Market Driven Systems (FRTN20)

Exercise 2 - Solutions

Last updated: 2014

1. The proof can be done in several ways:

Proof alternative 1: Solution by a truth table:

x	y	$\bar{x}$	$\bar{y}$	$\bar{x}\bar{y}$	$+$	$x\bar{y}$	$+$	$\bar{x}y$	$=$	e_1	$\bar{x}$	$+$	$\bar{y}$	$=$	e_2
0	0	1	1	1	+	0	+	0	=	1	1	+	1	=	1
0	1	1	0	0	+	0	+	1	=	1	1	+	0	=	1
1	0	0	1	0	+	1	+	0	=	1	0	+	1	=	1
1	1	0	0	0	+	0	+	0	=	0	0	+	0	=	0

Proof alternative 2: Proof by algebraic operations:

$$\bar{x}+\bar{y} = \bar{x}\cdot 1+\bar{y}\cdot 1 = \bar{x}(y+\bar{y})+\bar{y}(x+\bar{x}) = \bar{x}\bar{y}+x\bar{y}+\bar{x}y$$

In the first equality $a\cdot 1 = a$ is used, in the second $a+\bar{a} = 1$, and in the third $a+a = a$.

2.

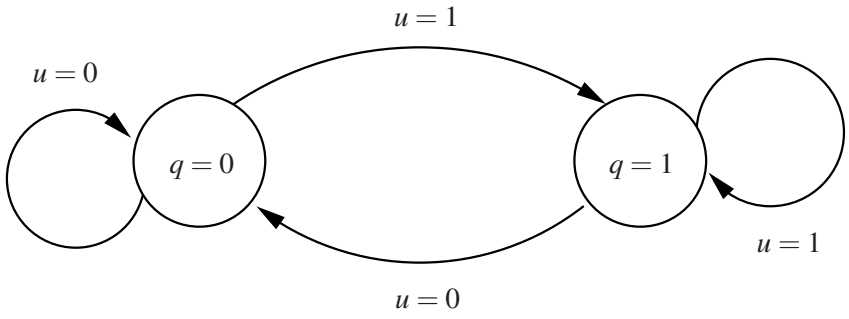
a.

q^+	q	u
0	0	0
1	0	1
0	1	0
1	1	1

b. $q^+ = u$

c.

Figure 1



3.

a. F, G and H are not PNs, since they have unconnected arcs. K and L are not PNs, since they are not bipartite. Whether I and J are PNs or not, depends on what definition is used. The common definition requires a positive numer of places as well as transitions. For this reason we will not consider I or J PNs.

All transitions of all the PNs are enabled.

b. The markings after firing are shown in Figure 2.

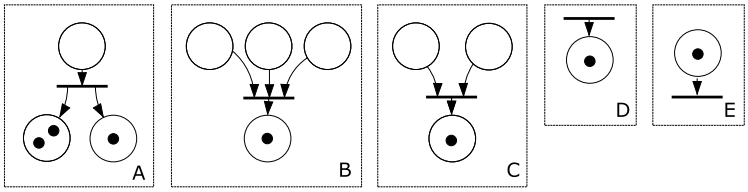


Figure 2

c. The transitions of PNs D and E are the only ones, which are enabled after the initial firing.

4.

a. B, C, and E are bounded.

b. A, C, and D are live.

c. A, C, and D are deadlock free. Note: Deadlock-free PNs are not necessarily livethe same as the live ones.

5. The resulting PN is shown in Figure 3. The producer and consumer parts of the Petri Net have been omitted and are shown as (invalid) loose arcs.

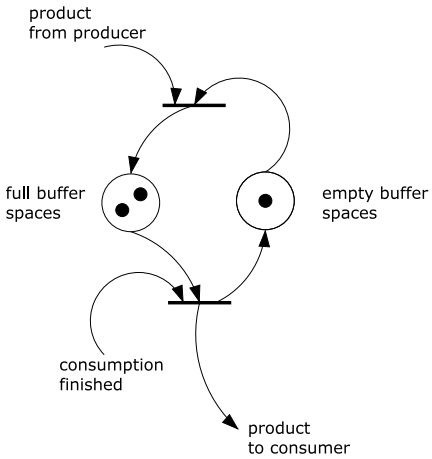


Figure 3

6.

a. The transition between step 1 and step 2 will fire, see Figure 4.

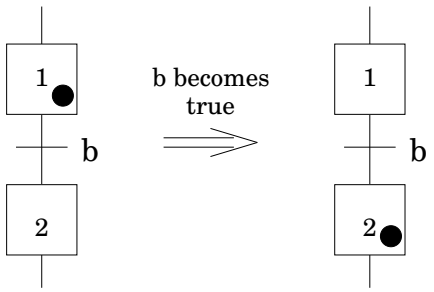


Figure 4: The Grafcet diagram in Problem a.

b. Nothing will happen, see Figure 5.

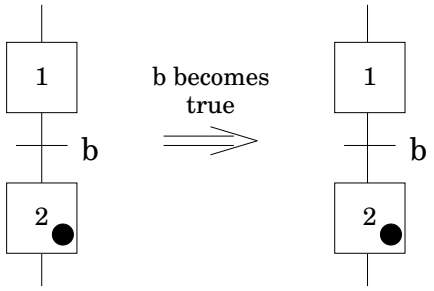


Figure 5: The Grafcet diagram in Problem b.

c. Depending on the status of a, the transition will or will not fire, see Figure 6.

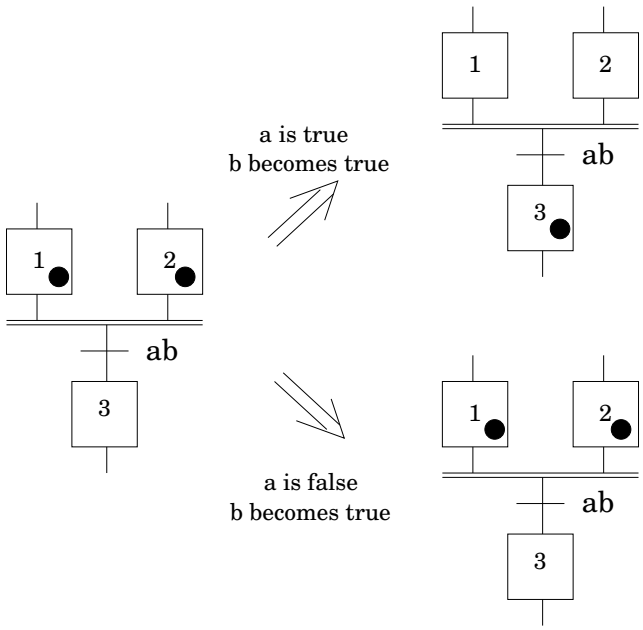


Figure 6: The Grafcet diagram in Problem c.

d. Depending on the status of a, the transition will or will not fire, see Figure 7.

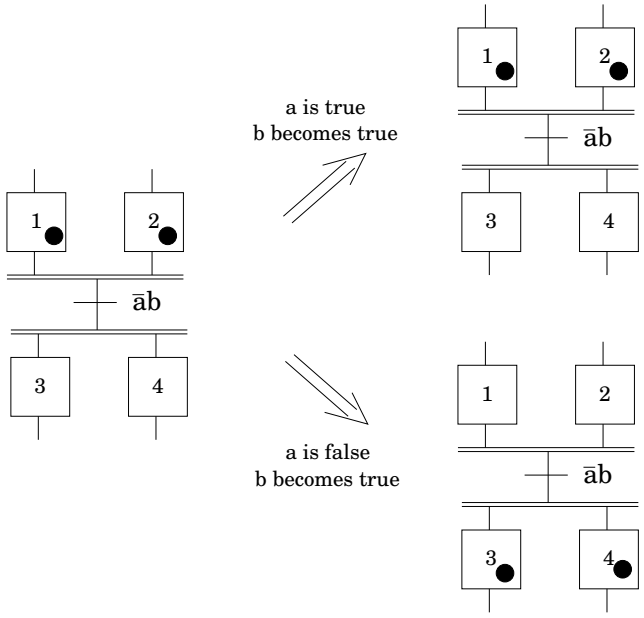


Figure 7: The Grafcet diagram in Problem d.

e. Nothing will happen, see Figure 8.

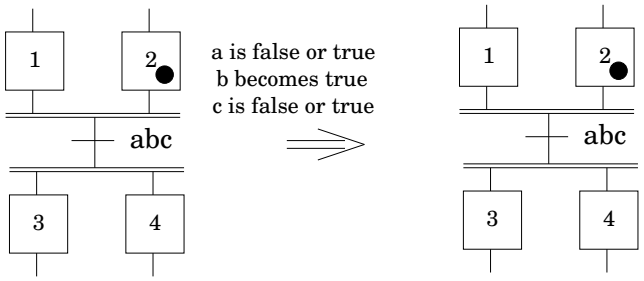


Figure 8: The Grafcet diagram in Problem e.

7. The Grafcet for the on-off controller is shown in Figure 9.

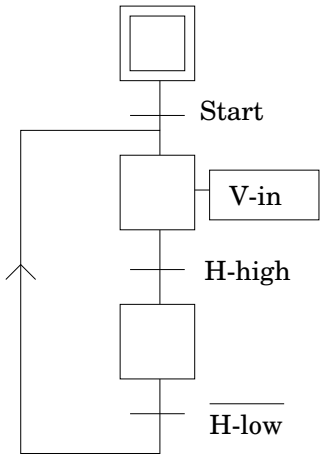


Figure 9

8. The Grafcet for controlling the automatic gas chromatograph (GC) is shown in Figure 10.

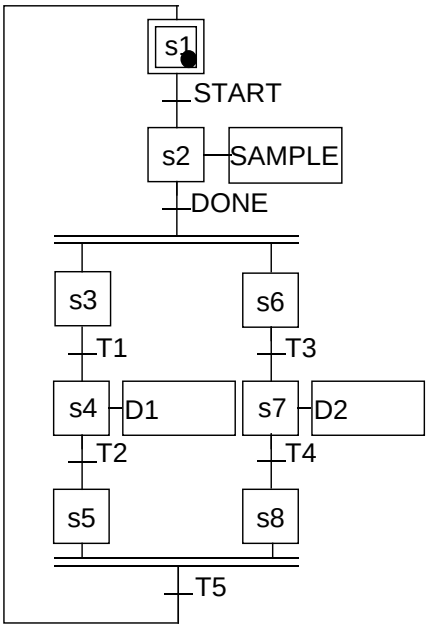


Figure 10

9.

a. A Grafcet for the scenario is shown in Figure 11.

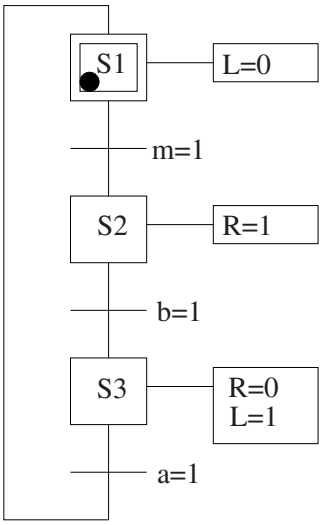


Figure 11

b. A Grafcet for the scenario is shown in Figure 12.

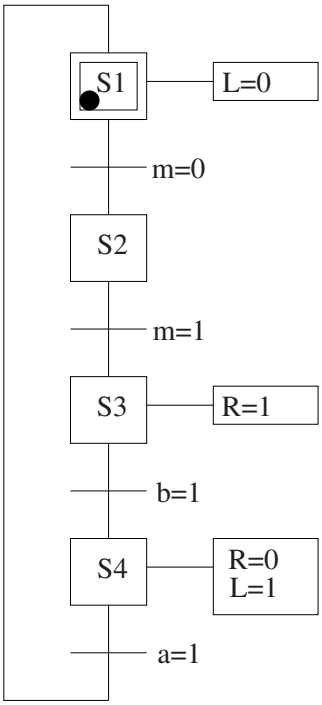


Figure 12

c. A Grafcet for the scenario is shown in Figure 13.

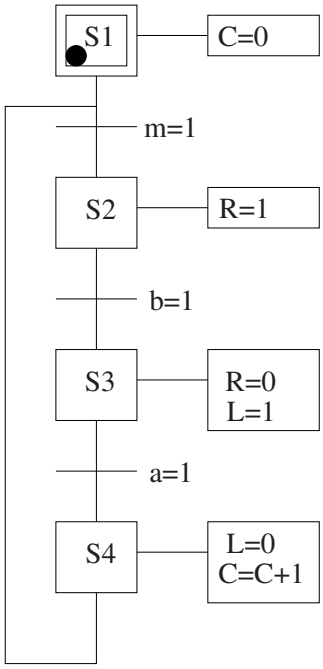


Figure 13

10. A Grafcet for the scenario is shown in Figure 14.

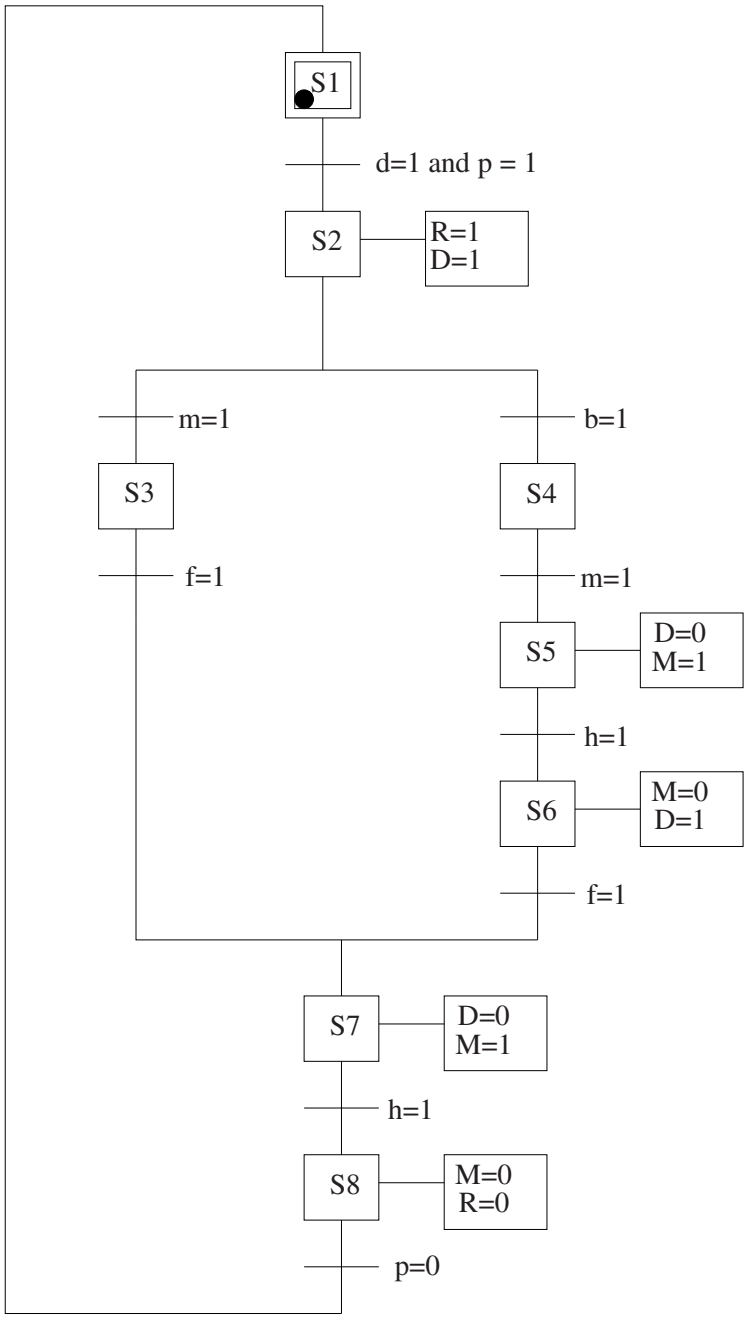


Figure 14