SAT Solving Sudoku

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Sudoku is a puzzle game which consists of a 9×9 square grid, subdivided into 3×3 blocks and partially filled with the digits 1-9. The goal is to fill in the rest of the digits such that every row, column and block contains each digit exactly once. Sudoku is a well-studied problem, and there are many algorithms out there to solve it, from pencil-and-paper tricks used mostly by human players to trial-and-error methods used by computers, such as backtracking. However, I will focus on one particular approach: SAT solving.

SAT is short for "satisfiability," and a SAT solver is a program that checks whether a given statement is satisfiable. In this case, a statement is a logical proposition such as "P and Q", and a statement is satisfiable if there is some way to assign each variable (P and Q, in this case) to either true or false such that the entire statement is true. "P and Q," for example, is satisfiable: it has exactly one solution, where P and Q are both true. "P and not P," on the other hand, is not satisfiable, since for both possible values of P, the statement is false. A brute-force SAT solver would simply check every possible combination, of which there are 2^n, where n is the number of variables.