

Zac Pullman 695145

The format of the results is a direct screen capture of the command line.

15puzzle is the executable and the puzzle implement is N.puzzle where N is the ID.

During testing some took longer due to the computer doing other things as well as running the 15puzzle (YouTube, Facebook ect). We see this in the expanded/second row. Typically had average of 5million nodes expanded per second. But during testing see around 3.8million.

Implemented a basic version of the pruning described in Richard E. Korf and Larry A. Taylor , finding optimal solution to 24 puzzle.

N	Initial state (s0)	Heuristic h(s0)	Cost	Nodes expanded (nearest mil)
1	14 13 15 7 11 12 9 5 6 0 2 1 4 8 10 3	41	57	500M
2	13 5 4 10 9 12 8 14 2 3 7 1 0 15 11 6	43	55	19M
3	14 7 8 2 13 11 10 4 9 12 5 0 3 6 1 15	41	59	455M
4	5 12 10 7 15 11 14 0 8 2 1 13 3 4 9 6	42	56	82M
14	7 6 8 1 11 5 14 10 3 4 9 13 15 2 0 12	41	59	938M
88	15 2 12 11 14 13 9 5 1 3 8 7 0 10 6 4	43	65	6195M

```
$ ./15puzzle 1.puzzle
14 13 15 7
11 12 9 5
6 0 2 1
4 8 10 3
Initial Estimate = 41
Threshold = 43 45 47 49 51 53 55 57
Solution = 57
Generated = 253,079,569
Expanded = 499,911,606
Time (seconds) = 133.44
Expanded/Second = 3,746,423
```

```
$ ./15puzzle 2.puzzle
13 5 4 10
9 12 8 14
2 3 7 1
0 15 11 6
Initial Estimate = 43
Threshold = 45 47 49 51 53 55
Solution = 55
Generated = 9,777,817
Expanded = 18,983,862
Time (seconds) = 3.80
Expanded/Second = 5,001,017
```

```
01422@LAPTOP-B0B2F8B8 /cygar/ve/c/users/01422/  
$ ./15puzzle 3.puzzle  
14 7 8 2  
13 11 10 4  
9 12 5 0  
3 6 1 15  
Initial Estimate = 41  
Threshold = 43 45 47 49 51 53 55 57 59  
Solution = 59  
Generated = 229,658,364  
Expanded = 455,125,298  
Time (seconds) = 112.86  
Expanded/Second = 4,032,725
```

```
01422@LAPTOP-B0B2F8B8 /cygar/ve/c/users/01422/  
$ ./15puzzle 4.puzzle  
5 12 10 7  
15 11 14 0  
8 2 1 13  
3 4 9 6  
Initial Estimate = 42  
Threshold = 44 46 48 50 52 54 56  
Solution = 56  
Generated = 41,689,061  
Expanded = 82,631,583  
Time (seconds) = 16.59  
Expanded/Second = 4,979,906
```

```
$ ./15puzzle 14.puzzle  
7 6 8 1  
11 5 14 10  
3 4 9 13  
15 2 0 12  
Initial Estimate = 41  
Threshold = 43 45 47 49 51 53 55 57 59  
Solution = 59  
Generated = 475,109,940  
Expanded = 937,956,626  
Time (seconds) = 275.31  
Expanded/Second = 3,406,898
```

```
$ ./15puzzle 88.puzzle
15  2 12 11
14 13  9  5
 1  3  8  7
 0 10  6  4
Initial Estimate = 43
Threshold = 45 47 49 51 53 55 57 59 61 63 65
Solution = 65
Generated = 3,176,234,880
Expanded = 6,195,467,140
Time (seconds) = 1716.95
Expanded/Second = 3,608,408
```

```
$ ./15puzzle 88.puzzle
15  2 12 11
14 13  9  5
 1  3  8  7
 0 10  6  4
Initial Estimate = 43
Threshold =
Solution = 65
Generated = 3,176,234,880
Expanded = 6,195,467,140
Time (seconds) = 1041.94
Expanded/Second = 5,946,099
```