ETH Zurich
Institut für Theoretische Informatik
Prof. Dr. Angelika Steger
Prof. Dr. Emo Welzl
Prof. Dr. Peter Widmayer

Algorithms Lab

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

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

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), $1 \le i_1 \le i_2 \le n$ and $1 \le j_1 \le j_2 \le n$.

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 $1 \le t \le 15$ 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 $1 \le n \le 200$.

- This is followed by n lines, where the i-th line contains the n bits $x_{i,1}, \ldots, x_{i,n}$, separated by spaces.

Output For each test case output a line that contains the number of quadruples (i_1, i_2, j_1, j_2) where $1 \le i_1 \le i_2 \le n$ and $1 \le j_1 \le j_2 \le n$ 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 test sets, worth 100 points in total.

1. For the first test set, worth 20 points, you may assume that $1 \le n \le 10$.

2. For the second test set, worth 50 points, you may assume that $1 \le n \le 50$.

3. For the third test set, worth 30 points, there are no additional assumptions.

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

Sample Input	Sample Output
3	5
2	15
1 1	52
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	