DUS

- diskrétne
- udalostné
- systémy

Marček Stanislav

S T U
F E I

SLOVENSKÁ TECHNICKÁ UNIVERZITA V BRATISLAVE
Fakulta elektrotechniky a informatiky
SLOVAK UNIVERSITY OF TECHNOLOGY IN BRATISLAVA
Faculty of Electrical Engineering and Information Technology

Semantics of PN

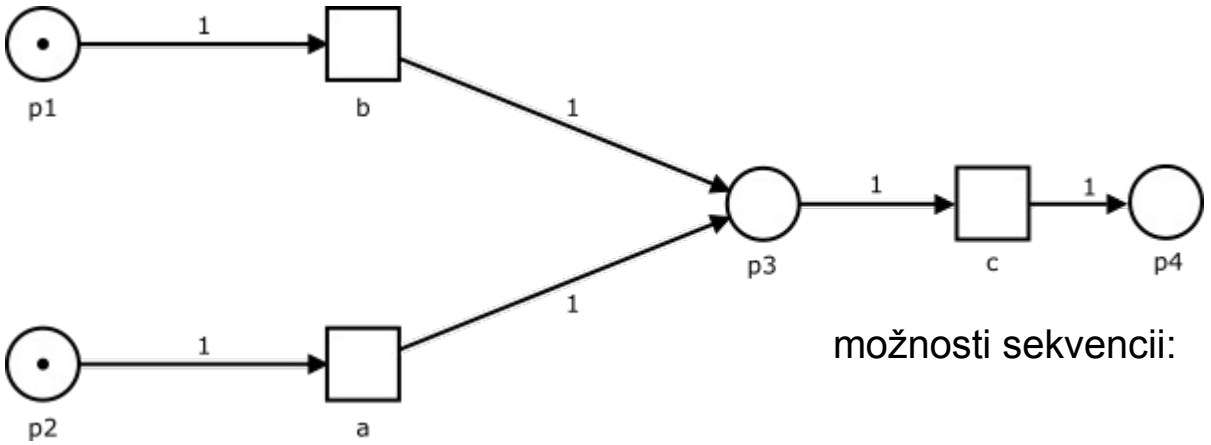
Sekvenčná sémantika

- sekvencia spustení

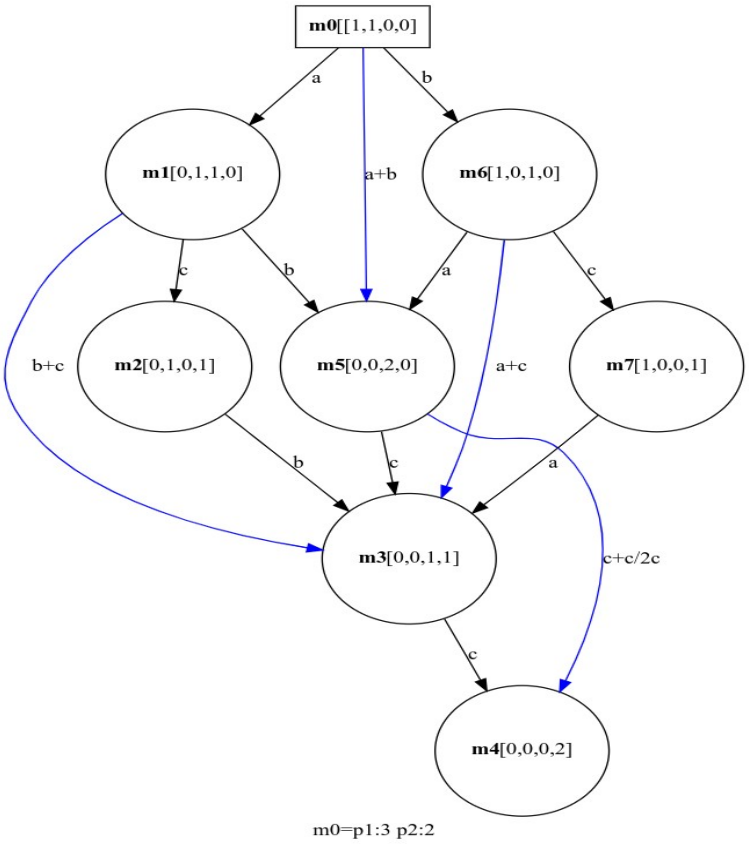
Nesekvenčná sémantika

- kroková sekvencia
- výrazy
- procesy
- označené čiastočné usporiadanie (multimnožiny prechodov)

Steps sequence semantics



možnosti sekvencii:



prepisovacie pravidlá:
- kauzalita ;
- paralelizmus +

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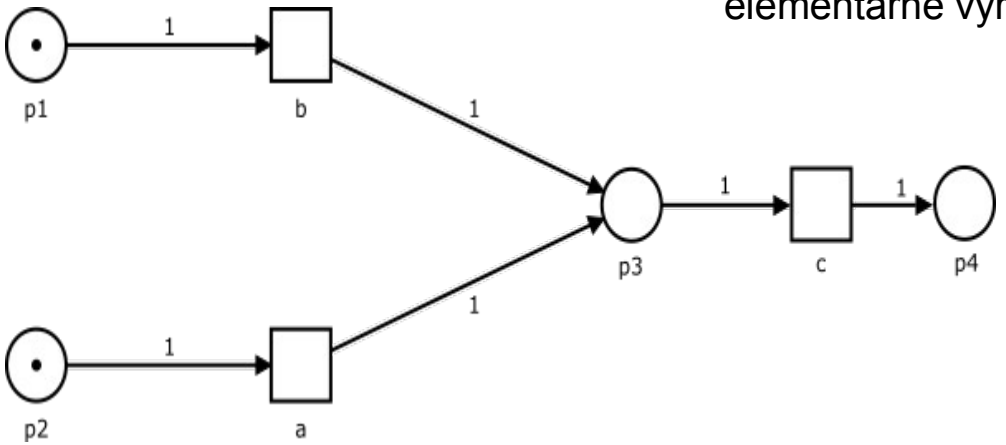
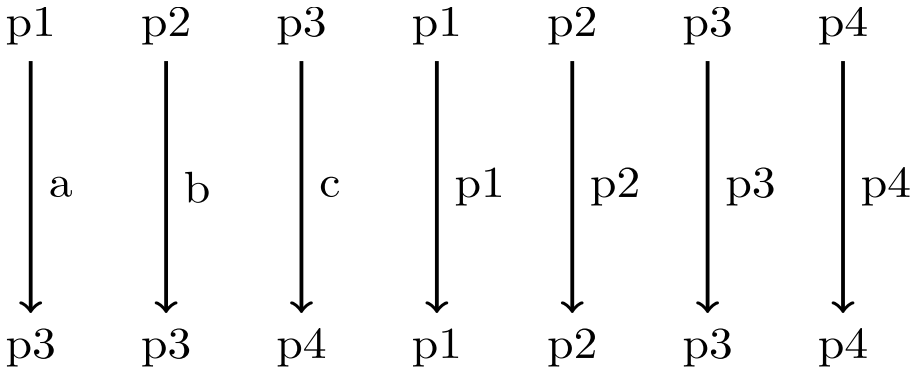
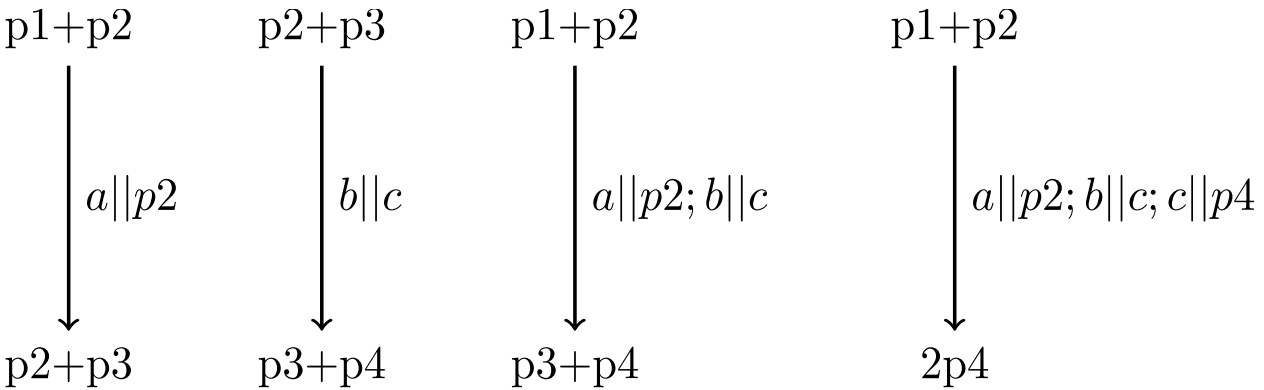
Algebraic terms

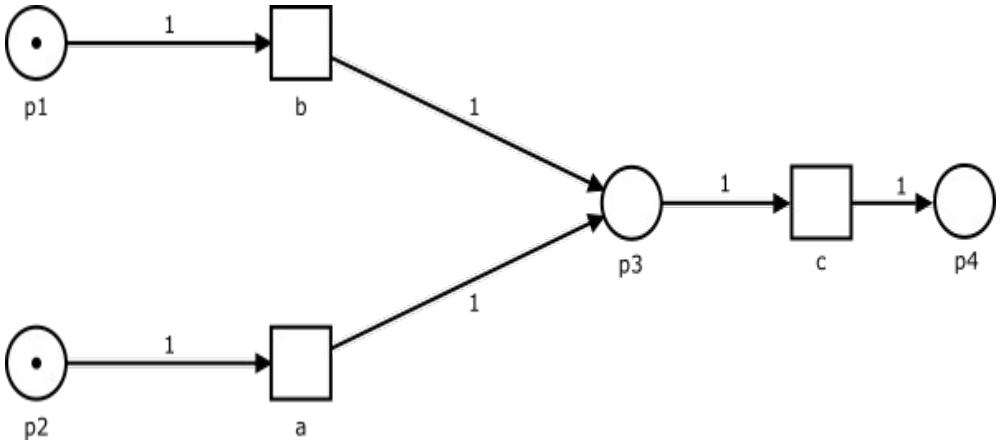


elementárne výrazy:



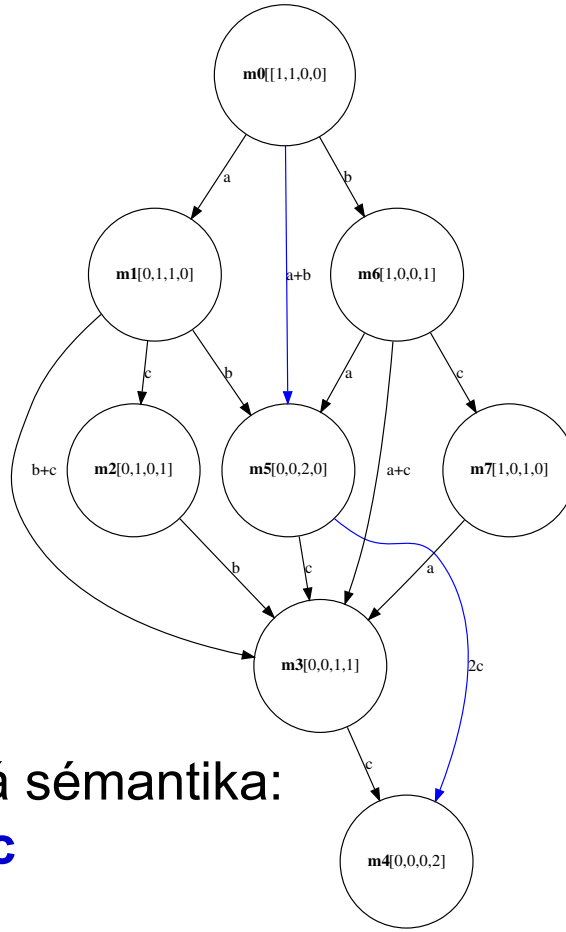


Semantics



Výrazova sémantika:

$$p1 + p2 \xrightarrow{(a||b);(2c)} 2p4$$



Kroková sémantika:

a+b;c+c

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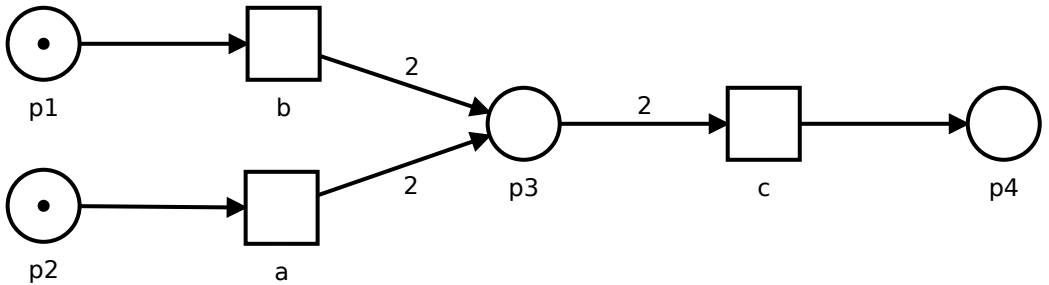
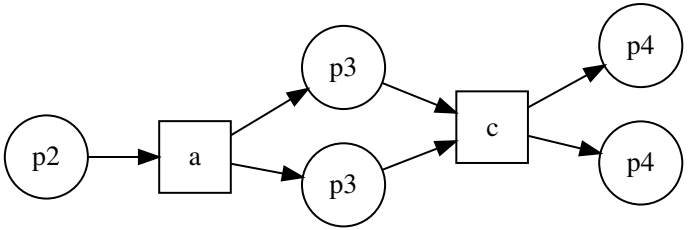
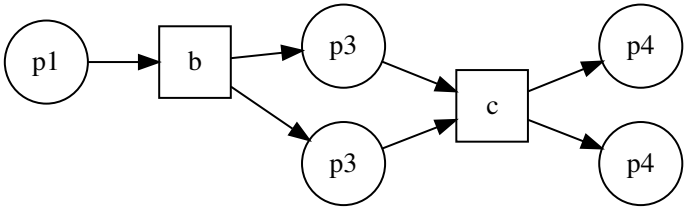
Process semantic



Výrazova sémantika:

$$p1 + p2 \xrightarrow{(a||b);(2c)} 2p4$$

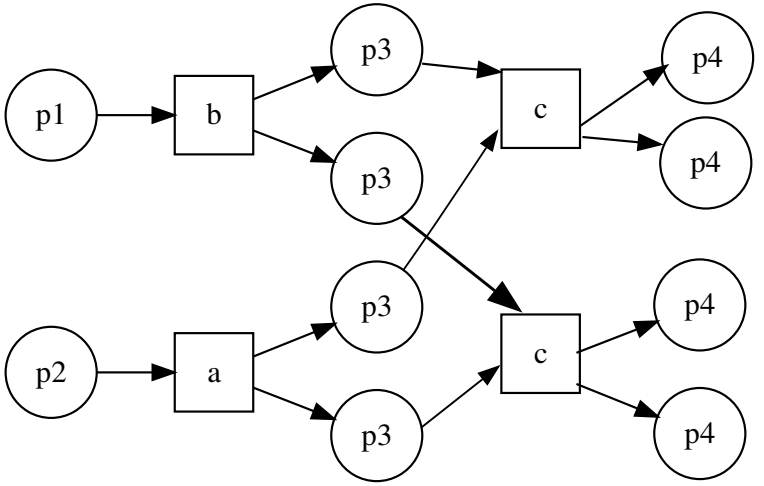




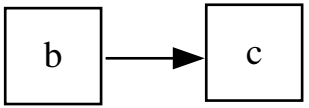
Procesná sémantika toho istého výrazu.

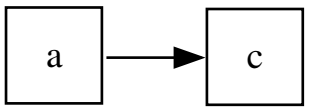
a,

b,

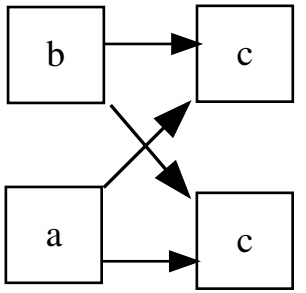


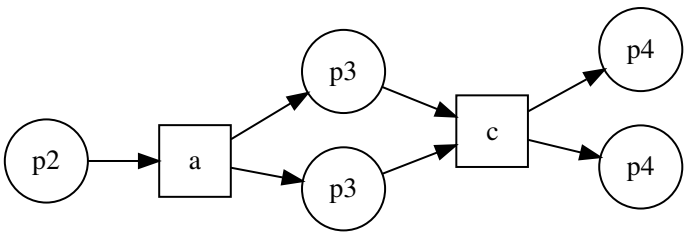
Process semantic

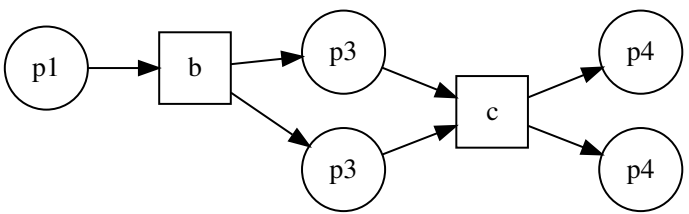




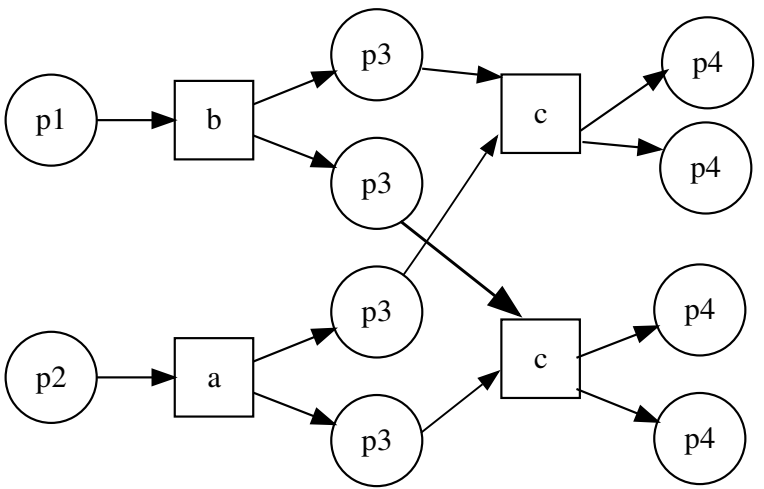
behy







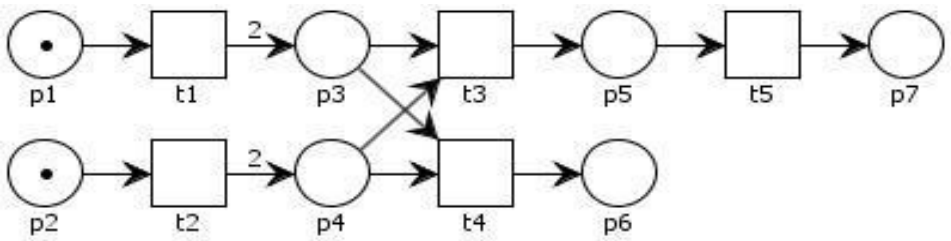
procesy

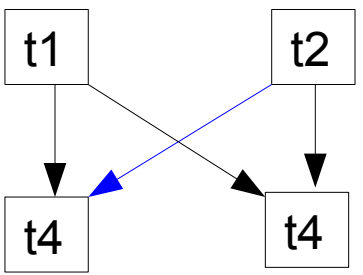


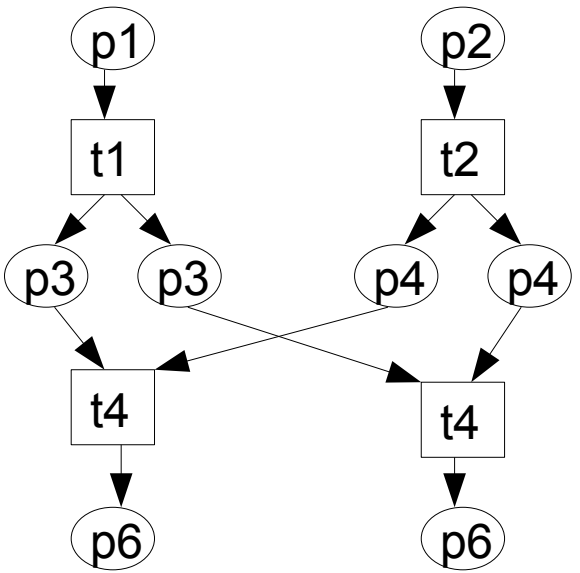
Process semantics

Určite či je proces/beh spustiteľný v PS.

N-free LPO → beh + značky v miestach = proces







DAG / LPO

Čiastočné usporiadanie je dvojica (V, →), kde

V je množina vrcholov/**udalostí**,

→ je **binárna relácia** na V (→ je podmnožina V x V, t.j. podmnožina množiny všetkých usporiadaných dvojíc prvkov z V, skutočnosť, že dvojica (v,v‘) je v relácii → graficky znázorňujeme ako v → v‘),

pričom relácia → je

ireflexívna. ($\forall v \in V$: (v,v) $\notin \rightarrow$)

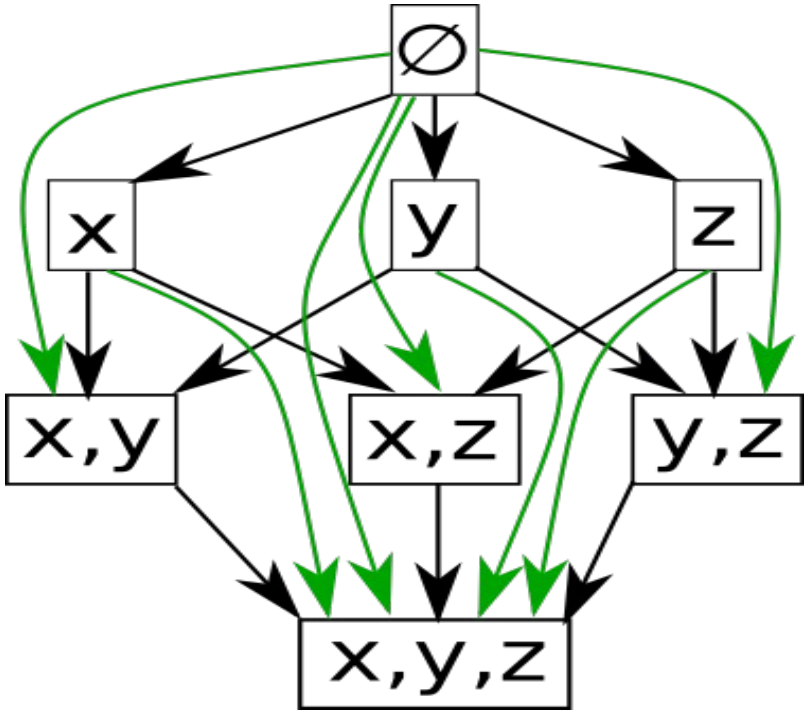
tranzitívna. (x,y,z$\in$V: x → y ^ y → z ⇒ x→ z).

DAG / LPO

Smerový **a**cyklický **g**raf.

Označené **Č**iastočné **U**sporiadanie.**(V, →)**

Tranzitívna, ireflexívna.



maximálny paralelizmus, probl. maximálneho toku

DAG / LPO

Čiastočné usporiadanie je dvojica (V, →), kde

V je množina vrcholov/udalostí,

→ je ireflexívna tranzitívna binárna relácia

Čiastočné usporiadanie spolu s funkciou, ktorá každému prvku z V priradí nejaký prvok z množiny T budeme nazývať **označené čiastočné usporiadanie**. **Rezom** v čiastočnom usporiadaní sa nazýva taká podmnožina $X_s \subseteq V$, že

. $\forall x,y \in X_s: ((x,y) \notin \rightarrow) \wedge ((y,x) \notin \rightarrow)$,

$\forall v \in V : v \notin X_s , (v,x) \in \rightarrow \wedge (x,v) \in \rightarrow$

Minulosť rezu X_s (označované ako X_m) X_m:$\{v \in V \mid (\exists x \in X_s: v \rightarrow x)\}$

WC: Wrong continuations

Pozorované scénare: {**a;b;d**}, {**a;c;d**}

Sekvencia **a;b;d**: $m \geq a_z$; $m \geq a_z - a_d + b_z$; $m \geq a_z - a_d + b_z - b_d + d_z$;

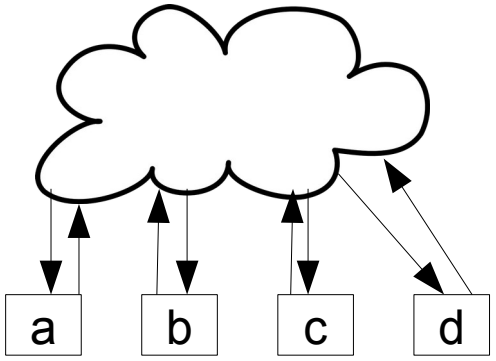
Sekvencia **a;c;d**: $m \geq a_z$; $m \geq a_z - a_d + c_z$; $m \geq a_z - a_d + c_z - c_d + d_z$;

Sekvencie {b},{c},{d}: $m < b_z$; $m < c_z$; $m < d_z$; ďalej

Sekvencie {(a);d},{(a);a}: $m < a_z - a_d + d_z$; $m < 2a_z - a_d$;

Sekvencie {(ab);a},{(ab);b},{(ab);c}, {(ac);a},{(ac);b},{(ac);c}

Sekvencie {**(abd);a**},{**(abd);b**},{**(abd);c**},{**(abd);d**},
{**(acd);a**},{**(acd);b**},{**(acd);c**},{**(acd);d**}



X_m=(a,b,c,d); X_s=(a,b,c,d);

minulost spustenie{X_a;X_b;X_c;X_d}

$\mathbf{m^T_m \geq I.X^T_s}$

$m^T_m = m^T + O.X^T_m - I.X^T_m = m^T$ ...+/- ...

$m^T_a < I.X^T_d$

$m^T + O.X^T_a - I.X^T_a < I.X^T_d$

$m^T < a_z - a_d + d_z$

$\mathbf{m^T_{acd} < I.X^T_a}$

$\mathbf{X_m = (1,0,1,1)}$; $\mathbf{X_s = (1,0,0,0)}$;

$m^T + O.X^T_{acd} - I.X^T_{acd} < I.X^T_a$

$m^T < a_z - a_d + c_z - c_d + d_z - d_d + a_z$

...

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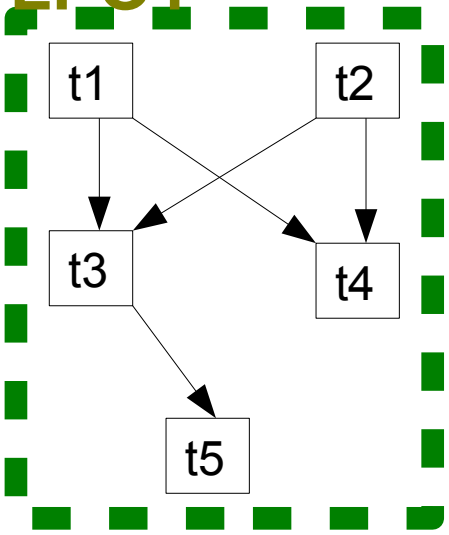
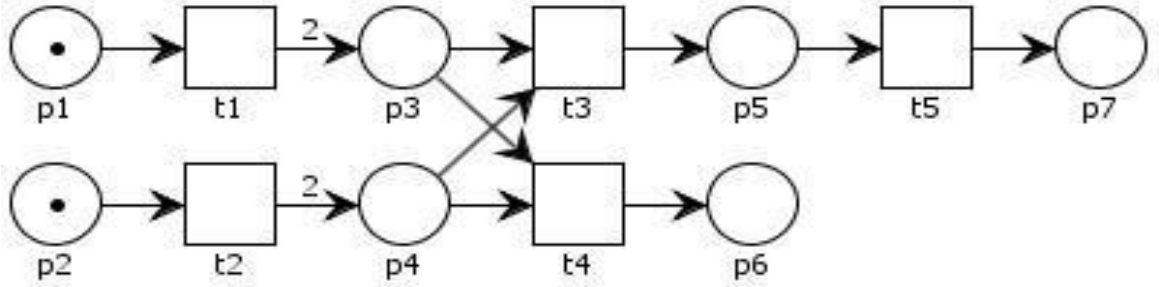
DAG / LPO

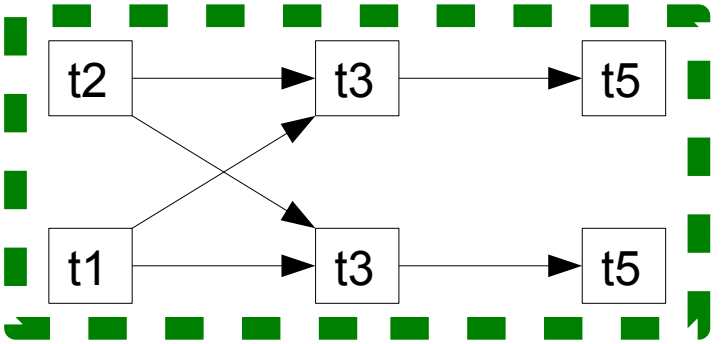
Určite či je LPO spustiteľné v PS.

LPO1





LPO2



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LPO cut

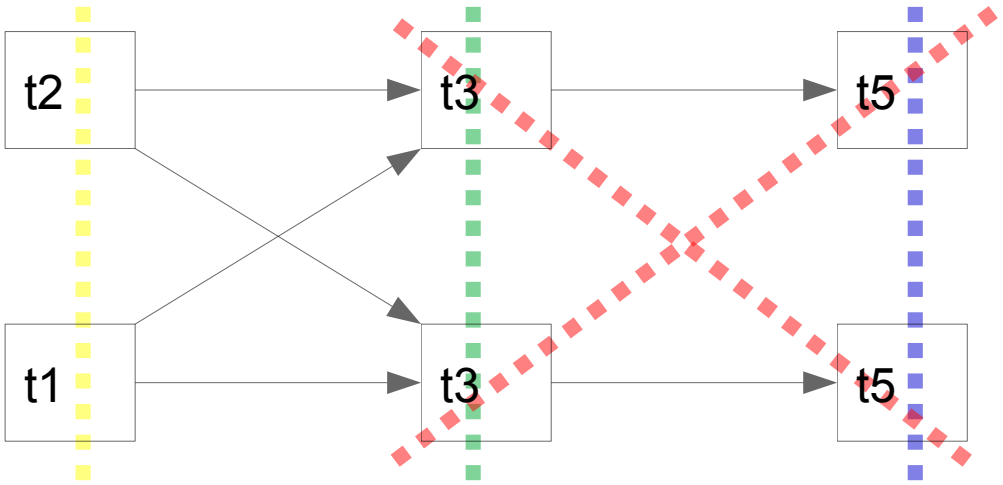
podľa definície rezu:

(t1+t2)

(t3+t3)

(t3+t5)*

(t5+t5)



ďalšie možné, redundantné kontroly:

t1, t2, t3*, t5* -- **nie sú rezy**

$\forall x,y \in X_s: ((x,y) \notin \rightarrow) \wedge ((y,x) \notin \rightarrow)$,

$\forall v \in V : v \notin X_s , (v,x) \in \rightarrow \wedge (x,v) \in \rightarrow$

LPO cut

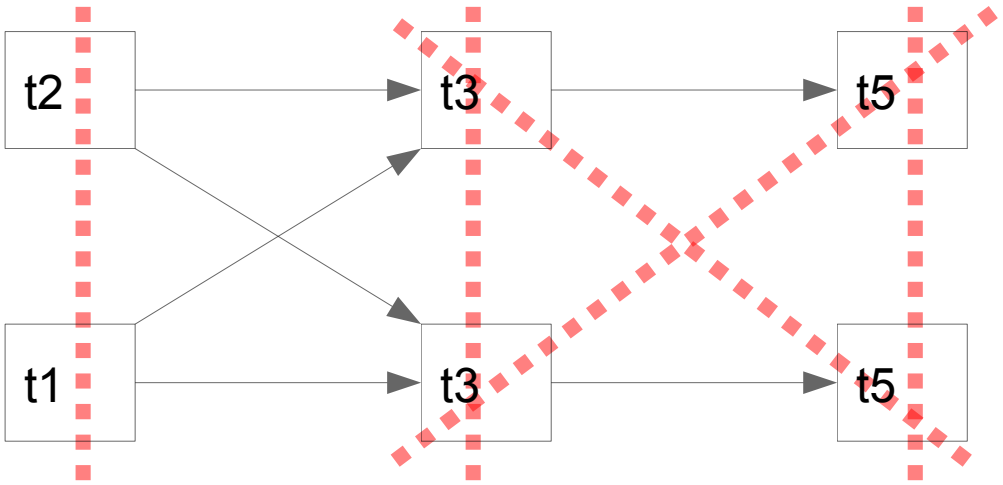
X_s=(t1+t2): X_m={}

X_s=(t3+t3): X_m={t1,t2}

X_s=(t3+t5): X_m={t1,t2,t3}

X_s=(t5+t5): X_m={t1,t2,t3,t3}

X_s=(2.t5): X_m={t1+t2+2.t3}



executability LPO

X_s={t3+t3}: X_m={t1,t2}

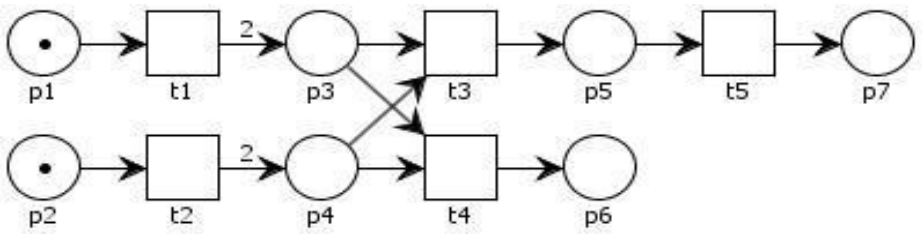
X_s=(0,0,2,0,0)

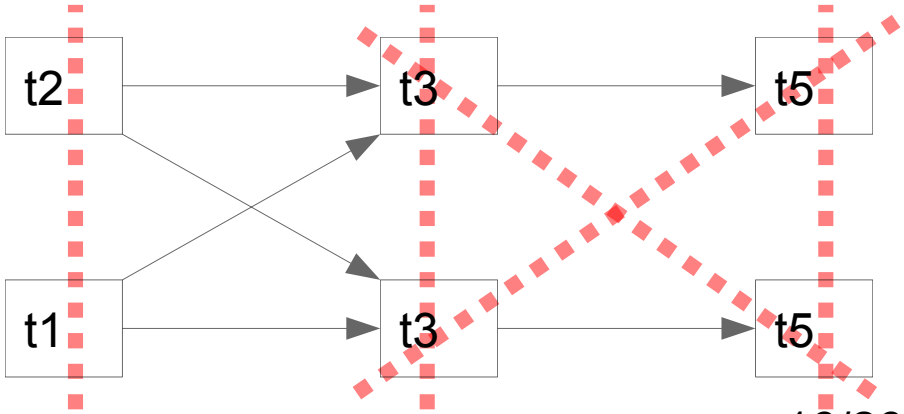
X_m=(1,1,0,0,0)

$$m_0^T(p) + C(p,t) \cdot X_m^T(t) \geq I(p,t) \cdot X_s^T(t)$$

$$\begin{pmatrix}1\\1\\0\\0\\0\\0\\0\end{pmatrix} + \begin{pmatrix}-1&0&0&0&0\\0&-1&0&0&0\\2&0&-1&-1&0\\0&2&-1&-1&0\\0&0&1&0&-1\\0&0&0&1&0\\0&0&0&0&1\end{pmatrix} \cdot \begin{pmatrix}1\\1\\0\\0\\0\end{pmatrix} \geq \begin{pmatrix}1&0&0&0&0\\0&1&0&0&0\\0&0&1&1&0\\0&0&1&1&0\\0&0&0&0&1\\0&0&0&0&0\\0&0&0&0&0\end{pmatrix} \cdot \begin{pmatrix}0\\0\\2\\0\\0\end{pmatrix}$$

$$m_{dosiahnute} = (0,0,2,2,0,0,0) \geq (0,0,2,2,0,0,0) = m_{nutne}$$





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executability LPO

rezy:

(1-2)

(3)

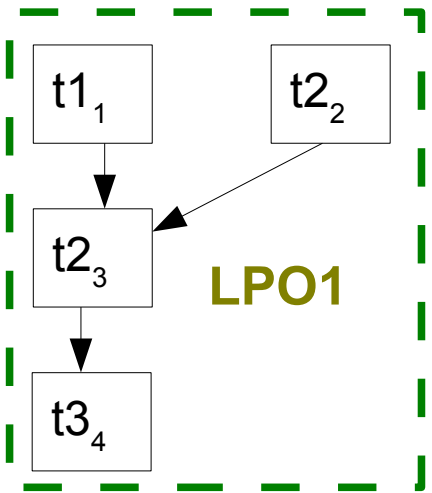
(4)

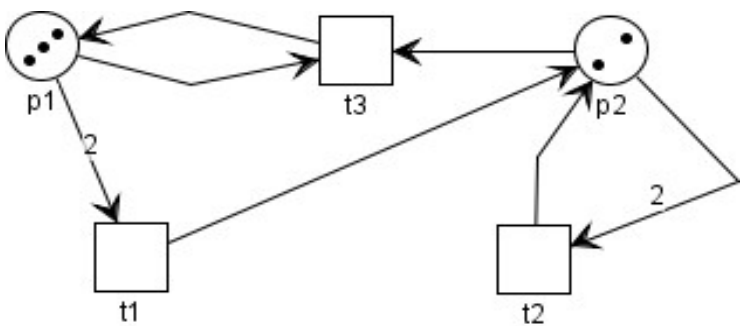
$$m_0^T(p) + C(p,t) \cdot X_m^T(t) \geq I(p,t) \cdot X_s^T(t)$$

$$\begin{pmatrix}3\\2\end{pmatrix} + \begin{pmatrix}-2 & 0 & 0\\ 1 & -1 & -1\end{pmatrix} \cdot \begin{pmatrix}1\\2\\0\end{pmatrix} \geq \begin{pmatrix}2 & 0 & 1\\ 0 & 2 & 1\end{pmatrix} \cdot \begin{pmatrix}0\\0\\1\end{pmatrix}$$

$$\begin{pmatrix}3\\2\end{pmatrix} + \begin{pmatrix}-2\\-1\end{pmatrix} \geq \begin{pmatrix}1\\1\end{pmatrix}$$

$$m_{dosiahnute} = (1,1) \geq (1,1) = m_{nutne}$$





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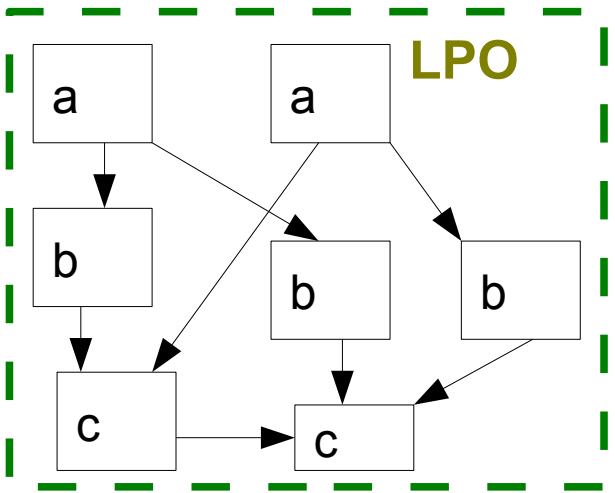
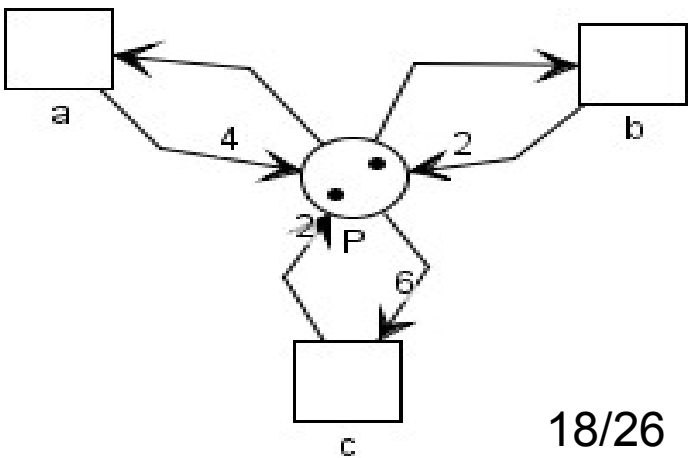
executability LPO

rez:

minulost rezu:





executability LPO

rezy:

(a_1+a_2)

(a_1+b_3)

(a_2+b_1+b_2)

(b+b+b)

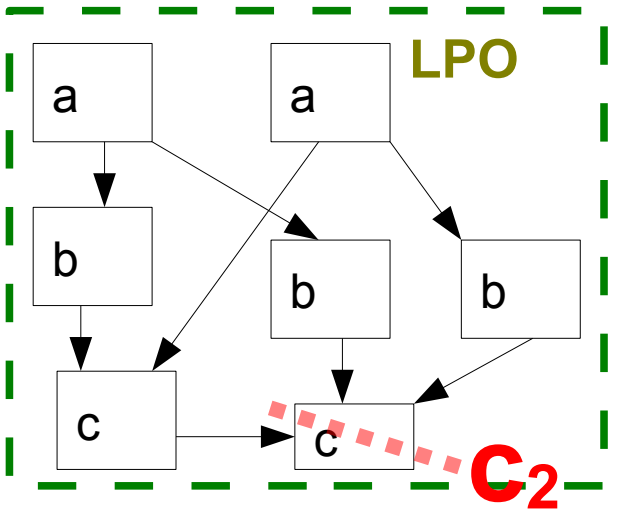
(b_2+b_3+c_1)

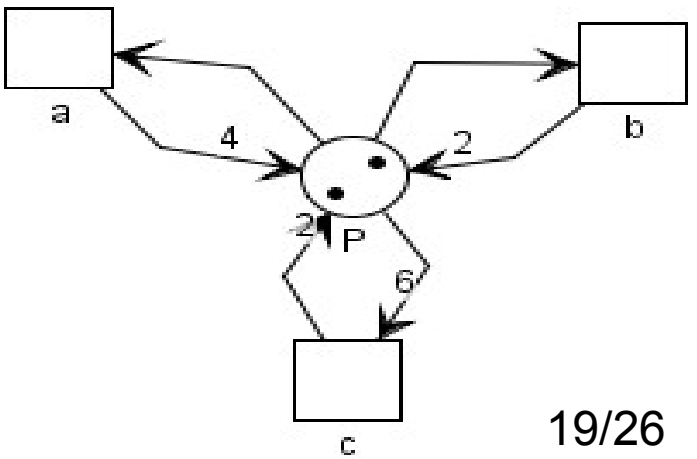
postačujúce??

$$m_0^T + \quad C \quad \cdot X_m^T \geq \quad I \quad \cdot X_s^T$$

$$(2) + (3 \quad 1 \quad -4) \cdot \begin{pmatrix} 2 \\ 1 \\ 0 \end{pmatrix} \geq (1 \quad 1 \quad 6) \cdot \begin{pmatrix} 0 \\ 2 \\ 1 \end{pmatrix}$$

$$m_{dosiahnute} = (9) \geq \quad (8) = m_{nutne}$$





executability LPO

rezy:

(a_1+a_2)

(a_1+b_3)

(a_2+b_1+b_2)

(b+b+b)

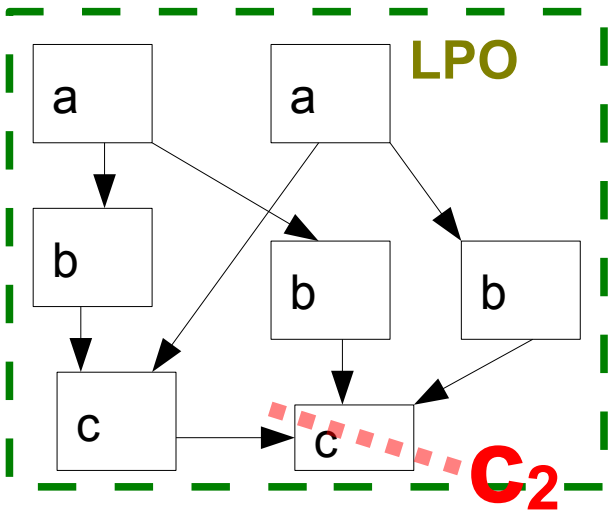
(b_2+b_3+c_1)

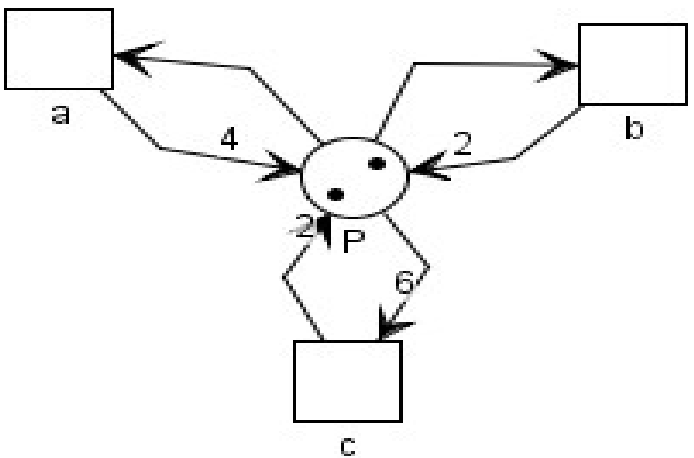
c_2

$$m_0^T + \quad C \quad \cdot X_m^T \geq \quad I \quad \cdot X_s^T$$

$$(2) + (3 \quad 1 \quad -4) \cdot \begin{pmatrix} 2 \\ 3 \\ 1 \end{pmatrix} \geq (1 \quad 1 \quad 6) \cdot \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$$

$$m_{dosiahnute} = (7) \geq \quad (6) = m_{nutne}$$





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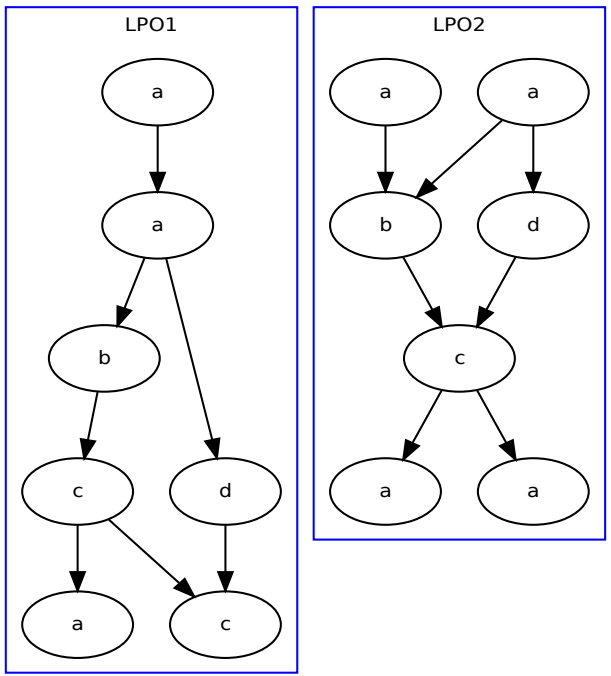
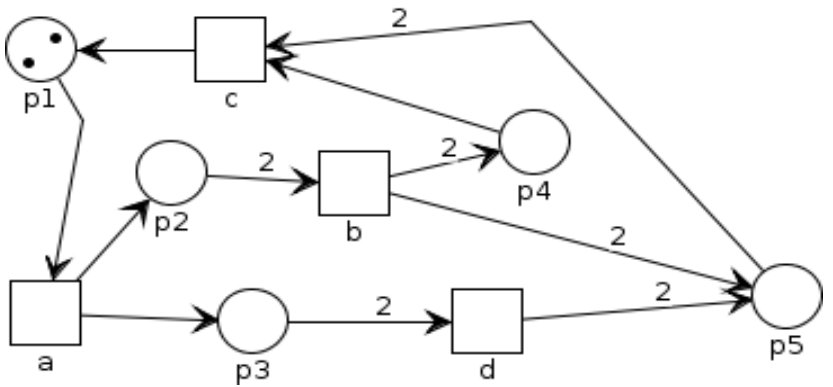
executability LPO

úloha (test 2017):

Pre PS a čiastočné usporiadania (LPO1 LPO2) zistite spustiteľnosť jednotlivých LPO. *Ak je LPO spustiteľné vypíšte jeho rezy, ak nie zapíšte ten, pre ktorý nie je spustiteľné.*

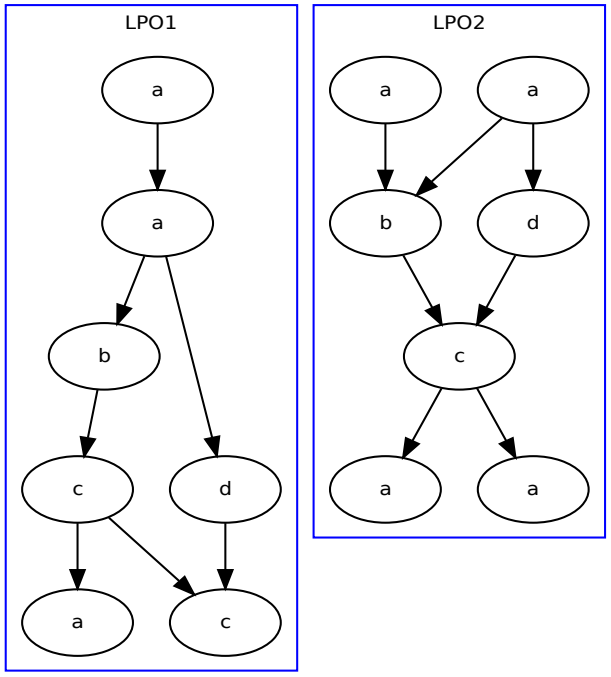




executability LPO

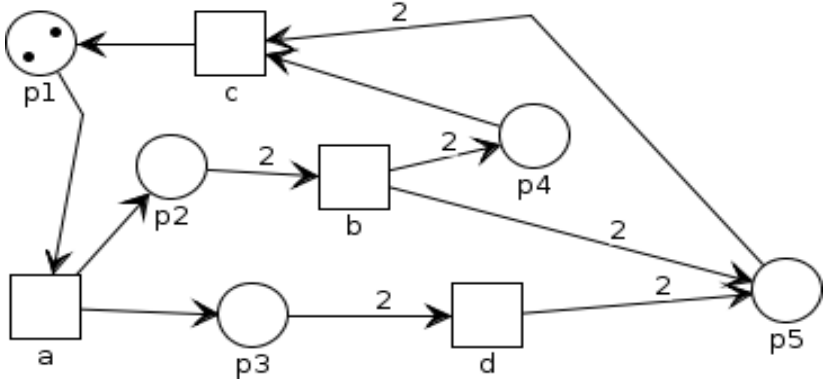
úloha (test 2017):

Pre PS a čiastočné usporiadania (LPO1 LPO2) zistite spustiteľnosť jednotlivých LPO. *Ak je LPO spustiteľné vypíšte jeho rezy, ak nie zapíšte ten, pre ktorý nie je spustiteľné.*



LPO1:
v1(a){};
v2(a){a};
v3v5(bd){aa};
v4v5(cd){aab};
v5v6(ad){aabc};
v6v7(ac){aabcd}

LPO2:
v1v2(aa){};
v1v4(ad){a};
v3v4(bd){aa};
v5(c){aabd};
v6v7(aa){aabcd}



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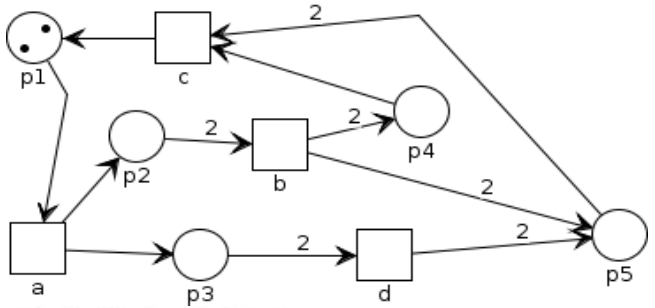
v3v4(bd){aa};
v5(c){aabd};
v6v7(aa){aabcd}



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v3v4(bd){aa};
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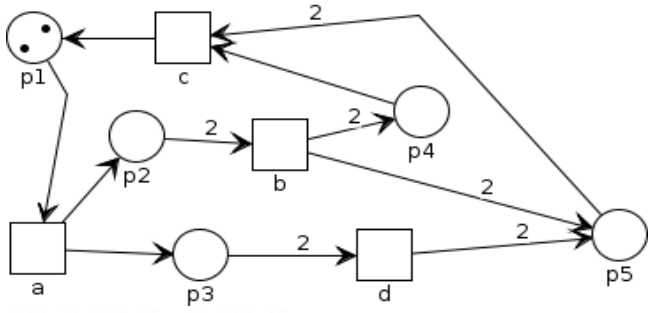
v6v7(aa){aabcd}



$$m_0^T(p) + C(p,t) \cdot X_m^T(t) \geq I(p,t) \cdot X_s^T(t)$$

$$\begin{pmatrix}2\\0\\0\\0\\0\end{pmatrix} + \begin{pmatrix}-1 & 0 & 1 & 0\\ 1 & -2 & 0 & 0\\ 1 & 0 & 0 & -2\\ 0 & 2 & -1 & 0\\ 0 & 2 & -2 & 2\end{pmatrix} \cdot \begin{pmatrix}0\\0\\0\\0\end{pmatrix} \geq \begin{pmatrix}1 & 0 & 0 & 0\\ 0 & 2 & 0 & 0\\ 0 & 0 & 0 & 2\\ 0 & 0 & 1 & 0\\ 0 & 0 & 2 & 0\end{pmatrix} \cdot \begin{pmatrix}1\\0\\0\\0\end{pmatrix}$$

$$\begin{aligned}
X_m = (0,0,0,0) &: (2,0,0,0,0) \geq (1,0,0,0,0) : X_s = (1,0,0,0)\\
X_m = (1,0,0,0) &: (1,1,1,0,0) \geq (1,0,0,0,0) : X_s = (1,0,0,0)\\
X_m = (2,0,0,0) &: (0,2,2,0,0) \geq (0,2,2,0,0) : X_s = (0,1,0,1)\\
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\end{aligned}$$

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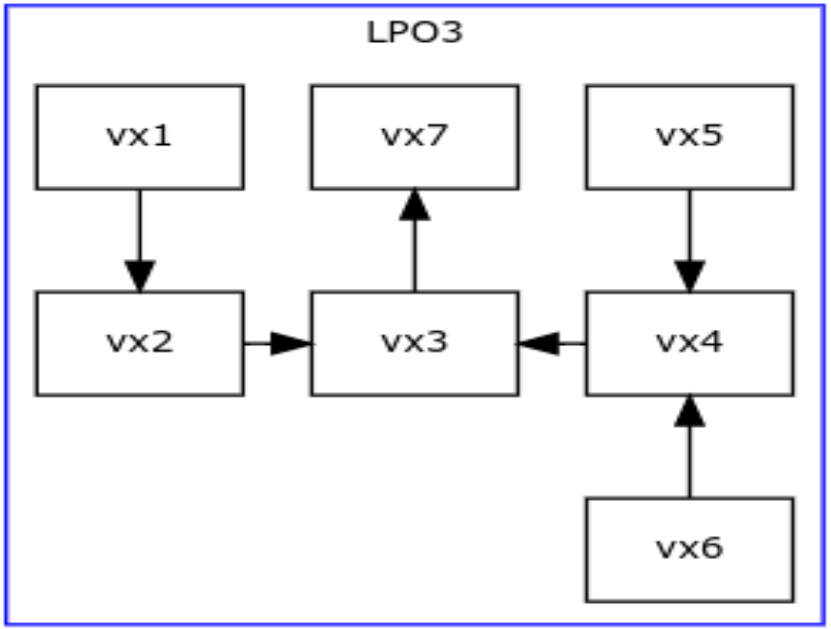
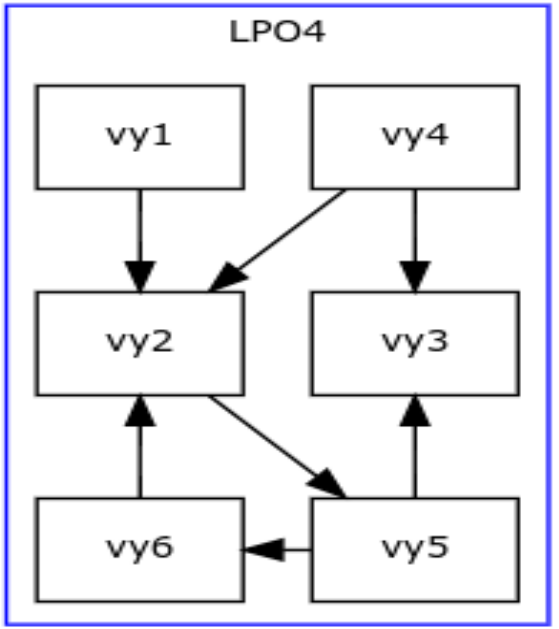
X_m = (2,0,0,0) &: (0,2,2,0,0) \geq (0,2,2,0,0) : X_s = (0,1,0,1)\\
X_m = (2,0,1,1) &: (1,2,0,-1,0) \geq (0,0,0,1,2) : X_s = (0,0,1,0)\\
X_m = (2,1,1,1) &: (1,0,0,1,2) \geq (2,0,0,0,0) : X_s = (2,0,0,0)
\end{aligned}$$

executability LPO

Vypíšte rezy pre čiastočné usporiadania (LPO3 LPO4). Vypíšte pre jednotlivé rezy ich minulosť.





executability LPO

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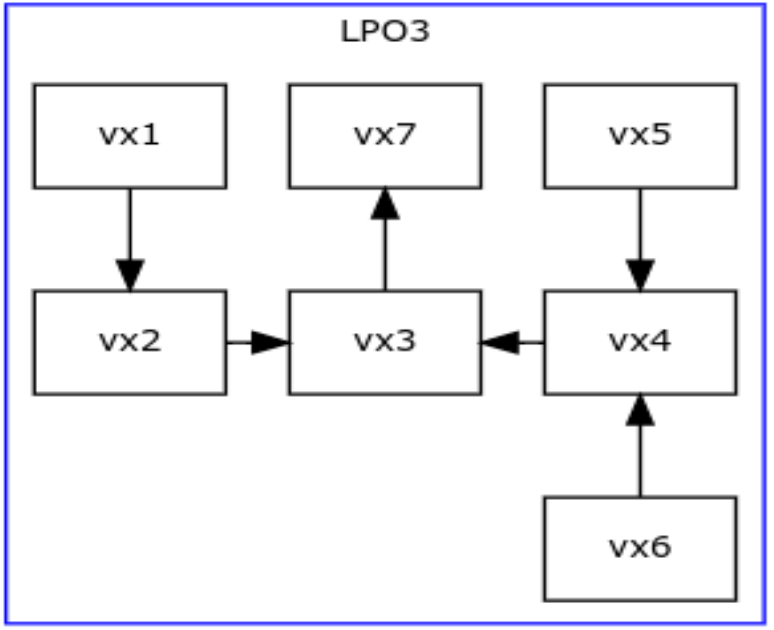

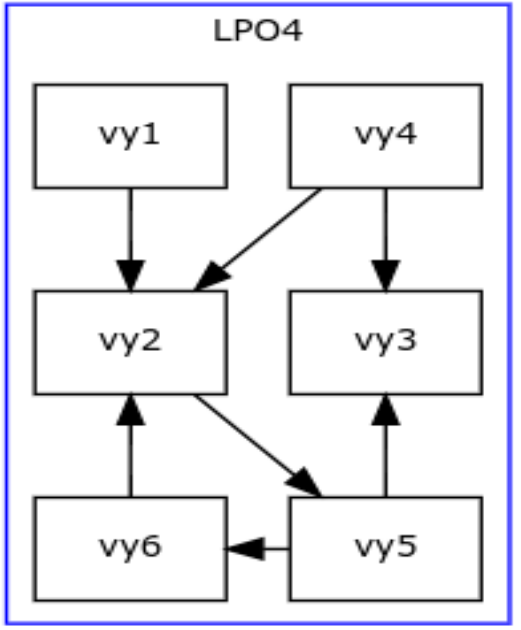

LPO3:

vx1,vx5,vx6{}

vx1,vx4{vx5,vx6}

vx2,vx5,vx6{vx1}

vx2,vx4{vx1,vx5,vx6}

vx3{vx1,vx2,vx4,vx5,vx6}

vx7{vx1,vx2,vx3,vx4,vx5,vx6}

LPO4: nie je DAG

vy5,vy6,vy2

STU FEI