## Assignment 1

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## Task 2

Figure 1: Solvable and unsolvable 5x5 puzzle

Ø	-				×	6	<b>∅</b> –				×	
	1	2	2	1	3		4	1	1	2	3	
ĺ	1	3	3	2	3		3	3	2	3	1	
	1	2	2	2	2		2	1	1	3	1	
ĺ	3	2	1	1	4		1	1	2	1	2	
	4	2	4	4	0		3	2	2	3	0	
	0	1	3	2	3		0	2	3	4	1	
	1	2	Х	3	3		2	3	4	3	3	
	2	2	4	3	5		5	5	6	5	4	
	3	6	5	4	4		4	5	3	Х	2	
	Х	3	5	4	4		1	4	Х	2	Х	
	F	uncti	ion v	alue	4		Fu	ıncti	on va	lue:	-3	

Figure 2: Solvable and unsolvable 7x7 puzzle

Ø		_			)	×	9		_			>	×	
2	5	3	6	4	2	6	5	3	5	2	4	5	3	
5	2	3	5	2	1	2	1	1	3	2	1	2	2	
1	5	4	2	4	3	6	2	3	2	1	3	3	4	
6	5	3	1	4	2	2	1	2	3	3	4	3	2	
2	4	4	2	1	1	4	2	5	4	2	4	4	2	
3	5	1	2	4	5	1	5	3	5	3	5	5	3	
2	2	6	5	1	5	0	2	4	3	6	4	4	0	
0	7	1	3	Х	2	6	0	Х	Х	Х	Х	1	Х	
2	Х	5	5	4	3	4	X	Х	Х	Х	Х	Х	Х	
1	2	4	5	Х	3	3	Х	Х	Х	Х	Х	Х	Х	
2	Х	2	4	4	3	3	Х	Х	Х	Х	Х	Х	Х	
4	6	5	5	7	6	5	X	Х	Х	Х	Х	Х	Х	
5	7	Х	6	8	4	4	1	Х	Х	Х	Х	2	Х	
3	Х	3	4	Х	Х	5	X	Х	Х	Х	Х	Х	Х	
	F	uncti	on v	alue	5	Function value: -45								

Figure 3: Solvable and unsolvable 9x9 puzzle

0	tk		_			□ ×				Ø tk			_				×			
7	7	7	1	8	2	3	8	8		6	1	4	4	2	6	7	4	2		
3	6	3	5	1	5	3	1	5		3	7	5	2	5	6	2	2	6		
6	7	5	2	1	6	1	5	5		7	1	4	1	6	2	1	3	5		
6	2	2	4	5	2	3	3	5		2	3	5	4	4	2	6	2	1		
1	1	6	4	2	1	4	6	5		4	3	3	2	4	4	5	5	2		
4	4	5	2	4	5	4	5	6		6	4	1	3	2	4	5	2	8		
1	2	2	6	5	2	6	4	1		5	3	4	3	5	1	6	2	8		
6	4	7	5	4	7	2	2	5		5	4	7	4	1	7	1	6	3		
7	6	8	4	6	2	2	2	0		3	4	3	4	2	2	1	3	0		
0	Х	5	5	6	7	6	1	Х		0	6	6	Х	5	4	1	Х	Х		
2	6	Х	3	6	7	4	7	4		2	4	6	3	4	4	10	4	5		
Х	6	5	5	6	6	Х	4	4		Х	Х	8	7	6	10	9	10	6		
4	5	Х	6	4	6	5	7	Х		7	5	8	4	6	6	10	5	7		
3	4	5	5	6	5	5	6	6		3	6	7	6	4	7	6	Х	5		
4	5	4	Х	5	6	3	5	6		5	4	7	8	Х	3	6	5	Х		
7	8	Х	4	7	4	6	3	5		1	6	7	7	3	2	3	Х	6		
1	7	6	4	3	6	2	5	3		Х	4	8	5	7	3	2	3	6		
Х	9	Х	4	5	3	6	2	7		4	5	6	5	5	4	3	4	Х		
	Function value: 7										Function value: -11									

Figure 4: Solvable and unsolvable 11x11 puzzle

Ø	tk					_					Ø	<b>∅</b> tk					_			×	
5	7	3	6	10	6	7	6	4	10	10	2	3	10	9	5	7	10	3	8	7	5
9	9	1	8	1	2	2	2	1	9	3	1	1	5	1	8	4	9	2	7	8	6
7	8	4	1	3	4	2	8	8	5	2	9	1	7	2	1	4	3	5	7	7	9
4	4	6	1	7	1	5	7	5	6	7	10	6	8	4	3	4	4	3	2	4	10
3	2	7	5	5	5	6	2	1	5	5	3	7	5	7	6	2	1	7	8	5	10
8	2	2	1	5	1	4	7	2	6	2	6	6	1	6	4	3	3	3	6	8	1
2	1	4	6	4	4	4	3	4	6	2	10	5	2	4	1	5	6	4	3	5	6
9	5	5	4	5	7	2	1	1	5	1	8	8	8	6	6	6	6	1	4	5	5
2	6	1	3	5	8	4	7	5	3	6	6	4	8	5	3	2	2	1	2	5	1
6	9	3	8	5	8	3	4	7	6	9	10	9	8	2	8	8	2	1	6	8	5
10	7	4	1	9	7	7	7	8	7	0	7	7	10	2	1	2	6	10	4	5	0
0	9	Х	5	6	1	7	Х	6	4	7	0	5	1	10	6	10	12	8	Х	7	9
6	Х	Х	6	5	6	4	6	5	6	Х	6	5	5	13	8	7	12	6	11	4	Х
6	4	5	5	5	3	6	6	5	4	6	1	6	3	9	Х	9	10	9	Х	2	10
7	5	5	4	5	4	5	6	3	6	4	9	6	12	11	8	11	11	7	10	10	8
5	Х	Х	5	8	5	7	7	6	7	6	7	12	7	8	Х	13	12	8	13	Х	6
1	4	4	5	5	Х	3	7	2	6	3	8	10	9	10	7	8	9	11	8	10	10
4	3	4	4	5	2	5	5	4	3	5	7	Х	6	8	7	8	11	8	12	Х	8
6	4	5	Х	5	Х	5	4	3	4	4	8	Х	Х	12	8	10	11	10	9	8	9
5	7	6	5	6	Х	6	5	4	7	5	Х	11	7	10	10	9	10	10	11	9	8
7	8	6	5	9	6	4	6	Х	5	7	Х	4	4	11	8	6	12	11	12	3	5
6	5	5	Х	6	3	6	7	5	5	5	12	10	2	9	12	10	11	9	11	Х	Х
	Function value: 5													Fu	nctic	n va	lue: -	-14			

## Task 3

Figure 5: 5x5 puzzle hill climbing results at 100, 1000, and 10000 iterations. Run times were 0.2, 2.1, and 20.4 seconds respectively

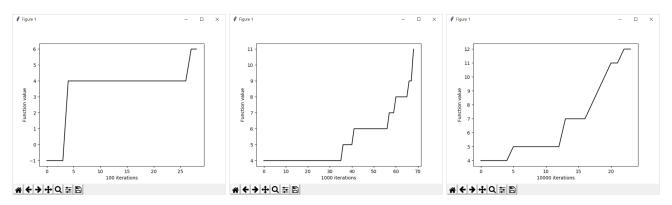


Figure 6: 7x7 puzzle hill climbing results at 100, 1000, and 10000 iterations. Run times were 1.1, 9.9, and 96.7 seconds respectively

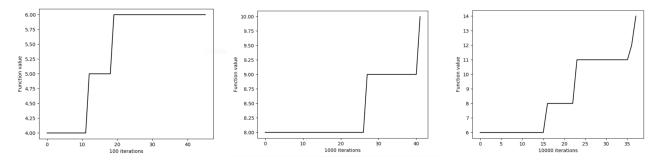


Figure 7: 9x9 puzzle hill climbing results at 100, 500, and 1000 iterations. Run times were 3.2, 17, and 33.4 seconds respectively

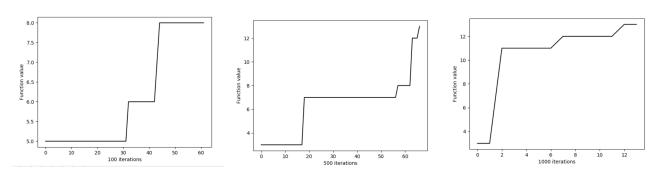


Figure 8: 11x11 puzzle hill climbing results at 100, 200, and 400 iterations. Run times were 8.7, 16.1, and 34.9 seconds respectively

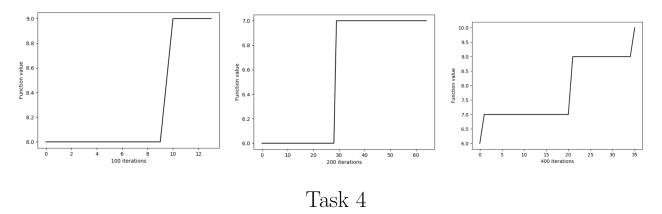


Figure 9: 5x5 puzzle hill climbing with random restarts results at 200x5, 2000x5, and 200x50 iterations. Run times were 2.1, 21, and 19.4 seconds respectively

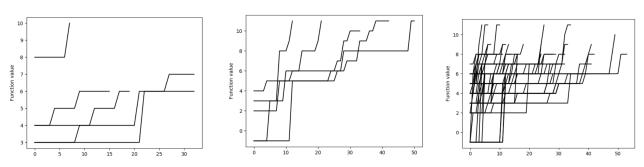


Figure 10: 7x7 puzzle hill climbing with random restarts results at 200x5, 2000x5, and 200x50 iterations. Run times were 9.4, 93.4, and 95.9 seconds respectively

