Smallest Bookcase (Hard)

Input file:	`standard input`
Output file:	`standard output`
Time limit:	0.25 seconds
Memory limit:	4 megabytes

This is the hard version of the problem. In this version, you need to minimize both the number of shelves and the maximum shelf length. You can make hacks once you solve both versions.

Li has a collection of n books of various sizes (w_i, h_i) and wants to build a bookcase to store them. However, Li is very capricious, as she wants the following condition to hold for every shelf:

- Books can be totally ordered by their size. I.e., there cannot be two books such that one is larger in width and smaller in height than the other (or vice-versa).

For example, the following configuration would be invalid: $(1, 2), (2, 2), (2, 1)$. This is because the first book conflicts with the last one. On the other hand, $(1, 2), (3, 2)$ would be valid. More formally, in a shelf of length m, for any book indices i and j, with $i \neq j$, either $w_i \leq w_j$ and $h_i \leq h_j$, or $w_i \geq w_j$ and $h_i \geq h_j$.

To save on materials, Li wants to know the smallest number of shelves that the bookcase can have. Additionally, with this many shelves, she wants to know the smallest length that the longest shelf can have (in number of books).

Input

The first line of the input contains a single integer, t ($1 \leq t \leq 250$) — the number of test cases.

The first line of each test case contains a single integer, n ($1 \leq n \leq 18$) — the number of books.

Then follow n lines of each test case, each with two integers, w_i and h_i ($1 \leq w_i, h_i \leq 10^9$) — the width and height of the i-th book.

It is guaranteed that the sum of 2^n over all test cases does not exceed 2^{18}.

Output

For each test case, first output a single integer, k — the minimum number of shelves that the bookcase can have to accommodate all of the books according to Li's whim.

Then, on the next line, output n integers — the shelf number ($1 \leq s_i \leq k$) of each book in its original order. If there are multiple possible configurations, output any of them.

Example

standard input	standard output
4 2 1 1 1 1 4 1 1 1 2 2 1 2 2 5 1 1 1 2 2 2 2 3 3 1 5 1 3 2 1 2 2 3 1 3 3	1 1 1 2 1 1 2 2 2 2 1 1 1 2 3 1 2 2 3 1

Note

The examples below use book indices.

In the first test case, a single shelf with both books is the only possible configuration.

In the second test case, two shelves each with two books can be achieved. The selected configuration is $\{1, 2\}, \{3, 4\}$. An alternative configuration would be $\{1, 3\}, \{2, 4\}$.

In the third test case, two shelves each with at most three books can be achieved. The only possible configuration is $\{2, 3, 4\}, \{1, 5\}$.