

# Assignment 4, TDT4136

Silje Anfindsen

**Screenshots from terminal after running each of the four boards.**

Including for each board:

- Solution
- number of times BACKTRACK function was called
- number of times BACKTRACK function returned failure for each board

```

Solution to easy.txt
 7 8 4 | 9 3 2 | 1 5 6
 6 1 9 | 4 8 5 | 3 2 7
 2 3 5 | 1 7 6 | 4 8 9
-----+-----+-----
 5 7 8 | 2 6 1 | 9 3 4
 3 4 1 | 8 9 7 | 5 6 2
 9 2 6 | 5 4 3 | 8 7 1
-----+-----+-----
 4 5 3 | 7 2 9 | 6 1 8
 8 6 2 | 3 1 4 | 7 9 5
 1 9 7 | 6 5 8 | 2 4 3

Number of backtracks: 108

Number of failures: 60
```

```

Solution to medium.txt
 8 7 5 | 9 3 6 | 1 4 2
 1 6 9 | 7 2 4 | 3 8 5
 2 4 3 | 8 5 1 | 6 7 9
-----+-----+-----
 4 5 2 | 6 9 7 | 8 3 1
 9 8 6 | 4 1 3 | 2 5 7
 7 3 1 | 5 8 2 | 9 6 4
-----+-----+-----
 5 1 7 | 3 6 9 | 4 2 8
 6 2 8 | 1 4 5 | 7 9 3
 3 9 4 | 2 7 8 | 5 1 6

Number of backtracks: 537

Number of failures: 490
```

```

Solution to hard.txt
1 5 2 | 3 4 6 | 8 9 7
4 3 7 | 1 8 9 | 6 5 2
6 8 9 | 5 7 2 | 3 1 4
-----+-----+-----
8 2 1 | 6 3 7 | 9 4 5
5 4 3 | 8 9 1 | 7 2 6
9 7 6 | 4 2 5 | 1 8 3
-----+-----+-----
7 9 8 | 2 5 3 | 4 6 1
3 6 5 | 9 1 4 | 2 7 8
2 1 4 | 7 6 8 | 5 3 9

Number of backtracks: 572
Number of failures: 521

```

```

Solution to veryhard.txt
4 3 1 | 8 6 7 | 9 2 5
6 5 2 | 4 9 1 | 3 8 7
8 9 7 | 5 3 2 | 1 6 4
-----+-----+-----
3 8 4 | 9 7 6 | 5 1 2
5 1 9 | 2 8 4 | 7 3 6
2 7 6 | 3 1 5 | 8 4 9
-----+-----+-----
9 4 3 | 7 2 8 | 6 5 1
7 6 5 | 1 4 3 | 2 9 8
1 2 8 | 6 5 9 | 4 7 3

Number of backtracks: 5631
Number of failures: 5581

```

### Comments on the results for each board:

First, I noticed that the algorithm uses remarkable more time for the difficult boards compared to easy and medium. Another observations is the ratio between number of times BACKTRACK is called and failed. The ratio is closer to 1 for the more difficult boards indicating that the algorithm performs worse for difficult constraint satisfaction problems.

This can be due to for example the lack of a heuristic function, for example the least constraining value, when we decide the order of domain values chosen in the BACKTRACK function. Maybe this would have improved especially total number of failures of the BACKTRACK function.