H. Wonderful XOR Problem

time limit per test: 2 seconds
memory limit per test: 256 megabytes

You are the proud... never mind, just solve this problem.

There are n intervals $[l_1, r_1], [l_2, r_2], \ldots [l_n, r_n]$. For each x from 0 to $2^m - 1$, find the number, modulo $998\,244\,353$, of sequences $a_1, a_2, \ldots a_n$ such that:

- $l_i \le a_i \le r_i$ for all i from 1 to n;
- $a_1 \oplus a_2 \oplus \ldots \oplus a_n = x$, where $\oplus$ denotes the bitwise XOR operator.

Input

Each test contains multiple test cases. The first line contains the number of test cases t ($1 \le t \le 10^4$). The description of the test cases follows.

The first line contains two integers n and m ($1 \le n \le 2 \cdot 10^5$, $1 \le m \le 18$).

The i-th of the next n lines contains two integers l_i and r_i ($0 \le l_i \le r_i < 2^m$).

It is guaranteed that the sum of n over all test cases does not exceed $2 \cdot 10^5$, and the sum of 2^m over all test cases does not exceed 2^{18}.

Output

For each x from 0 to $2^m - 1$, let:

- f_x be the number of valid sequences, modulo $998\,244\,353$;
- $g_x = f_x \cdot 2^x \mod 998\,244\,353$.

Here, f_x and g_x are both integers in the interval $[0, 998\,244\,352]$.

Let $h = g_0 \oplus g_1 \oplus \ldots \oplus g_{2^m-1}$.

Output a single integer — the value of h itself. **Do not** perform a modulo operation.

Example

input Copy

```
4
2 2
0 2
1 3
5 3
3 7
1 3
0 2
1 5
3 6
10 14
314 1592
653 5897
932 3846
264 3383
279 5028
841 9716
939 9375
105 8209
749 4459
230 7816
1 5
0 29
```

output Copy

```
22
9812
75032210
1073741823
```

Note

Neowise Labs Contest 1 (Codeforces Round 1018, Div. 1 + Div. 2)
Finished
Practice

→ Virtual participation

Virtual contest is a way to take part in past contest, as close as possible to participation on time. It is supported only ICPC mode for virtual contests. If you've seen these problems, a virtual contest is not for you - solve these problems in the archive. If you just want to solve some problem from a contest, a virtual contest is not for you - solve this problem in the archive. Never use someone else's code, read the tutorials or communicate with other person during a virtual contest.

Start virtual contest

→ Clone Contest to Mashup

You can clone this contest to a mashup.

Clone Contest

→ Submit?

Language: GNU G++23 14.2 (64 bit, ms

Choose file: Choose File No file chosen

Submit

→ Last submissions

Submission	Time	Verdict
317148815	Apr/25/2025 11:42	Accepted
317146604	Apr/25/2025 11:18	Time limit exceeded on test 4
317146136	Apr/25/2025 11:13	Time limit exceeded on test 4
317145942	Apr/25/2025 11:11	Time limit exceeded on test 4
317145707	Apr/25/2025 11:09	Time limit exceeded on test 4
317144973	Apr/25/2025 11:01	Time limit exceeded on test 4
316793803	Apr/23/2025 13:14	Time limit exceeded on test 4
316793385	Apr/23/2025 13:10	Time limit exceeded on test 4
316792981	Apr/23/2025 13:07	Time limit exceeded on test 4

For the first test case, the values of f_x are as follows:

- $f_0 = 2$, because there are 2 valid sequences: $[1, 1]$ and $[2, 2]$;
- $f_1 = 2$, because there are 2 valid sequences: $[0, 1]$ and $[2, 3]$;
- $f_2 = 2$, because there are 2 valid sequences: $[0, 2]$ and $[1, 3]$;
- $f_3 = 3$, because there are 3 valid sequences: $[0, 3]$, $[1, 2]$, and $[2, 1]$.

The values of g_x are as follows:

- $g_0 = f_0 \cdot 2^0 = 2 \cdot 2^0 = 2$;
- $g_1 = f_1 \cdot 2^1 = 2 \cdot 2^1 = 4$;
- $g_2 = f_2 \cdot 2^2 = 2 \cdot 2^2 = 8$;
- $g_3 = f_3 \cdot 2^3 = 3 \cdot 2^3 = 24$.

Thus, the value to output is $2 \oplus 4 \oplus 8 \oplus 24 = 22$.

For the second test case, the values of f_x are as follows:

- $f_0 = 120$;
- $f_1 = 120$;
- $f_2 = 119$;
- $f_3 = 118$;
- $f_4 = 105$;
- $f_5 = 105$;
- $f_6 = 106$;
- $f_7 = 107$.

316695815	Apr/22/2025 17:17	Wrong answer on test 1

→ Problem tags

bitmasks | combinatorics | dp | fft | math | *3200

No tag edit access

→ Contest materials

- Announcement (en)
- Tutorial (en)