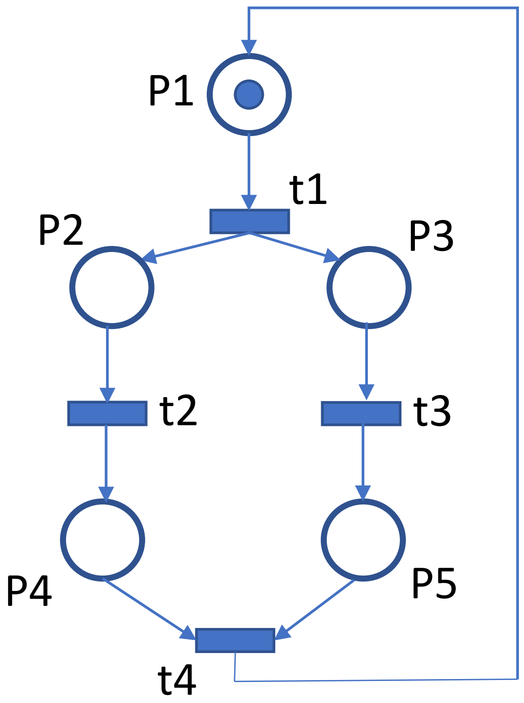
Lab 5 . Evolutia marcajului retelelor Petri

Cuprins

1. Reprezentarea matematica a unei RP
2. Matricea de incidenta
3. Admisibilitatea si executia tranzitiilor pornind din marcajul/starea current/a
4. Calcularea starii urmatoare pornind dintr-o stare data
5. Ce este marcajul din punct de vedere matematic?

Retele Petri



Retele Petri

$N = (P, T, Pre, Post)$

N = Retea (Network)

P = Locatii (Places)

T = Tranzitii (Transitions)

Pre, Post = Matrici de incidenta inainte/dupa

$PN = (N, M_0)$

M_0 = Marcajul initial (starea initiala) este un vector care contine ca elemente numarul de jetoane din fiecare locatie a retelei

$M_0 = \{M(P1), M(P2), \ldots, M(Pn)\}$

Matricea de incidenta

Matricea de incidenta se foloseste pentru determinarea evolutiei marcajului (comportament)

$$C = Post - Pre$$

$$C_{ij} = Post(t_j, p_i) - Pre(p_i, t_j), \quad i = 1..m, \ j = 1..n$$

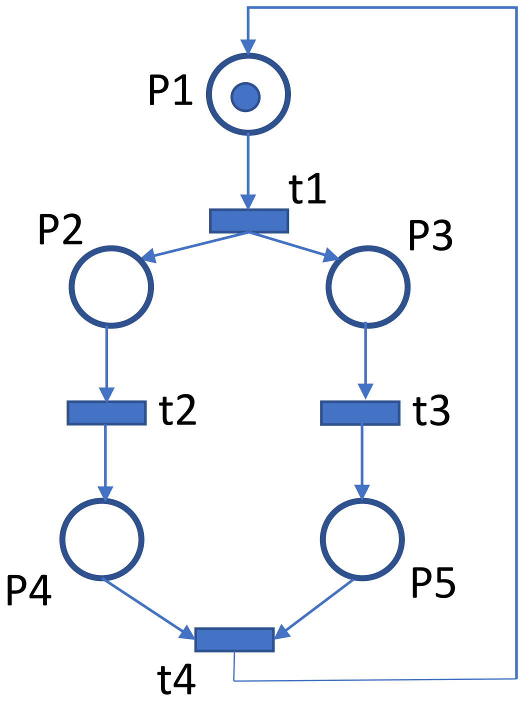
m=nr. de locatii

n=nr. de tranzitii

Matricea de incidenta

$$
\text{Pre} = \begin{array}{c c}
\begin{array}{cccc} \color{green}{t1} & \color{green}{t2} & \color{green}{t3} & \color{green}{t4} \end{array} & \\
\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix} & \begin{array}{c} P1 \\ P2 \\ P3 \\ P4 \\ P5 \end{array}
\end{array}
$$

Arcele care intra in tranzitii
N = 4 (nr. de tranzitii)
M = 5 (nr. De locatii)



$$
M0 = \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}
$$

$$
\text{Post} = \begin{bmatrix} 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}
$$

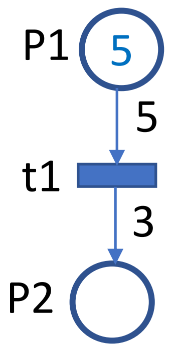
Arcele care ies din tranzitii

Matricea de incidenta

$$C = Post - Pre = \begin{bmatrix} 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} - \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} -1 & 0 & 0 & 1 \\ 1 & -1 & 0 & 0 \\ 1 & 0 & -1 & 0 \\ 0 & 1 & 0 & -1 \\ 0 & 0 & 1 & -1 \end{bmatrix}$$

Executia tranzitiilor

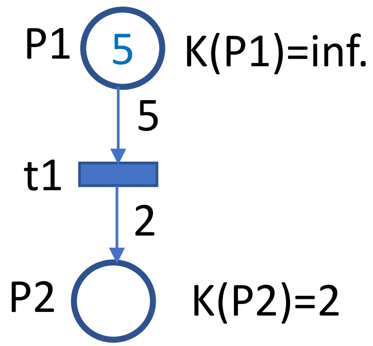
1. Regula nestricta



$$M(P)>=Pre_{(p,t)}$$

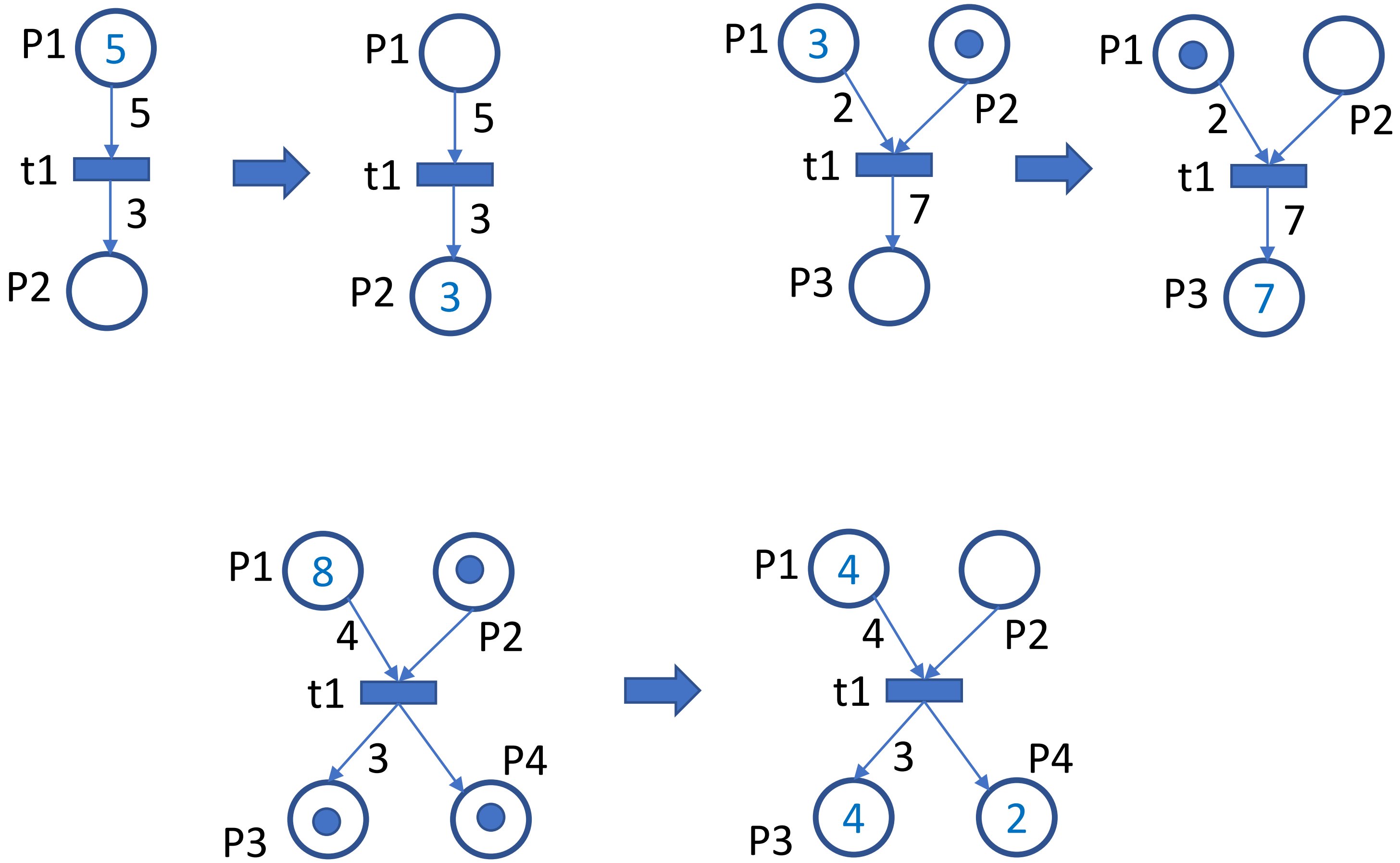
Marcajul current acopera coloana corespunzatoare tranzitiei din matricea de incidenta inainte

2. Regula stricta



$$K(P)>=M(P)+Post_{(t,p)}-Pre_{(t,p)}$$

Capacitatea locatiilor trebuie sa acopere marcajul urmator


P1
5
5
t1
3
P2
P1
5
t1
3
P2
3
P1
3
2
P2
t1
7
P3
P1
2
P2
t1
7
P3
7
P1
8
4
P2
t1
3
P4
P3
P1
4
4
P2
t1
3
P4
P3
4
2

Marcajul urmator

Ecuatiile de stare ne ajuta sa calculam marcajul urmator:

1) $M_2(P) = M_1(P) + Post_{(t,p)} - Pre_{(p,\ t)}$

$\boxed{\text{2) } M_2(P) = M_1(P) + Colt(C)}$

M_1 = marcaj curent

M_2 = marcaj urmator

$$M_1(P) = M_0(P) + Col_{t1}(C) = \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} -1 \\ 1 \\ 1 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 1 \\ 0 \\ 0 \end{bmatrix}$$

M_0 = marcaj initial
M_1 = marcaj urmator

$$M_2(P) = M_1(P) + Col_{t2}(C) = \begin{bmatrix} 0 \\ 1 \\ 1 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} 0 \\ -1 \\ 0 \\ 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 1 \\ 1 \\ 0 \end{bmatrix}$$

$$M_3(P) = M_1(P) + Col_{t3}(C) = \begin{bmatrix} 0 \\ 1 \\ 1 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ -1 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 1 \end{bmatrix}$$

Cerinte

1) Se identifica marcajul initial (care este dat)
2) Matrice de incidenta C (Pre, Post), marcaj initial/curent
3) Se identifica tranzitiile executabile folosind regulile de admisibilitate
4) Pentru fiecare tranzitie executabila din marcajul actual se calculeaza marcajul urmator folosind una din ecuatiile de stare
5) Se repeta 3 si 4 pentru fiecare marcaj nou obtinut (cel putin 5 executii de tranzitii pentru fiecare retea)