Exercise 1: Minefield [50 marks]

Problem Statement

During the World War II period, anti-tank mines were used to damage or destroy vehicles including tanks and armored fighting vehicles. As a counter-move, minesweepers were trained to deal with these mines.

One (fictional) way of doing so is to first survey the areas in a minefield to classify the mines by power. A mine of power ***k***, where ***k*** is a positive integer, deals damage to the area itself, as well as ***k***-1 area(s) in four directions (i.e., north, south, east and west). For simplicity's sake, damage dealt diagonally or to areas outside the minefield is ignored.

For example, as shown in Fig. 1, a mine of power 1 only deals damage to the area itself (without affecting the neighbouring areas). In contrast, a mine of power 2 deals damage to the area itself and 1 neighbouring area in four directions.

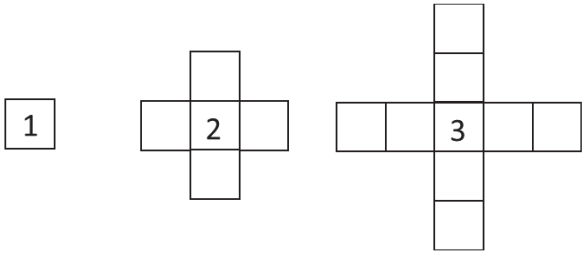

Figure 1. Areas of effect of mines of power 1, 2, and 3.

After mapping out the mines in a zone, the minesweepers assess the **aftermath** (i.e., the number of mines each area will be hit by if all the mines are detonated). They also compute the **maximum damage** sustained and the **number of safe areas**. Based on this information, they then decide the best strategy to deal with the mines.

For example, the minefield as shown below in Fig. 2a contains 4 mines: The two mines at [1][2] and [3][2] are of power 1, while the two at [2][1] and [2][3] are of power 2.

	[0]	[1]	[2]	[3]	[4]
minefield[0]	0	0	0	0	0
minefield[1]	0	0	1	0	0
minefield[2]	0	2	0	2	0
minefield[3]	0	0	1	0	0
minefield[4]	0	0	0	0	0

Figure 2a. A minefield with 4 mines.

	[0]	[1]	[2]	[3]	[4]
aftermath[0]	0	0	0	0	0
aftermath[1]	0	1	1	1	0
aftermath[2]	1	1	2	1	1
aftermath[3]	0	1	1	1	0
aftermath[4]	0	0	0	0	0

Figure 2b.The aftermath after all mines are detonated.

The areas affected by these mines are as shown in the table below, while the aftermath after all the mines are detonated is as shown above in Fig. 2b.

Location	Power	Area(s) affected
[1][2]	1	[1][2]
[2][1]	2	[2][1], as well as [1][1], [2][0], [2][2] and [3][1]
[2][3]	2	[2][3], as well as [1][3], [2][2], [2][4] and [3][3]
[3][2]	1	[3][2]

In the aftermath, the maximum damage sustained is 2 (i.e., [2][2] is hit by the two mines at [2][1] and [2][3]), while the number of safe areas is 14 since there are 14 areas which do not sustain any damage from any mine (e.g., [0][0]).

In this exercise, you are to write a program to 1) simulate the aftermath of the detonation of all the mines in a given minefield, and 2) compute the maximum damage sustained and the number of safe areas.

Your program should read in the size of the minefield ***n*** (1<=n<=10), as well as ***n*****n*** numbers representing the locations and the powers of the mines. The numbers in this input are either 0 (no mine) or a positive integer ***k*** (a mine of power ***k***).

Your program should print the aftermath, the maximum damage sustained, and the number of safe areas as the output.

Write on the skeleton file **minefield.c** given to you. You must include the following function in your program:

- **`detonate()`**

  This function takes in the minefield, which is a 2D **int** array, as well as the size of the minefield, which is an integer. It returns the computed aftermath, as well as the maximum damage sustained and the number of safe areas.

You are to determine the return type and parameters for this function. You may define additional functions as needed. Check sample runs for input and output format.

Sample Runs

Three sample runs are shown below with user input highlighted in **bold**.

```
Enter size:
3
Enter minefield:
0 0 0
0 1 0
0 0 0
Aftermath:
0 0 0
0 1 0
0 0 0
Maximum damage: 1
Number of safe areas: 8
```

```
Enter size:
5
Enter minefield:
0 0 0 0 0
0 0 0 0 0
0 0 3 0 0
0 0 0 0 0
0 0 0 0 0
Aftermath:
0 0 1 0 0
0 0 1 0 0
1 1 1 1 1
0 0 1 0 0
0 0 1 0 0
Maximum damage: 1
Number of safe areas: 16
```

```
Enter size:
5
Enter minefield:
0 0 0 0 0
0 0 1 0 0
0 2 0 2 0
0 0 1 0 0
0 0 0 0 0
Aftermath:
0 0 0 0 0
0 1 1 1 0
1 1 2 1 1
0 1 1 1 0
0 0 0 0 0
Maximum damage: 2
Number of safe areas: 14
```