Midterm test

60 minutes

1 Binary Search in Rotated Array (5 points)

Given a rotated sorted array (which is originally sorted but then rotated at an unknown position), find the index (start from 1) of a target element in the array in $O(\log n)$ time complexity.

Constraints:

- $1 \leq n \leq 10^5$.
- $-10^9 \leq x \leq 10^9$.
- $-10^9 \leq a_i \leq 10^9$, with $\forall i \in [1, \ldots, n]$.
- $a_i \neq a_j$, with $\forall i, j \in [1, \ldots, n]$ where $i \neq j$.

Input:

- The first line contains an integer n, the size of the array.
- The second line contains n integers representing the rotated sorted array.
- The third line contains an integer x, the target element to search for.

Output:

- The index of x in the array.
- If the element is not present, return `0`.

Example:

Input	**Output**

`8`
`3 4 5 6 7 0 1 2`
`6`
	`4`

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

2 Merge Intervals (5 points)

Given a list of intervals, where each interval is represented as a pair (l_i, r_i) indicating the starting and ending points (inclusive), implement a program to merge overlapping intervals and print the sorted list of non-overlapping intervals.

Constraints:

- $1 \le n \le 10^5$.
- $-10^9 \le l_i \le r_i \le 10^9$ for each interval i.

Input:
The input is read from the file `input.txt` with:

- The first line contains an integer n, the number of intervals.
- The following n lines each contain two integers l_i and r_i, representing the start and end points of the i-th interval.

Output:
Write to the `output.txt` file:

- A sorted list of merged intervals. Each interval should be printed in the format "start end" on a new line.

Example:

`input.txt`	`output.txt`

`4`
`8 10`
`1 3`
`3 6`
`-1 2`
	`-1 6`
	`8 10`

Explanation:
The intervals are sorted and merged if they overlap. For example:

- $[-1, 2]$ and $[1, 3]$ merge into $[-1, 3]$, and then $[3, 6]$ merges into $[-1, 6]$.
- The final result is $[-1, 6]$, $[8, 10]$.