CS & IT ENGINEERING

Algorithms

Greedy Method

Lecture No.- 03

By- Aditya Jain sir

Topics to be Covered

- Topic
- Topic — JSD
- Topic — OMP

About Aditya Jain sir

1. Appeared for GATE during BTech and secured AIR 60 in GATE in very first attempt - City topper
2. Represented college as the first Google DSC Ambassador.
3. The only student from the batch to secure an internship at Amazon. (9+ CGPA)
4. Had offer from IIT Bombay and IISc Bangalore to join the Masters program
5. Joined IIT Bombay for my 2 year Masters program, specialization in Data Science
6. Published multiple research papers in well known conferences along with the team
7. Received the prestigious excellence in Research award from IIT Bombay for my Masters thesis
8. Completed my Masters with an overall GPA of 9.36/10
9. Joined Dream11 as a Data Scientist
10. Have mentored 12,000+ students & working professions in field of Data Science and Analytics
11. Have been mentoring & teaching GATE aspirants to secure a great rank in limited time
12. Have got around 27.5K followers on Linkedin where I share my insights and guide students and professionals.

Telegram

Telegram Link for Aditya Jain sir: https://t.me/AdityaSir_PW

Topic : Greedy of Algorithms

- Job sequencing with deadline (JSD):

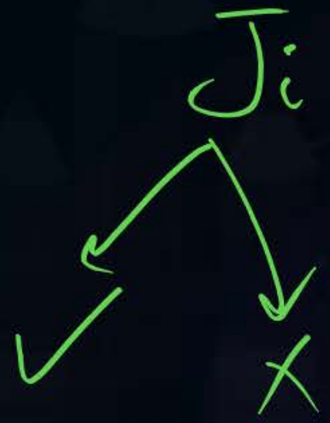
1. Enumeration logic:

   → $O(2^n)$

Hence,

We Need greedy based Algo to reduce the TC.

n = # of Jobs



Topic : Greedy Algorithms

Eg.1. n = 4

Jobs	(Di) Deadline	(Pi) Profit	
J1	2	200 ✓	.....(1)
J2	1	30 ✗	.....(4)
J3	2	50 ✗	.....(3)
J4	1	80 ✓	.....(2)

Enumeration

N→ $O(2^n)$ Expo Max(D) =2 Max profit =280

Topic : Greedy Algorithms

Greedy based optimal solution for previous Ques.

Logic:-

1. Max (Deadline) → Queue size of

J4	J1
1	2
×	×

2. Sort jobs on basis of decreasing profit

J1 → 2 → 200 (✓)

J4 → 1 → 80 (✓)

J3 → 2 → 50 (×)

J2 → 1 → 30 (×)

Max profit greedy appr.

= 200 + 80 + 0 + 0

= 280

Topic : Greedy Algorithms

#Q.

n=6	(Di) Deadline	(Pi) Profit
J1	2	28
J2	3	36
J3	4	24
J4	2	20
J5	4	16
J6	3	30

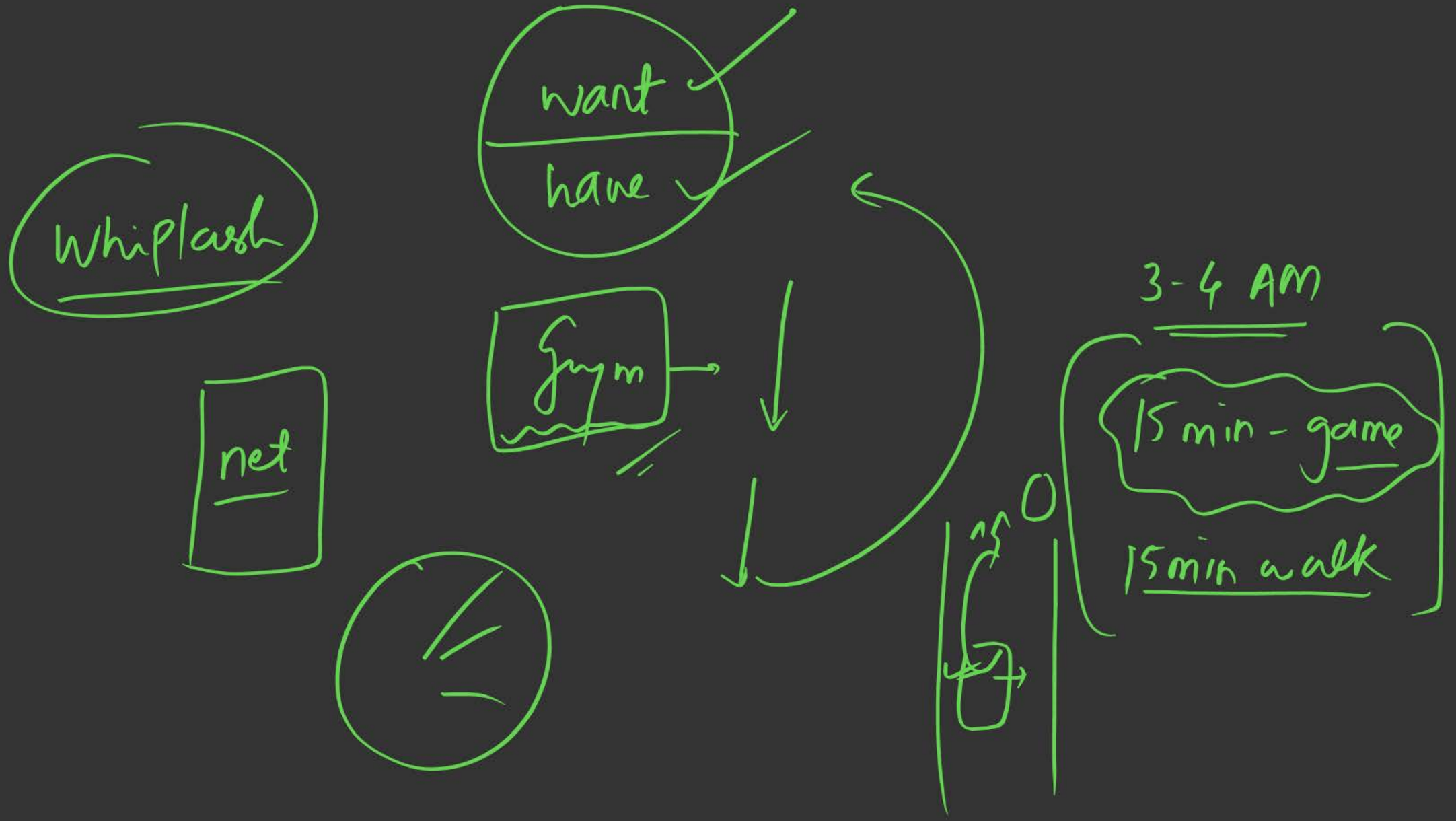
3 1 4 5 x 6 x 2

max(D) = 4

J_1	J_6	J_2	J_3
1	2	3	4

MaxP = 28+30+24+36

= 118


want
have
Whiplash
Gym
net
3-4 AM
15 min - game
15 min walk

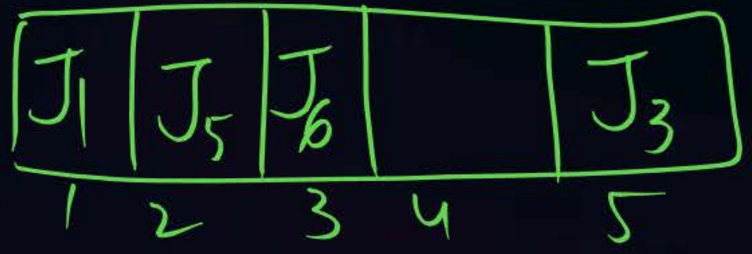
Topic : Greedy Algorithms

#Q.

n=6	~~(Di)~~ Deadline	~~(Pi)~~ Profit	
J1	56	2	.....(2)
J2	24	1	.....(5)
J3	10	5	.....(6)
J4	36	1	.....(4)
J5	60	2	.....(1)
J6	40	3	.....(3)

Profit

Deadline



56
10
60
40
= 166

Max(D) = 5

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#Q.

	Deadline	Profit	
J1	4	140 ✓	.....(2) (✓)
J2	4	170 ✓	.....(1) (✓)
J3	4	24 ✗	.....(6) (✗)
J4	4	36 ✗	.....(5) (✗)
J5	3	100 ✓	.....(4) (✓)
J6	4	120 ✓	.....(3) (✓)
J7	3	20 ✗	.....(7) (✗)

J_5	J_6	J_1	J_2
1	2	3	4

Profit: 140 + 170 + 100 + 120 = 530

Max(D) = 4

Max profit =?

Topic : Greedy Algorithms

Bonus

```
1.  Algorithm Greedy Job(d, J, n)
2.  // J is a set of jobs that can be completed by t heir deadlines.
3.  {
4.      J : {1};
5.      For i : = 2 to n do
6.      {
7.          If (all jobs in j U {i} can be completed
8.              By their deadlines) then J: = J U {i};
9       }
10. }
```

Topic : Greedy Algorithms

#Q. We are given 9 tasks T1, T2...., T9. The execution of each task requires one unit of time. We can execute one task at a time. Each tasks T1 has a profit Pi and a deadline di, profit pi is earned if the task is completed before the end of the Deadline.

Task	T1	T2	T3	T4	T5	T6	T7	T8	T9
Profit	15	20	30	18	18	10	23	16	25
Deadline	7	2	5	3	4	5	2	7	3

max(D) = 7

T2	T7	T9	T5	T3	T1	T8
1	2	3	4	5	6	7

15, 20, 30, 18 → 23, 16, 25

98
49
147

Topic : Greedy Algorithms

#Q. Are all tasks completed in the schedule that gives maximum profit?

A All tasks are completed

B T1 and T3 are left out

C T1 and T6 are left out

D T4 and T6 are left out

Topic : Greedy Algorithms

#Q. What is the maximum profit earned?

A 147

B 165

C 167

D 175

OMP

Topic : Greedy Algorithms

P3: Optimal merge patterns:- (Application of merging algo.)

Given ‘n’ files

It is required to merge them using 2-way merging, such that the total number of record moments are minimum.

Default:- [Merging 2-files at a time]

Topic : Greedy Algorithms

Concept:-

Given 2 sorted files 'A' & 'B' having 'n' and 'm' records respectively. To merge them into a single sorted file, it requires (n + m) record movements.

Topic : Greedy Algorithms

Eg.2.

n =3

A: [2, 3, 5]

m = 4

B : [1, 4, 8, 10]

[1, 2, 3, 4, 5, 8, 10,]

Record movement = n+ m

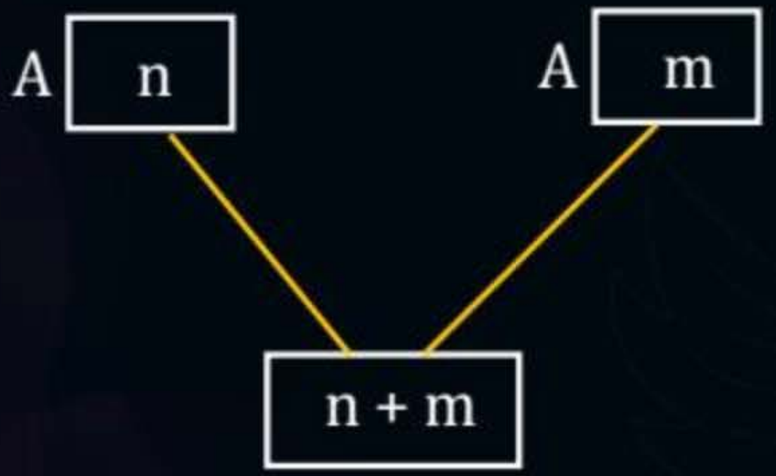
= 3 + 4

= 7

Topic : Greedy Algorithms

2-way merging Algorithm (merge sort)

Number of elements comparisons:



Best case = min (n,m)

Worst case= (m + n –1) element comparisons.

A = 10

B = 15

C = 5

ABC

TRM = ?

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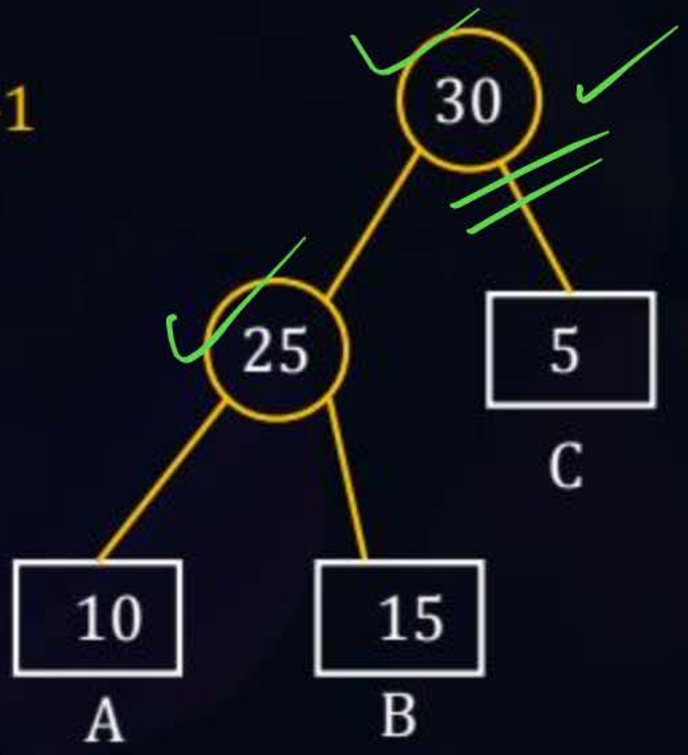
Eg.3. A: 10 → "number of records in files A"

B: 15 → "number of records in files B"

C: 5 → "number of records in files C"

Case-1

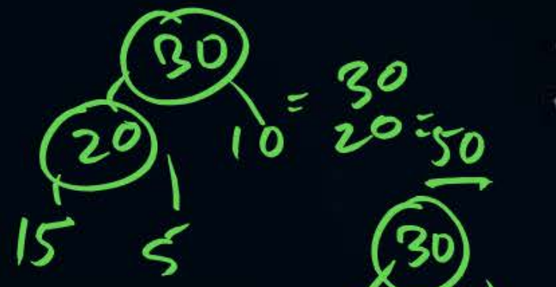


Total no. of records movement = 25 + 30

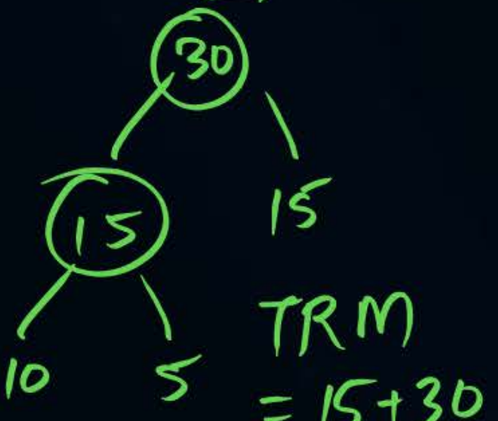
= 55

Order = ABC

3) BCA



1) ABC



2) ACB

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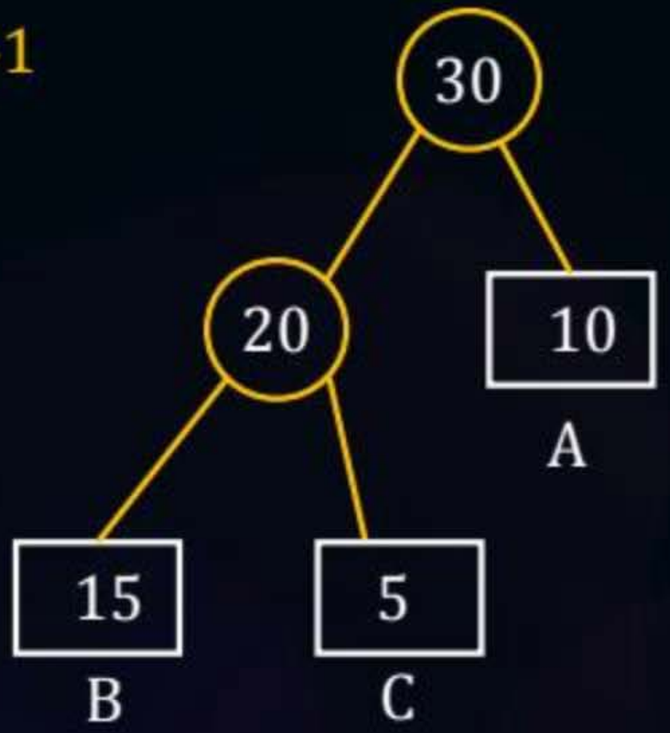
α - Way binary merge tree

Case-1



Total no. of records movement = 20 + 30
= 50

Order = BCA

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Observation.

1. Ordering matters and ~~inputs~~ impacts the total number of records movements.
2. For 'n' files, how many times 2-way merging operation is required ? ⇒ (n-1)
3. Objective:- Minimize the total number of records movements.

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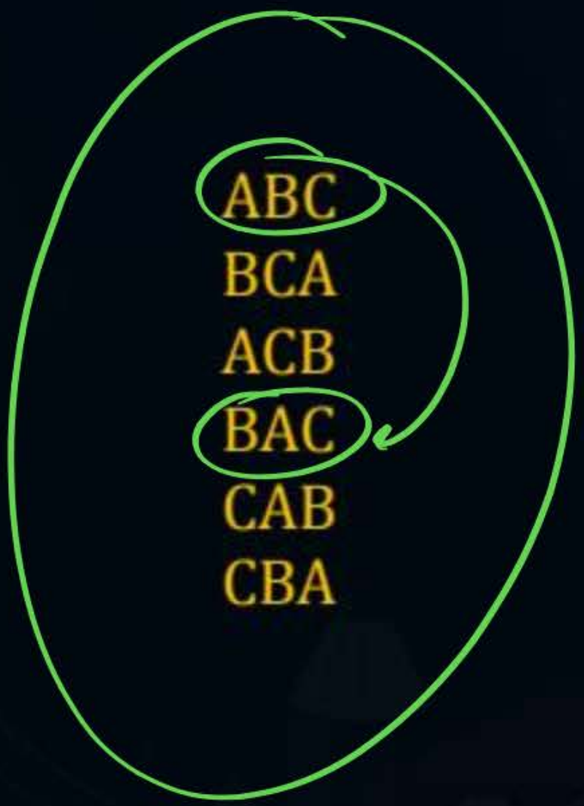
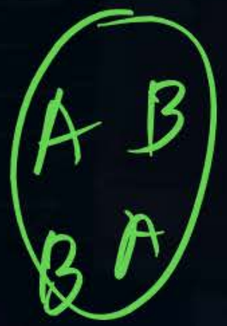
Observation.

4. Size of solution space = ?

   n! arrangement

All n! Solution are feasible.





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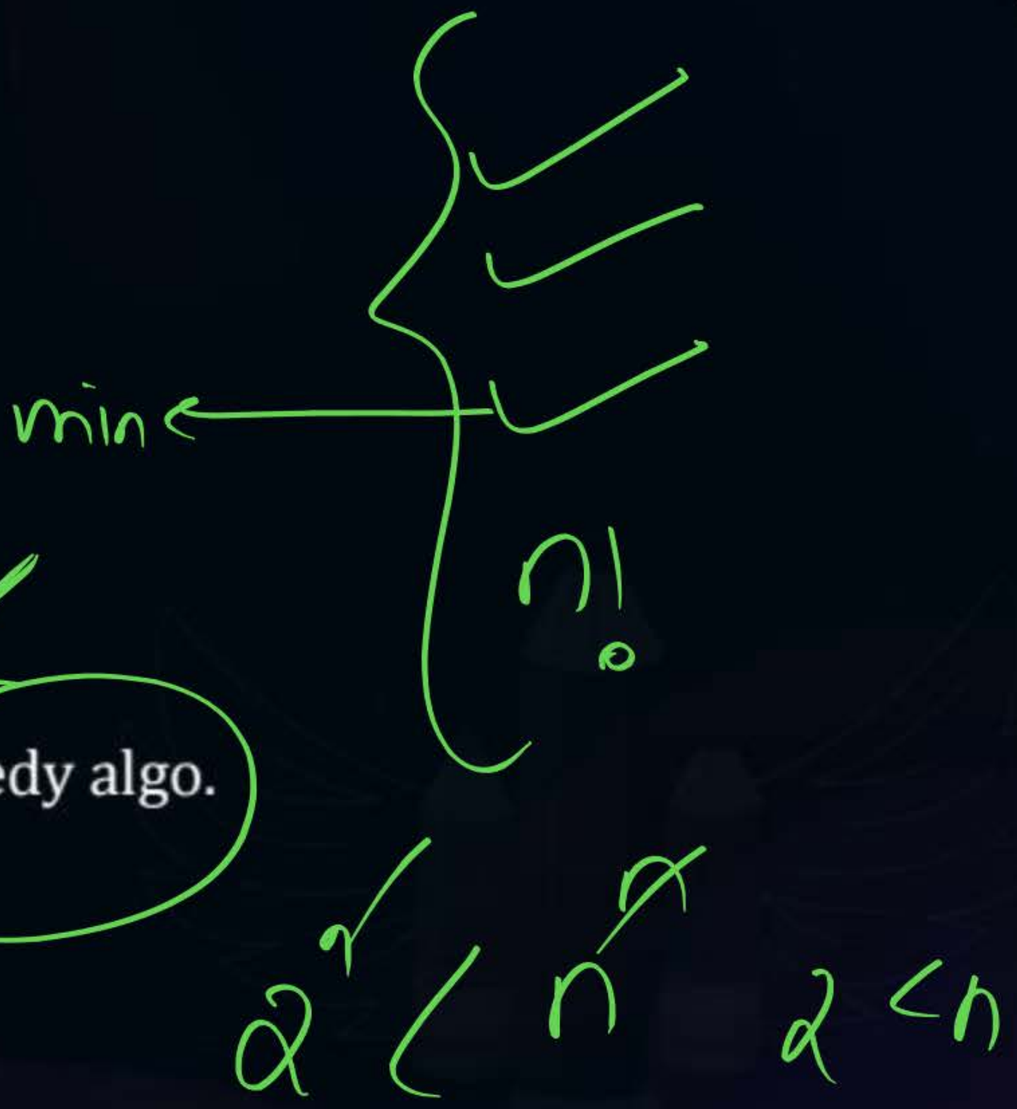
Appr.-1

Brute force/ Enumeration

- Guarantees optimal sol.
- But time complexity = $O(n!)$

$= O(n^n)$

Hence, we need a ~~based~~ solution → greedy algo.



THANK - YOU