

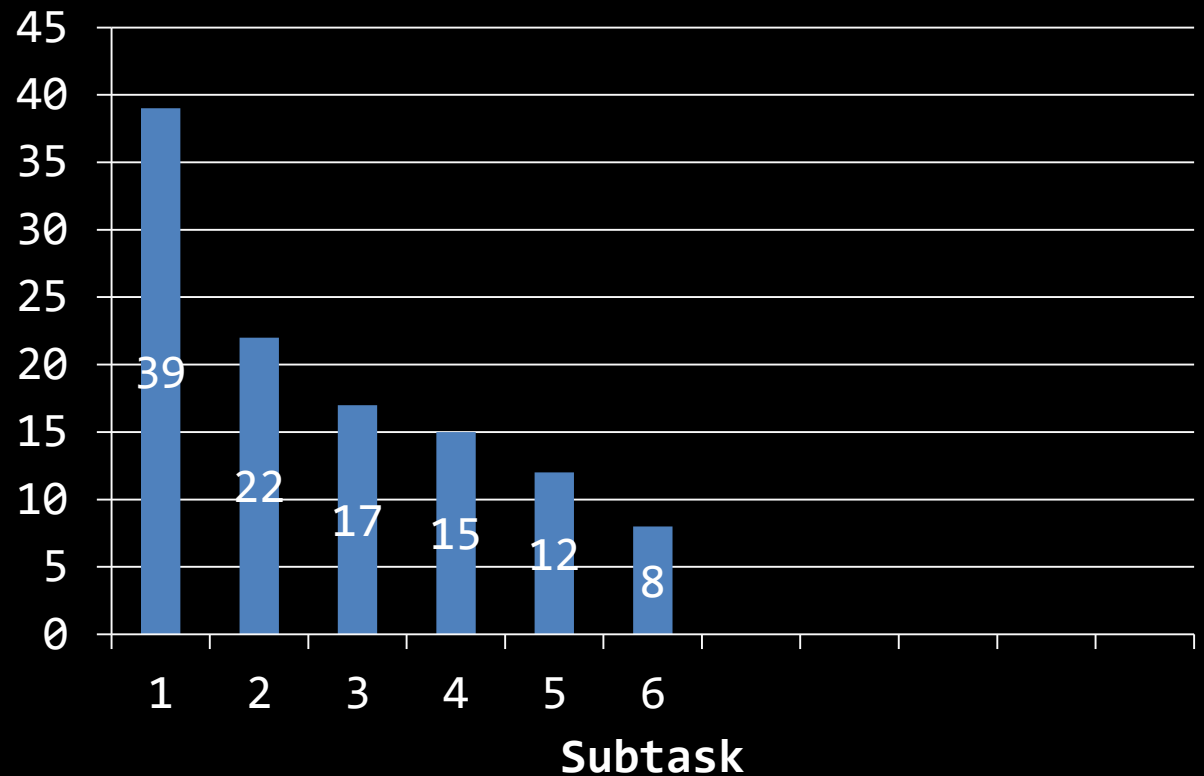
# Model Answer

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# Statistic

- 75 attempts
- mean: 21.52
- max: 100



# Problem Statement

- An exam paper consists of  $N$  MC questions with 3 choices
- Given Alice, Bob, Carlos's ans
- Output a possible "model answer" such that only Alice has  $\geq P$  marks or output "Impossible"

# Example

- $n=4, k=2$  Marks
- Alice(A) **AABC**  $3 \geq 2$
- Bob(B) **BBCC**  $0 < 2$
- Carlos(C) **ACAC**  $1 < 2$

Output: AABA

# Observation

- Each question is independent
- i.e. 2<sup>nd</sup> question's mark won't be affected by 1<sup>st</sup> question's mark
- → order of question is not important

# Possible Strategy

- If a question is possible to  $\uparrow A$  and  $\downarrow B$  and  $\downarrow C$ , then always do it
- But how about other cases?
- When  $A, B, C$  have the same answer, let them be all correct or all wrong ?

# Subtask 1

- $N \leq 100000$  and  $P=N$
- A can pass if and only if A's answer is the same with model answer
- Check whether B,C can pass
- $O(N)$

# Subtask 2

- $N = 2$
- Many possible ways to do
- Exhaustion  $O(3^N)$
- Consider possible cases and then solve them by hand



# Subtask 3

- $N \leq 100000$  and B,C's answers are same
- 3 people  $\rightarrow$  2 people
- Questions can be categorized into 2 groups: same answer, diff answer

# Subtask 3

- Diff ans: always let A be correct
- Same ans: let A be correct on first  $k$  questions, and wrong on the others
- (order is not important)
- Iterate  $k$  from  $0$  to  $n$  to see if requirements can be achieved
- $O(N)$

# Subtask 4

- $N \leq 10$
- Exhaustion  $O(3^N)$  if checking is implemented during the exhaustion
- $O(N3^N)$  else  
[0,  $3^N$ ): each number is representing a “model answer” (base 3)

# Subtask 5

- $N \leq 1000$
- categorized into 4 groups

	A	B	C
1	X	Y	Z
2	X	X	Y
3	X	Y	X
4	X	X	X

# Subtask 5

- Always use group 1 to increase A
- Iterate no. of marks that A get in group 2 and no. of marks that A get in group 3
- No. of marks that A get in group 4 can be calculated in  $O(1)$
- $O(N^2)$

# Observation

- If using some question can already let A pass while B,C haven't passed
- Then a possible solution always exist
- Since you can let B,C be all wrong in the remaining question

# Subtask 6 (Full solution)

- $N \leq 100000$

- Target:  $A=P$  and  $B, C < P$  using some question

Group 1(XYZ): use 0 “quota” of B,C

Group 2(XXY): use 1 “quota” of B

Group 3(XYX): use 1 “quota” of C

Group 4(XXX): use 1 “quota” of B,C

# Subtask 6 (Full solution)

- Greedy
- Priority:  $1 \rightarrow 2, 3 \rightarrow 4$
- Flow: let A be correct in some question in the order of the above priority if A won't  $>P$  and B,C won't  $\geq P$
- Then assign the answer of remaining question as stated in the previous observation
- $O(N)$



Thank you