Homework #3

1. (2 point) Please formally define the vending machine's FSM in Fig. 1, i.e., Σ, Q, q_0, δ, and F

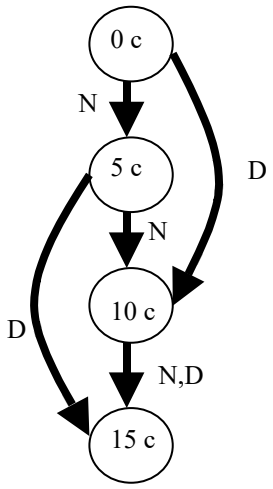


Fig. 1

Solution:

$\Sigma = \{$ receiving D , receiving N $\} = \{0, 1\}$

$Q = \{ q_0, q_1, q_2, q_3 \} = \{ 0, 5, 10, 15 \}$

$q_0 = 0$

δ : $\delta(q_0, 0) = q_2$ $\quad \delta(q_0, 1) = q_1$

$\delta(q_1, 0) = q_3$ $\quad \delta(q_1, 1) = q_2$

$\delta(q_2, 0) = q_3$ $\quad \delta(q_2, 1) = q_3$

$F = \{ \emptyset \}$

2. (2 point) Please derive L and L_m of the FSM in Fig. 1 if the state 15c is a final state.

Solution:

L = {ε, 0, 01, 00, 000, 001, 1, 10, 11}

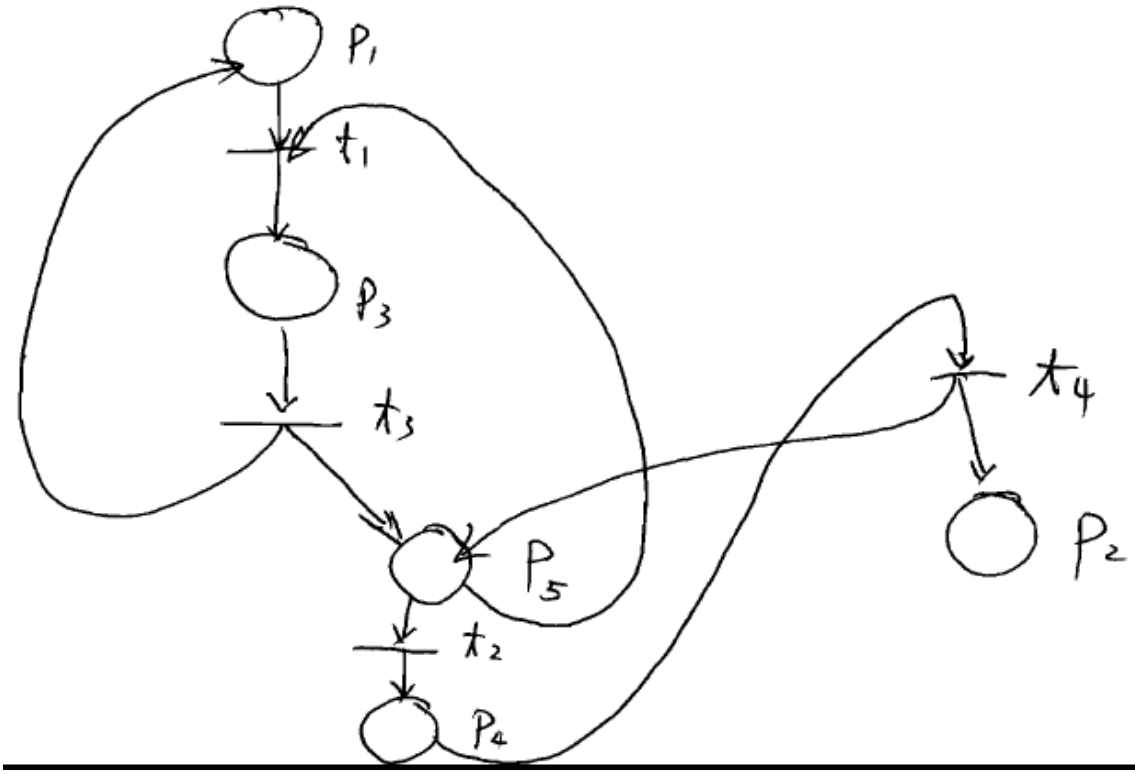
L_m = {01, 000, 10, 11, 001}

3. (2 point) Represent graphically the following Petri net (P, T, I, O) where P={p_i, 1≤i≤5} and T={t_i, 1≤i≤4},

$$I=\begin{pmatrix}1&0&0&0\\0&1&0&0\\0&0&1&0\\0&0&0&1\\1&1&0&0\end{pmatrix} O=\begin{pmatrix}0&0&1&0\\0&0&0&1\\1&0&0&0\\0&1&0&0\\0&0&1&1\end{pmatrix}$$

Solution

P2 is the input of t2 (which is missing in the solution)



4. (5 points) Please derive the reachability tree of the PN in Fig. 2, and determine its boundedness, safeness, liveness, and reversibility. J is the last digit of your banner ID. For i=1, 2, …, 9, a_i=0 if your i-th ID digit is smaller than or equal to 5, and otherwise 1. For example, if you ID =121291755, a_1-a_9=000010100. Let

$m_0(p_1)=a_6$, $m_0(p_2)=(1-a_6)$; $m_0(p_6)=a_7$, $m_0(p_3)= (J+2)*(1-a_7)$; $m_0(p_4)=a_8$, $m_0(p_5)=1-a_8$.

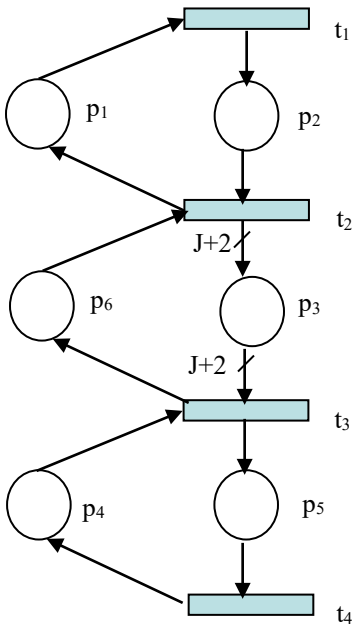
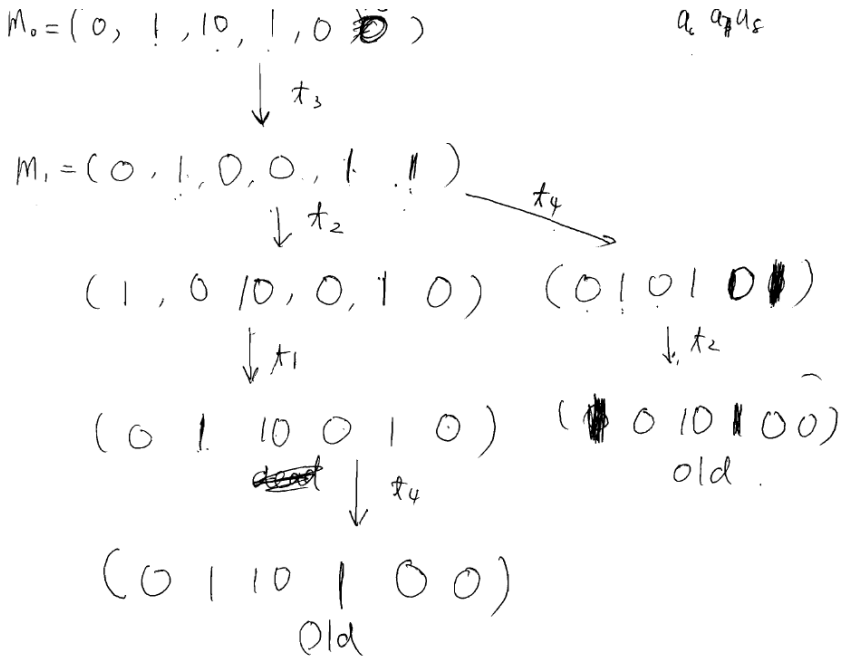


Fig. 2

Solution:

For this solution the ID used is 91008328
Thus, m0 ={0, 1, 10, 1, 0, 0}

Thus, the reachibility graph is as follows:



It is bounded, but not safe, and live, and reversible

5. (5 points) Please derive the reachability tree of the following PN in Fig. 3 and its boundedness, safeness, liveness, and reversibility. HINT: you may not be able to judge its properties based on the tree. Need more thinking and extra work.

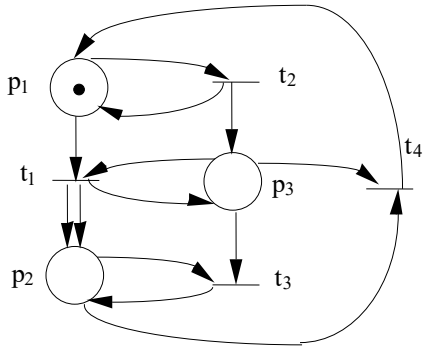
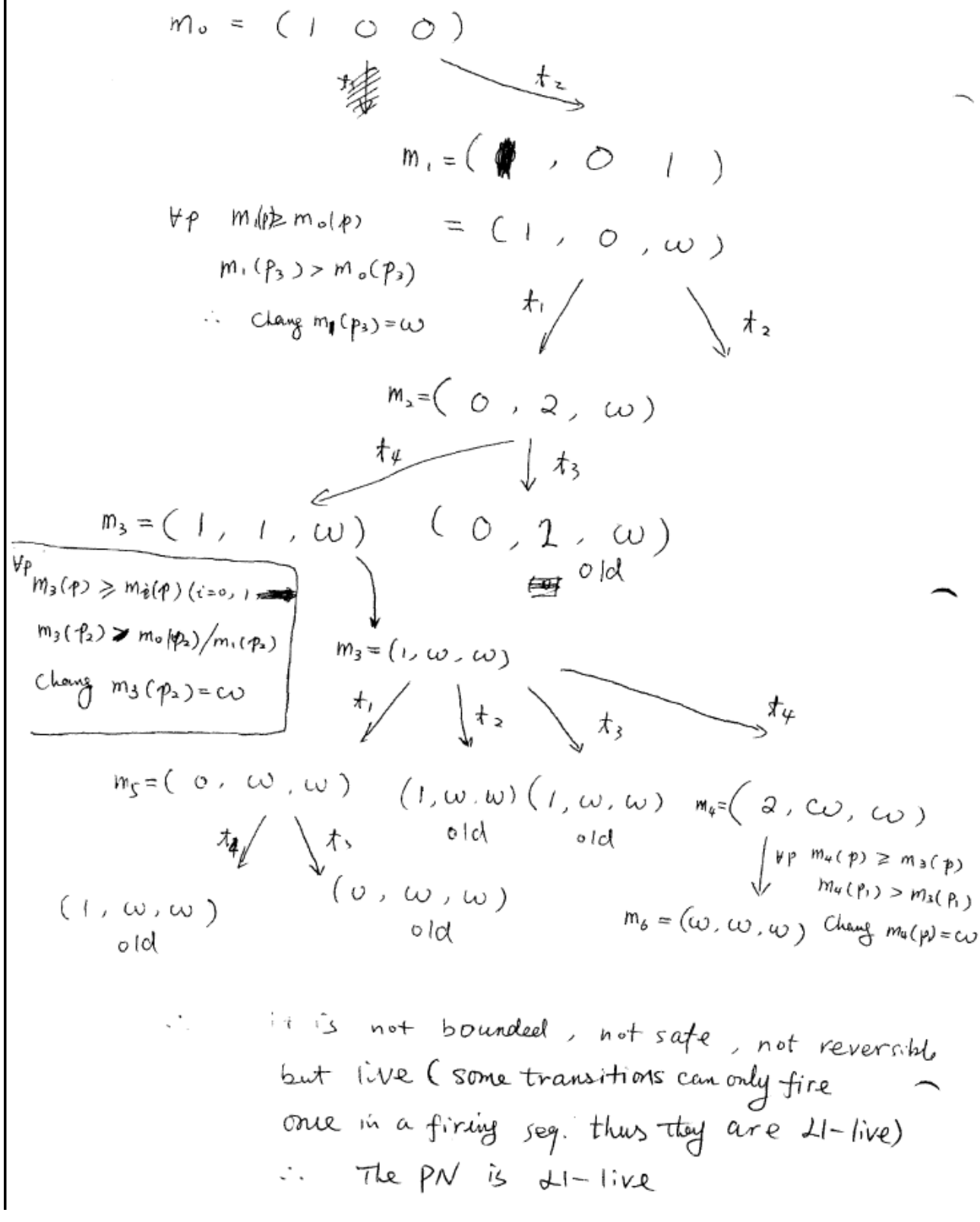


Fig. 3

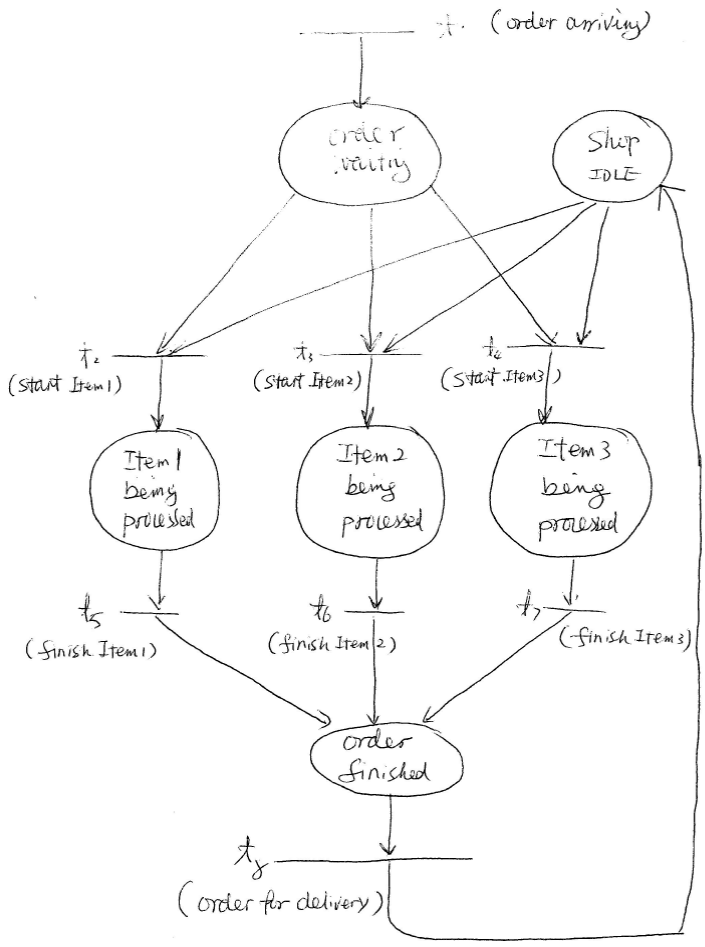
Solution



$\therefore$ it is not boundeel, not safe, not reversible
but live (some transitions can only fire
once in a firing seq. thus they are L1-live)
$\therefore$ The PN is L1-live

6. (4 points). A small machine shop can make three different items, though it can work on only one item at a time. The shop can be in six different "states" corresponding to: an order is waiting, one of the three items is being made, an order is finished, and the shop is idle. There are six actions: order arriving, start work on item 1, start work on item 2, start work on item 3, finish processing, and order sent for delivery. Construct a Petri net model for this machine shop?

   Solution:



7. (4 points) Construct a PN model for calculating the logic conjunction of two variables x and y, each of which takes the values of “true” and “false”. Each is assigned a value independently of the other.