

## Sudoku examples

Evil 4,548,706,601  
www.websudoku.com

## Sudoku

• Evil 4,548,706,601  
– www.websudoku.com

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

## Sudoku

• Pick a pair of 1s.

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

## Sudoku

• They block possible 1s

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

## Sudoku

• 1 must be in column 3

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

## Sudoku

• But that blocks a new column! One free cell!

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

### Sudoku

- Only one place for the 1.

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

### Sudoku

- Mark all pairs for 1s.

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

### Sudoku

- Triples are not so useful.

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

### Sudoku

- Mark pairs within blocks.

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

### Sudoku

- Repeat with each number.  
– Here we see 5.

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

### Sudoku

- Then 8.

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

### Sudoku

- Then 8. Step 2.

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

### Sudoku

- Result so far.

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

### Sudoku

- After all propagation.

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

### Sudoku

- After inferring all pairs.

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

### Sudoku

- Col.6 is missing: 1,2,3,4,6
- {top,bot} = {1,6}
- Only E.C can be 4.

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

### Sudoku

- D.col3 must contain 2
- D.col3 = {1,9,2}
- D.col1 = {4,5,8}

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

## Sudoku

- D.D := 4
- D.A := 5

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

## Sudoku

- Propagate the 4, and some pairs
- Notice: D.col3 is hard to represent. Likewise G.col2.

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

## Sudoku

- Notice 7s in Boxes A,B,C
- Only one possibility in row 1.

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

## Sudoku

- Propagate consequences
- Mostly through pairs

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

## Sudoku Strategies

- For each number . . . For each box . . .
  - Does the box already contain the number?
    - Move on.
  - Is there only one possible cell?
    - Fill it in.
  - Are there two possible cells?
    - Create a pair constraint.
  - Are all possible cells in a row or column?
    - Propagate in the direction they point.
  - Otherwise
    - Move on.

## Sudoku Strategies (2)

- When there are exactly two possible cells...
  - Create a constraint: when one cell becomes impossible, the other must get that value.
- For an empty cell,
  - Eliminate all values in its row, column, and box
  - If exactly one value is left, assign that value