Binairo

Puzzle

Given a partially filled grid of 0's and 1's. Fill in all empty cells such that the following occurs,

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- Each cell has either a 0 or a 1 (not both)
- No adjacent triple of 1's occurs in any row or column
- No adjacent triple of 0's occurs in any row or column
- No two rows are the same
- No two columns are the same
- The number of 1's and number of 0's in each row are equal
- The number of 1's and number of 0's in each column are equal

Solution

What do we use to solve this?

Solution

What do we use to solve this?

    Backtracking

Solution

What do we use to solve this?

    Backtracking

What are the decisions to make?

Solution

What do we use to solve this?

    Backtracking

What are the decisions to make?

    Empty cells

Solution

What do we use to solve this?
    Backtracking

What are the decisions to make?
    Empty cells

What are the choices?

Solution

What do we use to solve this?

    Backtracking

What are the decisions to make?

    Empty cells

What are the choices?

    0 or 1

Recursive Solve Function

Not like sudoku

Recursive Solve Function

Not like sudoku (9 choices)

Recursive Solve Function

Not like sudoku (9 choices)

Binairo has 2 choices per empty cell

Recursive Solve Function

Not like sudoku (9 choices)

Binairo has 2 choices per empty cell

```
int EMPTY = -1;
Function solve ( r, c )
    // Base cases
    // ...
    // Assume that the spot in the grid is
    // now EMPTY
    Grid[r][c] = 0; // try choice 1
    If valid ( r, c ) // prune
        If solve ( r, c + 1 ) has a solution
            Return has a solution
        End If
    End If
    Grid[r][c] = 1; // try choice 1
    If valid ( r, c ) // prune
        If solve ( r, c + 1 ) has a solution
            Return has a solution
        End If
    End If
    Grid[r][c] = EMPTY; // backtrack
    Return has no solution
End Function
```

Valid Function

Non Trivial

Valid Function

Non Trivial

Puzzle Requirements Driven

Valid Function

Non Trivial

Puzzle Requirements Driven

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Valid Function (in depth)

- Each cell has either a 0 or a 1 (not both)

Valid Function (in depth)

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Easy

Valid Function (in depth)

- Each cell has either a 0 or a 1 (not both)

Easy (check non-empty)

Valid Function (in depth)

- Each cell has either a 0 or a 1 (not both)

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Which triples does a value have to worry about?

Valid Function (in depth)

- Each cell has either a 0 or a 1 (not both)

Easy (check non-empty)

- No adjacent triple of 0/1's occurs in any row or column

Which triples does a value have to worry about?

		X		

Valid Function (in depth)

- Each cell has either a 0 or a 1 (not both)

Easy (check non-empty)

- No adjacent triple of 0/1's occurs in any row or column

Which triples does a value have to worry about?

Y	Y	X		

Valid Function (in depth)

- Each cell has either a 0 or a 1 (not both)

Easy (check non-empty)

- No adjacent triple of 0/1's occurs in any row or column

Which triples does a value have to worry about?

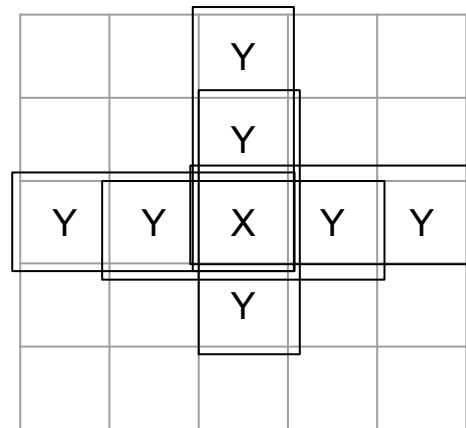|				
Y	Y	X	Y	

Valid Function (in depth)

- Each cell has either a 0 or a 1 (not both)

Easy (check non-empty)

- No adjacent triple of 0/1's occurs in any row or column

Which triples does a value have to worry about?

Y	Y	X	Y	Y

Valid Function (in depth)

- Each cell has either a 0 or a 1 (not both)

Easy (check non-empty)

- No adjacent triple of 0/1's occurs in any row or column

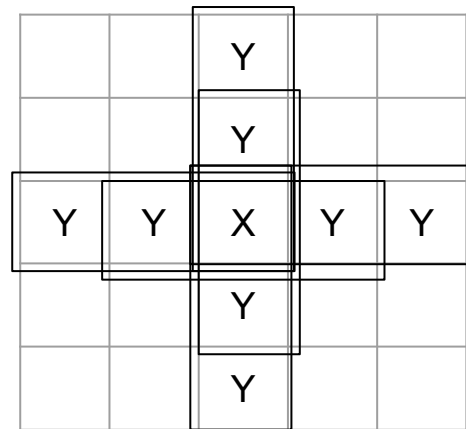Which triples does a value have to worry about?

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Which triples does a value have to worry about?

Valid Function (in depth)

● Each cell has either a 0 or a 1 (not both)

Easy (check non-empty)

● No adjacent triple of 0/1's occurs in any row or column

Which triples does a value have to worry about?
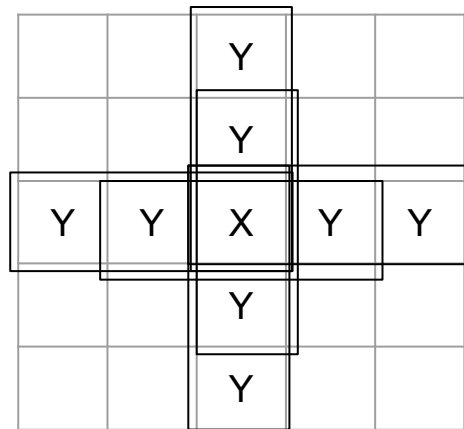
Valid Function (in depth)

- Each cell has either a 0 or a 1 (not both)

Easy (check non-empty)

- No adjacent triple of 0/1's occurs in any row or column

Which triples does a value have to worry about?

6 of them

			Y		
			Y		
Y	Y	X	Y	Y	
			Y		
			Y		

Valid Function (in depth)

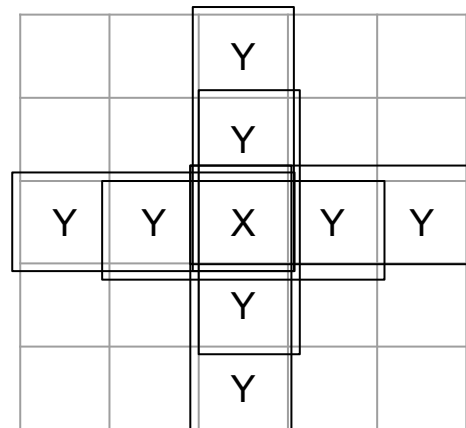- Each cell has either a 0 or a 1 (not both)

Easy (check non-empty)

- No adjacent triple of 0/1's occurs in any row or column

Which triples does a value have to worry about?
    6 of them

- No two rows are the same

Valid Function (in depth)

- Each cell has either a 0 or a 1 (not both)

Easy (check non-empty)

- No adjacent triple of 0/1's occurs in any row or column

Which triples does a value have to worry about?
    6 of them

- No two rows are the same

Compare the current row against all other rows

Valid Function (in depth)

- Each cell has either a 0 or a 1 (not both)

Easy (check non-empty)

- No adjacent triple of 0/1's occurs in any row or column

Which triples does a value have to worry about?
    6 of them

- No two rows are the same

Compare the current row against all other rows
Only if the row is complete!

		Y		
		Y		
Y	Y	X	Y	Y
		Y		
		Y		

Valid Function (in depth)

- Each cell has either a 0 or a 1 (not both)

Easy (check non-empty)

- No adjacent triple of 0/1's occurs in any row or column

Which triples does a value have to worry about?
    6 of them

- No two rows are the same

Compare the current row against all other rows
Only if the row is complete!

1	0		
1	0		

Valid Function (in depth)

- Each cell has either a 0 or a 1 (not both)

Easy (check non-empty)

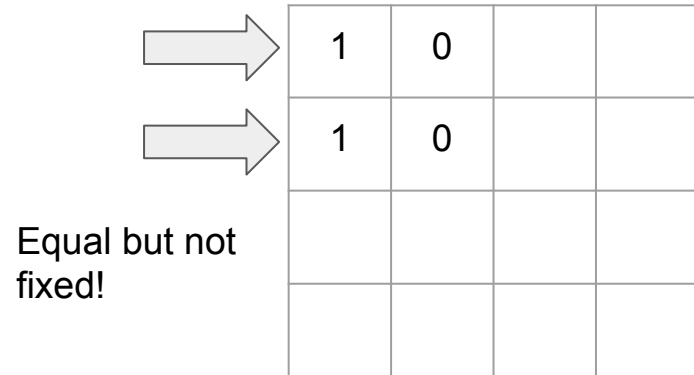- No adjacent triple of 0/1's occurs in any row or column

Which triples does a value have to worry about?
    6 of them

- No two rows are the same

Compare the current row against all other rows
Only if the row is complete!

Equal but not fixed!

1	0		
1	0		

Valid Function (in depth)

- No two columns are the same

Valid Function (in depth)

- No two columns are the same

Compare the current column against all other columns

Valid Function (in depth)

- No two columns are the same

Compare the current column against all other columns
Again only complete columns!

Valid Function (in depth)

- No two columns are the same

Compare the current column against all other columns
Again only complete columns!

- The number of 1's and number of 0's in each row/column are equal

Valid Function (in depth)

- No two columns are the same

Compare the current column against all other columns
Again only complete columns!

- The number of 1's and number of 0's in each row/column are equal

Easy

Valid Function (in depth)

- No two columns are the same

Compare the current column against all other columns
Again only complete columns!

- The number of 1's and number of 0's in each row/column are equal

Easy (Count the number of both in the current row/column and check)