

Section 1.3

Asynchronous Circuits

Exercises

Alfredo Benso
Politecnico di Torino, Italy
Alfredo.benso@polito.it

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- **Design the gate level model of an asynchronous circuit functioning in fundamental mode. The circuit has two inputs P (pulse) and R (reset) and one output Z, which is normally at '0'. Z follows the following rules:**
 - **It goes to '1' when a rising edge is detected on P.**
 - **It goes to '0' when $R=1$.**

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- Design the reduced transition table of an asynchronous circuit functioning in fundamental mode. The circuit has three inputs a, b, and c, and one output U, which is 1 only if all inputs are equal to '1', and they went to '1' in the order a, b, and c. U returns to 0 when all inputs returned to '0'.
- Also, find the minimum number of state variables required to have a race free state assignment, and find a possible state assignment.

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- Find the Future State and Output functions of an asynchronous circuit functioning in fundamental mode. The circuit has three inputs X, Y, and Z and one output U, which goes to '1' only when:
 - There is a rising edge of X AND
 - While the value of X was '0', Y and Z followed the sequence 00 - 01 - 11 (even if BEFORE or AFTER this sequence Y and Z changed to different values).
- U returns to '0' as soon as X returns to '0'.
- The circuit must have a race free state assignment.

#5

- Design the reduced transition table of an asynchronous circuit functioning in fundamental mode. The circuit has two inputs X and Y, and one output U, which is 1 only if $X=1$ and, during the last two rising-edges of X, Y maintained the same value.
- Also, find out the minimum number of state variables required to have a race free state assignment.

#10

- Design an asynchronous circuit functioning in fundamental mode. The circuit has two inputs A and B, and one output Z, which is normally at '0'. Z changes value when it recognizes the sequence 00 – 01 – 00 on the inputs. 00 can be considered concurrently the end of a sequence and the beginning of a new one.
- Show:
 - A Minimized Transition table
 - A race free state assignment
 - The Boolean function for Z

#1

- Find a minimal race free state coding for the following transition table.
- Also, find the boolean functions representing the future state.

		c=0				c=1			
		00	01	11	10	00	01	11	10
ab	A	A	A	B	C	D	A	A	B
	B	A	-	C	B	A	D	C	B
	C	C	C	C	C	B	B	D	C
	D	A	C	-	A	D	D	A	D

#16

- Design an asynchronous circuit with two inputs (A and B) and one output, functioning in fundamental mode. The output U of the circuit is equal to 1 iff:
 - $A=0$ AND
 - During the last interval in which $A=1$ there has been a SINGLE transition (1-0-1) on B.
- U changes back to '0' as soon as A goes back to '1'.
- Show:
 - A Minimized Transition table
 - A race free state assignment

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- **Design an asynchronous circuit with two inputs (A and B) and one output, functioning in fundamental mode. The output U of the circuit is equal to 1 iff it recognize the following input sequence:**
 - **AB = 00 – 01 – 11 – 10 - 00**
- **U changes back to '0' as soon as A or B change to 1.**
- **Show:**
 - **A Minimized Transition table**
 - **A race free state assignment**
 - **The output and state functions**