986. Interval List Intersections (/problems/interval-list-intersections/)

Feb. 2, 2019 | 66.2K views

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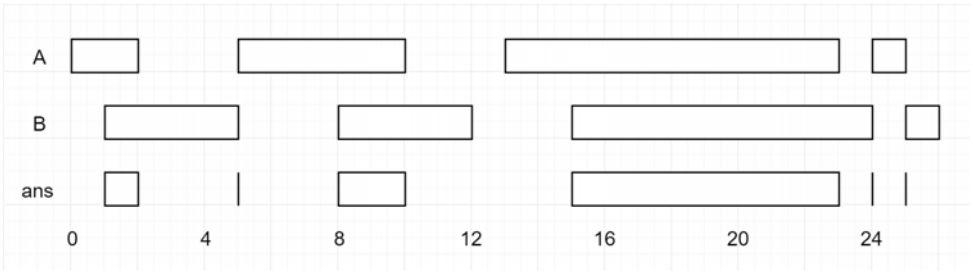
Given two lists of **closed** intervals, each list of intervals is pairwise disjoint and in sorted order.

Return the intersection of these two interval lists.

(Formally, a closed interval `[a, b]` (with `a <= b`) denotes the set of real numbers `x` with `a <= x <= b`. The intersection of two closed intervals is a set of real numbers that is either empty, or can be represented as a closed interval. For example, the intersection of [1, 3] and [2, 4] is [2, 3].)

Example 1:




```
Input: A = [[0,2],[5,10],[13,23],[24,25]], B = [[1,5],[8,12],[15,24],[25,26]]
Output: [[1,2],[5,5],[8,10],[15,23],[24,24],[25,25]]
Reminder: The inputs and the desired output are lists of Interval objects, and n
```

Note:

1. `0 <= A.length < 1000`
2. `0 <= B.length < 1000`
3. `0 <= A[i].start, A[i].end, B[i].start, B[i].end < 10^9`

NOTE: input types have been changed on April 15, 2019. Please reset to default code definition to get new method signature.

Solution

Approach 1: Merge Intervals

Intuition

In an interval `[a, b]`, call `b` the "endpoint".

Among the given intervals, consider the interval `A[0]` with the smallest endpoint. (Without loss of generality, this interval occurs in array `A`.)

Then, among the intervals in array `B`, `A[0]` can only intersect one such interval in array `B`. (If two intervals in `B` intersect `A[0]`, then they both share the endpoint of `A[0]` -- but intervals in `B` are disjoint, which is a contradiction.)

Algorithm

If `A[0]` has the smallest endpoint, it can only intersect `B[0]`. After, we can discard `A[0]` since it cannot intersect anything else.

Similarly, if `B[0]` has the smallest endpoint, it can only intersect `A[0]`, and we can discard `B[0]` after since it cannot intersect anything else.

We use two pointers, `i` and `j`, to virtually manage "discarding" `A[0]` or `B[0]` repeatedly.

Java Python

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```python
class Solution:
    def intervalIntersection(self, A: List[List[int]], B: List[List[int]]) -> List[List[int]]:
        ans = []
        i = j = 0

        while i < len(A) and j < len(B):
            # Let's check if A[i] intersects B[j].
            # lo - the startpoint of the intersection
            # hi - the endpoint of the intersection
            lo = max(A[i][0], B[j][0])
            hi = min(A[i][1], B[j][1])
            if lo <= hi:
                ans.append([lo, hi])

            # Remove the interval with the smallest endpoint
            if A[i][1] < B[j][1]:
                i += 1
            else:
                j += 1

        return ans
```

Complexity Analysis

- Time Complexity: $O(M + N)$, where M, N are the lengths of `A` and `B` respectively.
- Space Complexity: $O(M + N)$, the maximum size of the answer.

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(/haruna_yjc)

haruna_yjc (/haruna_yjc) ★ 27 April 4, 2019 12:04 AM

Shouldn't the space complexity be O(1)?

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(/wangjian4814)

wangjian4814 (/wangjian4814) ★ 95 May 26, 2019 10:00 PM

So nice solution!!!

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(/a_m_a_n)

a_m_a_n (/a_m_a_n) ★ 8 August 8, 2019 9:24 PM

Java solution with the latest input types.

```
public int[][] intervalIntersection(int[][] A, int[][] B) {
List<int[]> res = new ArrayList();
int i = 0, j=0;
```

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(/sithis)

Sithis (/sithis) ★ 10018 February 16, 2019 11:59 AM

@awice (https://leetcode.com/awice) It would be better to use `toArray(new T[0])` instead of `toArray(new T[size])` . See this (https://shipilev.net/blog/2016/arrays-wisdom-ancients/#_conclusion) for explanation.

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(/lumcoder)

LumCoder (/lumcoder) ★ 4 March 15, 2020 7:28 PM

The solution cannot handle cases with some non-intersect intervals, right?

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(/amarchin)

amarchin (/amarchin) ★ 97 July 25, 2019 7:25 PM

In python a List doesn't have any `start` or `end` attribute.

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(/lidaivet)

lidaivet (/lidaivet) ★ 54 April 15, 2020 10:28 PM

The constraint does not mention whether A[i] and A[i+1] won't overlap.
so let's say:

```
A = [[0, 6], [5,8]]
B = [[2, 6], [8,12]]
```

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(/mchen2)

mchen2 (/mchen2) ★ 11 October 20, 2019 10:24 PM

Nobody has error in List? what's the Interval?

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(/lopezpdvn)

lopezpdvn (/lopezpdvn) ★ 0 April 10, 2020 5:33 PM

Approach 1 in JavaScript

```
const intervalIntersection = (A, B) => {
  const ans = [];
  let a = b = 0;
```

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(/ajak6)

ajak6 (/ajak6) ★ 198 April 5, 2020 6:29 PM

Does pairwise disjoint means they will not be equal between A and B. This test cases fails for most of the solutions

```
[[2,4],[13,14]]
[[2,4],[3,5]]
```

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