

Contents

Preface	9
Chapter 1. A (Mathematical) History of Sudoku	11
1.1. The rules of the game	11
1.2. A long story made short	12
1.2.1. Modern sudoku	13
1.2.2. Sudoku and medias	14
1.3. Mathematics of sudoku	16
1.3.1. Main results	16
1.3.2. Counting sudoku grids	18
1.3.3. Number of givens	20
1.4. Sudoku variants	20
1.4.1. Sudoku with additional constraints	20
1.4.2. Arithmetical variants	21
PART 1. SOLVING RULES AND TECHNIQUES	23
Chapter 2. Basic Techniques	25
2.1. Notations	25
2.2. Determining values for cells	26
2.2.1. The single position technique	26
2.2.2. The single candidate technique	28
2.3. Discarding candidates for cells	29
2.3.1. The candidate lines technique	30
2.3.2. The multiple lines technique	32
Chapter 3. Advanced Techniques	37
3.1. Pairs, triples and subsets	37

3.1.1. The naked pair technique	37
3.1.2. The naked tuples technique	38
3.2. Hidden subsets	41
3.2.1. The hidden pair technique	41
3.2.2. The naked tuple technique	42
3.3. Intrinsic properties of subset based rules	44
3.3.1. Subset-based rules duality	44
3.3.2. Some properties of region reasoning	44
Chapter 4. “Expert” Techniques	49
4.1. The XWing technique	49
4.2. The Swordfish technique	51
4.3. Trial based techniques	54
4.3.1. Disjunctive construction	54
4.3.2. <i>Reductio ad absurdum</i>	55
PART 2. COMPUTER SOFTWARE DEVELOPMENT FOR SUDOKU	57
Chapter 5. Solving Sudoku Grids	59
5.1. Logic programming	59
5.1.1. Basic principles	60
5.1.2. The PROLOG language	61
5.1.3. Logic programming and sudoku	62
5.1.4. Solving expert grids	64
5.2. Constraint programming	65
5.2.1. Basic principles	65
5.2.2. Sudoku and constraint programming	67
Chapter 6. Evaluating and Generating Grids	71
6.1. Evaluating the difficulty of a sudoku grid	71
6.1.1. A subjective issue	71
6.1.2. A pragmatic solution	73
6.1.3. The need of solving to evaluate	75
6.2. Generating sudoku grids	75
6.2.1. Top-down generation	75
6.2.2. Bottom-up generation	76
6.2.3. An open problem	76

PART 3. TRAINING	79
Chapter 7. Very Easy Sudoku Grids	81
Chapter 8. Easy Sudoku Grids	87
Chapter 9. Medium Sudoku Grids	93
Chapter 10. Difficult Sudoku Grids	107
Chapter 11. Very Difficult Sudoku Grids	121
Chapter 12. Expert Sudoku Grids	135
Appendices	151
A. Corrections	153
B. Solutions	163
Bibliography	181
Index	183