Analyze worst case time complexity of above algorithm :

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Sorting intervals according to the right - most ends :

Implement " Quick Sort " , and the worst case time complexity will be $O(n^2)$, which occurs when the selected pivot is always an extreme value . (The smallest or largest)

Doing the interval selection :

Even in the worst case (going through all of the intervals) , the time complexity will still in linear time ⇒ $O(n)$

⇒ $n^2 + n$

⇒ n^2

⇒ $O(n^2)$ for worst case time complexity.

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Analyze worst case time complexity of above algorithm with sorted V :

We don't need to execute the sorting progress , then the only thing that can matter the time complexity is the interval selection progress. For interval selection progress, even in the worst condition (going through all of the ~~conditions~~ intervals) , the time complexity will still in linear time. Thus

⇒ $O(n)$ #

Rewrite above algorithm to detect target range may impossible to be covered by original interval set. Analyze space complexity, time complexity of best case and worst case of modified algorithm :

1. Set current position $p \to \ell^*$, answer set $\mathcal{V}' \leftarrow \{\}$
2. Sort the intervals using quick sort
3. Check if the first interval are able to cover the starting end
4. Find right-most (have largest right end) interval $v \in \mathcal{V}$ that $\ell_v \leq p$
5. Update $p \leftarrow r_v$, $\mathcal{V}' \leftarrow \mathcal{V}' \cup \{v\}$
6. Check the interval is combined together or overlap with each other. If not, break and return (-1)
7. Repeat the steps until $p \geq r^*$

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Best Case Time Complexity : $O(n\log n)$ (with sorting)

Best Case Space Complexity : $O(n)$

Worst Case Time Complexity : $O(n^2)$ (without sorting)

Worst Case Space Complexity : $O(n)$

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Above algorithm is doing through left to right. Please rewrite it to a through right to left version. Is your new algorithm always get the same result of original one ? Give example(s) to explain your answer :

In right to left :

1. Set current position $\ell^* \rightarrow p$,
   answer set $\{\} \rightarrow \nu'$
2. Find left-most (have largest left end) interval
   $\nu \in \nu$ that $p >= \ell_\nu$
3. Update $\nu' \cup \{\nu\} \rightarrow \nu'$, $r_\nu \rightarrow p$
4. Repeat step 3 and step 2 until $r^* <= p$

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The new algorithm always gets the same result of the original one :

Left to Right : $p \leftarrow 3+2$

Result : $p = 5$

Right to Left : $3+2 \rightarrow p$

Result : $p = 5$

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