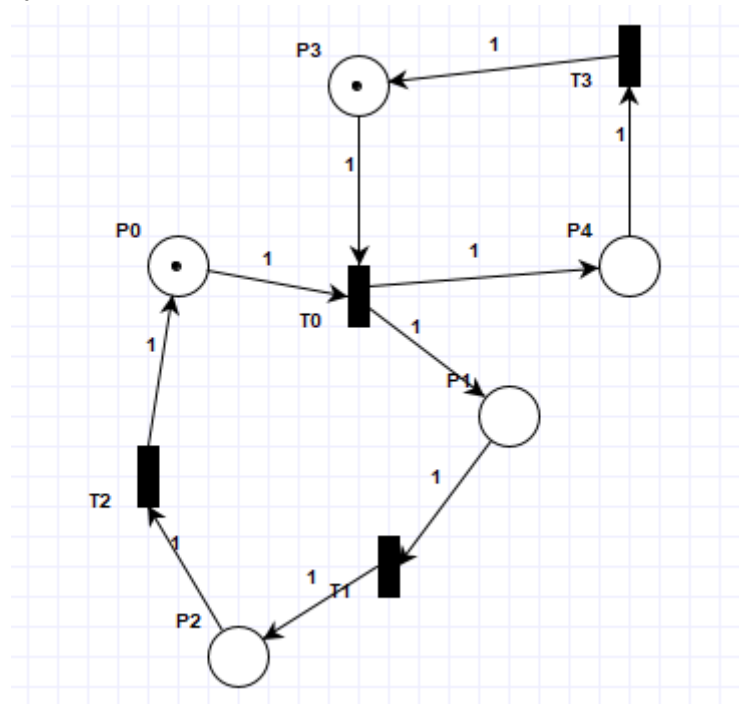


Zad.1.

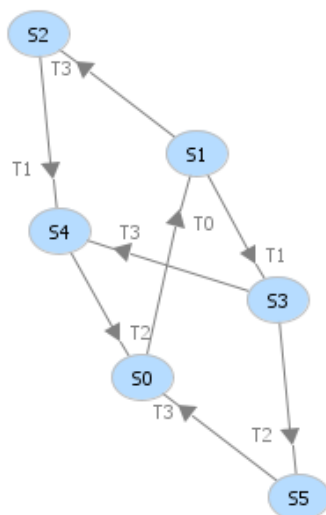
Przykładowa maszyna stanów:



### Petri net state space analysis results

Bounded	true
Safe	true
Deadlock	false

### Petri net invariant analysis results



#### T-Invariants

T0	T1	T2	T3
1	1	1	1

The net is covered by positive T-Invariants, therefore it might be bounded and live.

#### P-Invariants

P0	P1	P2	P3	P4
1	1	1	0	0
0	0	0	1	1

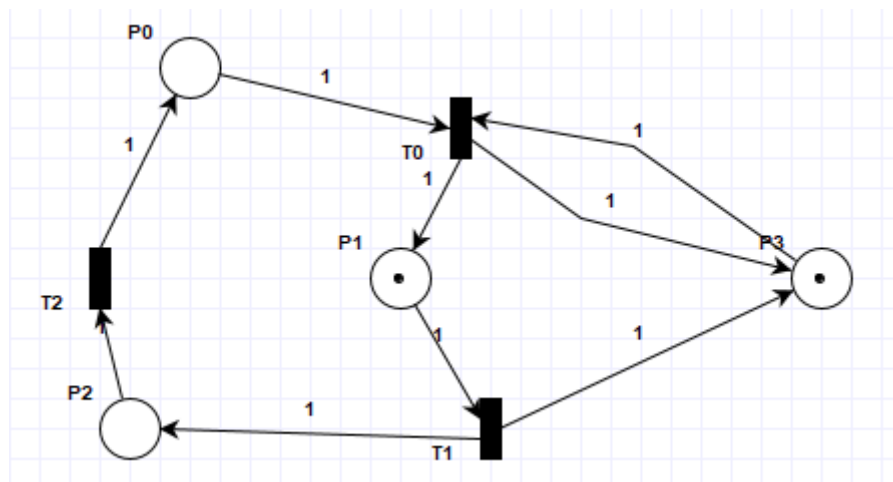
The net is covered by positive P-Invariants, therefore it is bounded.

#### P-Invariant equations

$$M(P0) + M(P1) + M(P2) = 1$$

$$M(P3) + M(P4) = 1$$

Zad.2.



### Petri net invariant analysis results

#### T-Invariants

T0	T1	T2
1	1	1

The net is not covered by positive T-Invariants, therefore we do not know if it is bounded and live.

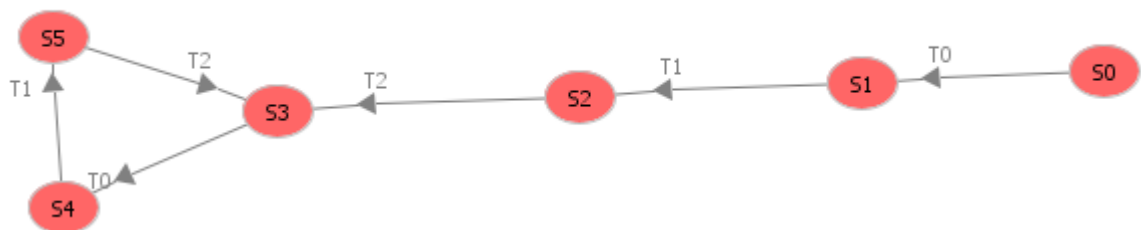
#### P-Invariants

P0	P1	P2	P3
1	1	1	0

The net is not covered by positive P-Invariants, therefore we do not know if it is bounded.

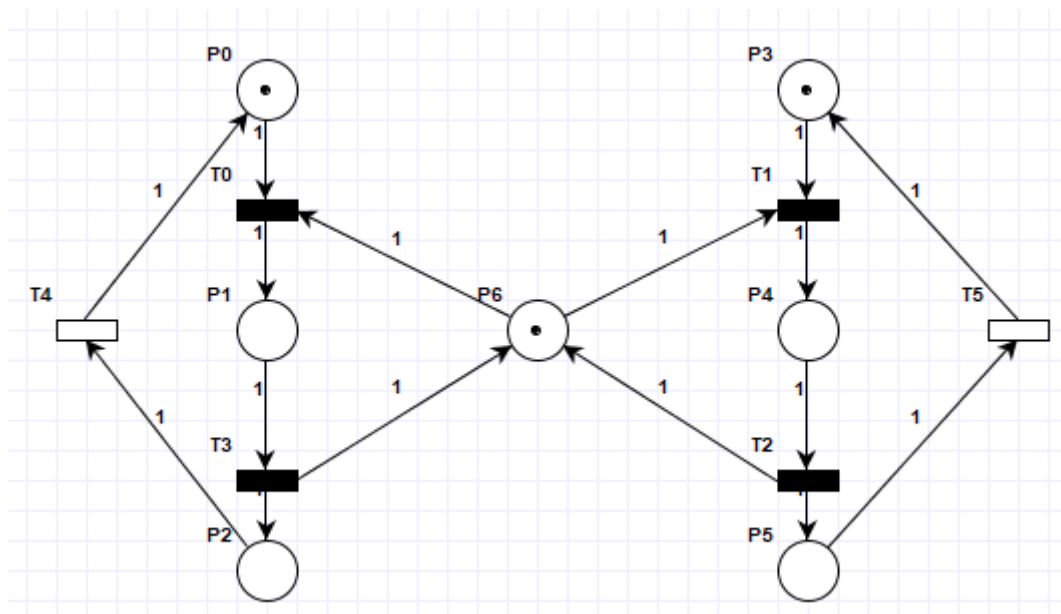
#### P-Invariant equations

$$M(P0) + M(P1) + M(P2) = 1$$



- Odwracalność: w P3 kumulują się znaczniki, nie ma sposobu na zmniejszenie ich, więc sieć nie jest odwracalna.
- Żywotność: graf osiągalności zawiera cykl ze wszystkimi tranzycjami, więc sieć jest żywa.
- Ograniczoność: nie jest ograniczona, bo w P3 przybywa znaczników.

Zad.3.



P6 - wspólny zasób, dwa procesy to odpowiednio lewa i prawa strona.

### Petri net invariant analysis results

#### T-Invariants

T0	T1	T2	T3	T4	T5
0	1	1	0	0	1
1	0	0	1	1	0

The net is covered by positive T-Invariants, therefore it might be bounded and live.

#### P-Invariants

P0	P1	P2	P3	P4	P5	P6
1	1	1	0	0	0	0
0	0	0	1	1	1	0
0	1	0	0	1	0	1

The net is covered by positive P-Invariants, therefore it is bounded.

#### P-Invariant equations

$$M(P0) + M(P1) + M(P2) = 1$$

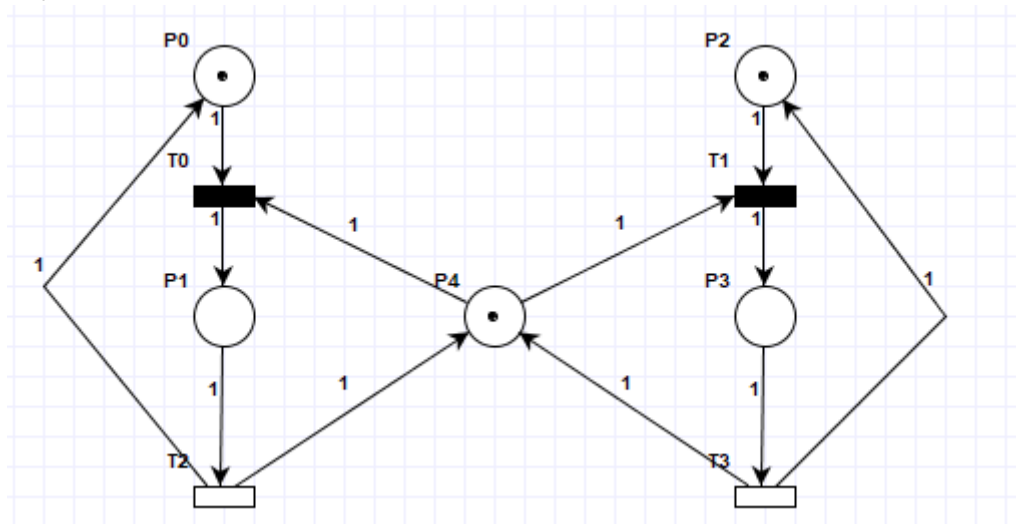
$$M(P3) + M(P4) + M(P5) = 1$$

$$M(P1) + M(P4) + M(P6) = 1$$

- Pierwsze równanie pokazuje przebieg działania pierwszego programu (w którym jest stanie)
- Drugie równanie pokazuje przebieg działania drugiego programu
- Trzecie równanie pokazuje działanie ochrony sekcji krytycznej, zasób posiada pierwszy proces, bądź drugi, bądź jest wolny.

Zad3b.

Inna wersja:



### Petri net invariant analysis results

#### T-Invariants

T0	T1	T2	T3
1	0	1	0
0	1	0	1

The net is covered by positive T-Invariants, therefore it might be bounded and live.

#### P-Invariants

P0	P1	P2	P3	P4
1	1	0	0	0
0	0	1	1	0
0	1	0	1	1

The net is covered by positive P-Invariants, therefore it is bounded.

#### P-Invariant equations

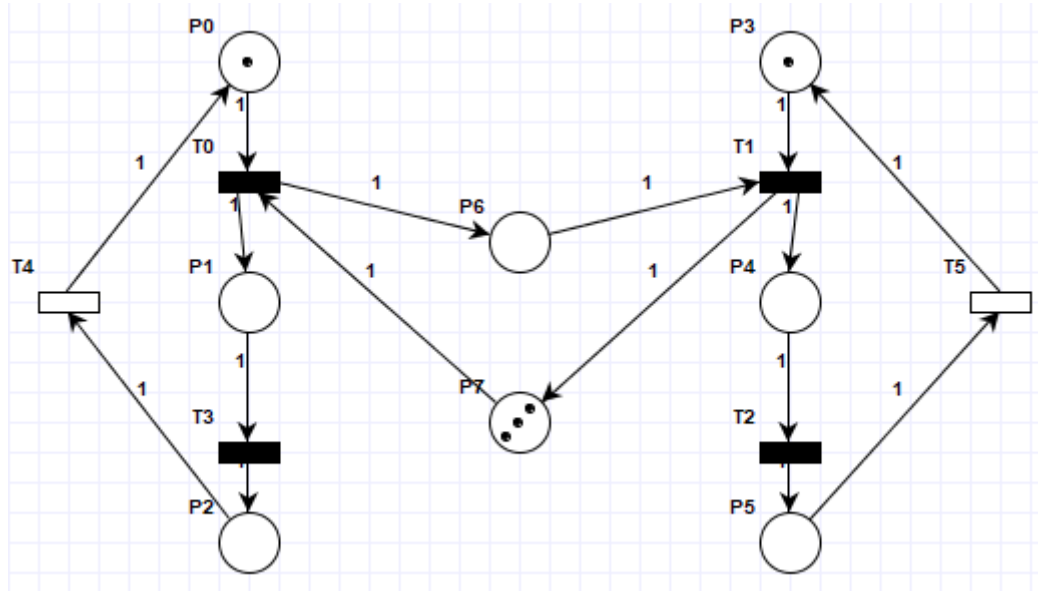
$$M(P0) + M(P1) = 1$$

$$M(P2) + M(P3) = 1$$

$$M(P1) + M(P3) + M(P4) = 1$$

Zad.4.

Producent-konsument z ograniczonym buforem(3).



### Petri net invariant analysis results

#### T-Invariants

T0	T1	T2	T3	T4	T5
1	1	1	1	1	1

The net is covered by positive T-Invariants, therefore it might be bounded and live.

#### P-Invariants

P0	P1	P2	P3	P4	P5	P6	P7
1	1	1	0	0	0	0	0
0	0	0	1	1	1	0	0
0	0	0	0	0	0	1	1

The net is covered by positive P-Invariants, therefore it is bounded.

#### P-Invariant equations

$$M(P0) + M(P1) + M(P2) = 1$$

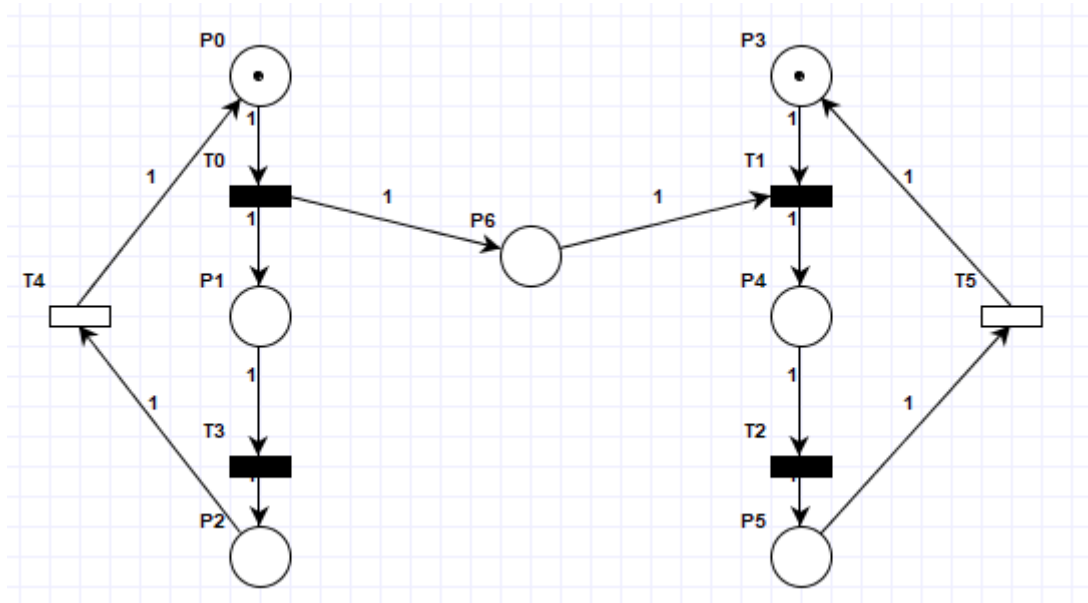
$$M(P3) + M(P4) + M(P5) = 1$$

$$M(P6) + M(P7) = 3$$

- Sieć jest zachowawcza, znaczniki powracają do tej samej liczby.
- Trzecie równanie mówi o rozmiarze bufora.

## Zad.5.

Producent-konsument z nieograniczonym buforem.



### Petri net invariant analysis results

#### T-Invariants

T0	T1	T2	T3	T4	T5
1	1	1	1	1	1

The net is covered by positive T-Invariants, therefore it might be bounded and live.

#### P-Invariants

P0	P1	P2	P3	P4	P5	P6
1	1	1	0	0	0	0
0	0	0	1	1	1	0

The net is not covered by positive P-Invariants, therefore we do not know if it is bounded.

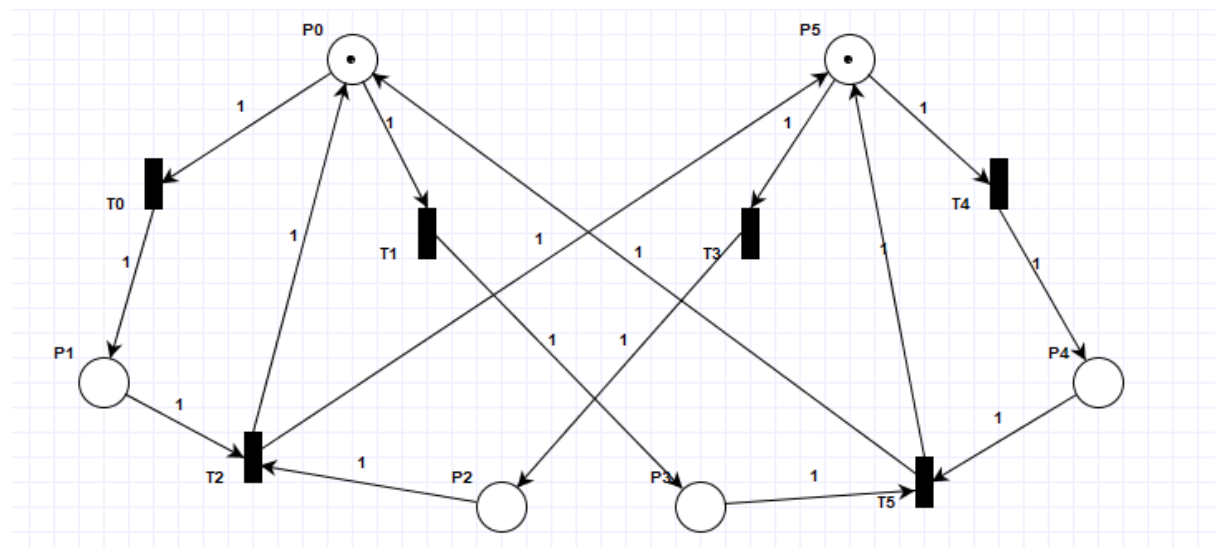
#### P-Invariant equations

$$M(P0) + M(P1) + M(P2) = 1$$

$$M(P3) + M(P4) + M(P5) = 1$$

- Sieć nie jest zachowawcza.
- P6 niepokryte.

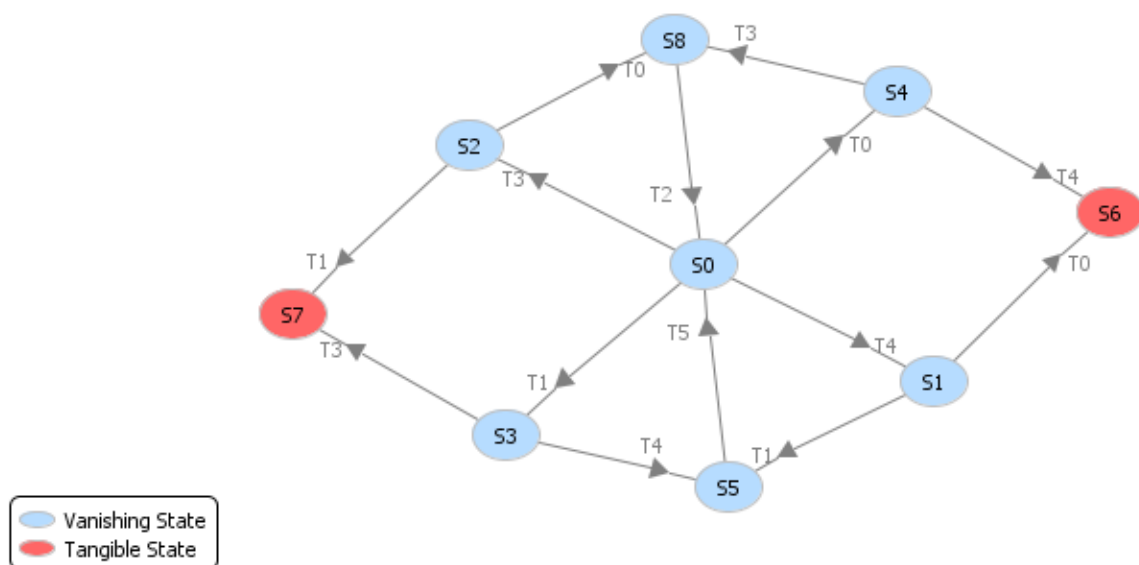
Zad.6.



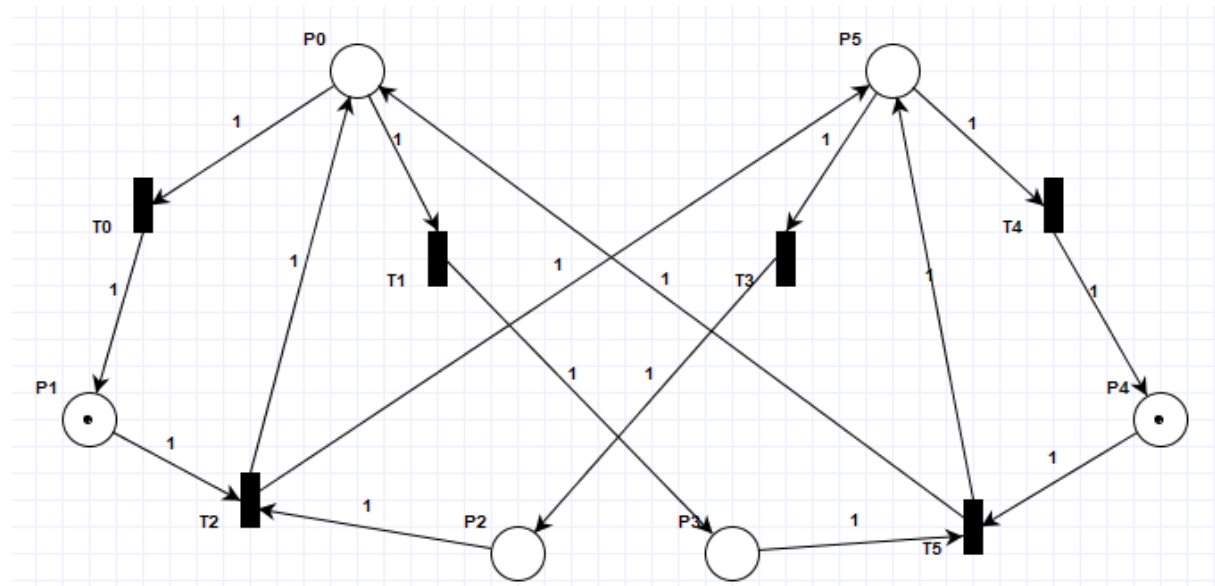
### Petri net state space analysis results

Bounded	true
Safe	true
Deadlock	true

Shortest path to deadlock: T0 T4



Deadlock 1:



Deadlock 2:

