966  
iter= 95 len\_frontier= 14 popped= 233 [18, 17] depth= 16 dist2goal= 17.2626765016  
pushed 234 [18, 18]  
pushed 252 [19, 18]  
iter= 96 len\_frontier= 15 popped= 219 [17, 17] depth= 17 dist2goal= 16.2788205961  
pushed 220 [17, 18]  
iter= 97 len\_frontier= 15 popped= 207 [16, 17] depth= 18 dist2goal= 15.2970585408  
pushed 208 [16, 18]  
iter= 98 len\_frontier= 15 popped= 194 [15, 17] depth= 19 dist2goal= 14.3178210633  
pushed 195 [15, 18]  
iter= 99 len\_frontier= 15 popped= 181 [14, 17] depth= 20 dist2goal= 13.3416640641  
pushed 182 [14, 18]  
pushed 171 [13, 19]  
iter= 100 len\_frontier= 16 popped= 171 [13, 19] depth= 21 dist2goal= 12.0415945788  
pushed 172 [13, 20]  
pushed 183 [14, 19]  
pushed 158 [12, 19]  
pushed 184 [14, 20]  
iter= 101 len\_frontier= 19 popped= 158 [12, 19] depth= 22 dist2goal= 11.0453610172  
pushed 159 [12, 20]  
pushed 153 [11, 19]  
iter= 102 len\_frontier= 20 popped= 153 [11, 19] depth= 23 dist2goal= 10.0498756211  
pushed 154 [11, 20]  
pushed 148 [10, 19]  
pushed 127 [8, 18]  
iter= 103 len\_frontier= 22 popped= 127 [8, 18] depth= 24 dist2goal= 7.28010988928  
pushed 128 [8, 19]  
pushed 126 [8, 17]  
pushed 110 [7, 18]  
pushed 143 [9, 19]  
pushed 109 [7, 17]  
iter= 104 len\_frontier= 26 popped= 110 [7, 18] depth= 25 dist2goal= 6.32455532034  
pushed 111 [7, 19]  
pushed 96 [6, 18]  
pushed 95 [6, 17]  
iter= 105 len\_frontier= 28 popped= 96 [6, 18] depth= 26 dist2goal= 5.38516480713  
pushed 97 [6, 19]  
pushed 84 [5, 18]  
pushed 83 [5, 17]  
iter= 106 len\_frontier= 30 popped= 84 [5, 18] depth= 27 dist2goal= 4.472135955  
pushed 85 [5, 19]  
pushed 72 [4, 18]  
pushed 71 [4, 17]  
iter= 107 len\_frontier= 32 popped= 72 [4, 18] depth= 28 dist2goal= 3.60555127546  
pushed 73 [4, 19]

pushed 56 [3, 18]  
pushed 55 [3, 17]  
iter= 108 len\_frontier= 34 popped= 109 [7, 17] depth= 25 dist2goal= 6.7082039325  
pushed 108 [7, 16]  
pushed 94 [6, 16]  
iter= 109 len\_frontier= 35 popped= 56 [3, 18] depth= 29 dist2goal= 2.82842712475  
pushed 57 [3, 19]  
pushed 37 [2, 18]  
pushed 36 [2, 17]  
iter= 110 len\_frontier= 37 popped= 95 [6, 17] depth= 26 dist2goal= 5.83095189485  
pushed 82 [5, 16]  
iter= 111 len\_frontier= 37 popped= 83 [5, 17] depth= 27 dist2goal= 5.0  
pushed 70 [4, 16]  
iter= 112 len\_frontier= 37 popped= 128 [8, 19] depth= 25 dist2goal= 7.07106781187  
pushed 129 [8, 20]  
pushed 144 [9, 20]  
iter= 113 len\_frontier= 38 popped= 111 [7, 19] depth= 26 dist2goal= 6.0827625303  
pushed 112 [7, 20]  
iter= 114 len\_frontier= 38 popped= 97 [6, 19] depth= 27 dist2goal= 5.09901951359  
pushed 98 [6, 20]  
iter= 115 len\_frontier= 38 popped= 85 [5, 19] depth= 28 dist2goal= 4.12310562562  
pushed 86 [5, 20]  
iter= 116 len\_frontier= 38 popped= 73 [4, 19] depth= 29 dist2goal= 3.16227766017  
pushed 74 [4, 20]  
iter= 117 len\_frontier= 38 popped= 37 [2, 18] depth= 30 dist2goal= 2.2360679775  
pushed 38 [2, 19]  
pushed 17 [1, 18]  
pushed 16 [1, 17]  
iter= 118 len\_frontier= 40 popped= 57 [3, 19] depth= 30 dist2goal= 2.2360679775  
pushed 58 [3, 20]  
iter= 119 len\_frontier= 40 popped= 71 [4, 17] depth= 28 dist2goal= 4.24264068712  
pushed 54 [3, 16]  
iter= 120 len\_frontier= 40 popped= 94 [6, 16] depth= 26 dist2goal= 6.40312423743  
pushed 93 [6, 15]  
pushed 81 [5, 15]  
iter= 121 len\_frontier= 41 popped= 38 [2, 19] depth= 31 dist2goal= 1.41421356237  
pushed 39 [2, 20]  
pushed 18 [1, 19]  
iter= 122 len\_frontier= 42 popped= 55 [3, 17] depth= 29 dist2goal= 3.60555127546  
pushed 35 [2, 16]  
iter= 123 len\_frontier= 42 popped= 126 [8, 17] depth= 25 dist2goal= 7.61577310586  
pushed 125 [8, 16]  
iter= 124 len\_frontier= 42 popped= 82 [5, 16] depth= 27 dist2goal= 5.65685424949  
pushed 69 [4, 15]  
iter= 125 len\_frontier= 42 popped= 70 [4, 16] depth= 28 dist2goal= 5.0  
pushed 53 [3, 15]  
iter= 126 len\_frontier= 42 popped= 58 [3, 20] depth= 31 dist2goal= 2.0  
iter= 127 len\_frontier= 41 popped= 112 [7, 20] depth= 27 dist2goal= 6.0  
iter= 128 len\_frontier= 40 popped= 86 [5, 20] depth= 29 dist2goal= 4.0

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iter= 129 len_frontier= 39 popped= 74 [4, 20] depth= 30 dist2goal= 3.0
iter= 130 len_frontier= 38 popped= 17 [1, 18] depth= 31 dist2goal= 2.0
iter= 131 len_frontier= 37 popped= 129 [8, 20] depth= 26 dist2goal= 7.0
iter= 132 len_frontier= 36 popped= 39 [2, 20] depth= 32 dist2goal= 1.0
pushed 19 [1, 20]
iter= 133 len_frontier= 36 popped= 18 [1, 19] depth= 32 dist2goal= 1.0
iter= 134 len_frontier= 35 popped= 19 [1, 20] depth= 33 dist2goal= 0.0
solution_path:
vertex 19 (1, 20)
vertex 39 (2, 20)
vertex 38 (2, 19)
vertex 37 (2, 18)
vertex 56 (3, 18)
vertex 72 (4, 18)
vertex 84 (5, 18)
vertex 96 (6, 18)
vertex 110 (7, 18)
vertex 127 (8, 18)
vertex 153 (11, 19)
vertex 158 (12, 19)
vertex 171 (13, 19)
vertex 181 (14, 17)
vertex 180 (14, 16)
vertex 179 (14, 15)
vertex 192 (15, 15)
vertex 191 (15, 14)
vertex 204 (16, 14)
vertex 231 (18, 15)
vertex 268 (20, 14)
vertex 248 (19, 13)
vertex 247 (19, 12)
vertex 246 (19, 11)
vertex 245 (19, 10)
vertex 263 (20, 9)
vertex 262 (20, 8)
vertex 261 (20, 7)
vertex 260 (20, 6)
vertex 259 (20, 5)
vertex 258 (20, 4)
vertex 257 (20, 3)
vertex 256 (20, 2)
vertex 255 (20, 1)
```

Some statistics:

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Search algorithm: ASTAR

Iteration Count: 134

max frontier size: 42

vertices visited: 168/275



Path length: 33

-----Completed Execution-----

[1, 1] to [20, 20]

iter= 0 len\_frontier= 1 popped= 0 [1, 1] depth= 0 dist2goal= 26.8700576851

pushed 1 [1, 2]

pushed 20 [2, 1]

pushed 21 [2, 2]

iter= 1 len\_frontier= 3 popped= 21 [2, 2] depth= 1 dist2goal= 25.4558441227

pushed 22 [2, 3]

pushed 41 [3, 2]

pushed 0 [1, 1]

pushed 42 [3, 3]

iter= 2 len\_frontier= 6 popped= 42 [3, 3] depth= 2 dist2goal= 24.0416305603

pushed 43 [3, 4]

pushed 61 [4, 3]

pushed 62 [4, 4]

iter= 3 len\_frontier= 8 popped= 62 [4, 4] depth= 3 dist2goal= 22.627416998

pushed 63 [4, 5]

iter= 4 len\_frontier= 8 popped= 63 [4, 5] depth= 4 dist2goal= 21.9317121995

pushed 64 [4, 6]

pushed 44 [3, 5]

iter= 5 len\_frontier= 9 popped= 64 [4, 6] depth= 5 dist2goal= 21.2602916255

pushed 65 [4, 7]

pushed 45 [3, 6]

iter= 6 len\_frontier= 10 popped= 43 [3, 4] depth= 3 dist2goal= 23.3452350599

pushed 23 [2, 4]

iter= 7 len\_frontier= 10 popped= 61 [4, 3] depth= 3 dist2goal= 23.3452350599

pushed 60 [4, 2]

pushed 77 [5, 3]

iter= 8 len\_frontier= 11 popped= 65 [4, 7] depth= 6 dist2goal= 20.6155281281

pushed 66 [4, 8]

pushed 46 [3, 7]

iter= 9 len\_frontier= 12 popped= 77 [5, 3] depth= 4 dist2goal= 22.6715680975

pushed 76 [5, 2]

pushed 89 [6, 3]

iter= 10 len\_frontier= 13 popped= 22 [2, 3] depth= 2 dist2goal= 24.7588368063

pushed 2 [1, 3]

iter= 11 len\_frontier= 13 popped= 41 [3, 2] depth= 2 dist2goal= 24.7588368063

pushed 40 [3, 1]

iter= 12 len\_frontier= 13 popped= 66 [4, 8] depth= 7 dist2goal= 20.0

pushed 67 [4, 9]

pushed 78 [5, 8]

pushed 47 [3, 8]

iter= 13 len\_frontier= 15 popped= 89 [6, 3] depth= 5 dist2goal= 22.0227155455

pushed 88 [6, 2]

pushed 101 [7, 3]

iter= 14 len\_frontier= 16 popped= 1 [1, 2] depth= 1 dist2goal= 26.1725046566

iter= 15 len\_frontier= 15 popped= 20 [2, 1] depth= 1 dist2goal= 26.1725046566

iter= 16 len\_frontier= 14 popped= 78 [5, 8] depth= 8 dist2goal= 19.2093727123  
pushed 90 [6, 8]  
iter= 17 len\_frontier= 14 popped= 101 [7, 3] depth= 6 dist2goal= 21.400934559  
pushed 100 [7, 2]  
pushed 115 [8, 3]  
iter= 18 len\_frontier= 15 popped= 67 [4, 9] depth= 8 dist2goal= 19.4164878389  
pushed 68 [4, 10]  
pushed 48 [3, 9]  
iter= 19 len\_frontier= 16 popped= 90 [6, 8] depth= 9 dist2goal= 18.4390889146  
pushed 104 [7, 8]  
iter= 20 len\_frontier= 16 popped= 44 [3, 5] depth= 5 dist2goal= 22.6715680975  
pushed 24 [2, 5]  
iter= 21 len\_frontier= 16 popped= 104 [7, 8] depth= 10 dist2goal= 17.691806013  
pushed 103 [7, 7]  
pushed 105 [7, 9]  
pushed 118 [8, 8]  
pushed 119 [8, 9]  
iter= 22 len\_frontier= 19 popped= 119 [8, 9] depth= 11 dist2goal= 16.2788205961  
pushed 120 [8, 10]  
pushed 136 [9, 9]  
pushed 137 [9, 10]  
iter= 23 len\_frontier= 21 popped= 137 [9, 10] depth= 12 dist2goal= 14.8660687473  
pushed 138 [9, 11]  
iter= 24 len\_frontier= 21 popped= 138 [9, 11] depth= 13 dist2goal= 14.2126704036  
pushed 139 [9, 12]  
pushed 121 [8, 11]  
iter= 25 len\_frontier= 22 popped= 136 [9, 9] depth= 12 dist2goal= 15.5563491861  
pushed 135 [9, 8]  
iter= 26 len\_frontier= 22 popped= 139 [9, 12] depth= 14 dist2goal= 13.6014705087  
pushed 140 [9, 13]  
pushed 122 [8, 12]  
iter= 27 len\_frontier= 23 popped= 120 [8, 10] depth= 12 dist2goal= 15.6204993518  
pushed 106 [7, 10]  
iter= 28 len\_frontier= 23 popped= 115 [8, 3] depth= 7 dist2goal= 20.8086520467  
pushed 114 [8, 2]  
pushed 132 [9, 3]  
iter= 29 len\_frontier= 24 popped= 68 [4, 10] depth= 9 dist2goal= 18.8679622641  
pushed 49 [3, 10]  
pushed 50 [3, 11]  
pushed 51 [3, 12]  
pushed 52 [3, 13]  
iter= 30 len\_frontier= 27 popped= 118 [8, 8] depth= 11 dist2goal= 16.9705627485  
pushed 117 [8, 7]  
iter= 31 len\_frontier= 27 popped= 45 [3, 6] depth= 6 dist2goal= 22.0227155455  
pushed 25 [2, 6]  
iter= 32 len\_frontier= 27 popped= 105 [7, 9] depth= 11 dist2goal= 17.0293863659  
iter= 33 len\_frontier= 26 popped= 140 [9, 13] depth= 15 dist2goal= 13.0384048104  
pushed 141 [9, 14]  
pushed 123 [8, 13]

iter= 34 len\_frontier= 27 popped= 23 [2, 4] depth= 4 dist2goal= 24.0831891576  
pushed 3 [1, 4]  
iter= 35 len\_frontier= 27 popped= 60 [4, 2] depth= 4 dist2goal= 24.0831891576  
pushed 59 [4, 1]  
iter= 36 len\_frontier= 27 popped= 132 [9, 3] depth= 8 dist2goal= 20.2484567313  
pushed 131 [9, 2]  
pushed 147 [10, 3]  
iter= 37 len\_frontier= 28 popped= 52 [3, 13] depth= 10 dist2goal= 18.3847763109  
pushed 32 [2, 13]  
pushed 31 [2, 12]  
iter= 38 len\_frontier= 29 popped= 46 [3, 7] depth= 7 dist2goal= 21.400934559  
pushed 26 [2, 7]  
iter= 39 len\_frontier= 29 popped= 76 [5, 2] depth= 5 dist2goal= 23.4307490277  
pushed 75 [5, 1]  
iter= 40 len\_frontier= 29 popped= 2 [1, 3] depth= 3 dist2goal= 25.495097568  
iter= 41 len\_frontier= 28 popped= 40 [3, 1] depth= 3 dist2goal= 25.495097568  
iter= 42 len\_frontier= 27 popped= 141 [9, 14] depth= 16 dist2goal= 12.5299640861  
pushed 142 [9, 15]  
iter= 43 len\_frontier= 27 popped= 147 [10, 3] depth= 9 dist2goal= 19.7230829233  
pushed 146 [10, 2]  
pushed 152 [11, 3]  
iter= 44 len\_frontier= 28 popped= 51 [3, 12] depth= 10 dist2goal= 18.7882942281  
pushed 30 [2, 11]  
iter= 45 len\_frontier= 28 popped= 88 [6, 2] depth= 6 dist2goal= 22.803508502  
pushed 87 [6, 1]  
iter= 46 len\_frontier= 28 popped= 47 [3, 8] depth= 8 dist2goal= 20.8086520467  
pushed 27 [2, 8]  
iter= 47 len\_frontier= 28 popped= 0 [1, 1] depth= 2 dist2goal= 26.8700576851  
iter= 48 len\_frontier= 27 popped= 121 [8, 11] depth= 14 dist2goal= 15.0  
iter= 49 len\_frontier= 26 popped= 142 [9, 15] depth= 17 dist2goal= 12.0830459736  
pushed 124 [8, 15]  
iter= 50 len\_frontier= 26 popped= 100 [7, 2] depth= 7 dist2goal= 22.2036033112  
pushed 99 [7, 1]  
iter= 51 len\_frontier= 26 popped= 152 [11, 3] depth= 10 dist2goal= 19.2353840617  
pushed 151 [11, 2]  
pushed 157 [12, 3]  
iter= 52 len\_frontier= 27 popped= 50 [3, 11] depth= 10 dist2goal= 19.2353840617  
pushed 29 [2, 10]  
iter= 53 len\_frontier= 27 popped= 48 [3, 9] depth= 9 dist2goal= 20.2484567313  
pushed 28 [2, 9]  
iter= 54 len\_frontier= 27 popped= 135 [9, 8] depth= 13 dist2goal= 16.2788205961  
pushed 134 [9, 7]  
iter= 55 len\_frontier= 27 popped= 103 [7, 7] depth= 11 dist2goal= 18.3847763109  
pushed 102 [7, 6]  
iter= 56 len\_frontier= 27 popped= 106 [7, 10] depth= 13 dist2goal= 16.4012194669  
iter= 57 len\_frontier= 26 popped= 122 [8, 12] depth= 15 dist2goal= 14.4222051019  
iter= 58 len\_frontier= 25 popped= 24 [2, 5] depth= 6 dist2goal= 23.4307490277  
pushed 4 [1, 5]  
iter= 59 len\_frontier= 25 popped= 114 [8, 2] depth= 8 dist2goal= 21.6333076528

pushed 113 [8, 1]  
iter= 60 len\_frontier= 25 popped= 117 [8, 7] depth= 12 dist2goal= 17.691806013  
pushed 116 [8, 6]  
iter= 61 len\_frontier= 25 popped= 49 [3, 10] depth= 10 dist2goal= 19.7230829233  
iter= 62 len\_frontier= 24 popped= 157 [12, 3] depth= 11 dist2goal= 18.7882942281  
pushed 156 [12, 2]  
pushed 162 [13, 3]  
iter= 63 len\_frontier= 25 popped= 25 [2, 6] depth= 7 dist2goal= 22.803508502  
pushed 5 [1, 6]  
iter= 64 len\_frontier= 25 popped= 3 [1, 4] depth= 5 dist2goal= 24.8394846967  
iter= 65 len\_frontier= 24 popped= 59 [4, 1] depth= 5 dist2goal= 24.8394846967  
iter= 66 len\_frontier= 23 popped= 123 [8, 13] depth= 16 dist2goal= 13.8924439894  
iter= 67 len\_frontier= 22 popped= 131 [9, 2] depth= 9 dist2goal= 21.0950231097  
pushed 130 [9, 1]  
iter= 68 len\_frontier= 22 popped= 26 [2, 7] depth= 8 dist2goal= 22.2036033112  
pushed 6 [1, 7]  
iter= 69 len\_frontier= 22 popped= 75 [5, 1] depth= 6 dist2goal= 24.2074368738  
iter= 70 len\_frontier= 21 popped= 32 [2, 13] depth= 11 dist2goal= 19.3132079158  
pushed 33 [2, 14]  
pushed 12 [1, 13]  
pushed 11 [1, 12]  
iter= 71 len\_frontier= 23 popped= 162 [13, 3] depth= 12 dist2goal= 18.3847763109  
pushed 161 [13, 2]  
pushed 175 [14, 3]  
iter= 72 len\_frontier= 24 popped= 146 [10, 2] depth= 10 dist2goal= 20.591260282  
pushed 145 [10, 1]  
iter= 73 len\_frontier= 24 popped= 87 [6, 1] depth= 7 dist2goal= 23.6008474424  
iter= 74 len\_frontier= 23 popped= 27 [2, 8] depth= 9 dist2goal= 21.6333076528  
pushed 7 [1, 8]  
iter= 75 len\_frontier= 23 popped= 31 [2, 12] depth= 11 dist2goal= 19.6977156036  
pushed 10 [1, 11]  
iter= 76 len\_frontier= 23 popped= 33 [2, 14] depth= 12 dist2goal= 18.973665961  
pushed 34 [2, 15]  
pushed 13 [1, 14]  
pushed 53 [3, 15]  
iter= 77 len\_frontier= 25 popped= 53 [3, 15] depth= 13 dist2goal= 17.7200451467  
pushed 54 [3, 16]  
pushed 69 [4, 15]  
pushed 70 [4, 16]  
iter= 78 len\_frontier= 27 popped= 70 [4, 16] depth= 14 dist2goal= 16.4924225025  
pushed 71 [4, 17]  
pushed 82 [5, 16]  
pushed 83 [5, 17]  
iter= 79 len\_frontier= 29 popped= 83 [5, 17] depth= 15 dist2goal= 15.2970585408  
pushed 84 [5, 18]  
pushed 95 [6, 17]  
pushed 96 [6, 18]  
iter= 80 len\_frontier= 31 popped= 96 [6, 18] depth= 16 dist2goal= 14.1421356237  
pushed 97 [6, 19]

```
pushed 110 [7, 18]
pushed 111 [7, 19]
iter= 81 len_frontier= 33 popped= 111 [7, 19] depth= 17 dist2goal= 13.0384048104
pushed 112 [7, 20]
pushed 128 [8, 19]
pushed 129 [8, 20]
iter= 82 len_frontier= 35 popped= 129 [8, 20] depth= 18 dist2goal= 12.0
pushed 144 [9, 20]
iter= 83 len_frontier= 35 popped= 144 [9, 20] depth= 19 dist2goal= 11.0
pushed 143 [9, 19]
pushed 149 [10, 20]
iter= 84 len_frontier= 36 popped= 149 [10, 20] depth= 20 dist2goal= 10.0
pushed 148 [10, 19]
pushed 154 [11, 20]
iter= 85 len_frontier= 37 popped= 154 [11, 20] depth= 21 dist2goal= 9.0
pushed 153 [11, 19]
pushed 159 [12, 20]
iter= 86 len_frontier= 38 popped= 159 [12, 20] depth= 22 dist2goal= 8.0
pushed 158 [12, 19]
pushed 172 [13, 20]
iter= 87 len_frontier= 39 popped= 172 [13, 20] depth= 23 dist2goal= 7.0
pushed 171 [13, 19]
pushed 184 [14, 20]
iter= 88 len_frontier= 40 popped= 184 [14, 20] depth= 24 dist2goal= 6.0
pushed 183 [14, 19]
pushed 197 [15, 20]
iter= 89 len_frontier= 41 popped= 197 [15, 20] depth= 25 dist2goal= 5.0
pushed 196 [15, 19]
pushed 210 [16, 20]
iter= 90 len_frontier= 42 popped= 210 [16, 20] depth= 26 dist2goal= 4.0
pushed 209 [16, 19]
pushed 222 [17, 20]
iter= 91 len_frontier= 43 popped= 222 [17, 20] depth= 27 dist2goal= 3.0
pushed 221 [17, 19]
pushed 236 [18, 20]
iter= 92 len_frontier= 44 popped= 236 [18, 20] depth= 28 dist2goal= 2.0
pushed 235 [18, 19]
pushed 254 [19, 20]
iter= 93 len_frontier= 45 popped= 254 [19, 20] depth= 29 dist2goal= 1.0
pushed 253 [19, 19]
pushed 274 [20, 20]
iter= 94 len_frontier= 46 popped= 274 [20, 20] depth= 30 dist2goal= 0.0
solution_path:
vertex 274 (20, 20)
vertex 254 (19, 20)
vertex 236 (18, 20)
vertex 222 (17, 20)
vertex 210 (16, 20)
vertex 197 (15, 20)
```

vertex 184 (14, 20)  
vertex 172 (13, 20)  
vertex 159 (12, 20)  
vertex 154 (11, 20)  
vertex 149 (10, 20)  
vertex 144 (9, 20)  
vertex 129 (8, 20)  
vertex 111 (7, 19)  
vertex 96 (6, 18)  
vertex 83 (5, 17)  
vertex 70 (4, 16)  
vertex 53 (3, 15)  
vertex 33 (2, 14)  
vertex 32 (2, 13)  
vertex 52 (3, 13)  
vertex 68 (4, 10)  
vertex 67 (4, 9)  
vertex 66 (4, 8)  
vertex 65 (4, 7)  
vertex 64 (4, 6)  
vertex 63 (4, 5)  
vertex 62 (4, 4)  
vertex 42 (3, 3)  
vertex 21 (2, 2)  
vertex 0 (1, 1)

Some statistics:

=====

Search algorithm: ASTAR

Iteration Count: 94

max frontier size: 46

vertices visited: 139/275

Path length: 30

-----Completed Execution-----

[1, 10] to [20, 10]

iter= 0 len\_frontier= 1 popped= 9 [1, 10] depth= 0 dist2goal= 19.0

pushed 8 [1, 9]

pushed 10 [1, 11]

pushed 29 [2, 10]

pushed 30 [2, 11]

iter= 1 len\_frontier= 4 popped= 29 [2, 10] depth= 1 dist2goal= 18.0

pushed 28 [2, 9]

pushed 9 [1, 10]

pushed 49 [3, 10]

pushed 50 [3, 11]

iter= 2 len\_frontier= 7 popped= 49 [3, 10] depth= 2 dist2goal= 17.0

pushed 48 [3, 9]

pushed 68 [4, 10]

iter= 3 len\_frontier= 8 popped= 68 [4, 10] depth= 3 dist2goal= 16.0  
pushed 67 [4, 9]  
pushed 51 [3, 12]  
pushed 52 [3, 13]  
iter= 4 len\_frontier= 10 popped= 30 [2, 11] depth= 1 dist2goal= 18.0277563773  
pushed 31 [2, 12]  
iter= 5 len\_frontier= 10 popped= 50 [3, 11] depth= 2 dist2goal= 17.0293863659  
iter= 6 len\_frontier= 9 popped= 8 [1, 9] depth= 1 dist2goal= 19.0262975904  
pushed 7 [1, 8]  
iter= 7 len\_frontier= 9 popped= 10 [1, 11] depth= 1 dist2goal= 19.0262975904  
pushed 11 [1, 12]  
iter= 8 len\_frontier= 9 popped= 28 [2, 9] depth= 2 dist2goal= 18.0277563773  
pushed 27 [2, 8]  
iter= 9 len\_frontier= 9 popped= 48 [3, 9] depth= 3 dist2goal= 17.0293863659  
pushed 47 [3, 8]  
iter= 10 len\_frontier= 9 popped= 67 [4, 9] depth= 4 dist2goal= 16.0312195419  
pushed 66 [4, 8]  
iter= 11 len\_frontier= 9 popped= 31 [2, 12] depth= 2 dist2goal= 18.1107702763  
pushed 32 [2, 13]  
iter= 12 len\_frontier= 9 popped= 9 [1, 10] depth= 2 dist2goal= 19.0  
iter= 13 len\_frontier= 8 popped= 11 [1, 12] depth= 2 dist2goal= 19.1049731745  
pushed 12 [1, 13]  
iter= 14 len\_frontier= 8 popped= 7 [1, 8] depth= 2 dist2goal= 19.1049731745  
pushed 6 [1, 7]  
iter= 15 len\_frontier= 8 popped= 27 [2, 8] depth= 3 dist2goal= 18.1107702763  
pushed 26 [2, 7]  
iter= 16 len\_frontier= 8 popped= 51 [3, 12] depth= 4 dist2goal= 17.1172427686  
iter= 17 len\_frontier= 7 popped= 47 [3, 8] depth= 4 dist2goal= 17.1172427686  
pushed 46 [3, 7]  
iter= 18 len\_frontier= 7 popped= 66 [4, 8] depth= 5 dist2goal= 16.1245154966  
pushed 65 [4, 7]  
pushed 78 [5, 8]  
iter= 19 len\_frontier= 8 popped= 78 [5, 8] depth= 6 dist2goal= 15.1327459504  
pushed 90 [6, 8]  
iter= 20 len\_frontier= 8 popped= 90 [6, 8] depth= 7 dist2goal= 14.1421356237  
pushed 104 [7, 8]  
iter= 21 len\_frontier= 8 popped= 104 [7, 8] depth= 8 dist2goal= 13.152946438  
pushed 103 [7, 7]  
pushed 105 [7, 9]  
pushed 118 [8, 8]  
pushed 119 [8, 9]  
iter= 22 len\_frontier= 11 popped= 119 [8, 9] depth= 9 dist2goal= 12.0415945788  
pushed 120 [8, 10]  
pushed 136 [9, 9]  
pushed 137 [9, 10]  
iter= 23 len\_frontier= 13 popped= 137 [9, 10] depth= 10 dist2goal= 11.0  
pushed 138 [9, 11]  
iter= 24 len\_frontier= 13 popped= 136 [9, 9] depth= 10 dist2goal= 11.0453610172  
pushed 135 [9, 8]

iter= 25 len\_frontier= 13 popped= 118 [8, 8] depth= 9 dist2goal= 12.1655250606  
pushed 117 [8, 7]  
iter= 26 len\_frontier= 13 popped= 32 [2, 13] depth= 3 dist2goal= 18.2482875909  
pushed 33 [2, 14]  
iter= 27 len\_frontier= 13 popped= 52 [3, 13] depth= 4 dist2goal= 17.2626765016  
iter= 28 len\_frontier= 12 popped= 120 [8, 10] depth= 10 dist2goal= 12.0  
pushed 121 [8, 11]  
pushed 106 [7, 10]  
iter= 29 len\_frontier= 13 popped= 105 [7, 9] depth= 9 dist2goal= 13.0384048104  
iter= 30 len\_frontier= 12 popped= 138 [9, 11] depth= 11 dist2goal= 11.0453610172  
pushed 139 [9, 12]  
iter= 31 len\_frontier= 12 popped= 135 [9, 8] depth= 11 dist2goal= 11.1803398875  
pushed 134 [9, 7]  
iter= 32 len\_frontier= 12 popped= 6 [1, 7] depth= 3 dist2goal= 19.2353840617  
pushed 5 [1, 6]  
iter= 33 len\_frontier= 12 popped= 12 [1, 13] depth= 3 dist2goal= 19.2353840617  
pushed 13 [1, 14]  
iter= 34 len\_frontier= 12 popped= 26 [2, 7] depth= 4 dist2goal= 18.2482875909  
pushed 25 [2, 6]  
iter= 35 len\_frontier= 12 popped= 46 [3, 7] depth= 5 dist2goal= 17.2626765016  
pushed 45 [3, 6]  
iter= 36 len\_frontier= 12 popped= 65 [4, 7] depth= 6 dist2goal= 16.2788205961  
pushed 64 [4, 6]  
iter= 37 len\_frontier= 12 popped= 103 [7, 7] depth= 9 dist2goal= 13.3416640641  
pushed 102 [7, 6]  
iter= 38 len\_frontier= 12 popped= 117 [8, 7] depth= 10 dist2goal= 12.3693168769  
pushed 116 [8, 6]  
iter= 39 len\_frontier= 12 popped= 33 [2, 14] depth= 4 dist2goal= 18.4390889146  
pushed 34 [2, 15]  
pushed 53 [3, 15]  
iter= 40 len\_frontier= 13 popped= 53 [3, 15] depth= 5 dist2goal= 17.7200451467  
pushed 54 [3, 16]  
pushed 69 [4, 15]  
pushed 70 [4, 16]  
iter= 41 len\_frontier= 15 popped= 69 [4, 15] depth= 6 dist2goal= 16.7630546142  
pushed 81 [5, 15]  
pushed 82 [5, 16]  
iter= 42 len\_frontier= 16 popped= 81 [5, 15] depth= 7 dist2goal= 15.8113883008  
pushed 80 [5, 14]  
pushed 93 [6, 15]  
pushed 94 [6, 16]  
iter= 43 len\_frontier= 18 popped= 93 [6, 15] depth= 8 dist2goal= 14.8660687473  
pushed 92 [6, 14]  
pushed 107 [7, 15]  
pushed 108 [7, 16]  
iter= 44 len\_frontier= 20 popped= 107 [7, 15] depth= 9 dist2goal= 13.9283882772  
pushed 124 [8, 15]  
pushed 125 [8, 16]  
iter= 45 len\_frontier= 21 popped= 124 [8, 15] depth= 10 dist2goal= 13.0



pushed 142 [9, 15]  
iter= 46 len\_frontier= 21 popped= 121 [8, 11] depth= 11 dist2goal= 12.0415945788  
pushed 122 [8, 12]  
iter= 47 len\_frontier= 21 popped= 142 [9, 15] depth= 11 dist2goal= 12.0830459736  
pushed 141 [9, 14]  
iter= 48 len\_frontier= 21 popped= 70 [4, 16] depth= 6 dist2goal= 17.0880074906  
pushed 71 [4, 17]  
pushed 83 [5, 17]  
iter= 49 len\_frontier= 22 popped= 82 [5, 16] depth= 7 dist2goal= 16.1554944214  
pushed 95 [6, 17]  
iter= 50 len\_frontier= 22 popped= 139 [9, 12] depth= 12 dist2goal= 11.1803398875  
pushed 140 [9, 13]  
iter= 51 len\_frontier= 22 popped= 94 [6, 16] depth= 8 dist2goal= 15.2315462117  
pushed 109 [7, 17]  
iter= 52 len\_frontier= 22 popped= 108 [7, 16] depth= 9 dist2goal= 14.3178210633  
pushed 126 [8, 17]  
iter= 53 len\_frontier= 22 popped= 134 [9, 7] depth= 12 dist2goal= 11.401754251  
pushed 133 [9, 6]  
iter= 54 len\_frontier= 22 popped= 125 [8, 16] depth= 10 dist2goal= 13.416407865  
iter= 55 len\_frontier= 21 popped= 5 [1, 6] depth= 4 dist2goal= 19.4164878389  
pushed 4 [1, 5]  
iter= 56 len\_frontier= 21 popped= 13 [1, 14] depth= 4 dist2goal= 19.4164878389  
pushed 14 [1, 15]  
iter= 57 len\_frontier= 21 popped= 25 [2, 6] depth= 5 dist2goal= 18.4390889146  
pushed 24 [2, 5]  
iter= 58 len\_frontier= 21 popped= 45 [3, 6] depth= 6 dist2goal= 17.4642491966  
pushed 44 [3, 5]  
iter= 59 len\_frontier= 21 popped= 64 [4, 6] depth= 7 dist2goal= 16.4924225025  
pushed 63 [4, 5]  
iter= 60 len\_frontier= 21 popped= 80 [5, 14] depth= 8 dist2goal= 15.5241746963  
pushed 79 [5, 13]  
iter= 61 len\_frontier= 21 popped= 83 [5, 17] depth= 7 dist2goal= 16.5529453572  
pushed 84 [5, 18]  
pushed 96 [6, 18]  
iter= 62 len\_frontier= 22 popped= 92 [6, 14] depth= 9 dist2goal= 14.5602197786  
pushed 91 [6, 13]  
iter= 63 len\_frontier= 22 popped= 102 [7, 6] depth= 10 dist2goal= 13.6014705087  
iter= 64 len\_frontier= 21 popped= 116 [8, 6] depth= 11 dist2goal= 12.6491106407  
iter= 65 len\_frontier= 20 popped= 95 [6, 17] depth= 8 dist2goal= 15.6524758425  
pushed 110 [7, 18]  
iter= 66 len\_frontier= 20 popped= 34 [2, 15] depth= 5 dist2goal= 18.6815416923  
pushed 35 [2, 16]  
iter= 67 len\_frontier= 20 popped= 141 [9, 14] depth= 12 dist2goal= 11.7046999107  
iter= 68 len\_frontier= 19 popped= 109 [7, 17] depth= 9 dist2goal= 14.7648230602  
pushed 127 [8, 18]  
iter= 69 len\_frontier= 19 popped= 126 [8, 17] depth= 10 dist2goal= 13.8924439894  
iter= 70 len\_frontier= 18 popped= 106 [7, 10] depth= 11 dist2goal= 13.0  
iter= 71 len\_frontier= 17 popped= 54 [3, 16] depth= 6 dist2goal= 18.0277563773  
pushed 55 [3, 17]

iter= 72 len\_frontier= 17 popped= 96 [6, 18] depth= 8 dist2goal= 16.1245154966  
pushed 97 [6, 19]  
pushed 111 [7, 19]  
iter= 73 len\_frontier= 18 popped= 122 [8, 12] depth= 12 dist2goal= 12.1655250606  
pushed 123 [8, 13]  
iter= 74 len\_frontier= 18 popped= 110 [7, 18] depth= 9 dist2goal= 15.2643375225  
pushed 128 [8, 19]  
iter= 75 len\_frontier= 18 popped= 79 [5, 13] depth= 9 dist2goal= 15.2970585408  
iter= 76 len\_frontier= 17 popped= 91 [6, 13] depth= 10 dist2goal= 14.3178210633  
iter= 77 len\_frontier= 16 popped= 140 [9, 13] depth= 13 dist2goal= 11.401754251  
iter= 78 len\_frontier= 15 popped= 127 [8, 18] depth= 10 dist2goal= 14.4222051019  
pushed 143 [9, 19]  
pushed 148 [10, 19]  
pushed 153 [11, 19]  
iter= 79 len\_frontier= 17 popped= 153 [11, 19] depth= 11 dist2goal= 12.7279220614  
pushed 154 [11, 20]  
pushed 158 [12, 19]  
pushed 159 [12, 20]  
iter= 80 len\_frontier= 19 popped= 158 [12, 19] depth= 12 dist2goal= 12.0415945788  
pushed 171 [13, 19]  
pushed 172 [13, 20]  
iter= 81 len\_frontier= 20 popped= 171 [13, 19] depth= 13 dist2goal= 11.401754251  
pushed 183 [14, 19]  
pushed 182 [14, 18]  
pushed 184 [14, 20]  
pushed 181 [14, 17]  
iter= 82 len\_frontier= 23 popped= 181 [14, 17] depth= 14 dist2goal= 9.21954445729  
pushed 180 [14, 16]  
pushed 194 [15, 17]  
pushed 195 [15, 18]  
iter= 83 len\_frontier= 25 popped= 180 [14, 16] depth= 15 dist2goal= 8.48528137424  
pushed 179 [14, 15]  
pushed 193 [15, 16]  
iter= 84 len\_frontier= 26 popped= 194 [15, 17] depth= 15 dist2goal= 8.60232526704  
pushed 207 [16, 17]  
pushed 208 [16, 18]  
iter= 85 len\_frontier= 27 popped= 193 [15, 16] depth= 16 dist2goal= 7.81024967591  
pushed 192 [15, 15]  
pushed 206 [16, 16]  
iter= 86 len\_frontier= 28 popped= 179 [14, 15] depth= 16 dist2goal= 7.81024967591  
pushed 170 [13, 15]  
iter= 87 len\_frontier= 28 popped= 182 [14, 18] depth= 14 dist2goal= 10.0  
pushed 196 [15, 19]  
iter= 88 len\_frontier= 28 popped= 207 [16, 17] depth= 16 dist2goal= 8.0622577483  
pushed 219 [17, 17]  
pushed 220 [17, 18]  
iter= 89 len\_frontier= 29 popped= 192 [15, 15] depth= 17 dist2goal= 7.07106781187  
pushed 191 [15, 14]  
pushed 205 [16, 15]

iter= 90 len\_frontier= 30 popped= 206 [16, 16] depth= 17 dist2goal= 7.21110255093  
pushed 218 [17, 16]  
iter= 91 len\_frontier= 30 popped= 205 [16, 15] depth= 18 dist2goal= 6.40312423743  
pushed 204 [16, 14]  
pushed 217 [17, 15]  
iter= 92 len\_frontier= 31 popped= 191 [15, 14] depth= 18 dist2goal= 6.40312423743  
pushed 190 [15, 13]  
iter= 93 len\_frontier= 31 popped= 195 [15, 18] depth= 15 dist2goal= 9.43398113206  
pushed 209 [16, 19]  
iter= 94 len\_frontier= 31 popped= 148 [10, 19] depth= 11 dist2goal= 13.4536240471  
pushed 149 [10, 20]  
iter= 95 len\_frontier= 31 popped= 71 [4, 17] depth= 7 dist2goal= 17.4642491966  
pushed 72 [4, 18]  
iter= 96 len\_frontier= 31 popped= 219 [17, 17] depth= 17 dist2goal= 7.61577310586  
pushed 233 [18, 17]  
pushed 234 [18, 18]  
iter= 97 len\_frontier= 32 popped= 4 [1, 5] depth= 5 dist2goal= 19.6468827044  
pushed 3 [1, 4]  
iter= 98 len\_frontier= 32 popped= 14 [1, 15] depth= 5 dist2goal= 19.6468827044  
pushed 15 [1, 16]  
iter= 99 len\_frontier= 32 popped= 204 [16, 14] depth= 19 dist2goal= 5.65685424949  
pushed 216 [17, 13]  
pushed 215 [17, 12]  
pushed 231 [18, 15]  
iter= 100 len\_frontier= 34 popped= 215 [17, 12] depth= 20 dist2goal= 3.60555127546  
iter= 101 len\_frontier= 33 popped= 216 [17, 13] depth= 20 dist2goal= 4.24264068712  
iter= 102 len\_frontier= 32 popped= 24 [2, 5] depth= 6 dist2goal= 18.6815416923  
pushed 23 [2, 4]  
iter= 103 len\_frontier= 32 popped= 133 [9, 6] depth= 13 dist2goal= 11.7046999107  
iter= 104 len\_frontier= 31 popped= 218 [17, 16] depth= 18 dist2goal= 6.7082039325  
pushed 232 [18, 16]  
iter= 105 len\_frontier= 31 popped= 44 [3, 5] depth= 7 dist2goal= 17.7200451467  
pushed 43 [3, 4]  
iter= 106 len\_frontier= 31 popped= 63 [4, 5] depth= 8 dist2goal= 16.7630546142  
pushed 62 [4, 4]  
iter= 107 len\_frontier= 31 popped= 159 [12, 20] depth= 12 dist2goal= 12.8062484749  
iter= 108 len\_frontier= 30 popped= 111 [7, 19] depth= 9 dist2goal= 15.8113883008  
pushed 112 [7, 20]  
pushed 129 [8, 20]  
iter= 109 len\_frontier= 31 popped= 183 [14, 19] depth= 14 dist2goal= 10.8166538264  
pushed 197 [15, 20]  
iter= 110 len\_frontier= 31 popped= 217 [17, 15] depth= 19 dist2goal= 5.83095189485  
iter= 111 len\_frontier= 30 popped= 190 [15, 13] depth= 19 dist2goal= 5.83095189485  
pushed 189 [15, 12]  
iter= 112 len\_frontier= 30 popped= 208 [16, 18] depth= 16 dist2goal= 8.94427191  
pushed 221 [17, 19]  
iter= 113 len\_frontier= 30 popped= 35 [2, 16] depth= 6 dist2goal= 18.973665961  
pushed 36 [2, 17]  
iter= 114 len\_frontier= 30 popped= 128 [8, 19] depth= 10 dist2goal= 15.0

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pushed 144 [9, 20]
iter= 115 len_frontier= 30 popped= 84 [5, 18] depth= 8 dist2goal= 17.0
pushed 85 [5, 19]
iter= 116 len_frontier= 30 popped= 172 [13, 20] depth= 13 dist2goal= 12.2065556157
iter= 117 len_frontier= 29 popped= 143 [9, 19] depth= 11 dist2goal= 14.2126704036
iter= 118 len_frontier= 28 popped= 233 [18, 17] depth= 18 dist2goal= 7.28010988928
pushed 251 [19, 17]
pushed 252 [19, 18]
iter= 119 len_frontier= 29 popped= 196 [15, 19] depth= 15 dist2goal= 10.295630141
pushed 210 [16, 20]
iter= 120 len_frontier= 29 popped= 232 [18, 16] depth= 19 dist2goal= 6.32455532034
pushed 250 [19, 16]
iter= 121 len_frontier= 29 popped= 123 [8, 13] depth= 13 dist2goal= 12.3693168769
iter= 122 len_frontier= 28 popped= 55 [3, 17] depth= 7 dist2goal= 18.3847763109
pushed 56 [3, 18]
iter= 123 len_frontier= 28 popped= 189 [15, 12] depth= 20 dist2goal= 5.38516480713
iter= 124 len_frontier= 27 popped= 231 [18, 15] depth= 20 dist2goal= 5.38516480713
pushed 249 [19, 15]
pushed 268 [20, 14]
iter= 125 len_frontier= 28 popped= 268 [20, 14] depth= 21 dist2goal= 4.0
pushed 269 [20, 15]
pushed 267 [20, 13]
pushed 248 [19, 13]
iter= 126 len_frontier= 30 popped= 267 [20, 13] depth= 22 dist2goal= 3.0
pushed 266 [20, 12]
pushed 247 [19, 12]
iter= 127 len_frontier= 31 popped= 266 [20, 12] depth= 23 dist2goal= 2.0
pushed 265 [20, 11]
pushed 246 [19, 11]
iter= 128 len_frontier= 32 popped= 265 [20, 11] depth= 24 dist2goal= 1.0
pushed 264 [20, 10]
pushed 245 [19, 10]
iter= 129 len_frontier= 33 popped= 264 [20, 10] depth= 25 dist2goal= 0.0
solution_path:
vertex 264 (20, 10)
vertex 265 (20, 11)
vertex 266 (20, 12)
vertex 267 (20, 13)
vertex 268 (20, 14)
vertex 231 (18, 15)
vertex 204 (16, 14)
vertex 205 (16, 15)
vertex 192 (15, 15)
vertex 193 (15, 16)
vertex 180 (14, 16)
vertex 181 (14, 17)
vertex 171 (13, 19)
vertex 158 (12, 19)
vertex 153 (11, 19)
```

vertex 127 (8, 18)  
vertex 109 (7, 17)  
vertex 94 (6, 16)  
vertex 81 (5, 15)  
vertex 69 (4, 15)  
vertex 53 (3, 15)  
vertex 33 (2, 14)  
vertex 32 (2, 13)  
vertex 31 (2, 12)  
vertex 30 (2, 11)  
vertex 9 (1, 10)

Some statistics:

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Search algorithm: ASTAR

Iteration Count: 129

max frontier size: 34

vertices visited: 161/275

Path length: 25

-----Completed Execution-----

[10, 1] to [10, 20]

iter= 0 len\_frontier= 1 popped= 145 [10, 1] depth= 0 dist2goal= 19.0

pushed 146 [10, 2]

pushed 130 [9, 1]

pushed 150 [11, 1]

pushed 151 [11, 2]

iter= 1 len\_frontier= 4 popped= 146 [10, 2] depth= 1 dist2goal= 18.0

pushed 145 [10, 1]

pushed 147 [10, 3]

pushed 131 [9, 2]

pushed 152 [11, 3]

iter= 2 len\_frontier= 7 popped= 147 [10, 3] depth= 2 dist2goal= 17.0

pushed 132 [9, 3]

iter= 3 len\_frontier= 7 popped= 151 [11, 2] depth= 1 dist2goal= 18.0277563773

pushed 156 [12, 2]

pushed 157 [12, 3]

iter= 4 len\_frontier= 8 popped= 152 [11, 3] depth= 2 dist2goal= 17.0293863659

iter= 5 len\_frontier= 7 popped= 157 [12, 3] depth= 2 dist2goal= 17.1172427686

pushed 162 [13, 3]

iter= 6 len\_frontier= 7 popped= 130 [9, 1] depth= 1 dist2goal= 19.0262975904

pushed 113 [8, 1]

iter= 7 len\_frontier= 7 popped= 150 [11, 1] depth= 1 dist2goal= 19.0262975904

pushed 155 [12, 1]

iter= 8 len\_frontier= 7 popped= 131 [9, 2] depth= 2 dist2goal= 18.0277563773

pushed 114 [8, 2]

iter= 9 len\_frontier= 7 popped= 132 [9, 3] depth= 3 dist2goal= 17.0293863659

pushed 115 [8, 3]

iter= 10 len\_frontier= 7 popped= 156 [12, 2] depth= 2 dist2goal= 18.1107702763

pushed 161 [13, 2]  
iter= 11 len\_frontier= 7 popped= 162 [13, 3] depth= 3 dist2goal= 17.2626765016  
pushed 175 [14, 3]  
iter= 12 len\_frontier= 7 popped= 145 [10, 1] depth= 2 dist2goal= 19.0  
iter= 13 len\_frontier= 6 popped= 155 [12, 1] depth= 2 dist2goal= 19.1049731745  
pushed 160 [13, 1]  
iter= 14 len\_frontier= 6 popped= 113 [8, 1] depth= 2 dist2goal= 19.1049731745  
pushed 99 [7, 1]  
iter= 15 len\_frontier= 6 popped= 114 [8, 2] depth= 3 dist2goal= 18.1107702763  
pushed 100 [7, 2]  
iter= 16 len\_frontier= 6 popped= 115 [8, 3] depth= 4 dist2goal= 17.1172427686  
pushed 101 [7, 3]  
iter= 17 len\_frontier= 6 popped= 161 [13, 2] depth= 3 dist2goal= 18.2482875909  
pushed 174 [14, 2]  
iter= 18 len\_frontier= 6 popped= 175 [14, 3] depth= 4 dist2goal= 17.4642491966  
pushed 187 [15, 3]  
iter= 19 len\_frontier= 6 popped= 160 [13, 1] depth= 3 dist2goal= 19.2353840617  
pushed 173 [14, 1]  
iter= 20 len\_frontier= 6 popped= 99 [7, 1] depth= 3 dist2goal= 19.2353840617  
pushed 87 [6, 1]  
iter= 21 len\_frontier= 6 popped= 100 [7, 2] depth= 4 dist2goal= 18.2482875909  
pushed 88 [6, 2]  
iter= 22 len\_frontier= 6 popped= 101 [7, 3] depth= 5 dist2goal= 17.2626765016  
pushed 89 [6, 3]  
iter= 23 len\_frontier= 6 popped= 174 [14, 2] depth= 4 dist2goal= 18.4390889146  
pushed 186 [15, 2]  
iter= 24 len\_frontier= 6 popped= 187 [15, 3] depth= 5 dist2goal= 17.7200451467  
pushed 200 [16, 3]  
iter= 25 len\_frontier= 6 popped= 173 [14, 1] depth= 4 dist2goal= 19.4164878389  
pushed 185 [15, 1]  
iter= 26 len\_frontier= 6 popped= 87 [6, 1] depth= 4 dist2goal= 19.4164878389  
pushed 75 [5, 1]  
iter= 27 len\_frontier= 6 popped= 88 [6, 2] depth= 5 dist2goal= 18.4390889146  
pushed 76 [5, 2]  
iter= 28 len\_frontier= 6 popped= 89 [6, 3] depth= 6 dist2goal= 17.4642491966  
pushed 77 [5, 3]  
iter= 29 len\_frontier= 6 popped= 186 [15, 2] depth= 5 dist2goal= 18.6815416923  
pushed 199 [16, 2]  
iter= 30 len\_frontier= 6 popped= 200 [16, 3] depth= 6 dist2goal= 18.0277563773  
pushed 213 [17, 3]  
iter= 31 len\_frontier= 6 popped= 185 [15, 1] depth= 5 dist2goal= 19.6468827044  
pushed 198 [16, 1]  
iter= 32 len\_frontier= 6 popped= 75 [5, 1] depth= 5 dist2goal= 19.6468827044  
pushed 59 [4, 1]  
iter= 33 len\_frontier= 6 popped= 76 [5, 2] depth= 6 dist2goal= 18.6815416923  
pushed 60 [4, 2]  
iter= 34 len\_frontier= 6 popped= 77 [5, 3] depth= 7 dist2goal= 17.7200451467  
pushed 61 [4, 3]  
iter= 35 len\_frontier= 6 popped= 199 [16, 2] depth= 6 dist2goal= 18.973665961

pushed 212 [17, 2]  
iter= 36 len\_frontier= 6 popped= 213 [17, 3] depth= 7 dist2goal= 18.3847763109  
pushed 225 [18, 3]  
pushed 226 [18, 4]  
pushed 227 [18, 5]  
iter= 37 len\_frontier= 8 popped= 227 [18, 5] depth= 8 dist2goal= 17.0  
pushed 228 [18, 6]  
pushed 241 [19, 5]  
pushed 242 [19, 6]  
pushed 214 [17, 8]  
iter= 38 len\_frontier= 11 popped= 214 [17, 8] depth= 9 dist2goal= 13.8924439894  
pushed 201 [16, 8]  
pushed 230 [18, 8]  
pushed 202 [16, 9]  
pushed 229 [18, 7]  
pushed 203 [16, 10]  
iter= 39 len\_frontier= 15 popped= 203 [16, 10] depth= 10 dist2goal= 11.6619037897  
pushed 188 [15, 8]  
iter= 40 len\_frontier= 15 popped= 202 [16, 9] depth= 10 dist2goal= 12.5299640861  
iter= 41 len\_frontier= 14 popped= 201 [16, 8] depth= 10 dist2goal= 13.416407865  
pushed 177 [14, 7]  
iter= 42 len\_frontier= 14 popped= 188 [15, 8] depth= 11 dist2goal= 13.0  
pushed 178 [14, 8]  
iter= 43 len\_frontier= 14 popped= 230 [18, 8] depth= 10 dist2goal= 14.4222051019  
pushed 244 [19, 8]  
iter= 44 len\_frontier= 14 popped= 177 [14, 7] depth= 11 dist2goal= 13.6014705087  
pushed 176 [14, 6]  
pushed 164 [13, 7]  
pushed 163 [13, 6]  
iter= 45 len\_frontier= 16 popped= 178 [14, 8] depth= 12 dist2goal= 12.6491106407  
pushed 165 [13, 8]  
iter= 46 len\_frontier= 16 popped= 228 [18, 6] depth= 9 dist2goal= 16.1245154966  
pushed 243 [19, 7]  
iter= 47 len\_frontier= 16 popped= 229 [18, 7] depth= 10 dist2goal= 15.2643375225  
iter= 48 len\_frontier= 15 popped= 164 [13, 7] depth= 12 dist2goal= 13.3416640641  
iter= 49 len\_frontier= 14 popped= 165 [13, 8] depth= 13 dist2goal= 12.3693168769  
iter= 50 len\_frontier= 13 popped= 242 [19, 6] depth= 9 dist2goal= 16.6433169771  
pushed 260 [20, 6]  
pushed 261 [20, 7]  
iter= 51 len\_frontier= 14 popped= 243 [19, 7] depth= 10 dist2goal= 15.8113883008  
pushed 262 [20, 8]  
iter= 52 len\_frontier= 14 popped= 226 [18, 4] depth= 8 dist2goal= 17.88854382  
pushed 240 [19, 4]  
iter= 53 len\_frontier= 14 popped= 198 [16, 1] depth= 6 dist2goal= 19.9248588452  
pushed 211 [17, 1]  
iter= 54 len\_frontier= 14 popped= 59 [4, 1] depth= 6 dist2goal= 19.9248588452  
pushed 40 [3, 1]  
iter= 55 len\_frontier= 14 popped= 60 [4, 2] depth= 7 dist2goal= 18.973665961  
pushed 41 [3, 2]

iter= 56 len\_frontier= 14 popped= 244 [19, 8] depth= 11 dist2goal= 15.0  
pushed 263 [20, 9]  
iter= 57 len\_frontier= 14 popped= 61 [4, 3] depth= 8 dist2goal= 18.0277563773  
pushed 62 [4, 4]  
pushed 42 [3, 3]  
iter= 58 len\_frontier= 15 popped= 62 [4, 4] depth= 9 dist2goal= 17.0880074906  
pushed 63 [4, 5]  
pushed 43 [3, 4]  
iter= 59 len\_frontier= 16 popped= 63 [4, 5] depth= 10 dist2goal= 16.1554944214  
pushed 64 [4, 6]  
pushed 44 [3, 5]  
iter= 60 len\_frontier= 17 popped= 64 [4, 6] depth= 11 dist2goal= 15.2315462117  
pushed 65 [4, 7]  
pushed 45 [3, 6]  
iter= 61 len\_frontier= 18 popped= 212 [17, 2] depth= 7 dist2goal= 19.3132079158  
pushed 224 [18, 2]  
iter= 62 len\_frontier= 18 popped= 65 [4, 7] depth= 12 dist2goal= 14.3178210633  
pushed 66 [4, 8]  
pushed 46 [3, 7]  
iter= 63 len\_frontier= 19 popped= 163 [13, 6] depth= 12 dist2goal= 14.3178210633  
iter= 64 len\_frontier= 18 popped= 261 [20, 7] depth= 10 dist2goal= 16.4012194669  
iter= 65 len\_frontier= 17 popped= 66 [4, 8] depth= 13 dist2goal= 13.416407865  
pushed 67 [4, 9]  
pushed 78 [5, 8]  
pushed 47 [3, 8]  
iter= 66 len\_frontier= 19 popped= 241 [19, 5] depth= 9 dist2goal= 17.4928556845  
pushed 259 [20, 5]  
iter= 67 len\_frontier= 19 popped= 67 [4, 9] depth= 14 dist2goal= 12.5299640861  
pushed 68 [4, 10]  
pushed 48 [3, 9]  
iter= 68 len\_frontier= 20 popped= 176 [14, 6] depth= 12 dist2goal= 14.5602197786  
iter= 69 len\_frontier= 19 popped= 262 [20, 8] depth= 11 dist2goal= 15.6204993518  
iter= 70 len\_frontier= 18 popped= 68 [4, 10] depth= 15 dist2goal= 11.6619037897  
pushed 49 [3, 10]  
pushed 50 [3, 11]  
pushed 51 [3, 12]  
pushed 52 [3, 13]  
iter= 71 len\_frontier= 21 popped= 52 [3, 13] depth= 16 dist2goal= 9.89949493661  
pushed 32 [2, 13]  
pushed 31 [2, 12]  
iter= 72 len\_frontier= 22 popped= 51 [3, 12] depth= 16 dist2goal= 10.6301458127  
pushed 30 [2, 11]  
iter= 73 len\_frontier= 22 popped= 225 [18, 3] depth= 8 dist2goal= 18.7882942281  
pushed 239 [19, 3]  
iter= 74 len\_frontier= 22 popped= 263 [20, 9] depth= 12 dist2goal= 14.8660687473  
pushed 264 [20, 10]  
pushed 245 [19, 10]  
iter= 75 len\_frontier= 23 popped= 245 [19, 10] depth= 13 dist2goal= 13.4536240471  
pushed 246 [19, 11]



pushed 265 [20, 11]  
iter= 76 len\_frontier= 24 popped= 246 [19, 11] depth= 14 dist2goal= 12.7279220614  
pushed 247 [19, 12]  
pushed 266 [20, 12]  
iter= 77 len\_frontier= 25 popped= 78 [5, 8] depth= 14 dist2goal= 13.0  
pushed 90 [6, 8]  
iter= 78 len\_frontier= 25 popped= 247 [19, 12] depth= 15 dist2goal= 12.0415945788  
pushed 248 [19, 13]  
pushed 267 [20, 13]  
iter= 79 len\_frontier= 26 popped= 264 [20, 10] depth= 13 dist2goal= 14.1421356237  
iter= 80 len\_frontier= 25 popped= 260 [20, 6] depth= 10 dist2goal= 17.2046505341  
iter= 81 len\_frontier= 24 popped= 40 [3, 1] depth= 7 dist2goal= 20.2484567313  
pushed 20 [2, 1]  
iter= 82 len\_frontier= 24 popped= 211 [17, 1] depth= 7 dist2goal= 20.2484567313  
pushed 223 [18, 1]  
iter= 83 len\_frontier= 24 popped= 41 [3, 2] depth= 8 dist2goal= 19.3132079158  
pushed 21 [2, 2]  
iter= 84 len\_frontier= 24 popped= 240 [19, 4] depth= 9 dist2goal= 18.3575597507  
pushed 258 [20, 4]  
iter= 85 len\_frontier= 24 popped= 42 [3, 3] depth= 9 dist2goal= 18.3847763109  
pushed 22 [2, 3]  
iter= 86 len\_frontier= 24 popped= 248 [19, 13] depth= 16 dist2goal= 11.401754251  
pushed 268 [20, 14]  
iter= 87 len\_frontier= 24 popped= 50 [3, 11] depth= 16 dist2goal= 11.401754251  
pushed 29 [2, 10]  
iter= 88 len\_frontier= 24 popped= 265 [20, 11] depth= 14 dist2goal= 13.4536240471  
iter= 89 len\_frontier= 23 popped= 43 [3, 4] depth= 10 dist2goal= 17.4642491966  
pushed 23 [2, 4]  
iter= 90 len\_frontier= 23 popped= 44 [3, 5] depth= 11 dist2goal= 16.5529453572  
pushed 24 [2, 5]  
iter= 91 len\_frontier= 23 popped= 32 [2, 13] depth= 17 dist2goal= 10.6301458127  
pushed 33 [2, 14]  
pushed 12 [1, 13]  
pushed 11 [1, 12]  
iter= 92 len\_frontier= 25 popped= 90 [6, 8] depth= 15 dist2goal= 12.6491106407  
pushed 104 [7, 8]  
iter= 93 len\_frontier= 25 popped= 45 [3, 6] depth= 12 dist2goal= 15.6524758425  
pushed 25 [2, 6]  
iter= 94 len\_frontier= 25 popped= 224 [18, 2] depth= 8 dist2goal= 19.6977156036  
pushed 238 [19, 2]  
iter= 95 len\_frontier= 25 popped= 46 [3, 7] depth= 13 dist2goal= 14.7648230602  
pushed 26 [2, 7]  
iter= 96 len\_frontier= 25 popped= 266 [20, 12] depth= 15 dist2goal= 12.8062484749  
iter= 97 len\_frontier= 24 popped= 47 [3, 8] depth= 14 dist2goal= 13.8924439894  
pushed 27 [2, 8]  
iter= 98 len\_frontier= 24 popped= 33 [2, 14] depth= 18 dist2goal= 10.0  
pushed 34 [2, 15]  
pushed 13 [1, 14]  
pushed 53 [3, 15]

```
iter= 99 len_frontier= 26 popped= 53 [3, 15] depth= 19 dist2goal= 8.60232526704
pushed 54 [3, 16]
pushed 69 [4, 15]
pushed 70 [4, 16]
iter= 100 len_frontier= 28 popped= 70 [4, 16] depth= 20 dist2goal= 7.21110255093
pushed 71 [4, 17]
pushed 82 [5, 16]
pushed 83 [5, 17]
iter= 101 len_frontier= 30 popped= 83 [5, 17] depth= 21 dist2goal= 5.83095189485
pushed 84 [5, 18]
pushed 95 [6, 17]
pushed 96 [6, 18]
iter= 102 len_frontier= 32 popped= 96 [6, 18] depth= 22 dist2goal= 4.472135955
pushed 97 [6, 19]
pushed 110 [7, 18]
pushed 111 [7, 19]
iter= 103 len_frontier= 34 popped= 111 [7, 19] depth= 23 dist2goal= 3.16227766017
pushed 112 [7, 20]
pushed 128 [8, 19]
pushed 129 [8, 20]
iter= 104 len_frontier= 36 popped= 129 [8, 20] depth= 24 dist2goal= 2.0
pushed 144 [9, 20]
iter= 105 len_frontier= 36 popped= 144 [9, 20] depth= 25 dist2goal= 1.0
pushed 143 [9, 19]
pushed 149 [10, 20]
iter= 106 len_frontier= 37 popped= 149 [10, 20] depth= 26 dist2goal= 0.0
solution_path:
vertex 149 (10, 20)
vertex 144 (9, 20)
vertex 129 (8, 20)
vertex 111 (7, 19)
vertex 96 (6, 18)
vertex 83 (5, 17)
vertex 70 (4, 16)
vertex 53 (3, 15)
vertex 33 (2, 14)
vertex 32 (2, 13)
vertex 52 (3, 13)
vertex 68 (4, 10)
vertex 67 (4, 9)
vertex 66 (4, 8)
vertex 65 (4, 7)
vertex 64 (4, 6)
vertex 63 (4, 5)
vertex 62 (4, 4)
vertex 61 (4, 3)
vertex 77 (5, 3)
vertex 89 (6, 3)
vertex 101 (7, 3)
```

vertex 115 (8, 3)  
vertex 132 (9, 3)  
vertex 147 (10, 3)  
vertex 146 (10, 2)  
vertex 145 (10, 1)

Some statistics:

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Search algorithm: ASTAR

Iteration Count: 106

max frontier size: 37

vertices visited: 142/275

Path length: 26

-----Completed Execution-----

[13, 6] to [7, 6]

iter= 0 len\_frontier= 1 popped= 163 [13, 6] depth= 0 dist2goal= 6.0

pushed 164 [13, 7]

pushed 176 [14, 6]

pushed 177 [14, 7]

iter= 1 len\_frontier= 3 popped= 164 [13, 7] depth= 1 dist2goal= 6.0827625303

pushed 163 [13, 6]

pushed 165 [13, 8]

pushed 178 [14, 8]

iter= 2 len\_frontier= 5 popped= 163 [13, 6] depth= 2 dist2goal= 6.0

iter= 3 len\_frontier= 4 popped= 176 [14, 6] depth= 1 dist2goal= 7.0

iter= 4 len\_frontier= 3 popped= 177 [14, 7] depth= 1 dist2goal= 7.07106781187

pushed 188 [15, 8]

pushed 201 [16, 8]

iter= 5 len\_frontier= 4 popped= 165 [13, 8] depth= 2 dist2goal= 6.32455532034

iter= 6 len\_frontier= 3 popped= 178 [14, 8] depth= 2 dist2goal= 7.28010988928

iter= 7 len\_frontier= 2 popped= 188 [15, 8] depth= 2 dist2goal= 8.24621125124

pushed 202 [16, 9]

pushed 203 [16, 10]

iter= 8 len\_frontier= 3 popped= 201 [16, 8] depth= 2 dist2goal= 9.21954445729

pushed 214 [17, 8]

iter= 9 len\_frontier= 3 popped= 202 [16, 9] depth= 3 dist2goal= 9.48683298051

iter= 10 len\_frontier= 2 popped= 203 [16, 10] depth= 3 dist2goal= 9.8488578018

iter= 11 len\_frontier= 1 popped= 214 [17, 8] depth= 3 dist2goal= 10.1980390272

pushed 230 [18, 8]

pushed 229 [18, 7]

pushed 228 [18, 6]

pushed 227 [18, 5]

iter= 12 len\_frontier= 4 popped= 228 [18, 6] depth= 4 dist2goal= 11.0

pushed 242 [19, 6]

pushed 243 [19, 7]

iter= 13 len\_frontier= 5 popped= 227 [18, 5] depth= 4 dist2goal= 11.0453610172

pushed 226 [18, 4]

pushed 241 [19, 5]

pushed 213 [17, 3]  
iter= 14 len\_frontier= 7 popped= 229 [18, 7] depth= 4 dist2goal= 11.0453610172  
pushed 244 [19, 8]  
iter= 15 len\_frontier= 7 popped= 230 [18, 8] depth= 4 dist2goal= 11.1803398875  
iter= 16 len\_frontier= 6 popped= 213 [17, 3] depth= 5 dist2goal= 10.4403065089  
pushed 212 [17, 2]  
pushed 200 [16, 3]  
pushed 225 [18, 3]  
pushed 199 [16, 2]  
iter= 17 len\_frontier= 9 popped= 200 [16, 3] depth= 6 dist2goal= 9.48683298051  
pushed 187 [15, 3]  
pushed 186 [15, 2]  
iter= 18 len\_frontier= 10 popped= 187 [15, 3] depth= 7 dist2goal= 8.54400374532  
pushed 175 [14, 3]  
pushed 174 [14, 2]  
iter= 19 len\_frontier= 11 popped= 175 [14, 3] depth= 8 dist2goal= 7.61577310586  
pushed 162 [13, 3]  
pushed 161 [13, 2]  
iter= 20 len\_frontier= 12 popped= 162 [13, 3] depth= 9 dist2goal= 6.7082039325  
pushed 157 [12, 3]  
pushed 156 [12, 2]  
iter= 21 len\_frontier= 13 popped= 157 [12, 3] depth= 10 dist2goal= 5.83095189485  
pushed 152 [11, 3]  
pushed 151 [11, 2]  
iter= 22 len\_frontier= 14 popped= 199 [16, 2] depth= 6 dist2goal= 9.8488578018  
pushed 198 [16, 1]  
pushed 185 [15, 1]  
iter= 23 len\_frontier= 15 popped= 186 [15, 2] depth= 7 dist2goal= 8.94427191  
pushed 173 [14, 1]  
iter= 24 len\_frontier= 15 popped= 152 [11, 3] depth= 11 dist2goal= 5.0  
pushed 147 [10, 3]  
pushed 146 [10, 2]  
iter= 25 len\_frontier= 16 popped= 174 [14, 2] depth= 8 dist2goal= 8.0622577483  
pushed 160 [13, 1]  
iter= 26 len\_frontier= 16 popped= 226 [18, 4] depth= 5 dist2goal= 11.1803398875  
pushed 240 [19, 4]  
iter= 27 len\_frontier= 16 popped= 161 [13, 2] depth= 9 dist2goal= 7.21110255093  
pushed 155 [12, 1]  
iter= 28 len\_frontier= 16 popped= 147 [10, 3] depth= 12 dist2goal= 4.24264068712  
pushed 132 [9, 3]  
pushed 131 [9, 2]  
iter= 29 len\_frontier= 17 popped= 156 [12, 2] depth= 10 dist2goal= 6.40312423743  
pushed 150 [11, 1]  
iter= 30 len\_frontier= 17 popped= 185 [15, 1] depth= 7 dist2goal= 9.43398113206  
iter= 31 len\_frontier= 16 popped= 173 [14, 1] depth= 8 dist2goal= 8.60232526704  
iter= 32 len\_frontier= 15 popped= 132 [9, 3] depth= 13 dist2goal= 3.60555127546  
pushed 115 [8, 3]  
pushed 114 [8, 2]  
iter= 33 len\_frontier= 16 popped= 151 [11, 2] depth= 11 dist2goal= 5.65685424949

pushed 145 [10, 1]  
iter= 34 len\_frontier= 16 popped= 212 [17, 2] depth= 6 dist2goal= 10.7703296143  
pushed 211 [17, 1]  
pushed 224 [18, 2]  
iter= 35 len\_frontier= 17 popped= 160 [13, 1] depth= 9 dist2goal= 7.81024967591  
iter= 36 len\_frontier= 16 popped= 146 [10, 2] depth= 12 dist2goal= 5.0  
pushed 130 [9, 1]  
iter= 37 len\_frontier= 16 popped= 242 [19, 6] depth= 5 dist2goal= 12.0  
pushed 260 [20, 6]  
pushed 261 [20, 7]  
iter= 38 len\_frontier= 17 popped= 243 [19, 7] depth= 5 dist2goal= 12.0415945788  
pushed 262 [20, 8]  
iter= 39 len\_frontier= 17 popped= 241 [19, 5] depth= 5 dist2goal= 12.0415945788  
pushed 259 [20, 5]  
iter= 40 len\_frontier= 17 popped= 155 [12, 1] depth= 10 dist2goal= 7.07106781187  
iter= 41 len\_frontier= 16 popped= 115 [8, 3] depth= 14 dist2goal= 3.16227766017  
pushed 101 [7, 3]  
pushed 100 [7, 2]  
iter= 42 len\_frontier= 17 popped= 244 [19, 8] depth= 5 dist2goal= 12.1655250606  
pushed 263 [20, 9]  
iter= 43 len\_frontier= 17 popped= 198 [16, 1] depth= 7 dist2goal= 10.295630141  
iter= 44 len\_frontier= 16 popped= 225 [18, 3] depth= 6 dist2goal= 11.401754251  
pushed 239 [19, 3]  
iter= 45 len\_frontier= 16 popped= 150 [11, 1] depth= 11 dist2goal= 6.40312423743  
iter= 46 len\_frontier= 15 popped= 131 [9, 2] depth= 13 dist2goal= 4.472135955  
pushed 113 [8, 1]  
iter= 47 len\_frontier= 15 popped= 145 [10, 1] depth= 12 dist2goal= 5.83095189485  
iter= 48 len\_frontier= 14 popped= 101 [7, 3] depth= 15 dist2goal= 3.0  
pushed 89 [6, 3]  
pushed 88 [6, 2]  
iter= 49 len\_frontier= 15 popped= 114 [8, 2] depth= 14 dist2goal= 4.12310562562  
pushed 99 [7, 1]  
iter= 50 len\_frontier= 15 popped= 240 [19, 4] depth= 6 dist2goal= 12.1655250606  
pushed 258 [20, 4]  
iter= 51 len\_frontier= 15 popped= 211 [17, 1] depth= 7 dist2goal= 11.1803398875  
pushed 223 [18, 1]  
iter= 52 len\_frontier= 15 popped= 130 [9, 1] depth= 13 dist2goal= 5.38516480713  
iter= 53 len\_frontier= 14 popped= 224 [18, 2] depth= 7 dist2goal= 11.7046999107  
pushed 238 [19, 2]  
iter= 54 len\_frontier= 14 popped= 260 [20, 6] depth= 6 dist2goal= 13.0  
iter= 55 len\_frontier= 13 popped= 100 [7, 2] depth= 15 dist2goal= 4.0  
pushed 87 [6, 1]  
iter= 56 len\_frontier= 13 popped= 261 [20, 7] depth= 6 dist2goal= 13.0384048104  
iter= 57 len\_frontier= 12 popped= 259 [20, 5] depth= 6 dist2goal= 13.0384048104  
iter= 58 len\_frontier= 11 popped= 113 [8, 1] depth= 14 dist2goal= 5.09901951359  
iter= 59 len\_frontier= 10 popped= 262 [20, 8] depth= 6 dist2goal= 13.152946438  
iter= 60 len\_frontier= 9 popped= 89 [6, 3] depth= 16 dist2goal= 3.16227766017  
pushed 77 [5, 3]  
pushed 76 [5, 2]

iter= 61 len\_frontier= 10 popped= 263 [20, 9] depth= 6 dist2goal= 13.3416640641  
pushed 264 [20, 10]  
pushed 245 [19, 10]  
iter= 62 len\_frontier= 11 popped= 239 [19, 3] depth= 7 dist2goal= 12.3693168769  
pushed 257 [20, 3]  
iter= 63 len\_frontier= 11 popped= 245 [19, 10] depth= 7 dist2goal= 12.6491106407  
pushed 246 [19, 11]  
pushed 265 [20, 11]  
iter= 64 len\_frontier= 12 popped= 99 [7, 1] depth= 15 dist2goal= 5.0  
iter= 65 len\_frontier= 11 popped= 223 [18, 1] depth= 8 dist2goal= 12.0830459736  
pushed 237 [19, 1]  
iter= 66 len\_frontier= 11 popped= 88 [6, 2] depth= 16 dist2goal= 4.12310562562  
pushed 75 [5, 1]  
iter= 67 len\_frontier= 11 popped= 258 [20, 4] depth= 7 dist2goal= 13.152946438  
iter= 68 len\_frontier= 10 popped= 264 [20, 10] depth= 7 dist2goal= 13.6014705087  
iter= 69 len\_frontier= 9 popped= 77 [5, 3] depth= 17 dist2goal= 3.60555127546  
pushed 61 [4, 3]  
pushed 60 [4, 2]  
iter= 70 len\_frontier= 10 popped= 238 [19, 2] depth= 8 dist2goal= 12.6491106407  
pushed 256 [20, 2]  
iter= 71 len\_frontier= 10 popped= 246 [19, 11] depth= 8 dist2goal= 13.0  
pushed 247 [19, 12]  
pushed 266 [20, 12]  
iter= 72 len\_frontier= 11 popped= 87 [6, 1] depth= 16 dist2goal= 5.09901951359  
iter= 73 len\_frontier= 10 popped= 257 [20, 3] depth= 8 dist2goal= 13.3416640641  
iter= 74 len\_frontier= 9 popped= 76 [5, 2] depth= 17 dist2goal= 4.472135955  
pushed 59 [4, 1]  
iter= 75 len\_frontier= 9 popped= 265 [20, 11] depth= 8 dist2goal= 13.9283882772  
iter= 76 len\_frontier= 8 popped= 237 [19, 1] depth= 9 dist2goal= 13.0  
pushed 255 [20, 1]  
iter= 77 len\_frontier= 8 popped= 61 [4, 3] depth= 18 dist2goal= 4.24264068712  
pushed 62 [4, 4]  
pushed 42 [3, 3]  
pushed 41 [3, 2]  
iter= 78 len\_frontier= 10 popped= 75 [5, 1] depth= 17 dist2goal= 5.38516480713  
iter= 79 len\_frontier= 9 popped= 247 [19, 12] depth= 9 dist2goal= 13.416407865  
pushed 248 [19, 13]  
pushed 267 [20, 13]  
iter= 80 len\_frontier= 10 popped= 256 [20, 2] depth= 9 dist2goal= 13.6014705087  
iter= 81 len\_frontier= 9 popped= 62 [4, 4] depth= 19 dist2goal= 3.60555127546  
pushed 63 [4, 5]  
pushed 43 [3, 4]  
iter= 82 len\_frontier= 10 popped= 60 [4, 2] depth= 18 dist2goal= 5.0  
pushed 40 [3, 1]  
iter= 83 len\_frontier= 10 popped= 63 [4, 5] depth= 20 dist2goal= 3.16227766017  
pushed 64 [4, 6]  
pushed 44 [3, 5]  
iter= 84 len\_frontier= 11 popped= 266 [20, 12] depth= 9 dist2goal= 14.3178210633  
iter= 85 len\_frontier= 10 popped= 59 [4, 1] depth= 18 dist2goal= 5.83095189485

iter= 86 len\_frontier= 9 popped= 248 [19, 13] depth= 10 dist2goal= 13.8924439894  
pushed 268 [20, 14]  
iter= 87 len\_frontier= 9 popped= 255 [20, 1] depth= 10 dist2goal= 13.9283882772  
iter= 88 len\_frontier= 8 popped= 42 [3, 3] depth= 19 dist2goal= 5.0  
pushed 22 [2, 3]  
pushed 21 [2, 2]  
iter= 89 len\_frontier= 9 popped= 64 [4, 6] depth= 21 dist2goal= 3.0  
pushed 65 [4, 7]  
pushed 45 [3, 6]  
iter= 90 len\_frontier= 10 popped= 43 [3, 4] depth= 20 dist2goal= 4.472135955  
pushed 23 [2, 4]  
iter= 91 len\_frontier= 10 popped= 41 [3, 2] depth= 19 dist2goal= 5.65685424949  
pushed 20 [2, 1]  
iter= 92 len\_frontier= 10 popped= 267 [20, 13] depth= 10 dist2goal= 14.7648230602  
iter= 93 len\_frontier= 9 popped= 44 [3, 5] depth= 21 dist2goal= 4.12310562562  
pushed 24 [2, 5]  
iter= 94 len\_frontier= 9 popped= 65 [4, 7] depth= 22 dist2goal= 3.16227766017  
pushed 66 [4, 8]  
pushed 46 [3, 7]  
iter= 95 len\_frontier= 10 popped= 40 [3, 1] depth= 19 dist2goal= 6.40312423743  
iter= 96 len\_frontier= 9 popped= 22 [2, 3] depth= 20 dist2goal= 5.83095189485  
pushed 2 [1, 3]  
pushed 1 [1, 2]  
iter= 97 len\_frontier= 10 popped= 45 [3, 6] depth= 22 dist2goal= 4.0  
pushed 25 [2, 6]  
iter= 98 len\_frontier= 10 popped= 268 [20, 14] depth= 11 dist2goal= 15.2643375225  
pushed 269 [20, 15]  
pushed 249 [19, 15]  
pushed 231 [18, 15]  
iter= 99 len\_frontier= 12 popped= 231 [18, 15] depth= 12 dist2goal= 14.2126704036  
pushed 232 [18, 16]  
pushed 217 [17, 15]  
pushed 250 [19, 16]  
pushed 204 [16, 14]  
iter= 100 len\_frontier= 15 popped= 204 [16, 14] depth= 13 dist2goal= 12.0415945788  
pushed 205 [16, 15]  
pushed 191 [15, 14]  
pushed 190 [15, 13]  
pushed 216 [17, 13]  
pushed 215 [17, 12]  
iter= 101 len\_frontier= 19 popped= 190 [15, 13] depth= 14 dist2goal= 10.6301458127  
pushed 189 [15, 12]  
iter= 102 len\_frontier= 19 popped= 189 [15, 12] depth= 15 dist2goal= 10.0  
iter= 103 len\_frontier= 18 popped= 191 [15, 14] depth= 14 dist2goal= 11.313708499  
pushed 192 [15, 15]  
iter= 104 len\_frontier= 18 popped= 215 [17, 12] depth= 14 dist2goal= 11.6619037897  
iter= 105 len\_frontier= 17 popped= 216 [17, 13] depth= 14 dist2goal= 12.2065556157  
iter= 106 len\_frontier= 16 popped= 23 [2, 4] depth= 21 dist2goal= 5.38516480713  
pushed 3 [1, 4]

```
iter= 107 len_frontier= 16 popped= 21 [2, 2] depth= 20 dist2goal= 6.40312423743
pushed 0 [1, 1]
iter= 108 len_frontier= 16 popped= 217 [17, 15] depth= 13 dist2goal= 13.4536240471
pushed 218 [17, 16]
iter= 109 len_frontier= 16 popped= 66 [4, 8] depth= 23 dist2goal= 3.60555127546
pushed 67 [4, 9]
pushed 78 [5, 8]
pushed 47 [3, 8]
iter= 110 len_frontier= 18 popped= 205 [16, 15] depth= 14 dist2goal= 12.7279220614
pushed 206 [16, 16]
iter= 111 len_frontier= 18 popped= 78 [5, 8] depth= 24 dist2goal= 2.82842712475
pushed 90 [6, 8]
iter= 112 len_frontier= 18 popped= 249 [19, 15] depth= 12 dist2goal= 15.0
pushed 270 [20, 16]
iter= 113 len_frontier= 18 popped= 192 [15, 15] depth= 15 dist2goal= 12.0415945788
pushed 193 [15, 16]
pushed 179 [14, 15]
iter= 114 len_frontier= 19 popped= 20 [2, 1] depth= 20 dist2goal= 7.07106781187
iter= 115 len_frontier= 18 popped= 24 [2, 5] depth= 22 dist2goal= 5.09901951359
pushed 4 [1, 5]
iter= 116 len_frontier= 18 popped= 46 [3, 7] depth= 23 dist2goal= 4.12310562562
pushed 26 [2, 7]
iter= 117 len_frontier= 18 popped= 90 [6, 8] depth= 25 dist2goal= 2.2360679775
pushed 104 [7, 8]
iter= 118 len_frontier= 18 popped= 179 [14, 15] depth= 16 dist2goal= 11.401754251
pushed 180 [14, 16]
pushed 170 [13, 15]
iter= 119 len_frontier= 19 popped= 2 [1, 3] depth= 21 dist2goal= 6.7082039325
iter= 120 len_frontier= 18 popped= 269 [20, 15] depth= 12 dist2goal= 15.8113883008
iter= 121 len_frontier= 17 popped= 170 [13, 15] depth= 17 dist2goal= 10.8166538264
iter= 122 len_frontier= 16 popped= 232 [18, 16] depth= 13 dist2goal= 14.8660687473
pushed 233 [18, 17]
pushed 251 [19, 17]
iter= 123 len_frontier= 17 popped= 104 [7, 8] depth= 26 dist2goal= 2.0
pushed 103 [7, 7]
pushed 105 [7, 9]
pushed 118 [8, 8]
pushed 119 [8, 9]
iter= 124 len_frontier= 20 popped= 103 [7, 7] depth= 27 dist2goal= 1.0
pushed 102 [7, 6]
pushed 117 [8, 7]
iter= 125 len_frontier= 21 popped= 25 [2, 6] depth= 23 dist2goal= 5.0
pushed 5 [1, 6]
iter= 126 len_frontier= 21 popped= 102 [7, 6] depth= 28 dist2goal= 0.0
solution_path:
vertex 102 (7, 6)
vertex 103 (7, 7)
vertex 104 (7, 8)
vertex 90 (6, 8)
```



vertex 78 (5, 8)  
vertex 66 (4, 8)  
vertex 65 (4, 7)  
vertex 64 (4, 6)  
vertex 63 (4, 5)  
vertex 62 (4, 4)  
vertex 61 (4, 3)  
vertex 77 (5, 3)  
vertex 89 (6, 3)  
vertex 101 (7, 3)  
vertex 115 (8, 3)  
vertex 132 (9, 3)  
vertex 147 (10, 3)  
vertex 152 (11, 3)  
vertex 157 (12, 3)  
vertex 162 (13, 3)  
vertex 175 (14, 3)  
vertex 187 (15, 3)  
vertex 200 (16, 3)  
vertex 213 (17, 3)  
vertex 227 (18, 5)  
vertex 214 (17, 8)  
vertex 201 (16, 8)  
vertex 177 (14, 7)  
vertex 163 (13, 6)

Some statistics:

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Search algorithm: ASTAR

Iteration Count: 126

max frontier size: 21

vertices visited: 146/275

Path length: 28

-----Completed Execution-----