

# Project Proposal

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## 1 Proposed Ideas

### 1.1 Gröbner bases and Shidoku boards

As the general case of a  $9 \times 9$  Sudoku board is computationally intensive to the point that answers to certain questions seem possibly unobtainable with currently implemented systems, the next smallest case of a  $4 \times 4$  board, known as a Shidoku board, is often considered. Using Gröbner bases, one can compute both solutions to Shidoku boards, as well as counting the number of possible distinct Shidoku boards.

We will attempt to formally explain these solutions and discuss how they can be applied, although perhaps computationally infeasibly, to the general case of the Sudoku board.

### 1.2 Sudoku and Boolean Gröbner bases

As the general case of Sudoku boards is computationally intensive, and perhaps solutions to smaller boards are not quite satisfying, our second proposal is to efficiently answer the questions of 1.1. in the specific case where our Sudoku board admits a boolean Gröbner basis.

## 2 References

1. Cox, David A. author. John B. Little, author.; Donal O'Shea, author. Ideals, varieties, and algorithms : an introduction to computational algebraic geometry and commutative algebra. 2015 Cham : Springer.
2. Arnold, Elizabeth, et al. Gröbner Basis Representations of Sudoku. March 26, 2009.
3. Sato, Yosuke, et al. Boolean Gröbner Bases and Sudoku. <http://www.mi.kagu.tus.ac.jp/inoue/BGSet.old/sudoku.pdf>