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Sudoku Solver

Instructions:

Run the file by typing “python3 sudoku.py” in the shell. Follow the instructions that appear. The included puzzles.txt has the example puzzles in it.

Information:

For custom sized puzzles and file input puzzles, only 9, 6, and square value sized puzzles are guaranteed to work.

A node includes the list of numbers in the solution so far. This is the list of numbers that go in the blank spaces, from left to right, top to bottom.

I pruned any state/node that broke the rules of sudoku. This means, if the state results in two of the same numbers being in the same row, column, or “section”, it got pruned.

I modified the BFS to keep a count of how many nodes i’ve explored, to automatically reject a clearly unsolvable puzzle, and to automatically return an empty solution for an already solved puzzle. It also prunes by not adding children who break the rules to the frontier.

Questions

1.

The search tree has a size of $b^0 + b^1 + b^2 + \ldots + b^{d-1} + b^d$, which is equal to $(b^{d+1} - 1)/(b-1)$.

This is different from the search space since we are only recording the frontier, not the entire tree. The maximum size of the search space (frontier) is the number of leaves, which would be b^d at max.

2.

The minimum number of nodes to search is if the solution is the first leaf we see, which would be the number of nodes in the tree up to d-1 depth, plus 1.

$(b^d - 1)/(b-1) + 1$.

The maximum number of nodes to search is if the solution is the last leaf we search, which would mean we searched the whole tree. Thus, the maximum is the same as the size of the tree, $(b^{d+1} - 1)/(b-1)$.

3.

Pruning reduces search tree by a large amount.

For a 9x9 puzzle, the number of possible nodes is (9^82 - 1) / 8.

In the example 9x9 puzzle, we only ended exploring 17386 nodes.

For a 6x6 puzzle, the number of possible nodes is (6^37 - 1) / 5.

In the example 6x6 puzzles, we only ended exploring 284 and 450 nodes.

Sudoku gets pruned heavily, since placing a single number into a sudoku puzzle of size 9 reduces the number of possible values in 24 other spaces by 1.