Project 2 soduko Report

Phase1

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**Sudoku is a logic puzzle**

**played on a 9x9 grid**

**subdivided into 9 3x3**

**subgrids. The player is**

**presented a partially**

**filled puzzle, and must**

**complete it following these rules:**

**Each column must contain**

**the numbers 1-9 (no**

**repeats!)**

**Each row must contain the numbers 1-9 (no repeats!)**

**Each 3x3 subgrid must contain the numbers 1-9 (no repeats!)**

**This program tests if a**

**Sudoku puzzle follows all**

**these rules and compares**

**two puzzles to see if they**

**are the same or different.**

2- main functionalities

3:similar applications in the market

**1-Bubble pop**

**2-Nonogram**

**3-sudoko master**

4:A literature review of Academic publications

**1)**

**https://www.researchgate.net/profile/Amy-Langville/publication/228615106\_An\_integer\_programming\_model\_for\_the\_sudoku\_problem/links/5c0883e7a6fdcc494fdca89d/An-integer-programming-model-for-the-sudoku-problem.pdf**

### 3) [An integer programming model for the Sudoku problem](https://www.researchgate.net/profile/Amy-Langville/publication/228615106_An_integer_programming_model_for_the_sudoku_problem/links/5c0883e7a6fdcc494fdca89d/An-integer-programming-model-for-the-sudoku-problem.pdf)

Sudoku is a logic-based puzzle that first appeared in the U.S. under the title “Number Place” in 1979 in the magazine Dell Pencil Puzzles & Word Games [6]. The game was designed by Howard Garns, an architect who, upon retirement, turned to puzzle creation. In the 1980s, the game grew in popularity in Japan and was renamed by publisher Nikoli to “suji wa dokushin ni kagiru,” which translates as the “the digits must remain single.” This was eventually shortened to “sudoku” or “single number.” By 1997 an entrepreneur named Wayne Gould saw the financial potential available in the game. Gould spent six years refining his computer program so that it could quickly generate puzzles of varying levels of difficulty. In November 2004, Gould convinced The Times of London to print a puzzle. From there the popularity of the puzzle spread until now they commonly appear in a wide variety of newspapers and magazines. Interestingly, Gould does not charge newspapers for his puzzles, but they must include the Web address http://www.sudoku.com where his Sudoku program can be downloaded (for a free trial version and a fee for permanent use). Sudoku most commonly appears in its 9 × 9 matrix form. The rules are simple: fill in the matrix so that every row, column, and 3 × 3 submatrix contains the digits 1 through 9 exactly once. Each puzzle appears with a certain number of givens. The number and location of these determine the game’s level of difficulty. Figure 1 is an example of a 9 × 9 Sudoku puzzle.

INTEGER PROGRAMMING MODEL FOR SUDOKU

Description: A picture containing text, crossword puzzle

Description automatically generated

Figure 1: An example Sudoku puzzle This puzzle idea can accommodate games of other sizes. Of course, a 4 × 4 puzzle would be easier and a 16 × 16 puzzle harder. In general, any n × n game can be created, where n = m2 and m is any positive integer. There are numerous other variants of the game; see [9, 2, 8]. Sudoku puzzles elicit the following two interesting mathematical questions: • How can these puzzles be solved mathematically? • What mathematical techniques can be used to create these puzzles? In the following sections, we explore these questions. We present a binary integer linear program to solve this feasibility problem. Further, such an approach is extended to variations on the traditional Sudoku puzzle. In addition, we speculate as to how Sudoku puzzles are created, and provide several theorems for generating many new puzzles from one given original puzzle. Exercises and challenge problems that use principles from optimization, combinatorics, linear algebra, and computer science are presented for students. Answers to the exercises are contained at the conclusion of the article.

**2)**

<https://books.google.com.eg/books?hl=en&lr=&id=iK2ze0Lyy8sC&oi=fnd&pg=PR10&dq=article+about+sudoku+game&ots=9XEw8bEuPm&sig=cFxQ2ro-nruJURGUHsslaWUufqQ&redir_esc=y#v=onepage&q&f=false>

### [BOOK] [Programming Sudoku](https://books.google.com/books?hl=en&lr=&id=iK2ze0Lyy8sC&oi=fnd&pg=PR10&dq=article+about+sudoku+game&ots=9XEw8bEuPm&sig=cFxQ2ro-nruJURGUHsslaWUufqQ)

The Sudoku Problem Definition 1 A Sudoku puzzle is represented by a 9×9 grid, which comprises nine 3×3 sub-grids (also called boxes). Some of the entries in the grid are filled with numbers from 1 to 9, whereas other entries are left blank. Figure 1 is an example of a Sudoku puzzle. Puzzles are often also assigned a difficulty level, which usually depends on the number of initial non-blank entries provided. This number may be as few as 17 to test expert players. As we shall see, the numbers 1 through 9 are used solely for convenience; arithmetic relationships between them are completely irrelevant. Hence, any set of distinct symbols could have been used. Definition 2 A Sudoku puzzle is solved by assigning numbers from 1 to 9 to the blank entries such that every row, every column, and every 3×3 sub-grid contains each of the nine possible numbers. Interestingly, this rule explains why Sudoku means “single number” in Japanese. Although the definition above characterizes Sudoku, the puzzles available in the entertainment literature have two additional properties. In the remainder of this paper, we will only consider Sudoku puzzles that have these properties, i.e.: Property 1 Sudoku puzzles that have only one solution. Property 2 Sudoku puzzles that can be solved with only reasoning, i.e., with no search. Having only one solution means that all the numbers to be assigned to the blank entries are necessary assignments. The second property requires in addition that, at any stage in the course of solving the puzzle, there should always be at least one blank entry that can be assigned to merely by considering what is immediately implied by the set of non-blank entries. Hence, reasoning consists in using inference rules in such a way that all of the assignments are found. To illustrate how to solve a Sudoku puzzle, let us consider entry (a) in the left-hand grid of Figure 2. Considering the relevant 3×3 sub-grid, this is the only position where number 3 can be placed. Also, consider entry (b) in the right-hand grid of the same figure. It is clear that (b) is the only position where number 7 can be

placed in the second row