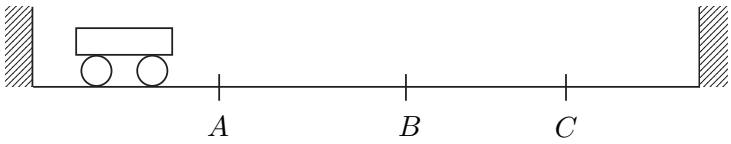
Test of Discrete Event Systems - 12.10.2020

Exercise 1

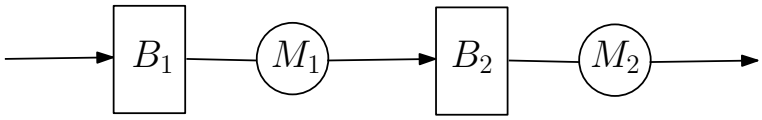
A cart moves along a track. Sensors are located at three points on the track (they are denoted by A, B and C in the figure). Each sensor sends an impulse when the cart crosses the corresponding point, in both directions. For the sake of simplicity, it is assumed that the cart never changes direction when it is across a sensor.



1. Provide a logical model of the cart position along the track.
2. Model a monitoring system which localizes the cart over the track, and detects possible failures of the sensors, by using only the signals it receives from the sensors.

Exercise 2

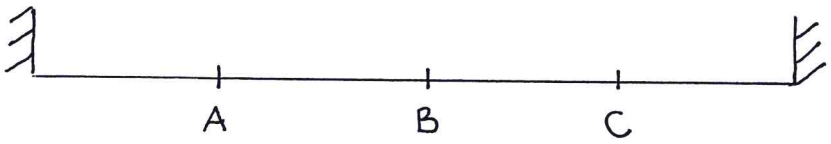
The production line in the figure is composed of two stations connected in series. Each station is composed of a machine M_i preceded by a one-place buffer B_i, $i = 1, 2$. Raw parts arriving when B_1 is full, are rejected. If M_1 terminates a job when B_2 is full, M_1 keeps the part (and therefore does not become available for a new job) until the part can be moved forward to B_2. Assume that the production line is initially empty.



1. Model the production line through a state automaton $(\mathcal{E}, \mathcal{X}, \Gamma, f, x_0)$.

EXERCISE 1

1. The cart position is discretized:

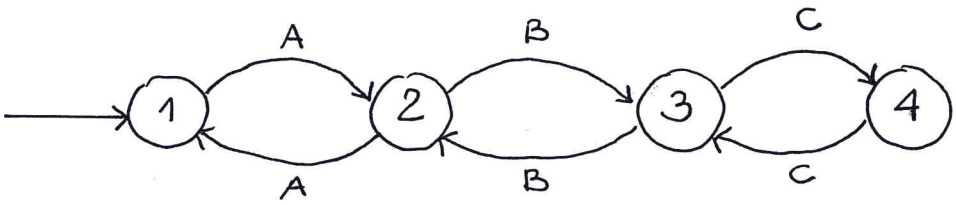


#interval: 1 2 3 4

state x = #interval $\in \underbrace{\{1,2,3,4\}}_{\mathcal{X}}$

events $\mathcal{E} = \{A, B, C\}$

- A: impulse from sensor A
- B: impulse from sensor B
- C: impulse from sensor C



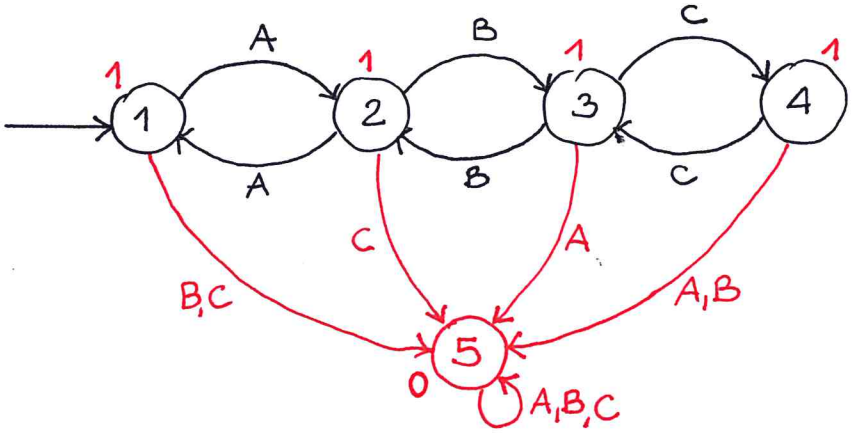
2. We add a dummy state collecting possible failure situations:

state 5: failure

We also define the following output:

$$y = \begin{cases} 0 & \text{if a failure has been detected} \\ 1 & \text{otherwise} \end{cases}$$

Resulting model:



EXERCISE 2

1. We say that M_1 is <u>blocked</u> when it terminates a job while B_2 is full.

events $\mathcal{E} = \{a, d_1, d_2\}$

- a: arrival of a raw part
- d_1: termination of a job in M_1
- d_2: termination of a job in M_2

state $x = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$

- x_1 → station #1: $x_1 \in \{0, 1, 2, 3, 4\}$
- x_2 → station #2: $x_2 \in \{0, 1, 2\}$

where:

0 : empty

1 : one part, machine working

2 : two parts, machine working

3 : one part, <u>machine blocked</u>

4 : two parts, <u>machine blocked</u>

State transition diagram: