4) $L = \{ww, w \in \{a,b\}^+\}$

ww is an even length string.

Two main steps :-

1) Find the mid point :- Break the even length string into 2 equal parts.

for example :- if the input is aabaab

output should be aab□aab

2) Match w □ w

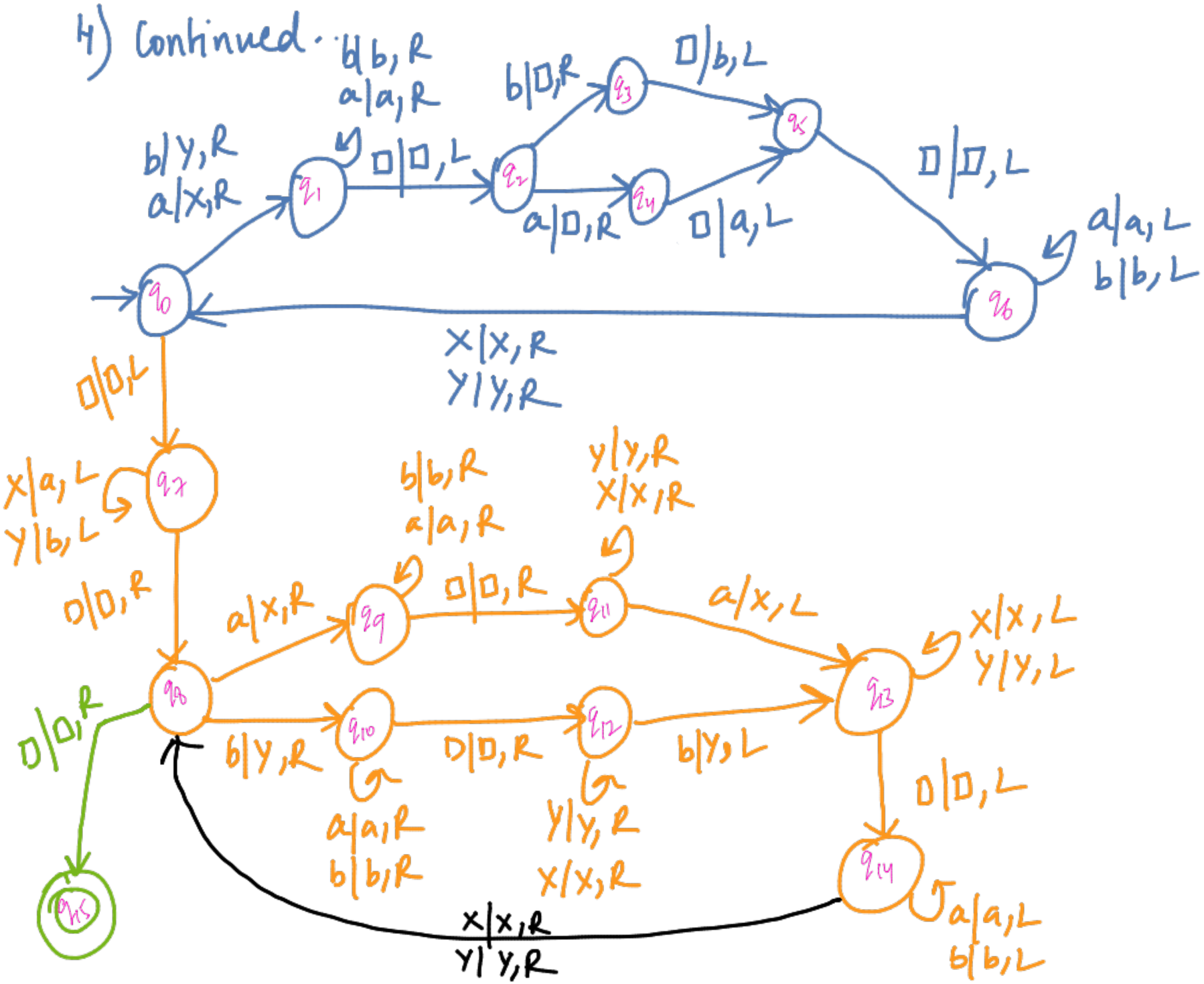
4) Continued....

	a	a	b	a	a	b			
	X	a	b	a	a		b		
	X	X	b	a		a	b		
	X	X	y		a	a	b		
	a	a	b		a	a	b		
	X	a	b		X	a	b		
	X	X	b		X	X	b		
	X	X	y		X	X	y		

Divides even length string into 2 equal halves

matches w□w

4) Continued...


b|b,R
a|a,R
b|□,R
□|b,L
b|y,R
a|x,R
□|□,L
a|□,R
□|a,L
□|□,L
a|a,L
b|b,L
X|X,R
Y|Y,R
□|□,L
x|a,L
y|b,L
□|□,R
a|x,R
□|□,R
a|x,L
x|x,L
y|y,L
□|□,R
b|y,R
□|□,R
b|y,L
□|□,L
a|a,R
b|b,R
y|y,R
x|x,R
a|a,L
b|b,L
x|x,R
y|y,R
q0
q1
q2
q3
q4
q5
q6
q7
q8
q9
q10
q11
q12
q13
q14

5) $L = \{0^n 1^{n^2}, n \geq 1\}$

Logic :-

↳ We mark the first 0 as Z and check for 'n' copies of '1'.

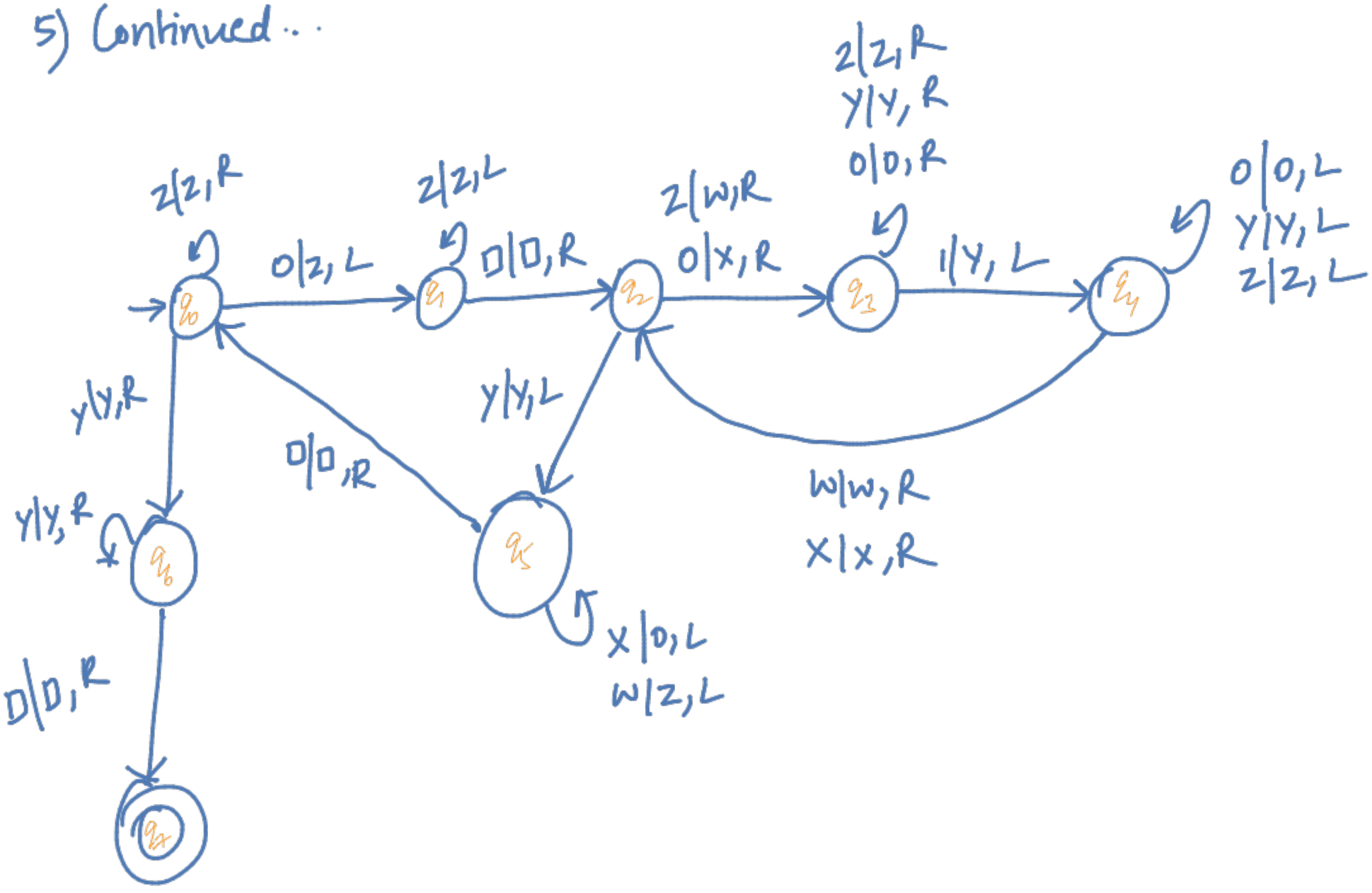
↳ Second 0 is then marked as Z and 'n' copies of '1' are checked.

↳ We repeat the above process until n times n copies of '1' are checked.

5) Continued....

		O	O	O	I	I	I	I	I	I	I	I	I	
		Z	O	O	I	I	I	I	I	I	I	I	I	
		W	O	O	Y	I	I	I	I	I	I	I	I	
		W	X	O	Y	Y	I	I	I	I	I	I	I	
		W	X	X	Y	Y	Y	I	I	I	I	I	I	
		Z	O	O	Y	Y	Y	I	I	I	I	I	I	
		Z	Z	O	Y	Y	Y	I	I	I	I	I	I	
		W	Z	O	Y	Y	Y	Y	I	I	I	I	I	
		W	W	O	Y	Y	Y	Y	Y	I	I	I	I	
		W	W	X	Y	Y	Y	Y	Y	Y	I	I	I	
		Z	Z	O	Y	Y	Y	Y	Y	Y	I	I	I	
		Z	Z	Z	Y	Y	Y	Y	Y	Y	I	I	I	
		W	Z	Z	Y	Y	Y	Y	Y	Y	Y	I	I	
		W	W	Z	Y	Y	Y	Y	Y	Y	Y	Y	I	
		W	W	W	Y	Y	Y	Y	Y	Y	Y	Y	Y	
		Z	Z	Z	Y	Y	Y	Y	Y	Y	Y	Y	Y	

5) Continued...


z|z,R
z|z,L
z|w,R
o|x,R
z|z,R
y|y,R
o|o,R
o|o,L
y|y,L
z|z,L
o|z,L
□|□,R
1|y,L
y|y,R
□|□,R
y|y,L
w|w,R
x|x,R
y|y,R
x|□,L
w|z,L
□|□,R

6) Language of subtraction $= \{a^n b^m c^K,\ K = n-m,\ n, m \geq 1\}$

Input :- $a^n b^m c^K$

output :- $a^n b^m c^K \sqcap c^K$ if K is positive

$a^n b^m c^K \sqcap -c^K$ if K is negative

Logic :-

↳ Match a's & b's

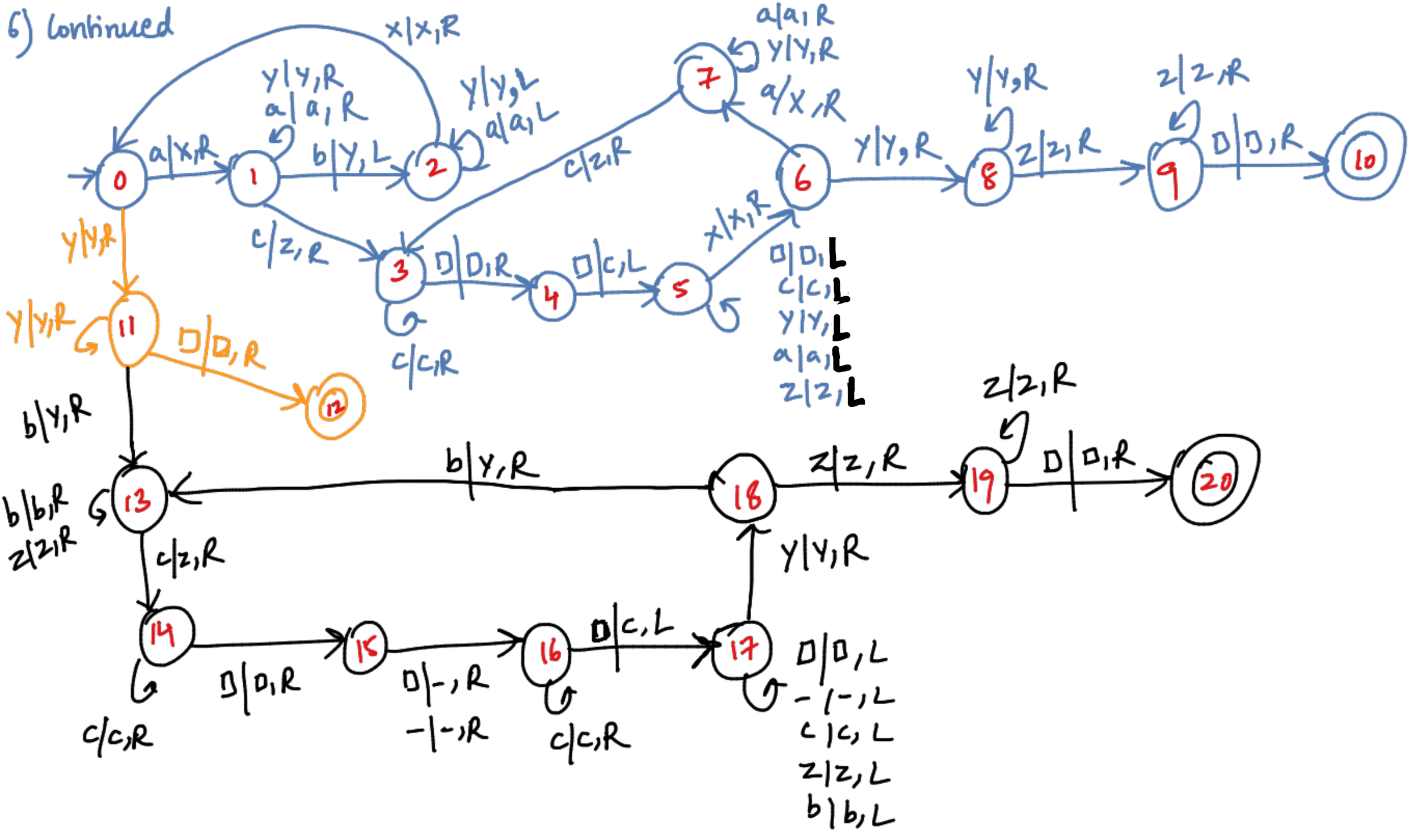
↳ if a's are more it should match with #c's.

• A copy of each c should then be made after the $\sqcap$.

↳ if #b's > #a's, leftover b's must be equal to #c's

• A copy of #c's, preceded with a '-' sign should be made after the blank.

6) Continued


0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
a|X,R
b|Y,L
c|Z,R
y|y,R
a|a,R
x|x,R
y|y,L
a|a,L
c|c,R
□|□,R
□|c,L
x|x,R
□|□,L
c|c,L
y|y,L
a|a,L
z|z,L
a|a,R
y|y,R
a|X,R
y|y,R
z|z,R
z|z,R
□|□,R
b|y,R
b|b,R
z|z,R
c|z,R
□|□,R
□|-,R
-|-,R
c|c,R
□|c,L
y|y,R
□|□,L
-|-,L
c|c,L
z|z,L
b|b,L

8) Continued.. $L = \{a^n b^m c^k , k = n-m , n, m \geq 1\}$

Logic

- Match a's & b's. 3 cases are possible :-

  1) #a's > #b's

  2) #a's = #b's

  3) #b's > #a's

- In case (1) and (3) we must match leftover a's and b's respectively with the #c's in the string.
- In case #b's > #a's we must write a '_' sign before copying the c's.