Q1 Table of equivalences (Moore machine)

	ab				Z_1Z_2
1	**1**	2	3	10	00
2	7	**2**	9	4	11
3	7	6	**3**	4	10
4	7	2	5	**4**	01
5	11	8	**5**	12	10
6	11	**6**	5	10	11
7	**7**	8	5	4	00
8	1	**8**	3	4	11
9	7	8	**9**	12	10
10	11	6	9	**10**	01
11	**11**	8	9	10	00
12	7	2	5	**12**	11

2	×										
3	×	×									
4	×	×	×								
5	×	×	7-11 6-8 4-12	×							
6	×	5-9 4-10 7-11	×	×	×						
7	2-8 3-5 4-10	×	×	×	×	×					
8	×	1-7 3-9	×	×	×	4-10 3-5 1-11	×				
9	×	×	6-8 4-12	×	7-11	×	×	×			
10	×	×	×	7-11 2-6 5-9	×	×	×	×	×		
11	2-8 3-9	×	×	×	×	×	4-10 5-9	×	×	×	
12	×	5-9 4-12	×	×	×	7-11 10-12 2-6	×	1-7 2-8 3-5 4-12	×	×	×
	1	2	3	4	5	6	7	8	9	10	11

Fast method: For each column "block" the button digit and see differences with states on the left (line [0])

Q2 Show automations if we can merge lines with:
- different, - same Z.

Y_1 Y_2	00	01	11	10	ab	Z
1	**1**	2	3	4		0
2	-	**2**	**2**	**2**		1
3	1	2	**3**	-		1
4	**4**	-	2	**4**		1

Moore machine: we cannot merge states having ≠ outputs

So, equivalence table:

2	×		
3	×	OK	
4	×	OK	1-4 2-3
	1	2	3

2 — 3 ← 2

2 — 4 ← 3

	00	01	11	10	Z
1	1	2	2	3	0
2	1	2	2	2	1
3	3	-	2	3	1

→

Y_1 Y_2	00	01	11	10	Z
0 0	00	01	01	11	0
0 1	00	01	01	01	1
1 1	11	-	01	11	1
1 0	-	-	-	-	-

y_1y_2 \ ab	00	01	11	10
00	0	0	0	1
01	0	0	0	0
11	1	-	0	1
10	-	-	-	-

$X_1 = y_1\bar{b} + \bar{y}_2 a\bar{b}$

y_1y_2 \ ab	00	01	11	10
00	0	1	1	1
01	0	1	1	1
11	1	-	1	1
10	-	-	-	-

$X_2 = y_1 + b + a$

y_1y_2 \ ab	00	01	11	10
00	0	-	-	-
01	-	1	1	1
11	1	-	1	1
10	-	-	-	-

$Z = y_2$

Mealy machine : We can merge NON-stable states with ≠ Z.

Y_1 Y_2	00	01	11	10	ab	Z
1	**1**	2	3	4		0
2	-	**2**	**2**	**2**		1
3	1	2	**3**	-		1
4	**4**	-	2	**4**		1

Equivalence Table :

2	2-3 2-4		
3	OK	OK	
4	×	OK	1-4 3-2
	1	2	3

OK because even if the 2 an 4 are stable, they have same output Z.

1 — 3 → 1

2 — 4 → 2

	00	01	11	10	Z
1	1	2	1	2	?
2	2	2	2	2	?

?

Since output depends on input & current state we will have to put an output in each cell like this: $^1/_Z$ following this rules:

If stable states Keep original state

else:

Z_p	Z_f	Z_x
0	0	0
0	1	-
1	0	-
1	1	1

why 1 ?

Y	00	01	11	10
1	1/0	2/-	1/1	2/-
2	2/1	2/1	2/1	2/1

Y	00	01	11	10
0	0	1	0	1
1	1	1	1	1

y_1 \ ab	00	01	11	10
0	0	1	0	1
1	1	1	1	1

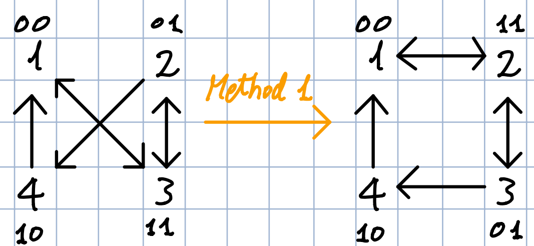
$$Y = y_1 + \bar{a}b + a\bar{b}$$

y_1 \ ab	00	01	11	10
0	0	1	1	1
1	1	1	1	1

$$Z = y_1 + a + b$$

Q3 1) Find coding without races, write retroactions funct. Y_1, Y_2

Y_1 Y_2	00	01	11	10	ab
1	**1**	**1**	3	-	
2	**2**	**2**	3	4	
3	2	1	**3**	**3**	
4	1	-	**4**	**4**	



Y_1 Y_2	00	01	11	10
0 0	00	00	01	-
1 1	11	11	01	10
0 1	11	00	01	01
1 0	00	-	10	10

⚠ When extracting K-maps, sort states 00 → 01 → 11 → 00

$y_1 y_2$ \ ab	00	01	11	10
00	0	0	0	-
01	1	0	0	0
11	1	1	0	1
10	0	-	1	1

$y_1 y_2$ \ ab	00	01	11	10
00	0	0	1	-
01	1	0	1	1
11	1	1	1	0
10	0	-	0	0

$$Y_1 = y_2\bar{a}\bar{b} + y_1\bar{a}b + y_1\bar{y}_2 a + y_1 a\bar{b}$$

$$Y_2 = y_2\bar{a}\bar{b} + y_1\bar{a}b + \bar{y}_2 a + y_2 ab$$

2) Solve race problems, imposing $1=00$, $2=01$, $3=11$, $4=10$

$Y_1 Y_2$	00	01	11	10	ab
0 0	00	00	11	-	
0 1	01	01	11	10	
1 1	01	00	11	11	
1 0	00	-	10	10	

race problems

We have to use Method 2:
Adding intermediary transitions

$Y_1 Y_2$	00	01	11	10	ab
0 0	00	00	01	10	
0 1	01	01	11	00	
1 1	01	10	11	11	
1 0	00	00	10	10	

Q4

Question 4. By coding states 1, 2, 3 and 4 by $y_1 y_2 = 00$, 01, 11 and 10, compute the excitation functions or memory modules for this automaton:

Y_1 Y_2	00	01	11	10	ab
1	**1**	**1**	2	-	
2	**2**	3	**2**	**2**	
3	4	**3**	2	-	
4	**4**	1	2	-	

Consider bistables D and SRc.

Q	Q^+		
0	0	μ_0	Maintien à 0
0	1	ε	Enclenchement
1	0	δ	Désenclenchement
1	1	μ_1	Maintien à 1

Table 2 – Excitation terms, Q is the current state, Q^+ the future state.

	D
μ_0	0
ε	1
δ	0
μ_1	1

(a) Flip-flop D

	S	R
μ_0	0	-
ε	1	0
δ	0	1
μ_1	-	0

(b) Flip-flop SR

Table 3 – Excitation tables of (a) D and (b) SR.

Huffmann Table

$Y_1 Y_2$	00	01	11	10
0 0	00	00	01	-
0 1	01	11	01	01
1 1	10	11	01	-
1 0	10	00	01	-

Rewrite using holding terms

$Q_1^+ Q_2^+$	00	01	11	10
0 0	μ_0 μ_0	μ_0 μ_0	μ_0 ε	—
0 1	μ_0 μ_1	ε μ_1	μ_0 μ_1	μ_0 μ_1
1 1	μ_1 δ	μ_1 μ_1	δ μ_1	—
1 0	μ_1 μ_0	δ μ_0	δ ε	—

When rewriting, Q is y_i, Q^+ is Y_i.

Separate into Q_1^+ et Q_2^+

Q_1^+	00	01	11	10
00	μ_0	μ_0	μ_0	—
01	μ_0	ε	μ_0	μ_0
11	μ_1	μ_1	δ	—
10	μ_1	δ	δ	—

Q_2^+	00	01	11	10
00	μ_0	μ_0	ε	-
01	μ_1	μ_1	μ_1	μ_1
11	δ	μ_1	μ_1	-
10	μ_0	μ_0	ε	-

Now use them according to chosen bistable

a) D: Rewrite accordingly & find excitation functions using K-maps

b) SR: Do the same, in addition separate tables S_1R_1 & S_2R_2 into S_1, R_1, S_2, R_2