

Algorithm explanation

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1. Algorithm X

Algorithm X finds rows from a matrix such that those rows contain a 1 in each column

For example, if algorithm X runs on the following matrix:

```
rows matrix
A  | 1 0 0 1 0 0 1
B  | 1 0 0 1 0 0 0
C  | 0 0 0 1 1 0 1
D  | 0 0 1 0 1 1 0
E  | 0 1 1 0 0 1 1
F  | 0 1 0 0 0 0 1
```

Algorithm X should return rows B, D, and F, because:

```
rows matrix
B  | 1 0 0 1 0 0 0
D  | 0 0 1 0 1 1 0
F  | 0 1 0 0 0 0 1
sum | 1 1 1 1 1 1 1
```

This is the pseudocode for algorithm X:

```
If matrix A only contains 1s, the current solution is a valid
  solution
Thus, return the list solutions

If matrix A is empty this is not a valid solution, so terminate the
  branch

Choose column c such that it contains the least number of 1s

For each row r such that A[r][c] = 1 (row r contains a 1 in column r)
  Include row r in the solution.

  For each column j such that A[r][j] = 1
    Add column j to the list of columns that have to be
    removed
  For each row i such that A[i][j] = 1
    Add row i to the list of rows that have to be
    removed

Remove the rows and columns that have to be removed
```

```
Repeat the algorithm recursively on matrix A

If the branch finds an valid solution add the solution to the
list of solutions
Else, remove row r from the solution because it is not a valid
solution

This is not a valid solution, so terminate the branch
```

2. Matrix Creator

In order to solve the pentomino puzzle using algorithm x, we have to create a matrix that contains all the possible placements of the pentominos.

The matrix has to look like this:

column	0	1	...	9	11	12	13	14	...
data	1	0		0	0	1	1	0	
	1	0		0	0	0	1	1	
	0	1		0	0	1	1	0	
	0	1		0	0	0	0	0	
	0	0		1	0	1	0	0	
	0	0		1	0	0	0	1	
	0	0		0	1	1	1	1	
	0	0		0	1	0	0	1	

Each row represents a distinct position and orientation of distinct pentominos

- The first 12 (depending on how many pentominos we use) columns should each represent a pentomino shape (eg, X, W, L, ...).
- The remaining columns represent the board in a 1 dimensional way

If the board had a state like this:

0 1 0
1 1 1
1 0 1

the remaining columns should look like this:

0 1 0 1 1 1 1 0 1

Each row should contain a single 1 in the first 12 columns representing which pentomino it is, and 5 (each pentomino fills 5 cells) 1s in the remaining columns.

3. Actual implementation

- (a) Create matrix A using the Matrix Creator
- (b) Add row numbers to the 0th column of matrix A, in order to keep track of the rows that we remove
- (c) Use Algorithm X to solve matrix A
- (d) The rows Algorithm X returns contain the position and orientation of the pentominos we have to use