NTNU

Assignment 2

Introduksjon til Kunstig Intelligens

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Contents

1 Solution

1.1 Sudoku solutions

The terminal outputs include: (1) AC-3 time, (2) domain summary after AC-3 (min/max/avg/singles/total), (3) the solved grid, (4) backtracking time, (5) total time, (6) `backtrack()` calls, and (7) `backtrack()` failures.

- **Board (a) Easy:**

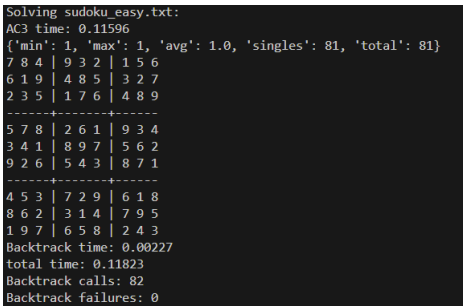

Figure 1: Easy sudoku results

Comment: AC-3 alone reduces all domains to singletons (81 singles), so backtracking is essentially not needed (0 failures).

- **Board (b) Medium:**

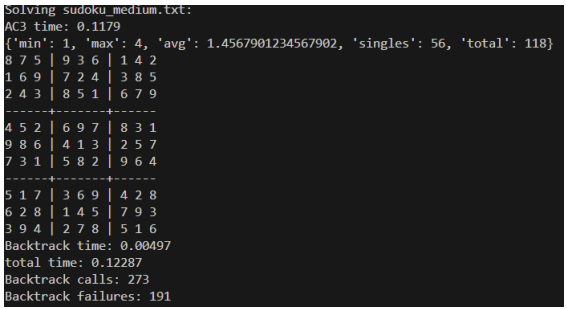

Figure 2: Medium sudoku results

- **Board (c) Hard:**

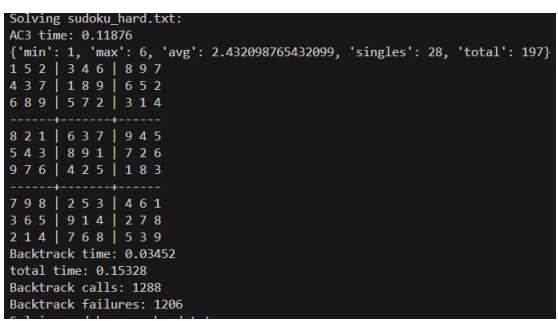

Figure 3: Hard sudoku results

- **Board (d) Very hard:**

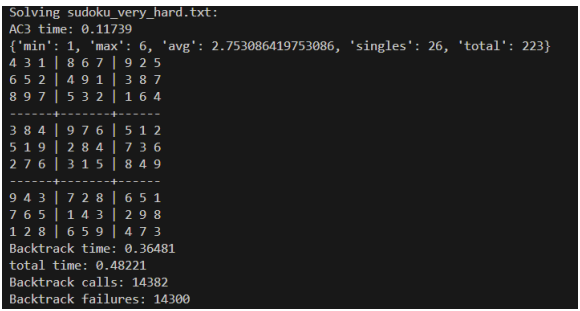

Figure 4: Very hard sudoku results

1.2 Domains after AC-3

- **Easy:** min =1, max =1, avg=1.00, singles=81, total=81
- **Medium:** min =1, max =4, avg=1.4568, singles=56, total=118.
- **Hard:** min =1, max =6, avg=2.4321, singles=28, total=197.
- **Very hard:** min =1, max =6, avg=2.7531, singles=26, total=223.

1.3 Timing and search statistics

Board	AC-3 (s)	BT (s)	Total (s)	Calls	Failures
Easy	0.11596	0.00227	0.11823	82	0
Medium	0.11790	0.00497	0.12287	273	191
Hard	0.11876	0.03452	0.15328	1288	1206
Very hard	0.11739	0.36481	0.48221	14382	14300

1.4 Discussion

AC-3 enforces arc consistency before the backtracking search by removing values that have no supporting values in neighboring variables. On the easy board, AC-3 collapses all domains to singletons, leaving nothing for backtracking to decide (0 failures). For progressively harder boards, AC-3 still shrinks domains markedly (e.g., Medium from 465 to 118 total candidates), which reduces but does not eliminate the need for search. Consequently, backtracking time and failures increase with difficulty (notably on the very hard board). Maybe choosing an effective strategy to select an unassigned variable, mentioned in [1, p. 177], would have led to better results. I just chose the first variable, which was not in the final solution.

References

[1] Stuart Russell and Peter Norvig. *Artificial Intelligence: A Modern Approach*. Pearson, 4 edition, 2020.