

Assignment 1

Kyle Reagle and Yigit Gungor

September 26, 2017

Task 2

Figure 1: Solvable and unsolvable 5x5 puzzle

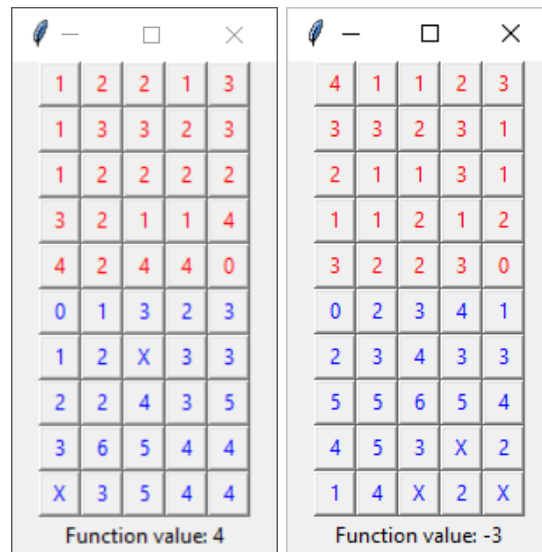



Figure 2: Solvable and unsolvable 7x7 puzzle

	—	□	×
2	5	3	6
5	2	3	5
1	5	4	2
6	5	3	1
2	4	4	2
3	5	1	2
2	2	6	5
0	7	1	3
2	X	5	5
1	2	4	5
2	X	2	4
4	6	5	5
5	7	X	6
3	X	3	4
Function value: 5			

	—	□	×
5	3	5	2
1	1	3	2
2	3	2	1
1	2	3	3
2	5	4	2
5	3	5	3
2	4	3	6
0	X	X	X
X	X	X	X
X	X	X	X
X	X	X	X
X	X	X	X
1	X	X	X
X	X	X	X
Function value: -45			

Figure 3: Solvable and unsolvable 9x9 puzzle

 tk	—	□	×
7	7	7	1
3	6	3	5
6	7	5	2
6	2	2	4
1	1	6	4
4	4	5	2
1	2	2	6
6	4	7	5
7	6	8	4
0	X	5	5
2	6	X	3
X	6	5	5
4	5	X	6
3	4	5	5
4	5	4	X
7	8	X	4
1	7	6	4
X	9	X	4
Function value: 7			


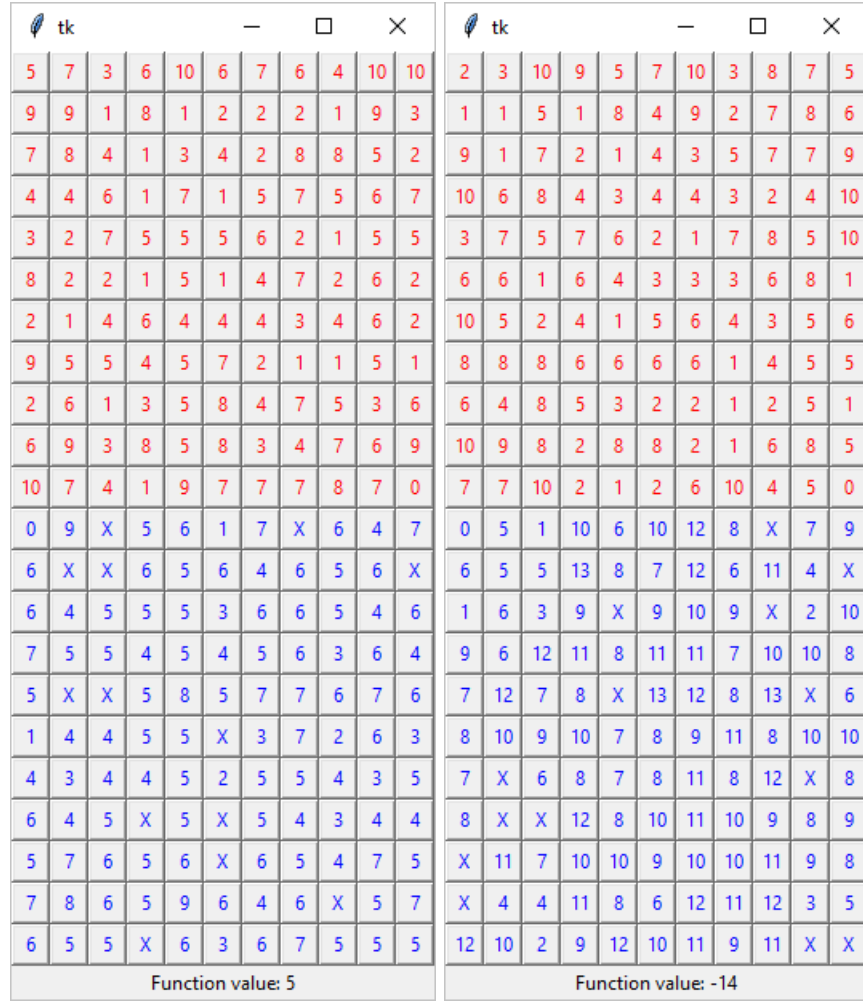
 tk	—	□	×
6	1	4	4
3	7	5	2
7	1	4	1
2	3	5	4
4	3	3	2
6	4	1	3
5	3	4	3
5	4	7	4
3	4	3	4
0	6	6	X
2	4	6	3
X	X	8	7
7	5	8	4
3	6	7	6
5	4	7	8
1	6	7	7
X	4	8	5
4	5	6	5
Function value: -11			

Figure 4: Solvable and unsolvable 11x11 puzzle



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

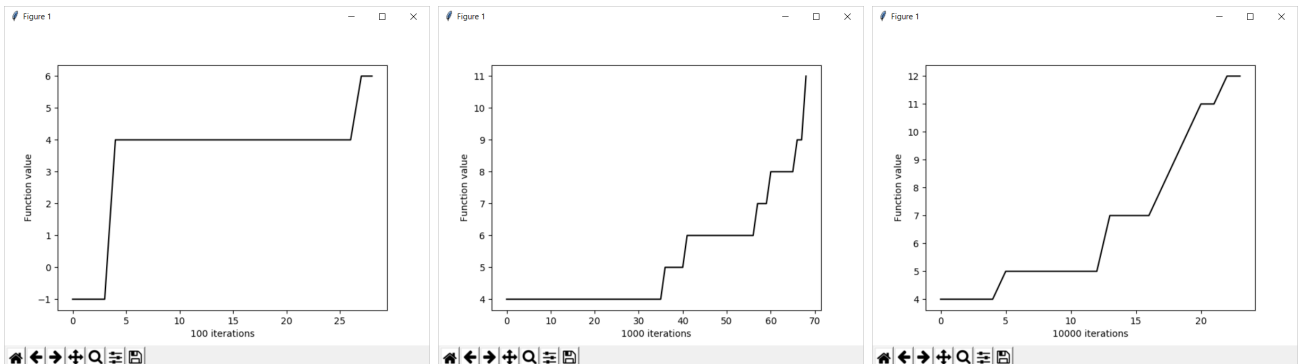


Figure 6: 7x7 puzzle hill climbing results at 100, 1000, and 10000 iterations. Run times were 1.1, 9.9, and 96.7 seconds respectively

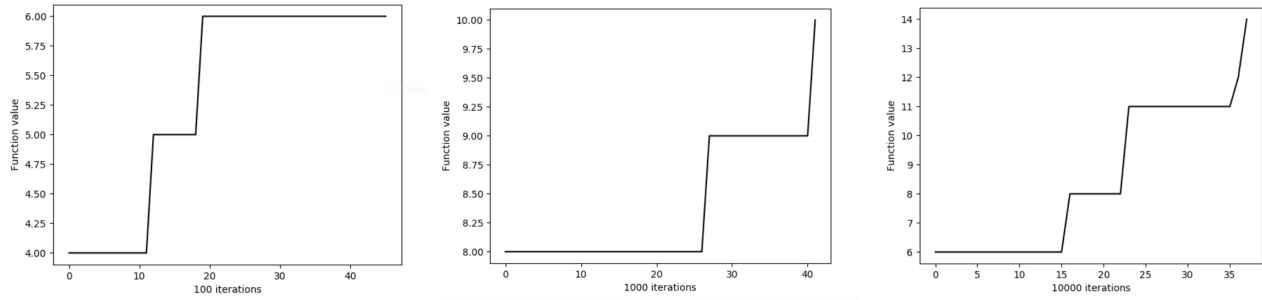


Figure 7: 9x9 puzzle hill climbing results at 100, 500, and 1000 iterations. Run times were 3.2, 17, and 33.4 seconds respectively

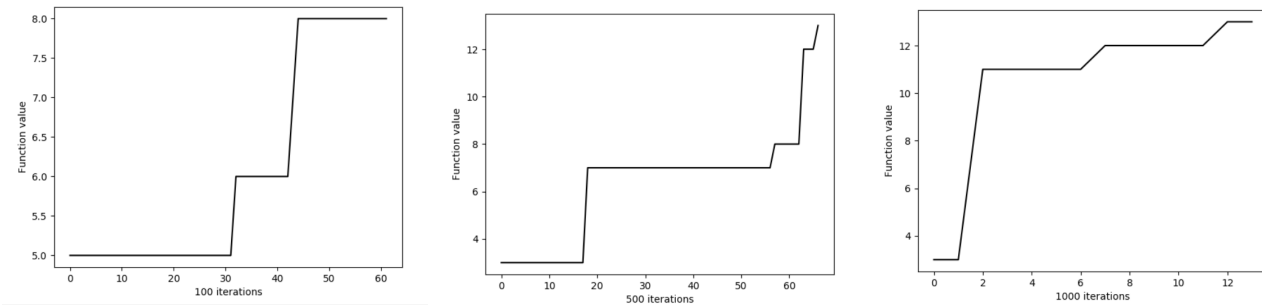
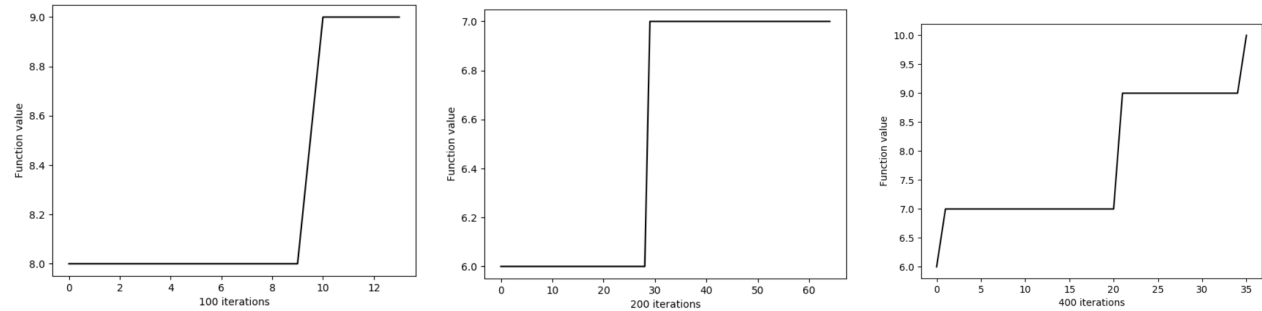


Figure 8: 11x11 puzzle hill climbing results at 100, 200, and 400 iterations. Run times were 8.7, 16.1, and 34.9 seconds respectively



Task 4

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

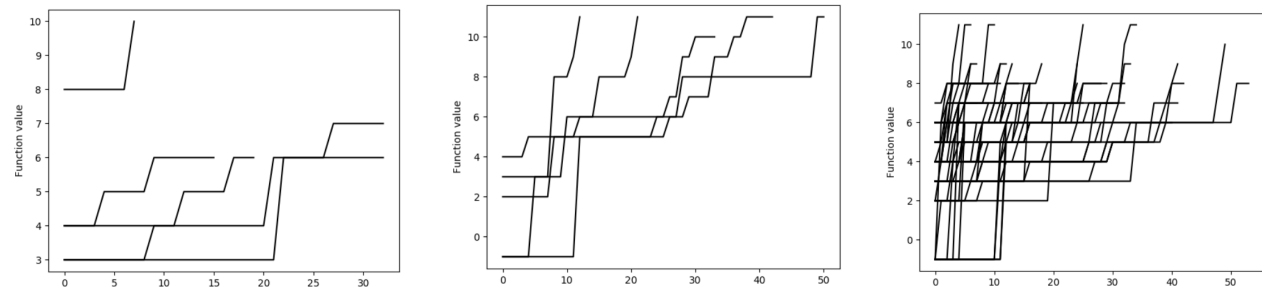


Figure 10: 7x7 puzzle hill climbing with random restarts results at 200x5, 2000x5, and 200x50 iterations. Run times were 9.4, 93.4, and 95.9 seconds respectively

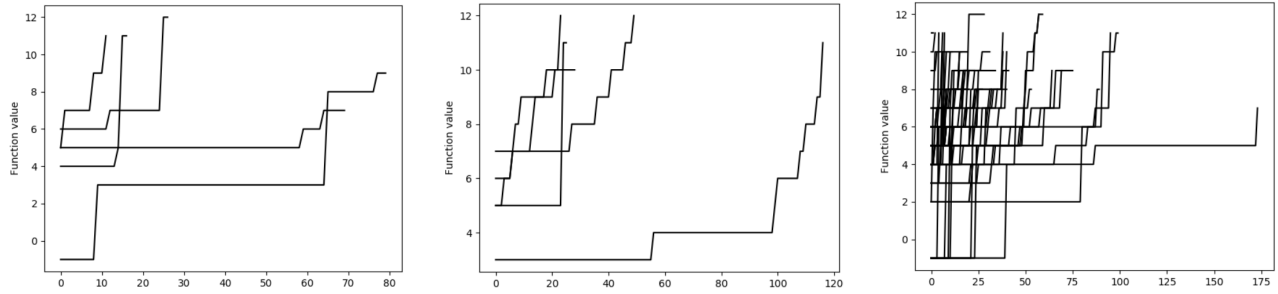


Figure 11: 9x9 puzzle hill climbing with random restarts results at 100x5, 100x10, and 1000x3 iterations. Run times were 14.6, 32.2, and 92.6 seconds respectively

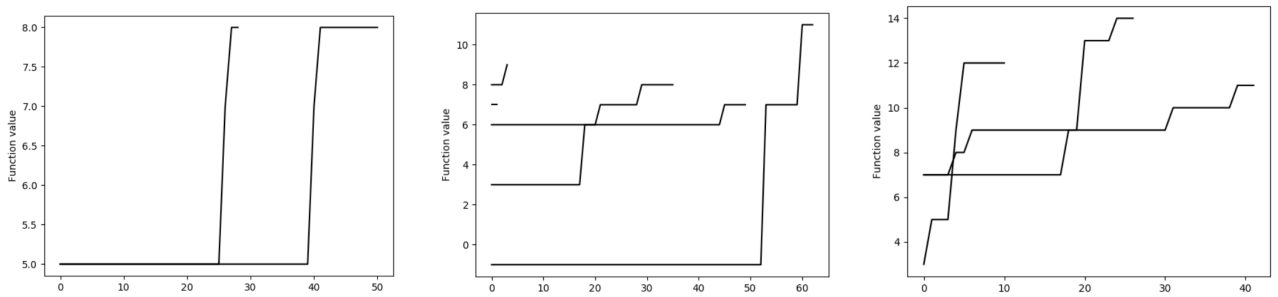
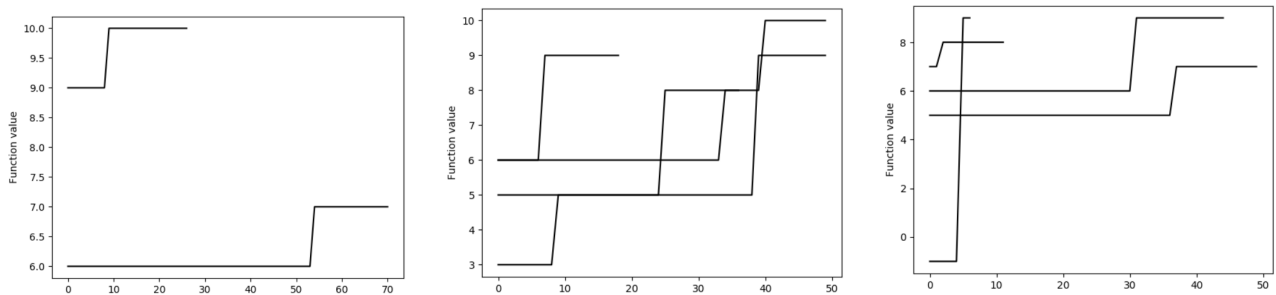


Figure 12: 11x11 puzzle hill climbing with random restarts results at 100x2, 50x4, and 100x4 iterations. Run times were 18.8, 17.2, and 32.8 seconds respectively



Task 5

Figure 13: 5x5 puzzle hill climbing with random walk results at 5000 iterations. Probability of accepting a downhill move was 0.2%, 1%, and 10% respectively. Run times were all about 10 seconds.

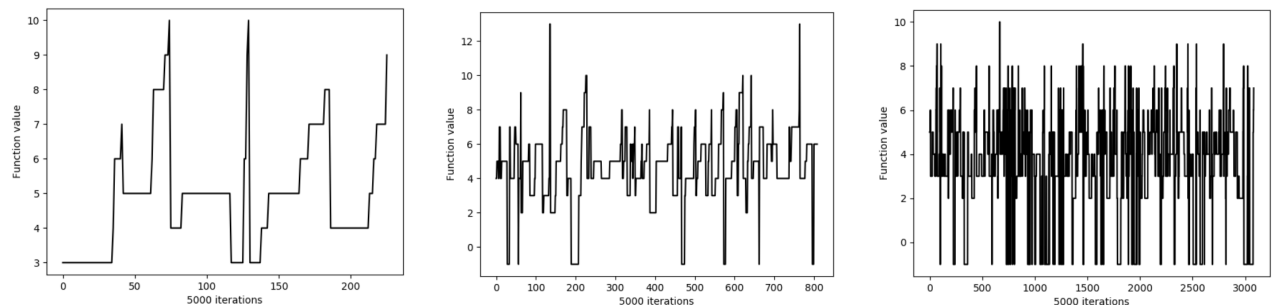


Figure 14: 7x7 puzzle hill climbing with random walk results at 1000 iterations. Probability of accepting a downhill move was 1%, 5%, and 10% respectively. Run times were all about 9 seconds.

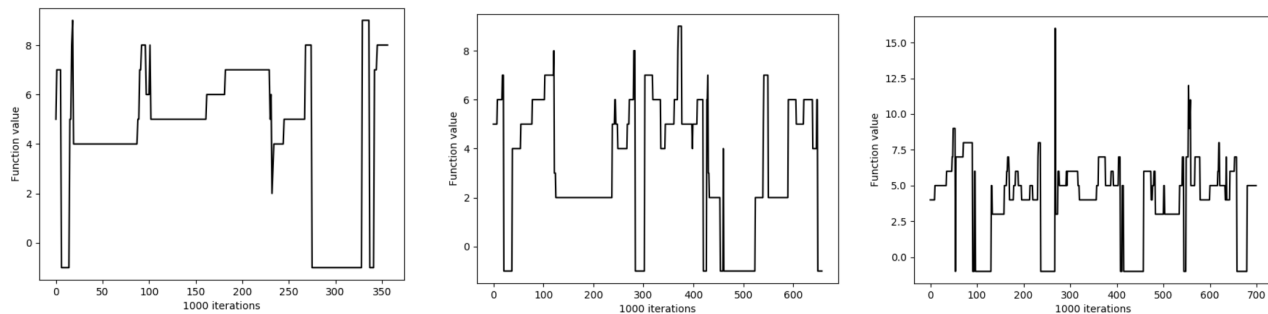


Figure 15: 9x9 puzzle hill climbing with random walk results at 1000 iterations. Probability of accepting a downhill move was 1%, 5%, and 10% respectively. Run times were all about 30 seconds.

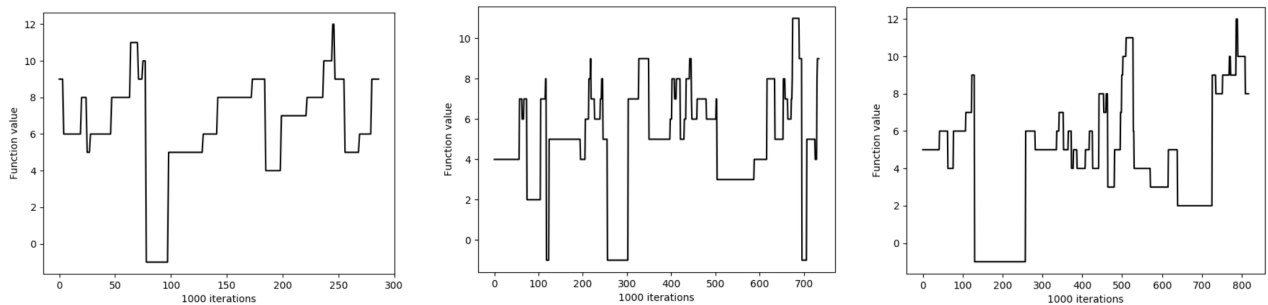
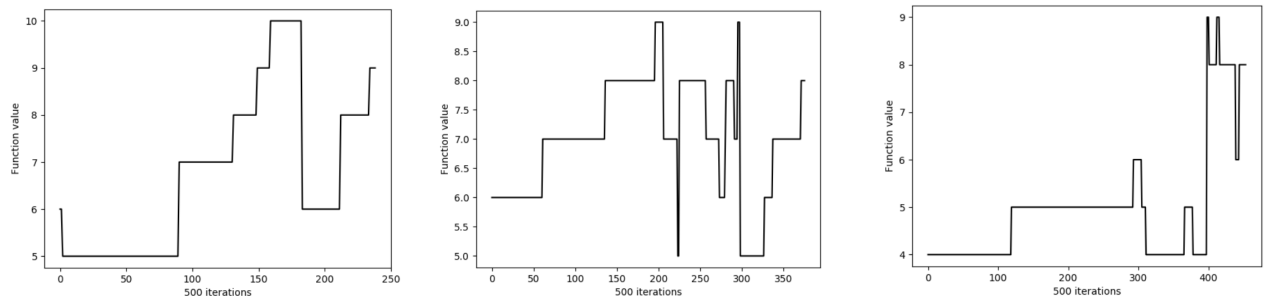


Figure 16: 11x11 puzzle hill climbing with random walk results at 500 iterations. Probability of accepting a downhill move was 1%, 5%, and 10% respectively. Run times were all about 45 seconds.



Task 6

Figure 17: 5x5 puzzle simulated annealing results at 5000 iterations. Initial temperatures were 10000, 1000, and 100, and decay rates were 0.9, 0.9, and 0.99 respectively. Run times were all about 10 seconds.

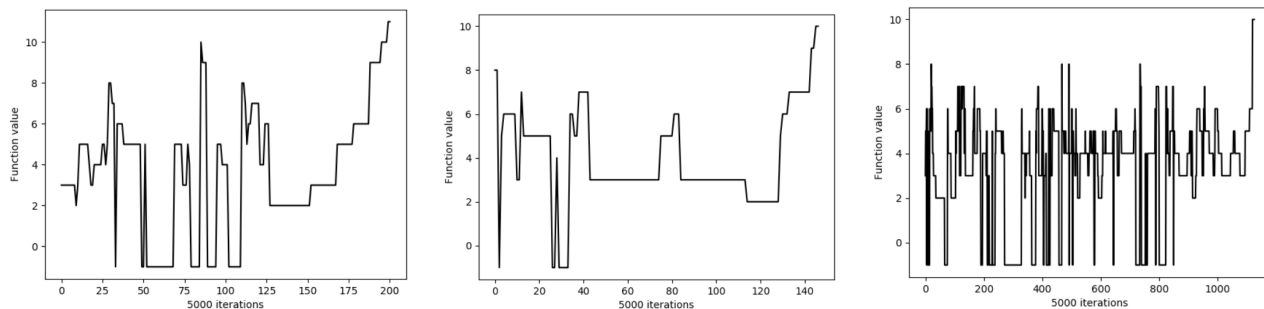


Figure 18: 7x7 puzzle simulated annealing results at 5000 iterations. Initial temperatures were 1000 and decay rates were 0.9, 0.75, and 0.99 respectively. Run times were all about 10 seconds.

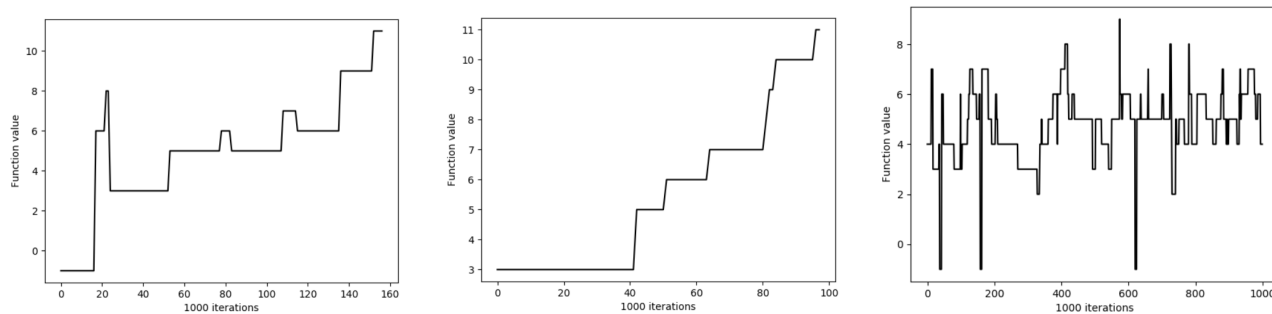


Figure 19: 9x9 puzzle simulated annealing results at 5000 iterations. Initial temperatures were 1000, 1000, 100 and decay rates were 0.9, 0.75, and 0.75 respectively. Run times were all about 15 seconds.

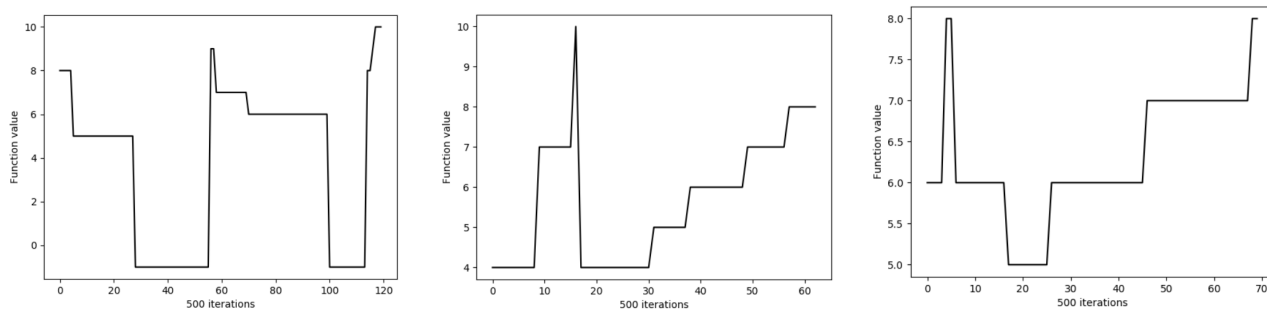


Figure 20: 11x11 puzzle simulated annealing results at 5000 iterations. Initial temperatures were 1000, 100, 1000 and decay rates were 0.9, 0.9, and 0.99 respectively. Run times were all about 42 seconds.

