**CS171: Introduction to Artificial Intelligence**

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**Sudoku Project Report**

1. A. Generate a set of 5 boards with P = 3, Q = 3, M = 15.

B. Run your Sudoku solver on the generated boards and fill in the following table:

|  |  |  |
| --- | --- | --- |
|  | Trail Pushes | Backtracks |
| FC | 3037 | 43 |
| FC MRV | 3660 | 78 |
| FC LCV | 2812 | 23 |
| FC MRV LCV | 2591 | 2 |
| NOR | 2914 | 28 |
| NOR MRV LCV | 2546 | 0 |
| NOR DEG LCV | 539658 | 35222 |
| NOR MAD LCV | 2552 | 4 |

C. Which set of heuristics produced the best results? Explain.

The best set of heuristics was produced by NOR MRV LCV with the lowest amount of trail pushes and zero backtracks.

D. Describe any anomalies or patterns. Explain in detail.

NOR DEG LCV took an incredibly long time to complete and produced a very high number of backtracks and trail pushes. NOR DEG LCV has nowhere near the performance of any of the other heuristics. Except for in the case of DEG, when LCV is added to any heuristics the amount of backtracks drops a considerable amount.

1. A. Generate a set of 5 boards with P = 4, Q = 3, M = 25.

B. Run your Sudoku solver on the generated boards and fill in the following table:

|  |  |  |
| --- | --- | --- |
|  | Trail Pushes | Backtracks |
| FC | 1240667 | 14304 |
| FC MRV | 152619 | 19393 |
| FC LCV | 353060 | 46775 |
| FC MRV LCV | 352181 | 41438 |
| NOR | 50441 | 3347 |
| NOR MRV LCV | 16753 | 1003 |
| NOR DEG LCV | infinite | infinite |
| NOR MAD LCV | 58330 | 4310 |

C. Which set of heuristics produced the best results? Explain.

NOR MRV LCV produced the least amount of trail pushes and backtracks. This was consistent with the results we got from the previous set of boards and was as expected.

D. Describe any anomalies or patterns. Explain in detail.

NOR DEG LCV ran for approximately 6 hours before I terminated it. This was not out of line with the results that previous set of boards produced but for it to run infinitely was not expected. The results for the set of heuristics using FC were interesting. They did not follow the same pattern as in the previous set of boards. The number of trail pushes for FC alone was extremely high and not on the same magnitude as it was in the previous set of boards.

1. A. Generate a set of 3 boards with P = 4, Q = 4, M = 45.

B. Run your Sudoku solver on the generated boards and fill in the following table:

|  |  |  |
| --- | --- | --- |
|  | Trail Pushes | Backtracks |
| FC | infinite | infinite |
| FC MRV | infinite | infinite |
| FC LCV | Infinite | infinite |
| FC MRV LCV | infinite | infinite |
| NOR | infinite | infinite |
| NOR MRV LCV | infinite | infinite |
| NOR DEG LCV | Infinite | Infinite |
| NOR MAD LCV | infinite | infinite |

C. Which set of heuristics produced the best results? Explain.

All of the heuristics produced the same results.

D. Describe any anomalies or patterns. Explain in detail.

None of the boards were able to be solved even after letting the program run overnight.

1. Did the same set of heuristics produce the best results for (1), (2), and (3)? If not, explain why this might have happened.

N/A

1. Did you implement the Extra Credit heuristics? If so, which heuristics did you implement? Why did you choose these heuristics? How did they compare to the results in questions (1), (2), and (3).

Yes. We entered our regular LCV, MRV and NOR into the tournament without any extra modifications. We chose these heuristics because they produced consistently good results on the sets of boards that we used for testing during development. While number 3 can be counted out since no results were produced, the results in 1 and 2 were consistent with our previous test results during development.

1. Did you encounter any problem when doing the project? How did you resolve these problems?

We did not encounter anything out of the ordinary during development. Once we learned our way around the shell, it was fairly easy to translate the heuristics into working code.

1. (Optional) Do you have any suggestions to improve the shells?