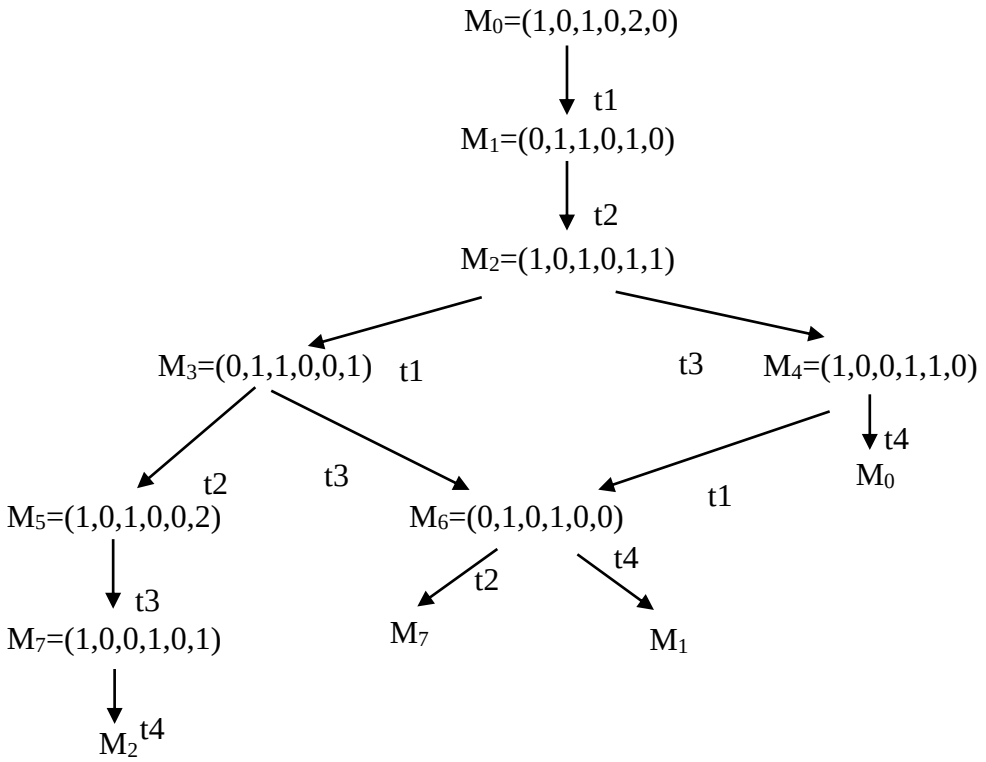
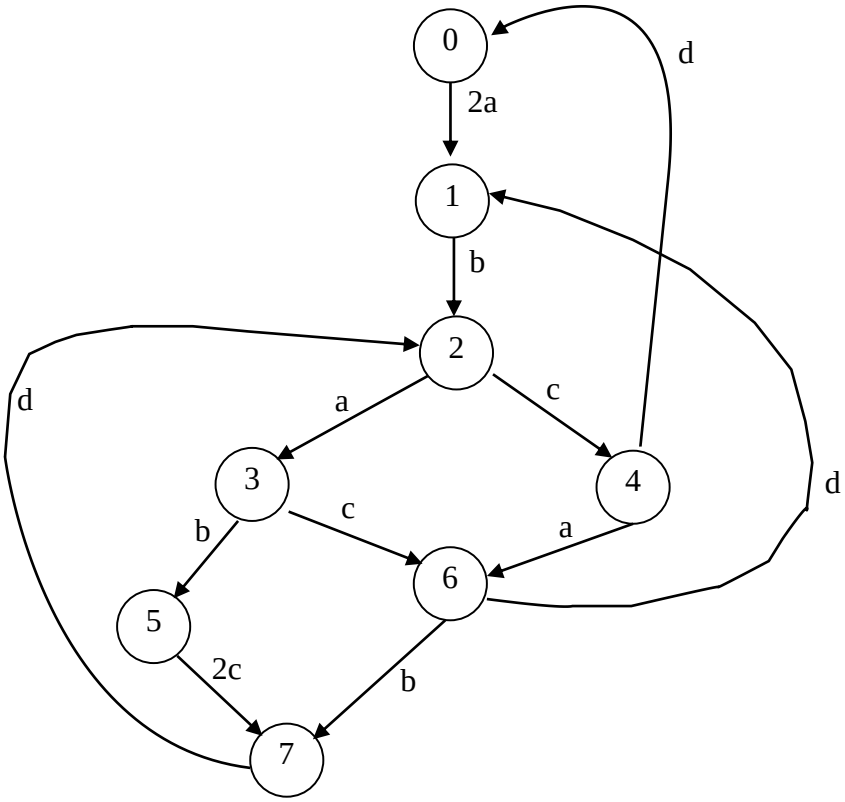
Solução dos exercícios 5, 6 e 8 da apostila

5)

a) Árvore de alcançabilidade e Cadeia de Markov





b) Sistema de Equações

$$Q = \begin{pmatrix} -2a & 2a & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -b & b & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -(c+a) & a & c & 0 & 0 & 0 \\ 0 & 0 & 0 & -(b+c) & 0 & b & c & 0 \\ d & 0 & 0 & 0 & -(a+d) & 0 & a & 0 \\ 0 & 0 & 0 & 0 & 0 & -2c & 0 & 2c \\ 0 & d & 0 & 0 & 0 & 0 & -(b+d) & b \\ 0 & 0 & d & 0 & 0 & 0 & 0 & -d \end{pmatrix}$$

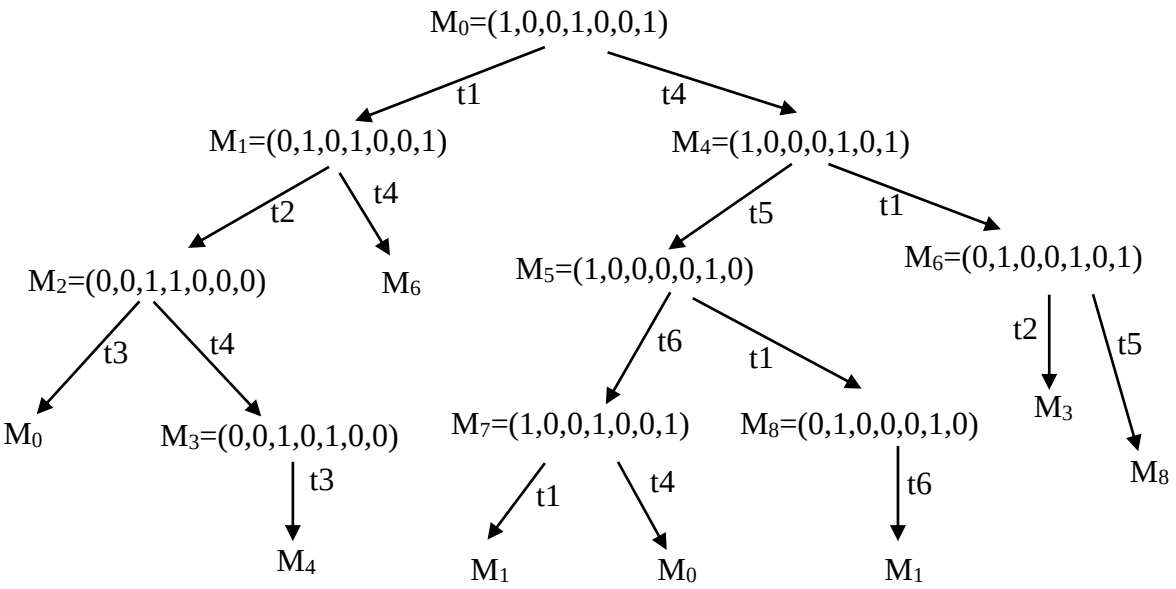
$$\pi * Q = 0 \Longrightarrow \begin{cases} -2a\pi_0 + d\pi_4 = 0 \\ 2a\pi_0 - b\pi_1 + d\pi_6 = 0 \\ b\pi_1 - (c+a)\pi_2 + d\pi_7 = 0 \\ a\pi_2 - (b+c)\pi_3 = 0 \\ c\pi_2 - (a+d)\pi_4 = 0 \\ b\pi_3 - 2c\pi_5 = 0 \\ c\pi_3 + a\pi_4 - (b+d)\pi_6 = 0 \\ 2c\pi_5 + b\pi_6 - d\pi_7 = 0 \end{cases}$$

$$\pi_0 + \pi_1 + \pi_2 + \pi_3 + \pi_4 + \pi_5 + \pi_6 + \pi_7 = 1$$

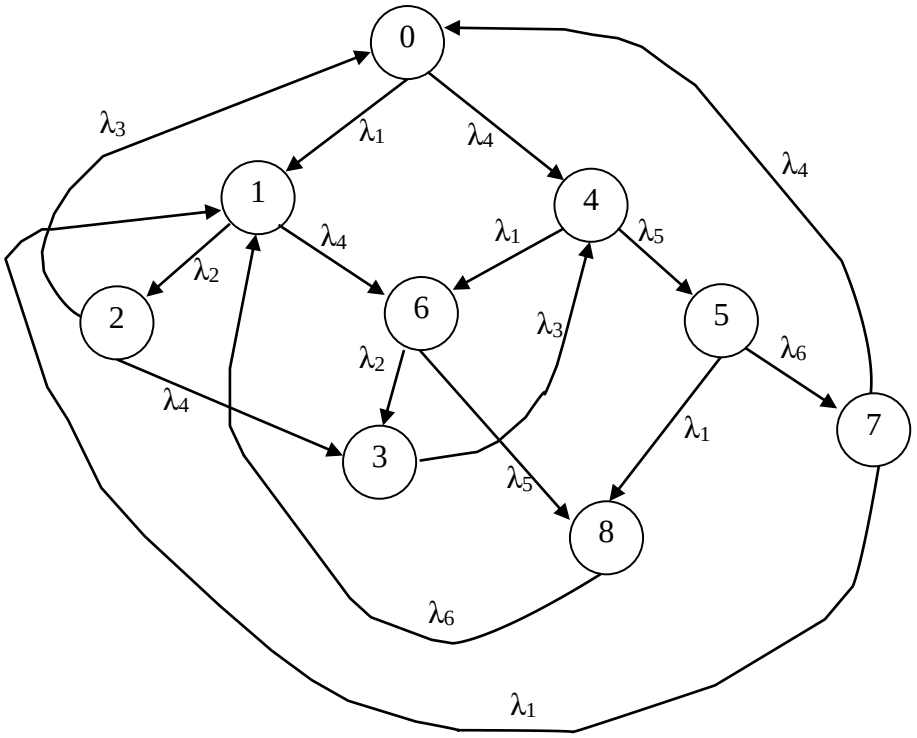
c) A natureza **exponencial** das taxas de disparo das transições, em Redes de Petri **Temporizadas** e **Estocásticas.**

6)

a) Árvore de alcançabilidade



b) Cadeia de Markov



c)

$$Q = \begin{pmatrix} -3 & 1 & 0 & 0 & 2 & 0 & 0 & 0 & 0 \\ 0 & -102 & 100 & 0 & 0 & 0 & 2 & 0 & 0 \\ 5 & 0 & -7 & 2 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -5 & 5 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -101 & 100 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -11 & 0 & 10 & 1 \\ 0 & 0 & 0 & 100 & 0 & 0 & -200 & 0 & 100 \\ 2 & 1 & 0 & 0 & 0 & 0 & 0 & -3 & 0 \\ 0 & 10 & 0 & 0 & 0 & 0 & 0 & 0 & -10 \end{pmatrix}$$

$$\pi * Q = 0 \quad \Rightarrow \quad \begin{cases} -3\pi_0 + 5\pi_2 + 2\pi_7 = 0 \\ \pi_0 - 102\pi_1 + \pi_7 + 10\pi_8 = 0 \\ 100\pi_1 - 7\pi_2 = 0 \\ 2\pi_2 - 5\pi_3 + 100\pi_6 = 0 \\ 2\pi_0 + 5\pi_3 - 101\pi_4 = 0 \\ 100\pi_4 - 11\pi_5 = 0 \\ 2\pi_1 + \pi_4 - 200\pi_6 = 0 \\ 10\pi_5 - 3\pi_7 = 0 \\ \pi_5 + 100\pi_6 - 10\pi_8 = 0 \end{cases}$$

$$\pi_0 + \pi_1 + \pi_2 + \pi_3 + \pi_4 + \pi_5 + \pi_6 + \pi_7 + \pi_8 = 1$$