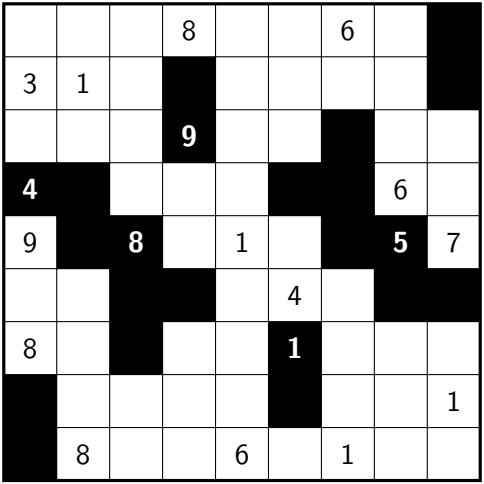
University of Basel

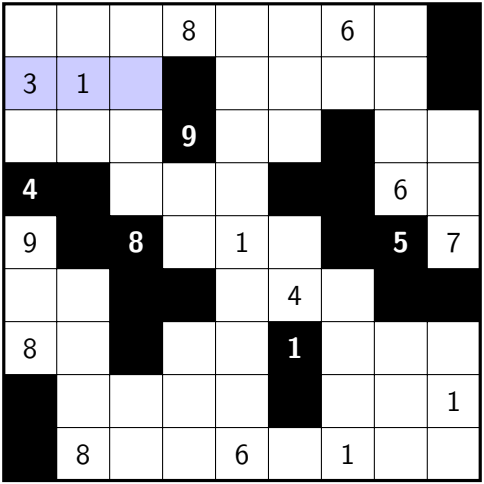
Modeling Str8ts Puzzles as Propositional Formulas

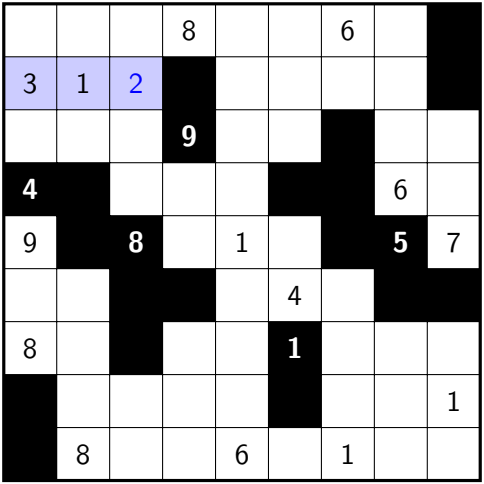
Lina Mehrle

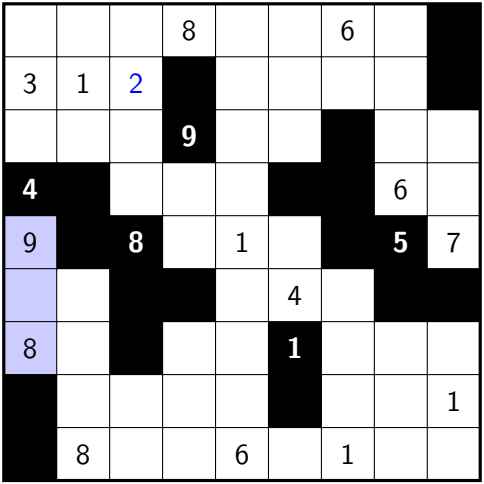
University of Basel

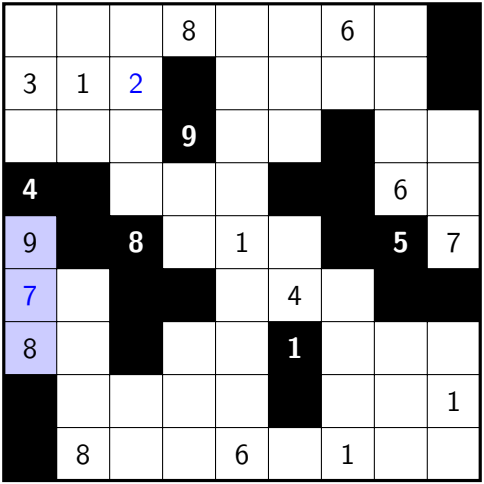
February 9, 2026

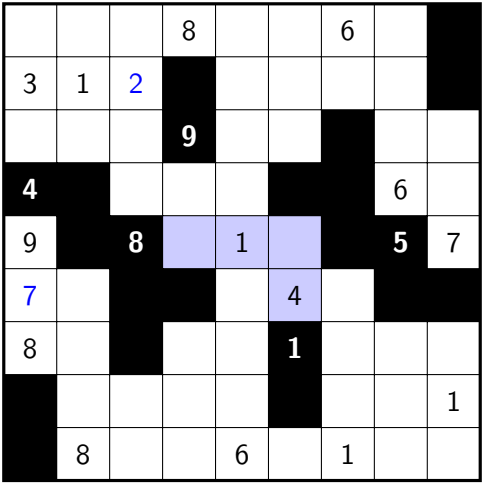

8 6
3 1
9
4 6
9 8 1 5 7
4
8 1
1
8 6 1

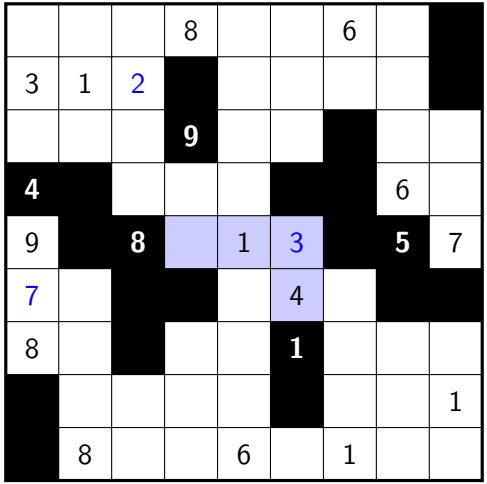

8 6
3 1
9
4 6
9 8 1 5 7
4
8 1
1
8 6 1

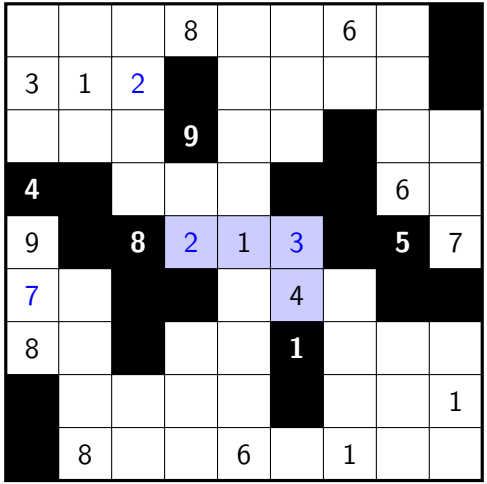

8 6
3 1 2
9
4 6
9 8 1 5 7
4
8 1
1
8 1
6 1


8
6
3 1 2
9
4
6
9
8
1
5 7
4
8
1
1
8
6
1


8
6
3 1 2
9
4
6
9 8 1 5 7
7 4
8 1
1
1
8 6 1


8
6
3 1 2
9
4
6
9 8 1 5 7
7 4
8 1
1
8 6 1


8
6
3 1 2
9
4
6
9 8 1 3 5 7
7 4
8 1
1
8 6 1

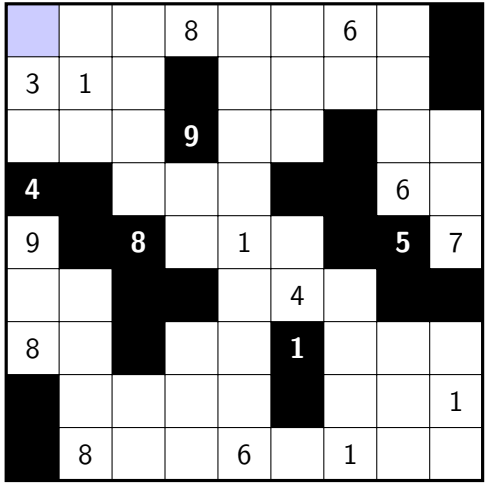

8 6
3 1 2
9
4 6
9 8 2 1 3 5 7
7 4
8 1
1
8 6 1

Propositional Logic

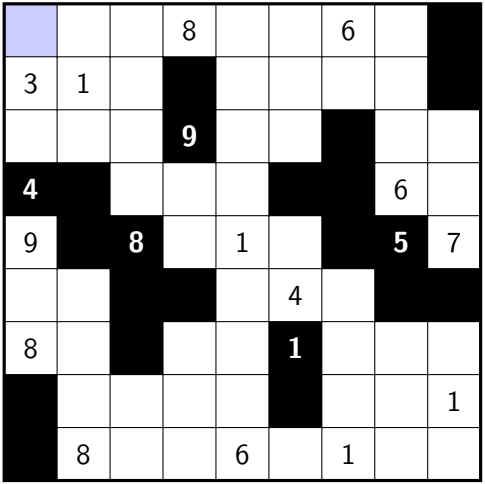
$$\neg(x_1 \vee x_2) \wedge x_3 \rightarrow \neg x_4$$

$$\neg(x_1 \vee x_2) \wedge x_3 \rightarrow \neg x_4$$
$$\equiv x_1 \vee x_2 \vee \neg x_3 \vee \neg x_4$$

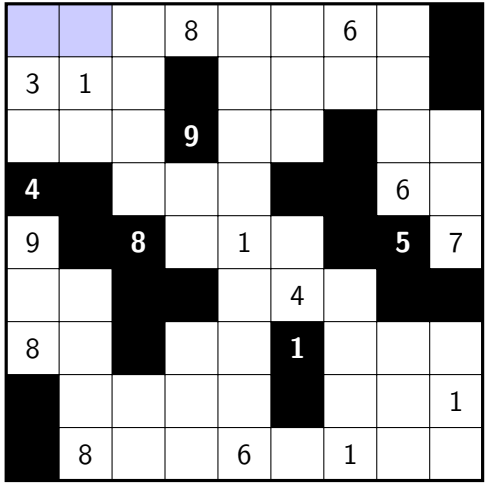
Specific Encoding



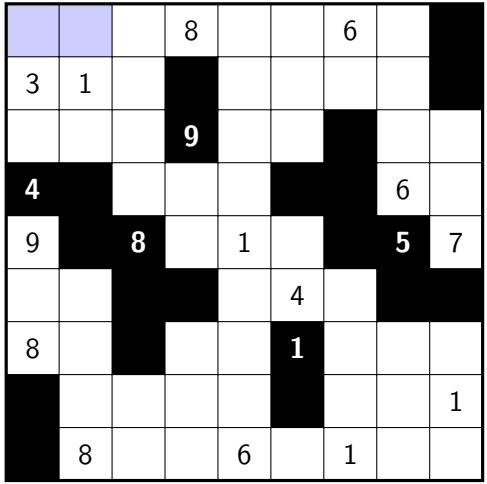
Possible numbers: $\{1, 2, 5, 7\}$



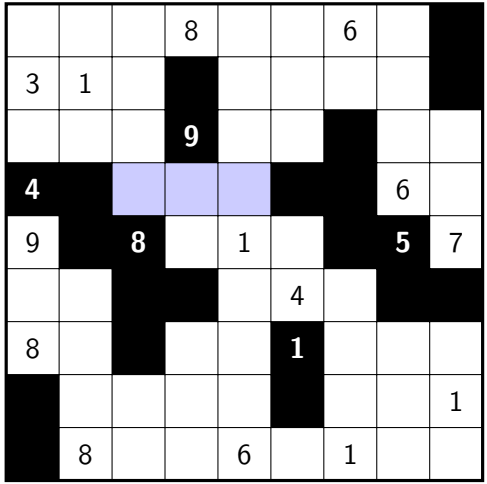
$$\neg(X_{1,1,1} \wedge X_{1,1,2})$$
$$\neg(X_{1,1,1} \wedge X_{1,1,5})$$
$$\neg(X_{1,1,1} \wedge X_{1,1,7})$$
$$\neg(X_{1,1,2} \wedge X_{1,1,5})$$
$$\neg(X_{1,1,2} \wedge X_{1,1,7})$$
$$\neg(X_{1,1,5} \wedge X_{1,1,7})$$



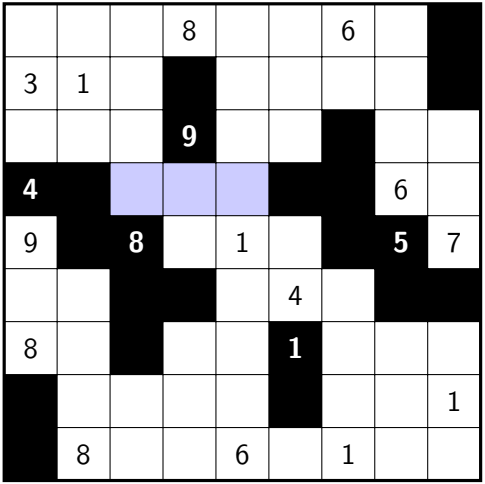
Possible numbers in both cells:
$\{2, 5, 7\}$



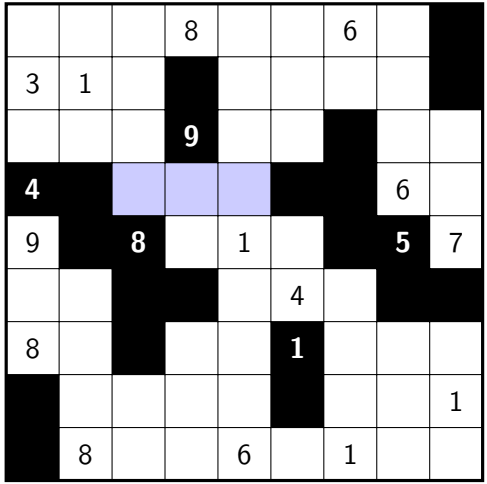
$$\neg(X_{1,1,2} \wedge X_{1,2,2})$$
$$\neg(X_{1,1,5} \wedge X_{1,2,5})$$
$$\neg(X_{1,1,7} \wedge X_{1,2,7})$$



Possible starting values: $\{1, 7\}$

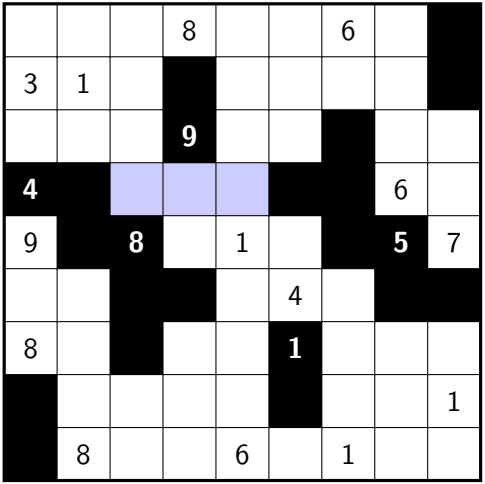


$S_{7,1} \vee S_{7,7}$

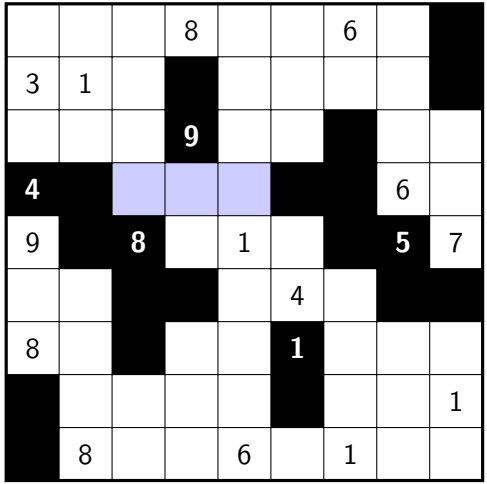


Possible numbers for starting value 1:

- cell $(4,3)$: $\{1,2,3\}$
- cell $(4,4)$: $\{1,2,3\}$
- cell $(4,5)$: $\{2,3\}$

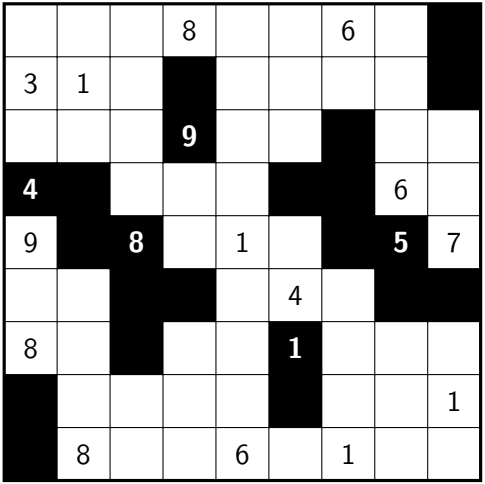


$$S_{7,1} \rightarrow X_{4,3,1} \vee X_{4,3,2} \vee X_{4,3,3}$$
$$S_{7,1} \rightarrow X_{4,4,1} \vee X_{4,4,2} \vee X_{4,4,3}$$
$$S_{7,1} \rightarrow X_{4,5,2} \vee X_{4,5,3}$$

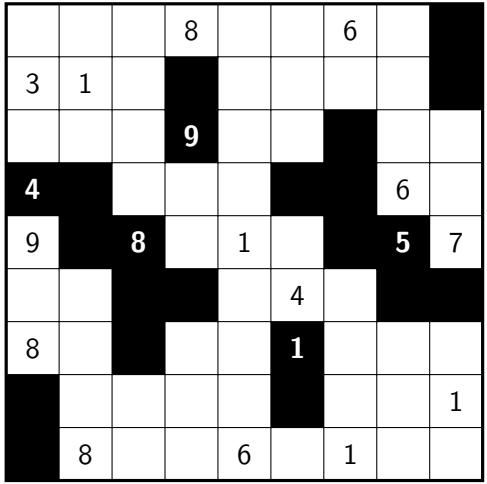


$$\neg(S_{7,1} \wedge S_{7,7})$$

General Encoding

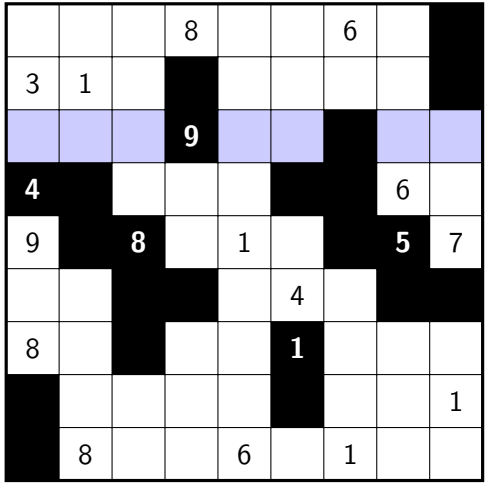


Each cell is black or part of at least one horizontal and one vertical straight.

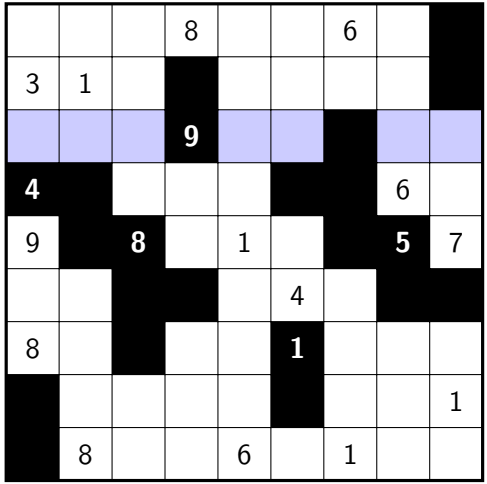


Which numbers are possible for each kind of straight?

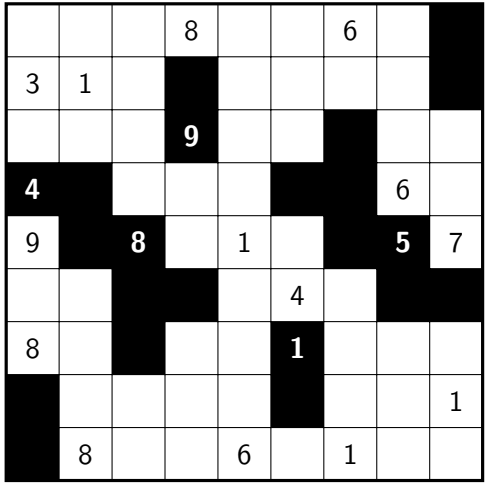
Straights - Version 1



Length: upper limit

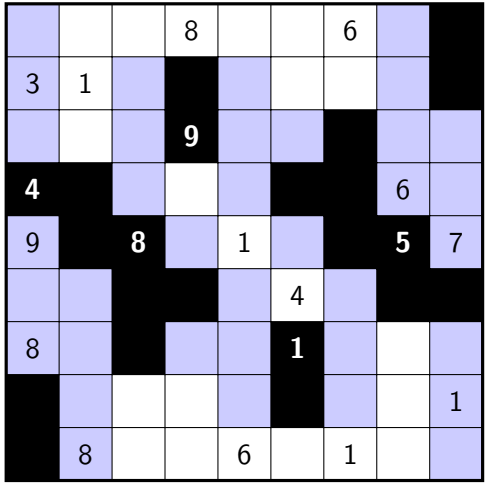


Length: lower limit



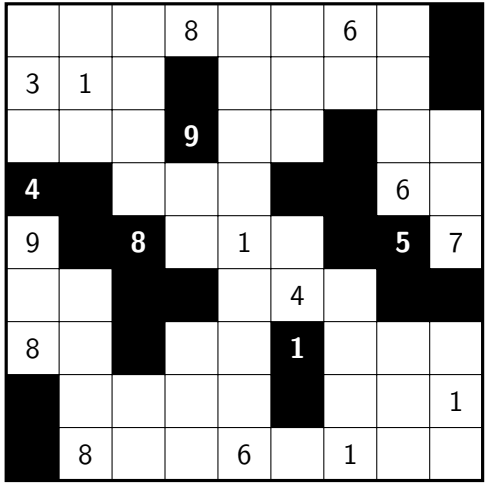
Cells that are in the same straight may not be in different kind of straights.

Straights - Version 2



Which cells are the border cells for each straight?

Specific Layout



- Black cells (i, j): $X_{i,j,0}$
- White cells (i, j): $\neg X_{i,j,0}$
- Cells (i, j) filled with number k: $X_{i,j,k}$
- Empty black cells: $\neg X_{i,j,k}$ for all $k \in \{1, \ldots, 9\}$

Experiment

Number of Clauses

	Specific version	General version 1	General version 2
Easy	485.52	84863.97	9887.97
Medium	492.79	84862.67	9886.67
Hard	564.50	84859.97	9883.97

	Specific version	General version 1	General version 2
Easy	1334.78	1352646.72	62766.72
Medium	1975.82	1352622.76	62742.76
Hard	3151.15	1352612.08	62732.08
Extra-Hard	3611.85	1352600.97	62720.97

Number of Variables

	mini Str8ts	Str8ts
Easy	119.36	278.78
Medium	119.21	355.23
Hard	131.88	476.15
Extra-Hard		518.63

Generation Time in Seconds

	Specific version	General version 1	General version 2
Easy	0.22	0.28	0.19
Medium	0.17	0.24	0.19
Hard	0.20	0.31	0.25

	Specific version	General version 1	General version 2
Easy	0.23	1.31	0.26
Medium	0.25	1.28	0.27
Hard	0.25	1.28	0.27
Extra-Hard	0.30	1.27	0.26

Solving Time in Seconds

	Specific version	General version 1	General version 2
Easy	0.01	0.13	0.07
Medium	0.01	0.12	0.06
Hard	0.01	0.13	0.06

	Specific version	General version 1	General version 2
Easy	0.01	1.06	0.09
Medium	0.01	0.91	0.14
Hard	0.03	1.05	0.26
Extra-Hard	0.04	0.90	0.24

Solving Memory in MB

	Specific version	General version 1	General version 2
Easy	11.58	22.76	11.60
Medium	11.60	23.15	11.98
Hard	11.57	23.38	12.70

	Specific version	General version 1	General version 2
Easy	11.57	145.38	16.81
Medium	11.59	146.77	18.96
Hard	11.58	147.79	22.82
Extra-Hard	11.56	148.43	23.01

Questions?