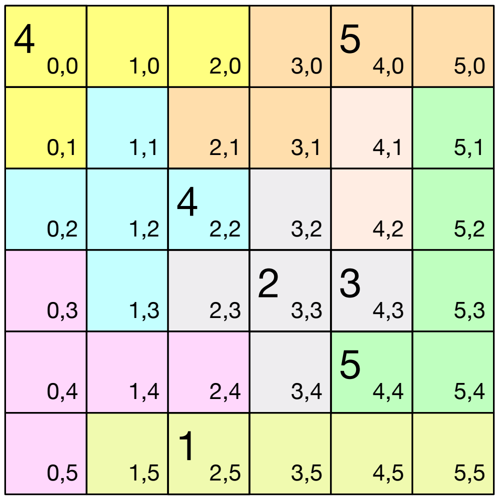
Programming Assignment 3

Backtracking can also be used to solve many mathematical puzzles such as Cryptogram and Sudoku. There is a variant of Sudoku, that has not yet found a published solution using backtracking in the net. This means that you do not need to worry about classmates gaining an unfair advantages by downloading and adapting someone else's solution.

A puzzle consists of a rectangular grid of cells. It is divided into blocks each containing up to five cells. In the task below, they are indicated by different colors. In the solution, each cell contains a digit from 1 to *n*, with *n* being the number of cells in the block. So, a single cell block contains only a cell with 1, a two-cell block contains one cell with 1 and one with 2, and so on. The same digit is not allowed to appear in a neighboring cell, not even diagonally. For example, the contents of cells (1,1), (2,1), (3,1), (1,2), (3,2), (1,3), (2,3), and (3,3) cannot be 4. Some cell contents are already given.

Use the <u>recursive backtracking scheme</u> from class to solve the following problem:



Here, i have numbered each cell with row and column coordinates. I invite you to try the number puzzle yourself. This will convince you that there is only one valid solution.

Hint: Create a list of lists to form a two-dimensional matrix, initialized with zeroes. Add the numbers in the current cell, i.e. `matrix[0][0] = 4`. Then create a list of sets of 2-tuples to define the blocks. You need to implement:

- `valid_so_far`, which checks that (a) no two non-zero integers are next to each other, even diagonally (b) each area contains only numbers larger than 0 once and not larger than the number of cells in the area.
- `done`, which checks that there are no zero cells left
- `find_empty`, which returns the coordinates of the first cell that still contains a zero.
- `print_it`, which prints out the matrix.

For your convenience, here is the encoding of the original board (called matrix):

```
di = 6
dj = 6
configuration = [{(0,0), (1,0), (0,1), (2,0)},
                 {(2,1), (3,1), (3,0), (4,0), (5,0)},
                 {(0,2), (1,1), (1,2), (1,3), (2,2)},
                 {(4,1), (4,2)},
                 {(5,1), (5,2), (5,3), (4,4), (5,4)},
                 {(3,2), (2,3), (3,3), (4,3), (3,4)},
                 {(0,3), (0,4), (0,5), (1,4), (2,4)},
                 {(1,5), (2,5), (3,5), (4,5), (5,5)}
                 ]


matrix = [[0 for j in range(dj)] for i in range(di)]
matrix[0][0]=4
matrix[4][0]=5
matrix[2][2]=4
matrix[3][3]=2
matrix[4][3]=3
matrix[4][4]=5
matrix[2][5]=1
```

Hand-in:

- Code: with comments and descriptive function and variable names
- Explanation of code, if you are not programming using Python
- Result of running the code and the solution of the puzzle (screen-shot)

Please make these into a single pdf, plus source code.