Market Driven Systems (FRTN20)

Exercise 2
Solutions

Last updated: March 2010

1. The proof can be done in several ways:

Proof alternative 1: Solution by a truth table:

x	y	$\bar{x}$	$\bar{y}$	$\overline{xy}$	$+$	$x\bar{y}$	$+$	$\bar{x}y$	$=$	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:
It is clear that always $x+\bar{x}=1$. Using this relation on the right hand side of the expression we get

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

(since only one of the $\overline{xy}$ needs to be included in the final expression).

2.

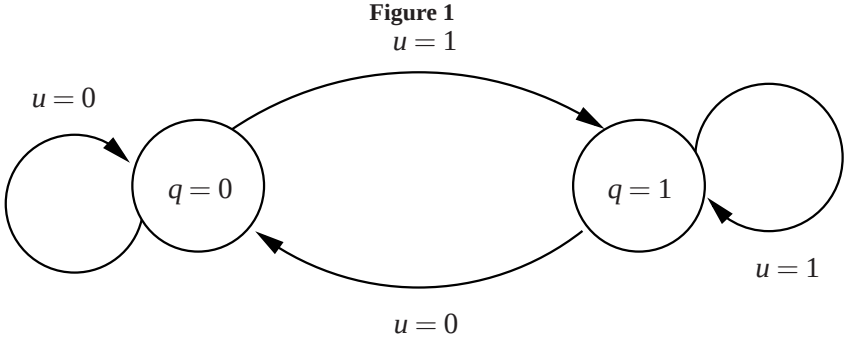
a.

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 markins after firing are shown in Figure 2.

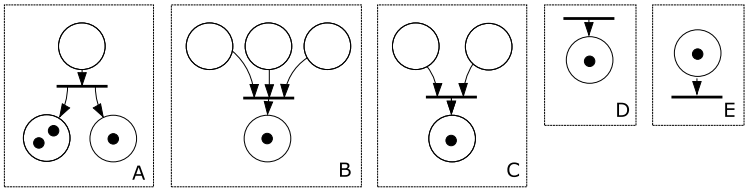


Figure 2

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

4.

a. All the PNs except for A are bounded.

b. B and E are not live, the other PNs are.

c. In this instance (but not generally) the deadlock-free PNs are the same as the live ones.

5. The resulting PN is shown in Figure 3.

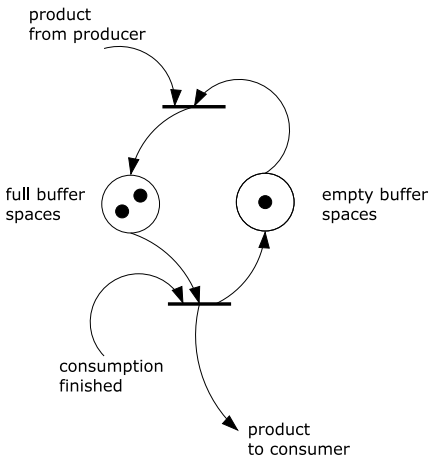


Figure 3

6.

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

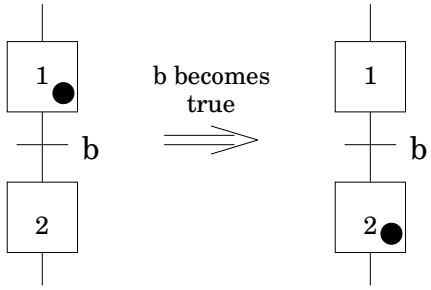


Figure 4 The Grafcet diagram in Problem a.

b. Nothing will happen, see Figure 5.

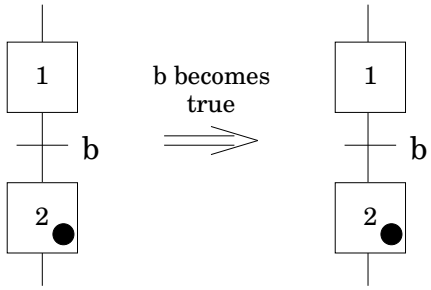


Figure 5 The Grafcet diagram in Problem b.

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

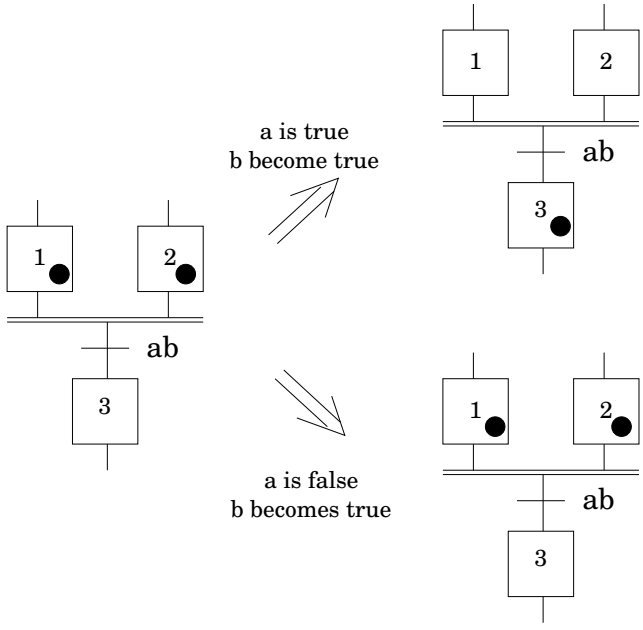


Figure 6 The Grafcet diagram in Problem c.

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

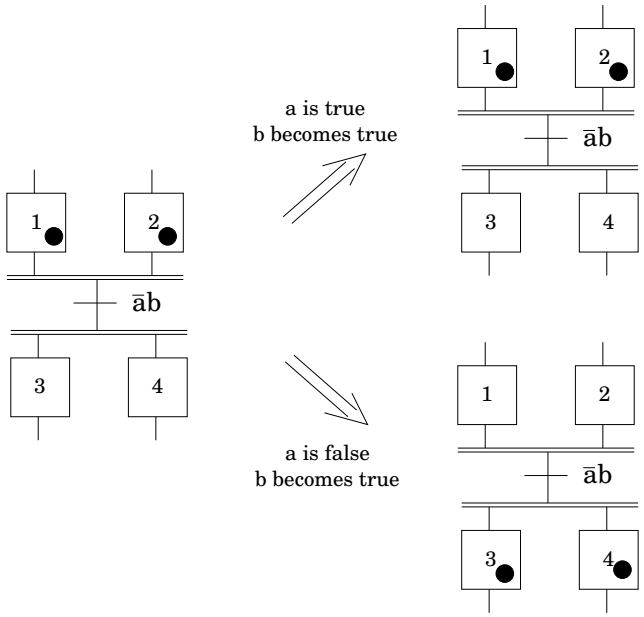


Figure 7 The Grafcet diagram in Problem d.

e. Nothing will happen, see Figure 8.

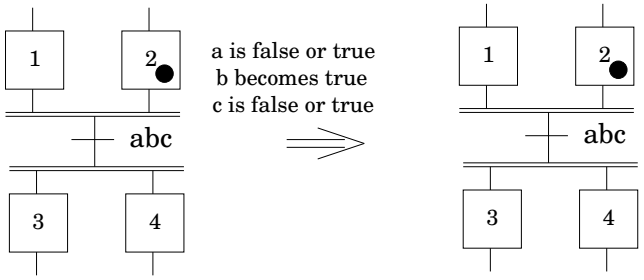


Figure 8 The Grafcet diagram in Problem e.

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

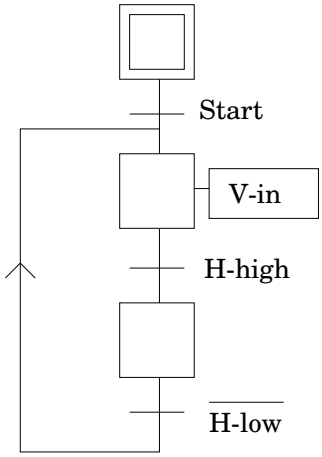


Figure 9

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

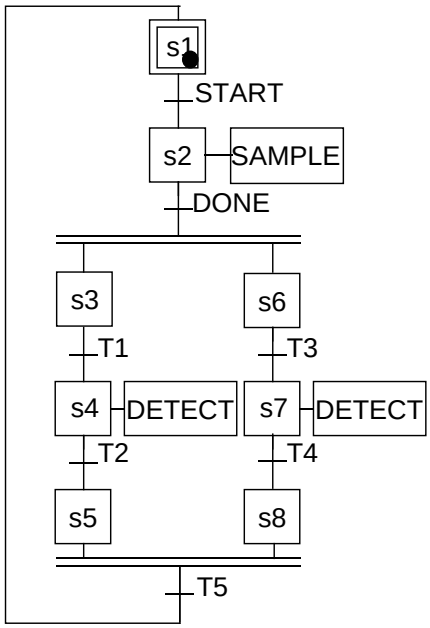


Figure 10

9.

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

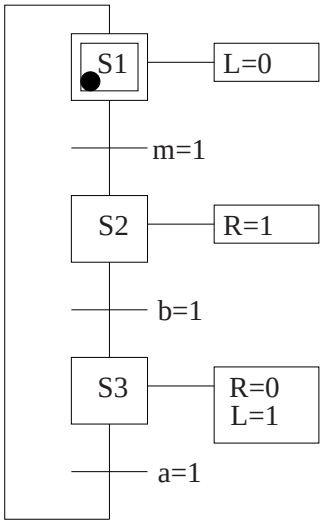


Figure 11

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

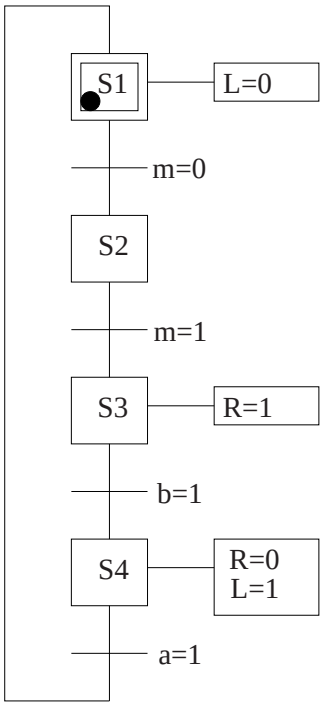


Figure 12

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

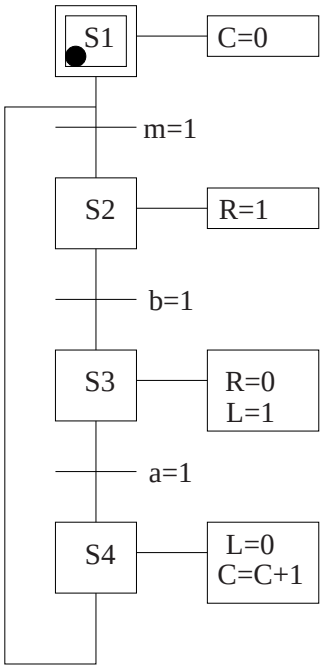


Figure 13

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

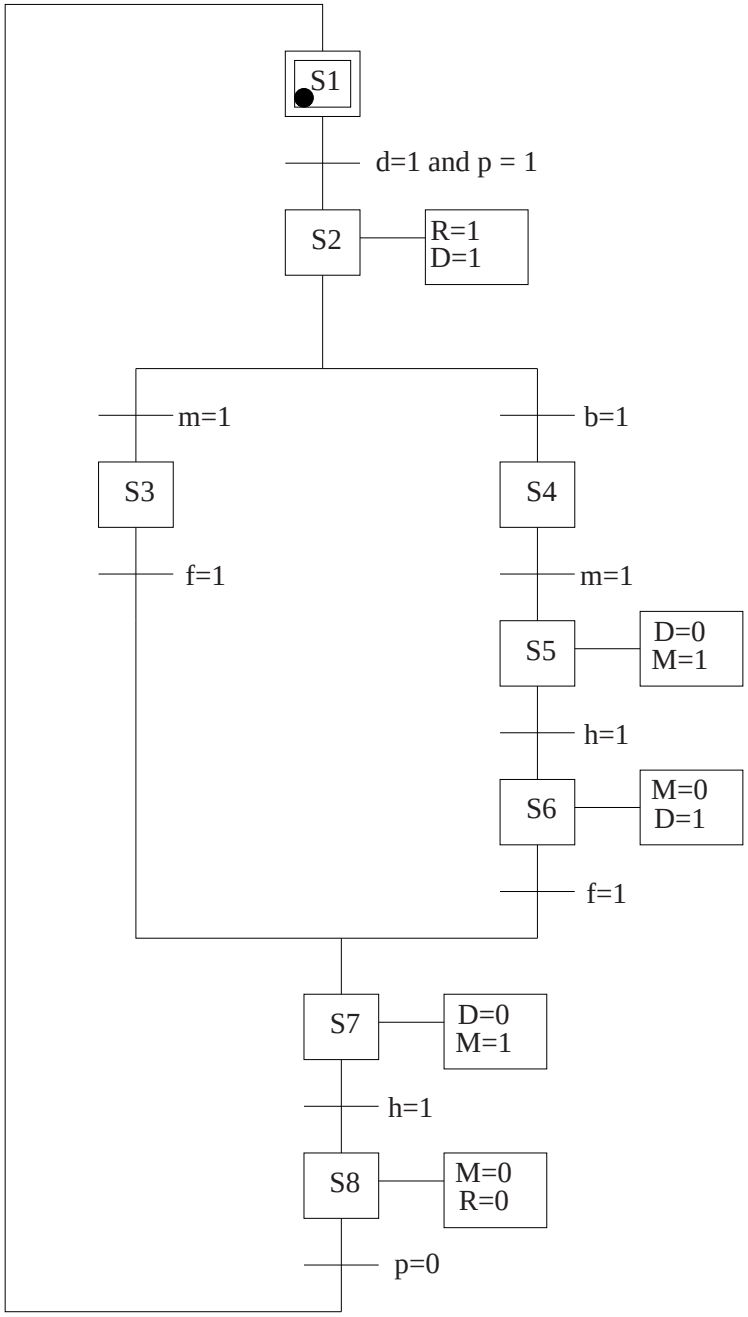


Figure 14