Dept. of CSE
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Greedy Algorithms:
Activity Selection Problem

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Acknowledgement

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Activity Selection Problem

- It is a problem of scheduling several activities that require exclusive use of a common resource, with the goal of selecting a maximum size set of **mutually compatible activities.**

Activity	1	2	3	4	5	6	7
Start	1	3	5	2	6	8	9
Finish	4	6	7	9	10	11	11
After sorting by finish time in ascending order							

Activity Selection Problem

Activity	1		3			6	
Start	1		5			8	
Finish	4		7			11	

	1	2	3	4	5	6	7	8	9	10	11
1	🟩	🟩	🟩	🟩							
2			🟨	🟨	🟨	🟨					
3					🟩	🟩	🟩				
4		🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	
5						🟦	🟦	🟦	🟦	🟦	
6								🟩	🟩	🟩	🟩
7									⬛	⬛	⬛

Activity Selection Algorithm

- Sort the activities by their finishing times (in ascending order).
- Select the first activity (which finishes the earliest).
- Iterate through the remaining activities:
  - If the start time of the current activity is greater than or equal to the finish time of the last selected activity, select it.
- Continue until all activities are checked.

Problem Statement

Given ***n*** activities with their ***start*** and ***finish*** times, the goal is to select the ***maximum number of activities*** that can be performed by a single person, assuming that the person can work on only one activity at a time.

Input

- An integer **N** representing the number of activities.
- An array **start[ ]** of size **N** where **start[i]** is the start time of the **i-th** activity.
- An array **finish[ ]** of size **N** where **finish[i]** is the finish time of the **i-th** activity.

Objective

- Select the maximum number of activities that can be performed without any overlapping.

Constraints

- $1 \leq N \leq 10^5$ (large input sizes possible)
- $1 \leq$ ***start[i], finish[i]*** $\leq 10^9$

Pseudocode:

```
ACTIVITY_SELECTION(start[], finish[], N)
    Sort activities based on finish times
    Select the first activity and print it
    lastSelected = 0

    FOR i = 1 to N-1 DO
        IF start[i] >= finish[lastSelected] THEN
            Select activity i and print it
            lastSelected = i
        ENDIF
    END FOR
END
```

Time Complexity

- **Sorting the activities**: O(nlogn)
- **Iterating through activities**: O(n)
- **Overall Complexity**: O(nlogn)

An Example

A person is given a set of activities, each with a specific start and finish time.
The goal is to select the maximum number of non-overlapping activities that can be performed by a single person.

Activity	Start Time	Finish Time
1	1	3
2	2	5
3	4	6
4	6	8
5	5	7
6	8	9

Sort activities based on finish times

Activity	1	2	3	5	4	6
Start Time	1	2	2	5	6	8
Finish Time	3	5	6	7	8	9

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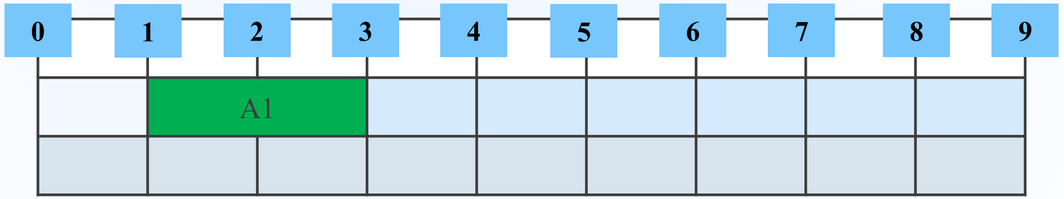

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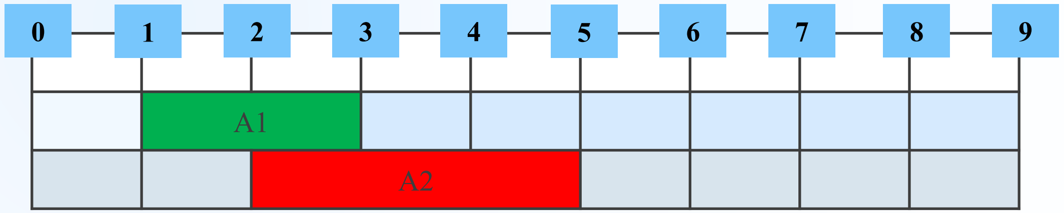

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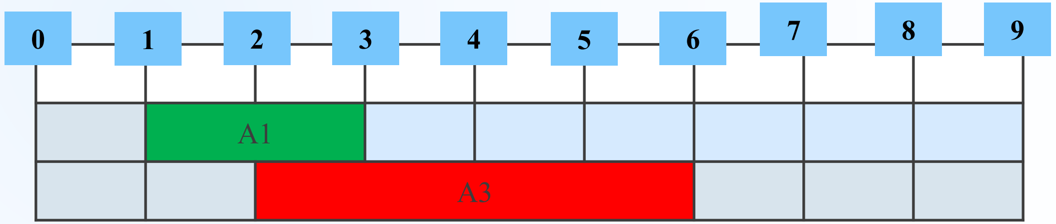

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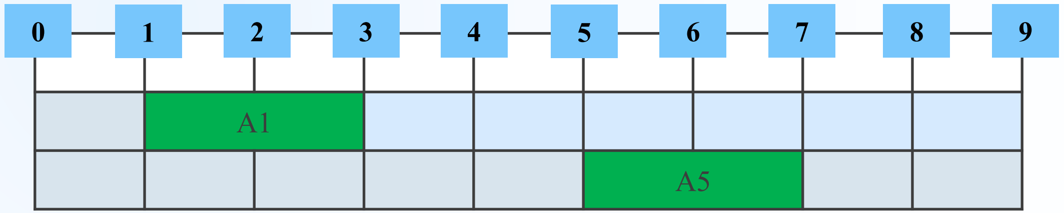

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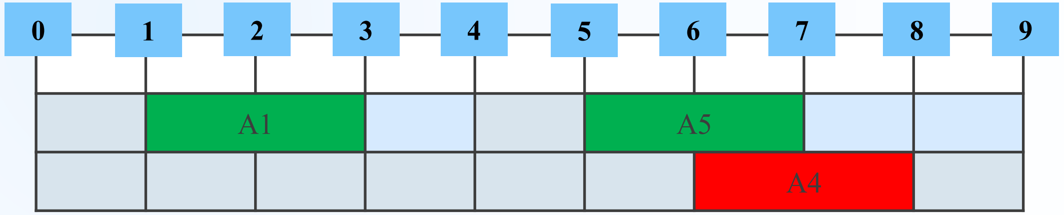

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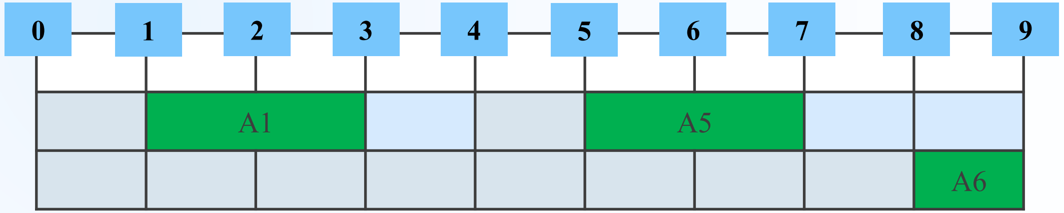

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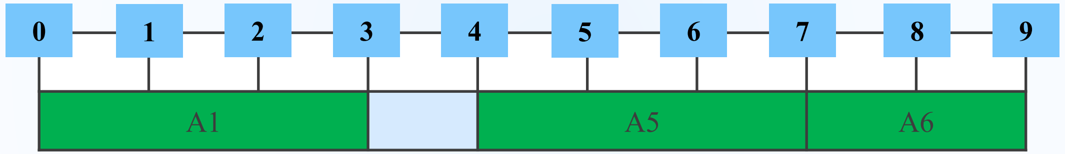
Example Cont'd



Applications

- **Job scheduling:** Scheduling jobs or tasks where each task has a deadline.
- **Conference room scheduling:** Allocating meeting rooms based on time slots.
- **CPU scheduling:** Selecting processes that can run in a non-overlapping manner.
- **Event planning:** Scheduling events with time constraints.

Thank You