

1. [3 marks] From a start position, here are the top two levels of a breadth-first-search of the 2×3 sliding tile puzzle (STP) graph. Beside each position, give taxicab score, number of inversions, and whether solvable (yes/no). For one position, we have answered for you.

3 5 2 TAXI 6
 4 1 _ INV 7
 SOL? no

3 5 2 TAXI 7 3 5 _ TAXI 7
 4 _ 1 INV 7 4 1 2 INV 7
 SOL? no SOL? no

2. [3 marks] For 2×3 STP 321450, `stp_search2.py` reports level 22: 0 nodes, no sol'n found, last position seen 450321. Using this info, give a solvable STP with shortest solution 21 moves.

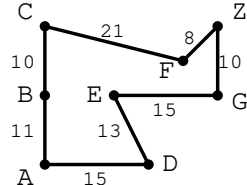
SHOW YOUR WORK HERE

your solvable STP 4 5 _
 1 2 3

Explain briefly here. _____

If you swap the labels for 3 and 1, the position 321450 becomes the solved state. Then, if you swap the labels for 3 and 1 in the position 450321, you get a position that is 21 moves away from the solved state.

3. [3 marks] Here is a road map and `astar.py` output after node D is done: show output after next node is done. ERD[x]: est. remaining dist to Z. DSF[x]: dist-so-far from A. ETD[x]: est. total dist A to x to Z.



	A	B	C	D	E	F	G	Z
ERD	28	26	24	22	18	7	10	0
DSF	0	11	21	15	inf	inf	inf	inf
ETD	0	37	45	37	inf	inf	inf	inf
done?	yes	yes		yes				
DSF	0	11	21	15	28	inf	inf	inf
ETD	0	37	45	37	46	inf	inf	inf
done?	yes	yes	yes	yes				

ROUGH WORK HERE

4. [3 marks] We ran `python3 15puzzle.py -p 14 15 13 12 10 9 8 11 7 6 4 1 5 2 3` three times, once for each schedule A,B,C. (Schedule A places tiles {1,2} first, etc.) For each run, in the solution found, guess the total moves made and nodes searched. Hint: each answer is in {74, 88, 120, 8615, 216085, 1538751}.

	moves made	nodes searched
A) [[1,2], [3,4], [5,6,7,8], [9,10,11,12,13,14,15]]	88	216,085
B) [[1], [2], [3,4], [5], [6], [7,8], [9,13], [10,14], [11,12,15]]	120	8,615
C) [[1,2,3,4], [5,9,13], [6,7,8,10,11,12,14,15]]	74	1,538,751

ROUGH WORK HERE

1. [3 marks] From a start position, here are the top two levels of a breadth-first-search of the 2×3 sliding tile puzzle (STP) graph. Beside each position, give taxicab score, number of inversions, and whether solvable (yes/no). For one position, we have answered for you.

4 5 2	TAXI	8		
3 1 _	INV	8		
	SOL?	yes		
4 5 2	TAXI	9	4 5 _	TAXI 9
3 _ 1	INV	8	3 1 2	INV 8
	SOL?	yes		SOL? yes

2. [3 marks] For 2×3 STP 132450, `stp_search2.py` reports level 22: 0 nodes, no sol'n found, last position seen 450132. Using this info, give a solvable STP with shortest solution 21 moves.

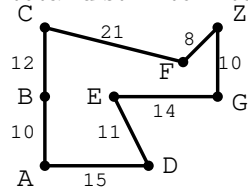
SHOW YOUR WORK HERE

your solvable STP 4 5 _
1 2 3

Explain briefly here. _____

If you swap the labels for 2 and 3, the position 132450 becomes the solved state. Then, if you swap the labels for 2 and 3 in the position 450132, you get a position that is 21 moves away from the solved state.

3. [3 marks] Here is a road map and `astar.py` output after node D is done: show output after next node is done. ERD[x]: est. remaining dist to Z. DSF[x]: dist-so-far from A. ETD[x]: est. total dist A to x to Z.



	A	B	C	D	E	F	G	Z
ERD	28	26	24	22	18	7	10	0
DSF	0	10	22	15	inf	inf	inf	inf
ETD	0	36	46	37	inf	inf	inf	inf
done?	yes	yes		yes				
DSF	0	10	22	15	26	inf	inf	inf
ETD	0	36	46	37	44	inf	inf	inf
done?	yes	yes		yes	yes			

ROUGH WORK HERE

4. [3 marks] We ran `python3 15puzzle.py -p 15 14 13 12 9 10 8 11 7 6 4 1 5 2 3` three times, once for each schedule A,B,C. (Schedule A places tile {1} first, etc.) For each run, in the solution found, guess the total moves made and nodes searched. Hint: each answer is in {78, 88, 124, 8665, 216311, 1658015}.

	moves made	nodes searched
A) [[1], [2], [3,4], [5], [6], [7,8], [9,13], [10,14], [11,12,15]]	124	8,665
B) [[1,2,3,4], [5,9,13], [6,7,8,10,11,12,14,15]]	78	1,658,015
C) [[1,2], [3,4], [5,6,7,8], [9,10,11,12,13,14,15]]	88	216,311

ROUGH WORK HERE