

A solution to Problem B of the 2008 Mathematical Contest in Modeling

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Abstract:

The problem at hand was to create the most efficient and simple algorithm to create a sudoku puzzle with varying difficulty levels. Sudoku is a 9 x 9 puzzle requiring the player to fill in all rows, columns and boxes to discover a unique solution. Each row, column and box must contain the numbers 1 – 9. Since these groups of numbers must be exclusive, it would seem as though the algorithm contained a fair amount of searching, checking and updating to ensure no conflicts existed. But our model would suggest otherwise. Although we have acknowledged that searching and checking would be necessary to ensure the uniqueness of our puzzles, we have stripped the algorithm of searching to the bare minimum in order to ensure efficiency. But with efficiency comes a small price. With our algorithm we generate a small fraction of every possible unique solution to sudoku. But a small fraction of a very large number is still a very large number. Our algorithm fills one box making it valid. We proceed to fill every other box in the puzzle with permutation of those same numbers until the board is full. To help ensure a sufficiently large number of possibilities, we jumble the order of rows and columns. After we have made empty a certain number of cells, we check the difficulty of the puzzle with a simple solver. This approach keeps things simple, not just for people but also for computers. This is the biggest strength of our algorithm. It far eclipses the fact that we can only come up with a small fraction of a very large number.