$L_1 = \{ a^p b^n a^q \mid p, n, q \geq 0, \; n = p + q \}$

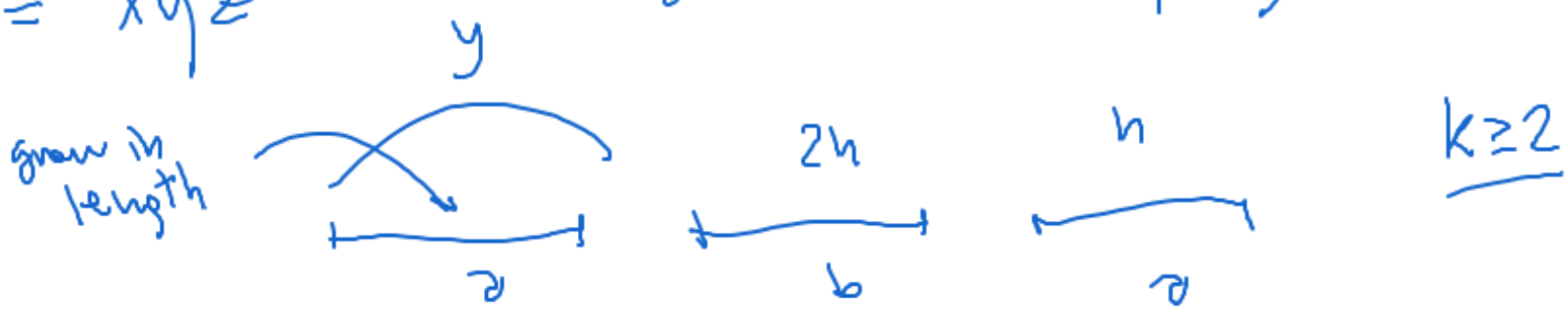
$w = a^n b^{2n} a^n$

we cannot count → L_1 not REG!

Mistakes

* have considered only a couple of factorizations (G3)

$w = xyz$ case 1 $|x| = 0$, $|y| = n$ (p.l. const.)



$k \geq 2$

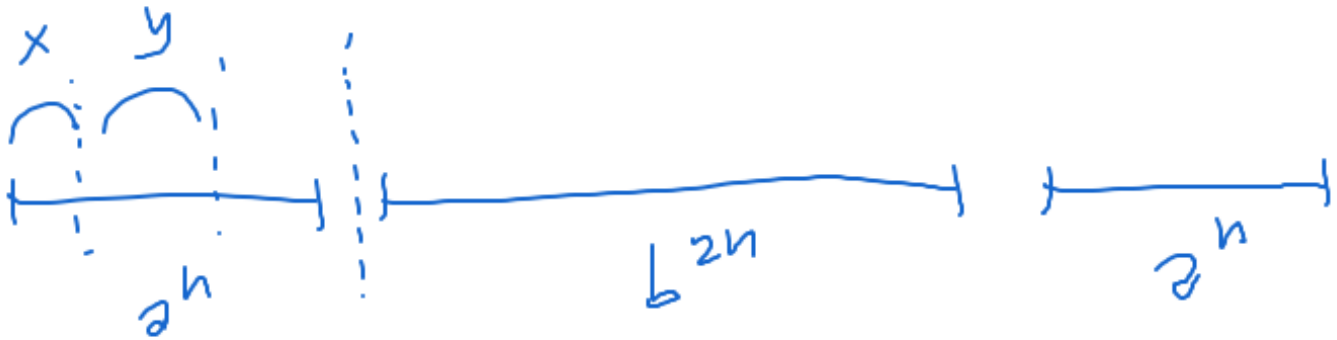
Case 3:

$|x| = n-1 \qquad |y| = 1$

$|xy| \leq n$

$k \geq 2$ → p.l. violated

group 3 : did not consider all factoriz.



$|x| = 3$ $|y| = 6$ ....

$1 \le |y|$

$|xy| \le n$

y has to end before or at the boundary between a's and b's

$k > 1$, p.l. violated!!

groups of a's and groups of b's

group #5 $\quad W = xyz = a^n b^{2n} a^n$

$|xy| = m \qquad k = 0$

$xy^0z = xz = w_0 = a^{n-m} b^{2n} a^n$ wrong

x is still there !

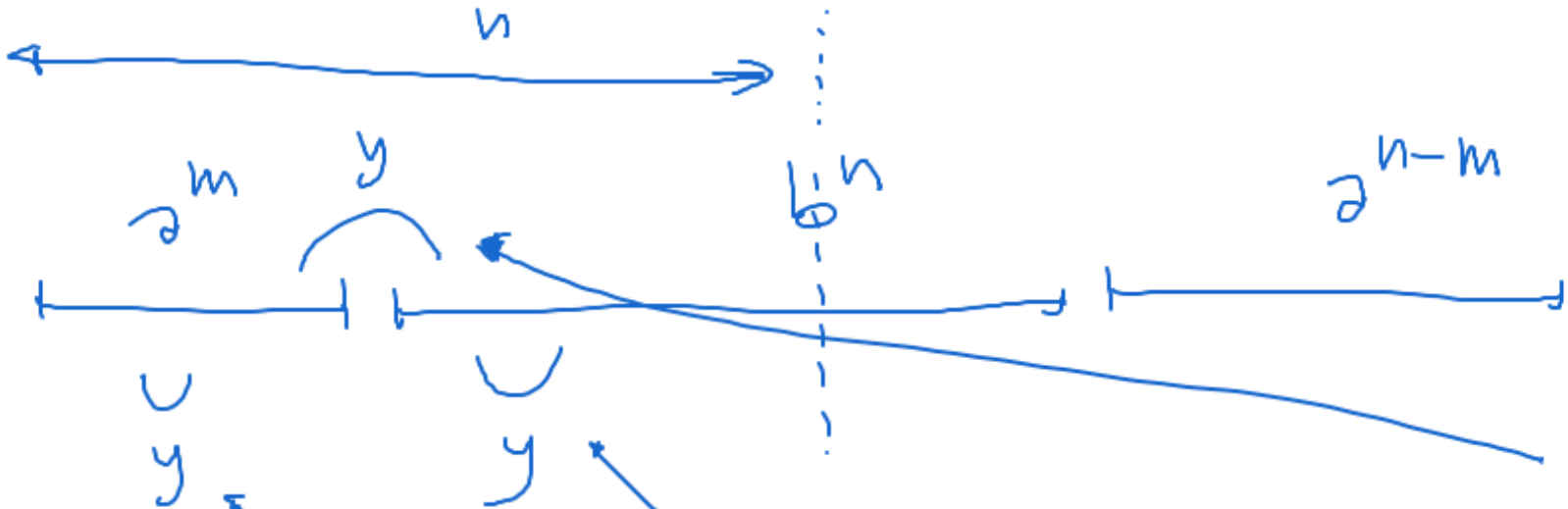
Correction:

$|y| = m \geq 1$ then

$W_0 = a^{n-m} b^{2n} a^n$

group #6: $m \geq 0$

$w = xyz = a^m b^n a^{n-m}$ (longer in length than n)



- $|xy| \leq n$

- $k=0$ does not work

- $k>1$ ←

xy^5z → violate structure of L_1 !!

problem with prev. solution is:

~~wrong~~ unfavourable choice of string w !!

Then group #6 switched to a different w:

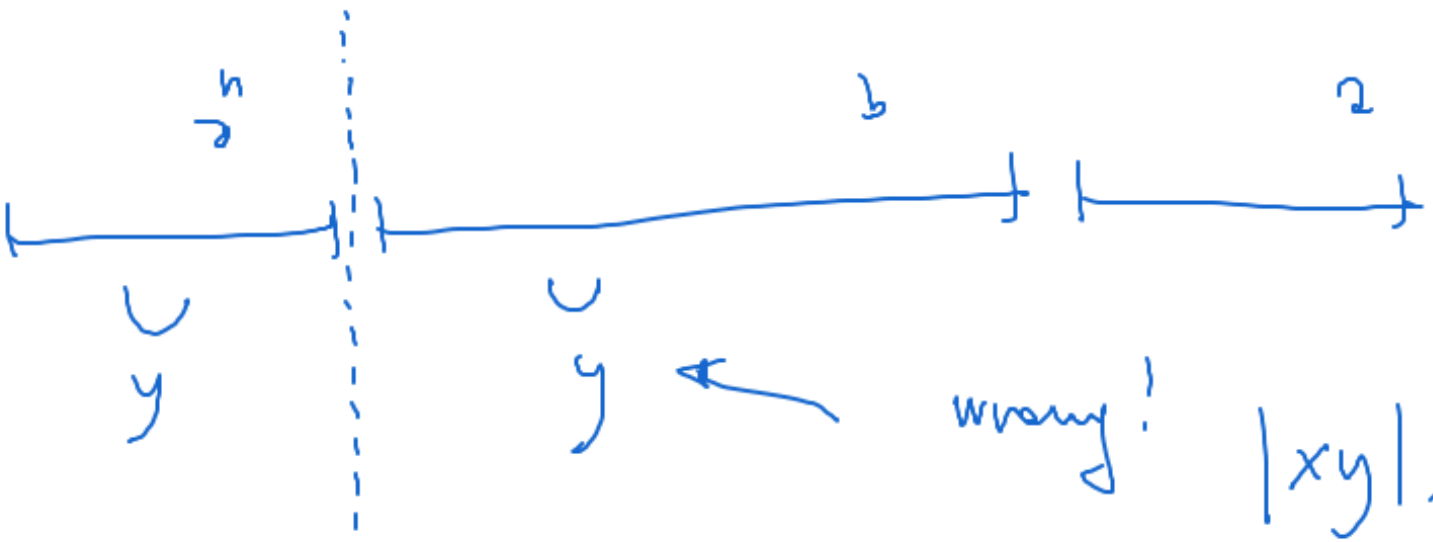
$$w = a^n b^n \in L_1$$

→ discuss this new scenario ...

you are providing 2 different solutions!

group #7

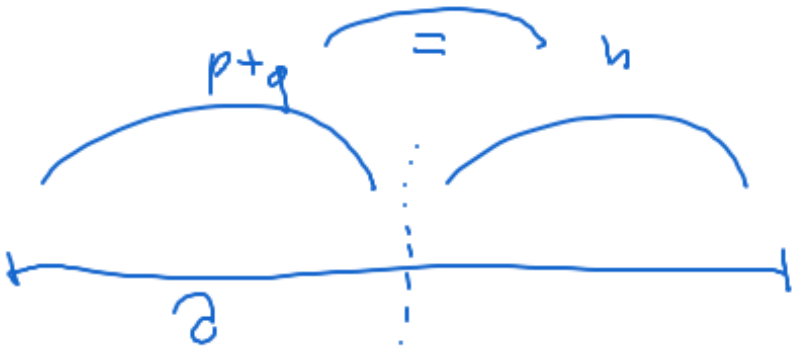
$w = a^h b^{2h} a^h$



p. lemma works for y in here only!

L_2 is regular

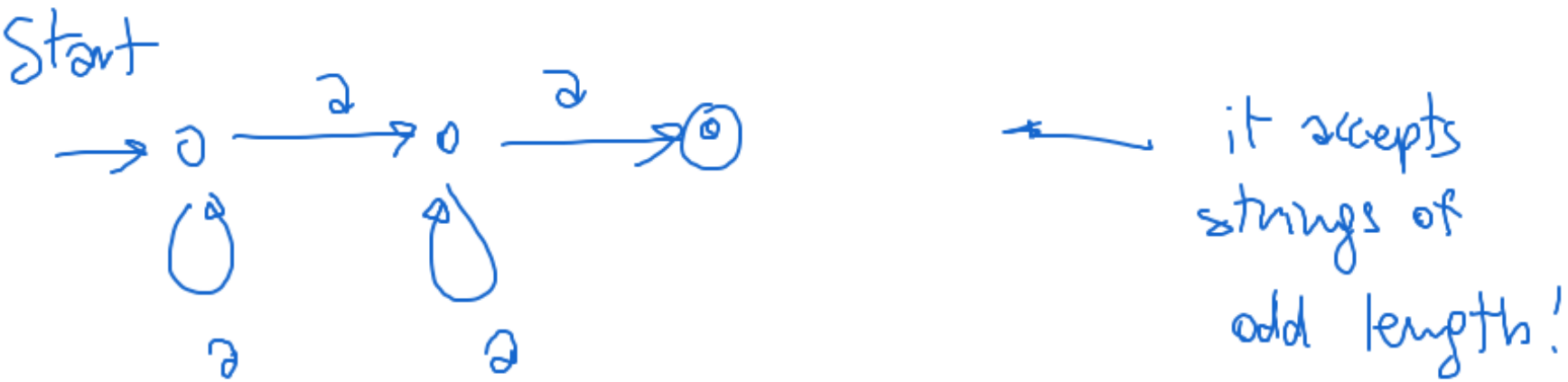
$$L_2 = \{ a^p a^n a^q \mid p, n, q \geq 0, \; p+q = n \}$$



this amounts to say that lengths of string in L_2 is evens! $(0, 2, 4, \ldots)$

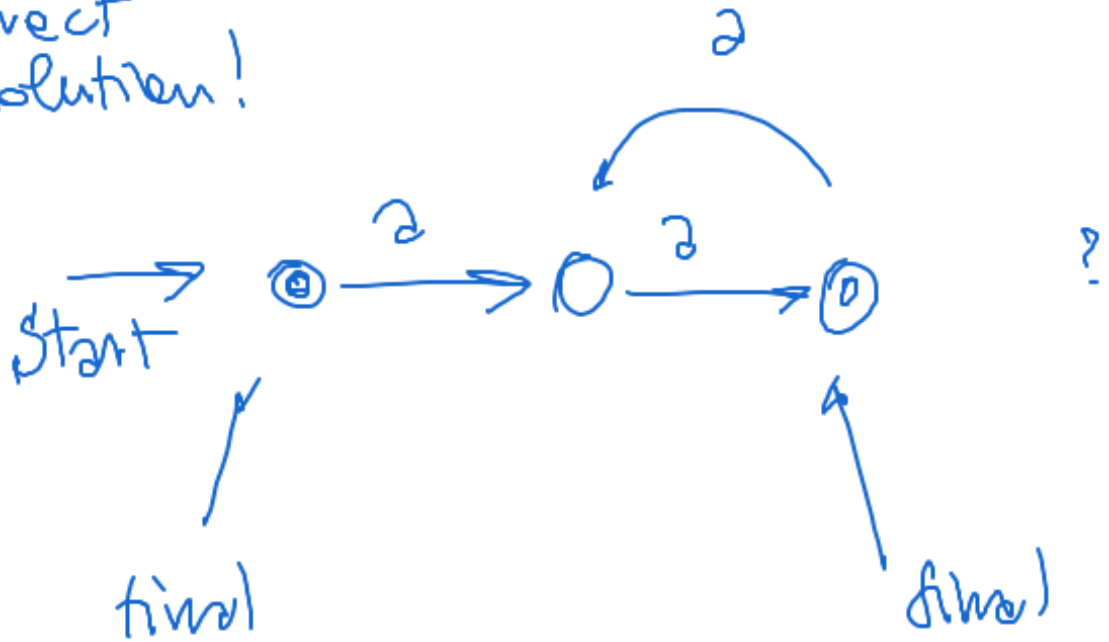
mistake : (group #5)

did not observe 'even length' condition !



group #6

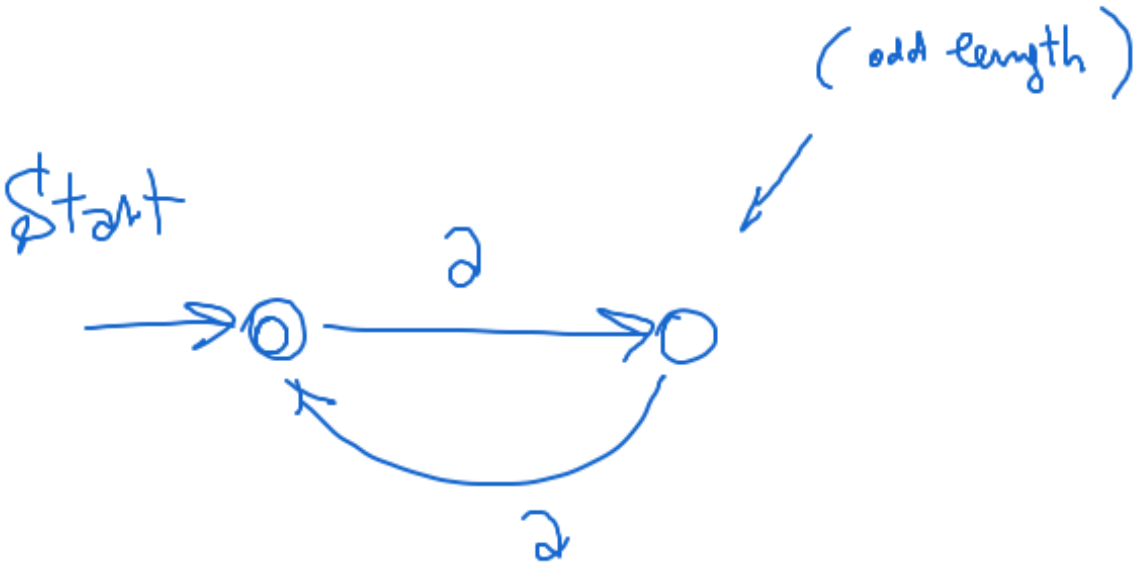
correct solution!



?

$\varepsilon \in L_{42}$

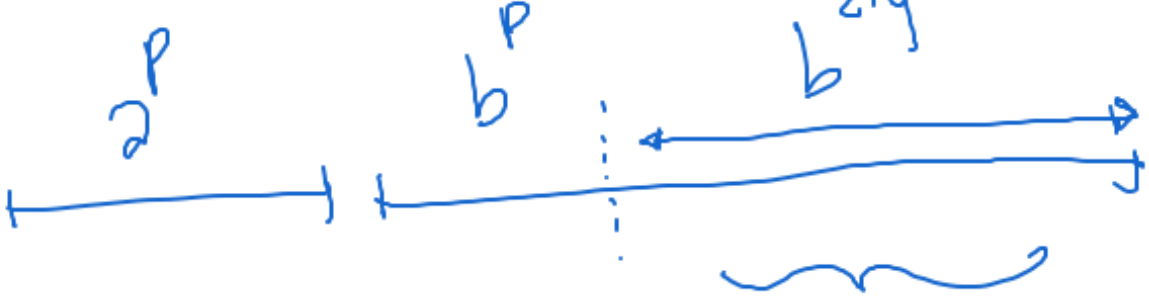
alternative solution:



$$L_3 = \{ a^p b^n b^q \mid p,q,n \geq 0 \;,\; p+q = n \}$$

rewrite L_3 as follows:

$$a^p b^{p+q} b^q = a^p b^p b^{2\cdot q} \leftarrow$$



$\epsilon \in L_3$

$ab \in L_3$

$abbb$

$aabb$

$aaabbb \cdot bb$

1. string in L_3 should have block of b's longer or equal than block of a's /
2. and the difference should be <u>even number</u>

to recognize strings in L_3, you need to count and compare arbitrary numbers !!

outside of REG

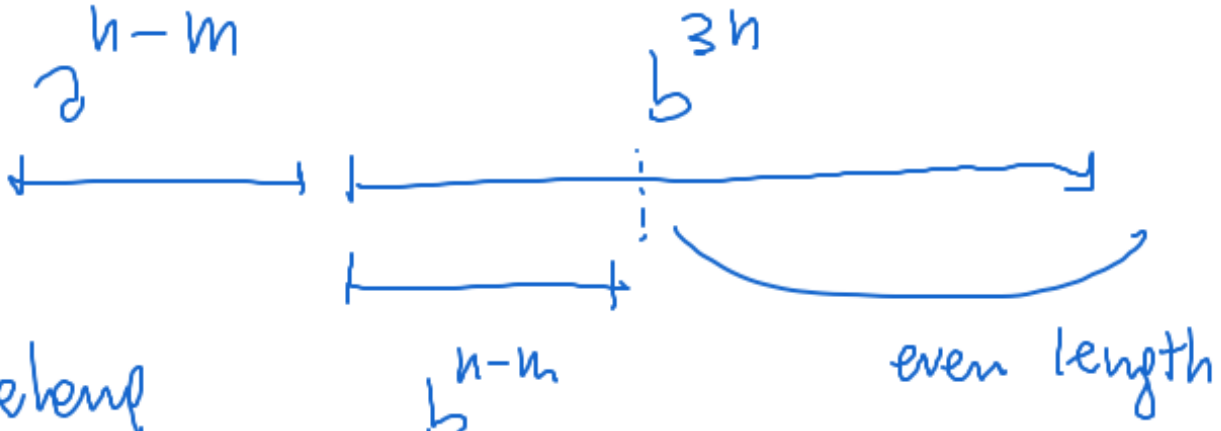
Mistakes

#3 did not consider all possible factors.

#5 : $w = a^n b^{2n} b^n$ $\quad |xy| \leq n$

$k = 0$

$|y| = m \geq 1$



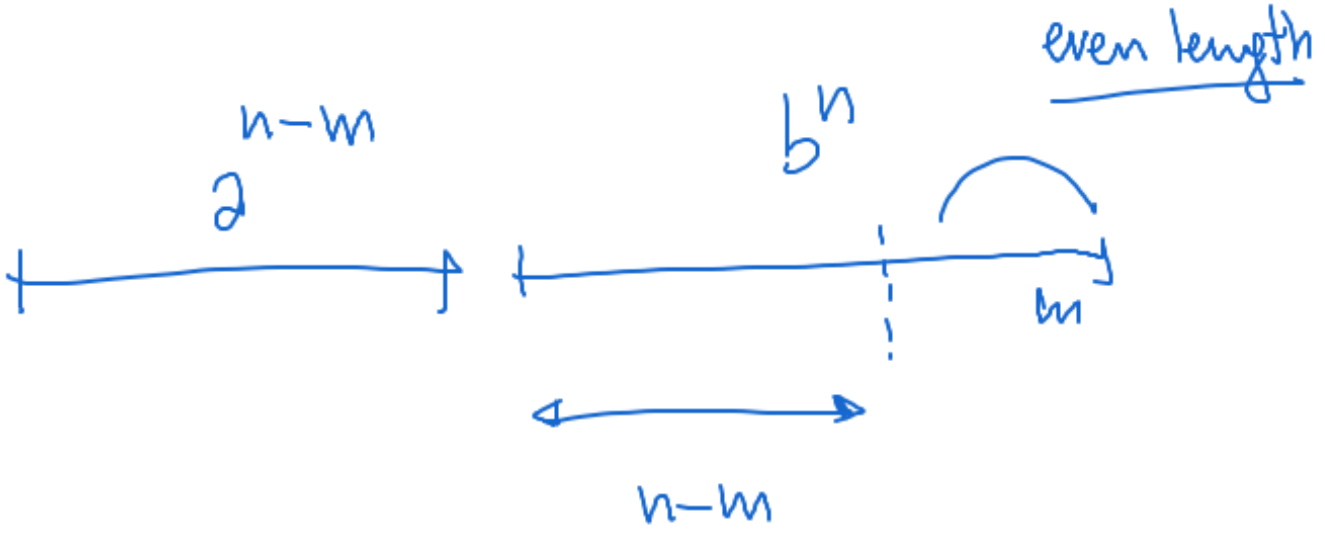
$w_{k=0}$ could still belong to L_3 !!

#6 (mistake)

$$w = a^n b^n \in L_3$$

$|y| = m$

$k = 0$



this is the mistake!

string $w_{k=0}$ could still be in L_3 ....

condition 1 still holds

condition 2 might still hold

group #7

you did not specify the string w of choice for p. lemma

correct solution for L_3

Let n be p-lemma constant.

Choose $w = a^n b^n$ (which satisfies p-lemma cond.)

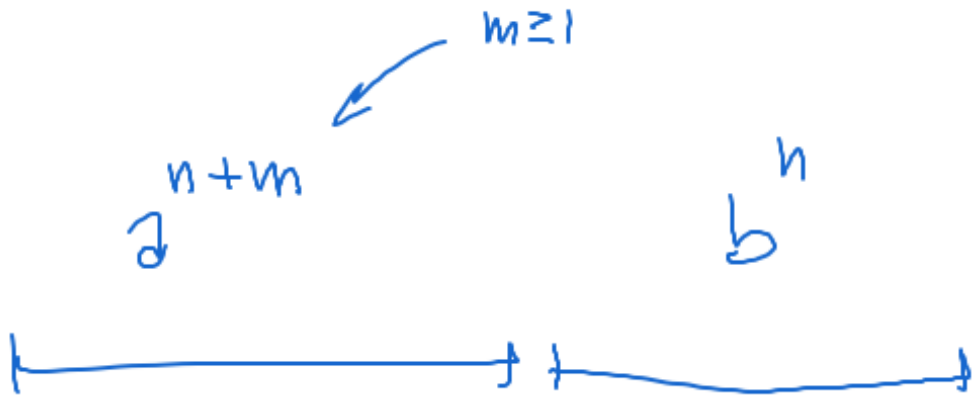
Because $|xy| \leq n$, y must be placed into the first block (a's) →

y contains only a's

→

pick $k > 1$: $\underline{k = 2}$

$w_{k=2}$:



this string is not in L_3 (more a's than b's !!)

$\Rightarrow$ p-lemma does not hold !

$\Rightarrow$ $L_3 \notin$ REG.