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## Algorithms Lab

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### Exercise – Even matrices

You are still part of a team to develop a pseudorandom number generator. Your generator has already passed some simple statistical tests, but now it is time to get serious. You arrange a list of bits produced by the generator in an  $n$  by  $n$  matrix. If

$$M = \begin{pmatrix} x_{1,1} & x_{1,2} & \cdots & x_{1,n} \\ x_{2,1} & x_{2,2} & \cdots & x_{2,n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n,1} & x_{n,2} & \cdots & x_{n,n} \end{pmatrix}$$

was a truly random matrix of bits, then it would have the property that the sum

$$\sum_{i'=i_1}^{i_2} \sum_{j'=j_1}^{j_2} x_{i',j'}$$

is even for about half of the quadruples  $(i_1, i_2, j_1, j_2)$ ,  $1 \leq i_1 \leq i_2 \leq n$  and  $1 \leq j_1 \leq j_2 \leq n$ .

To check whether this is the case for your generator, you need to be able to count the number of such quadruples.

**Input** The first line of the input contains the number  $t \leq 15$  of test cases. Each of the  $t$  test cases is described as follows.

- It starts with a line that contains an integer  $n$  such that  $1 \leq n \leq 200$ .
- This is followed by  $n$  lines, where the  $i$ -th line contains the  $n$  integers  $x_{i,1} \dots x_{i,n}$ , separated by a space, such that  $x_{i,j} \in \{0, 1\}$ , for all  $i \in \{1, \dots, n\}$  and  $j \in \{1, \dots, n\}$ .

**Output** For each test case output a single line that contains the number of quadruples  $(i_1, i_2, j_1, j_2)$  where  $1 \leq i_1 \leq i_2 \leq n$  and  $1 \leq j_1 \leq j_2 \leq n$  and for which the sum

$$\sum_{i'=i_1}^{i_2} \sum_{j'=j_1}^{j_2} x_{i',j'}$$

is even.

**Points** There are three groups of test sets, worth 100 points in total.

1. For the first group of test sets, worth 30 points, you may assume that  $1 \leq n \leq 10$ .
2. For the second group of test sets, worth 50 points, you may assume that  $1 \leq n \leq 50$ .
3. For the third group of test set, worth 20 points, there are no additional assumptions.

Corresponding sample test sets are contained in `testi.in/out` for  $i \in \{1, 2, 3\}$ .

**Sample Input**

```
3
2
1 1
1 1
3
1 0 1
0 1 0
0 0 1
4
1 1 0 0
0 0 1 1
1 0 1 0
0 1 0 1
```

**Sample Output**

```
5
15
52
```