Petri Nets

Petri Nets

- Used to model the functionality or behavior of the system.
- PN is a formal language or graphical language for modeling the systems with concurrency.
- PN is a bi-partite graph.
  - Types of nodes:

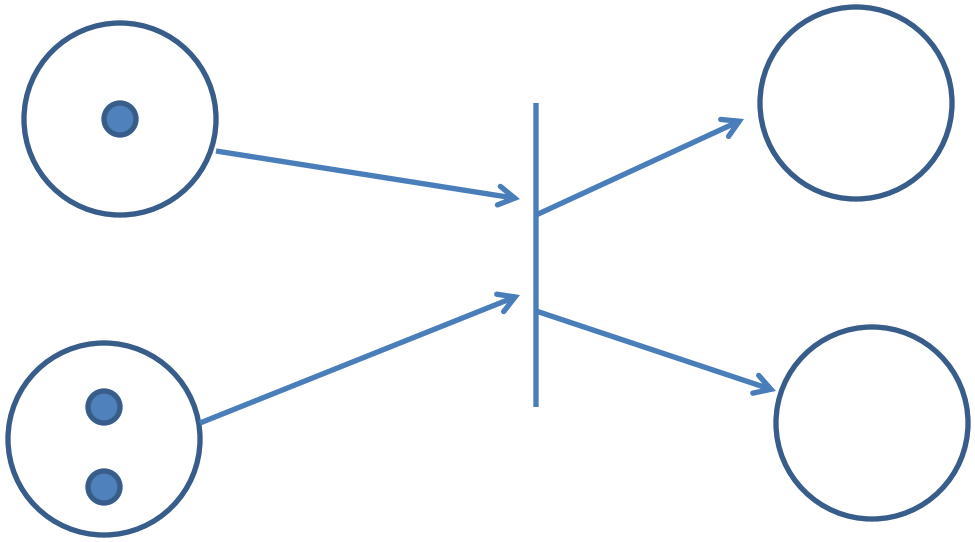
    PLACE (or Condition) that holds something (example, tokens)

    Transition that represent essentially some event or activity that occurs
- Tokens are circulated among the places

Petri Nets

- Places and Transitions are connected by a directed arcs.
- Arc only exist between Transition and Place, and vice-versa.

Petri Nets



Token

Transition

Output places

Input Places

Petri Nets

- Transition is triggered only when at least one token is present in all input places.

- Once fired, one token is removed from all input places and added to all of its output places.

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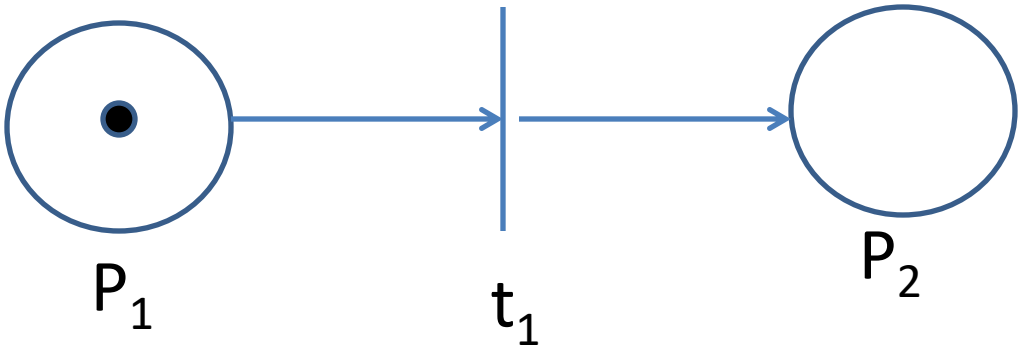
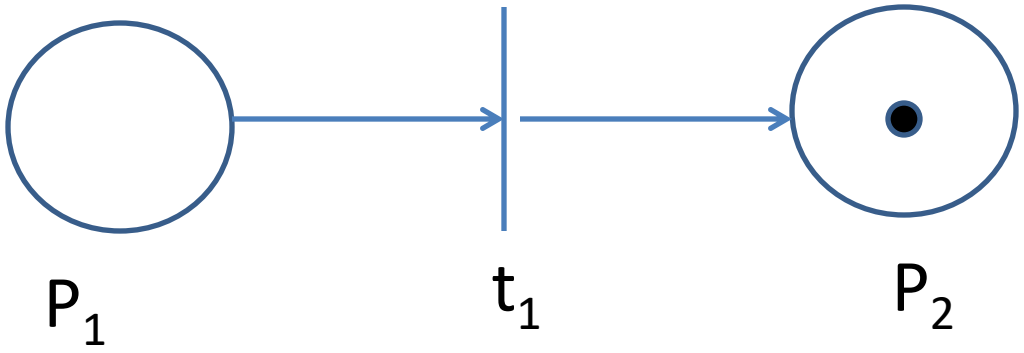
- Input places as Pre-condition and Output places as Post-condition.

Before firing t_1



After firing t1



Petri Nets

- Formally, PN = (P, T, I, O)

  $P = \{ P_1, P_2, \ldots, P_M \}$

  $T = \{ T_1, T_2, \ldots, T_N \}$

  I and **O** are the matrices showing Input places and output places for the transitions.

	T1	T2	T3	T4	T5
P1	1	0	0	0	0
P2	0	1	0	0	0
P3	0	0	1	0	0
P4	0	0		1	0
P5	0	0	0	0	1

Input (I)

- A marking of a PN at time t,

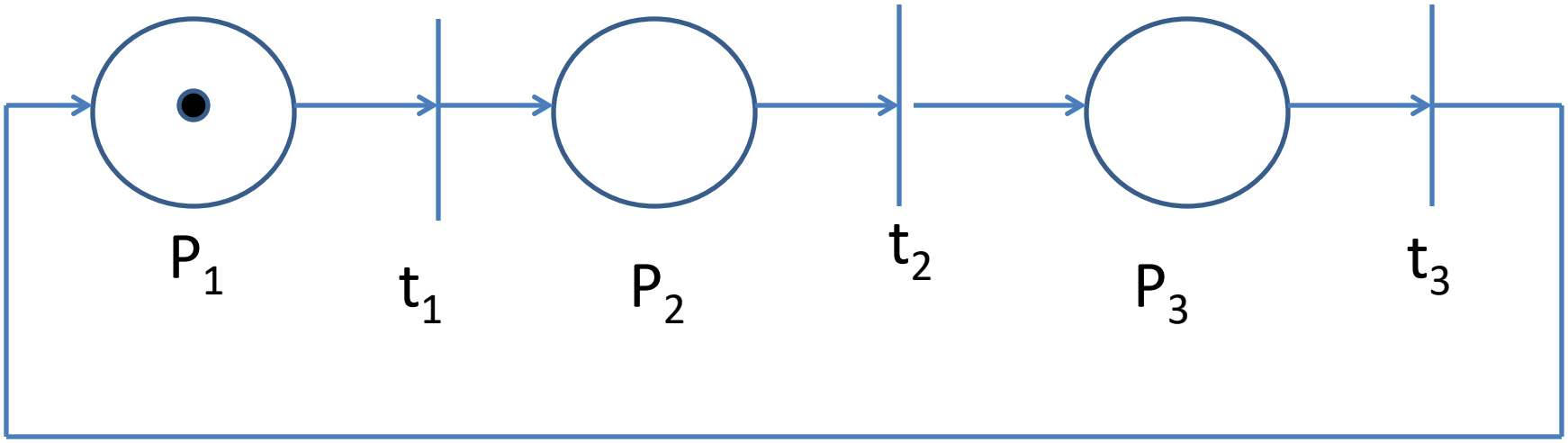
  $M(t) = \{ m_1(t), m_2(t), \ldots, m_M(t) \}$

  $m_i(t)$ is # of tokens in place ***i*** at time ***t***

  $M(t_0)$ is the initial marking of the system

Petri Nets

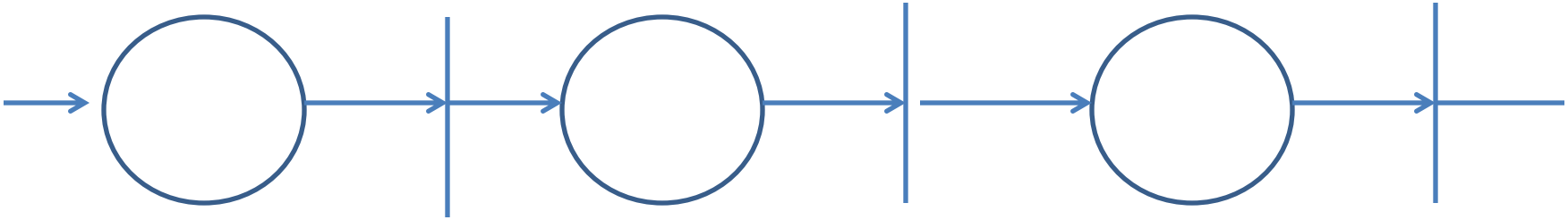
- Example



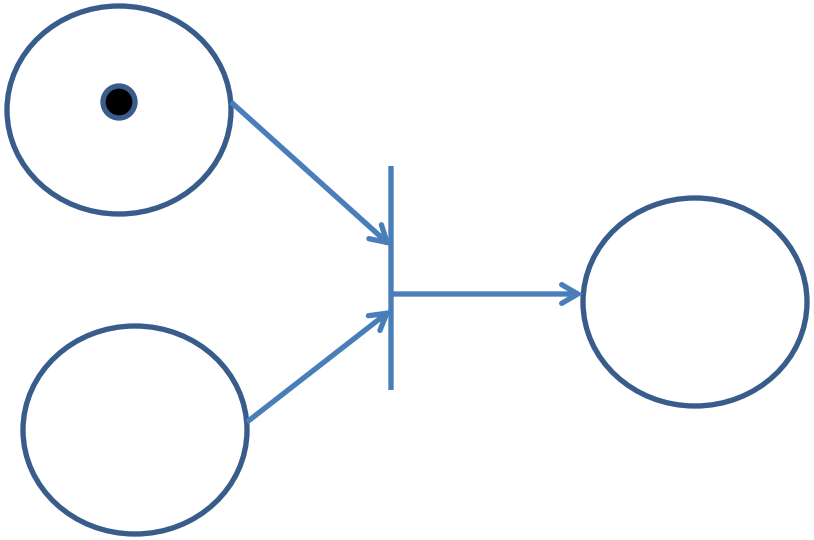
$M(t_0) = (1,0,0)$

Petri Nets

- Sequential Action



- Dependency



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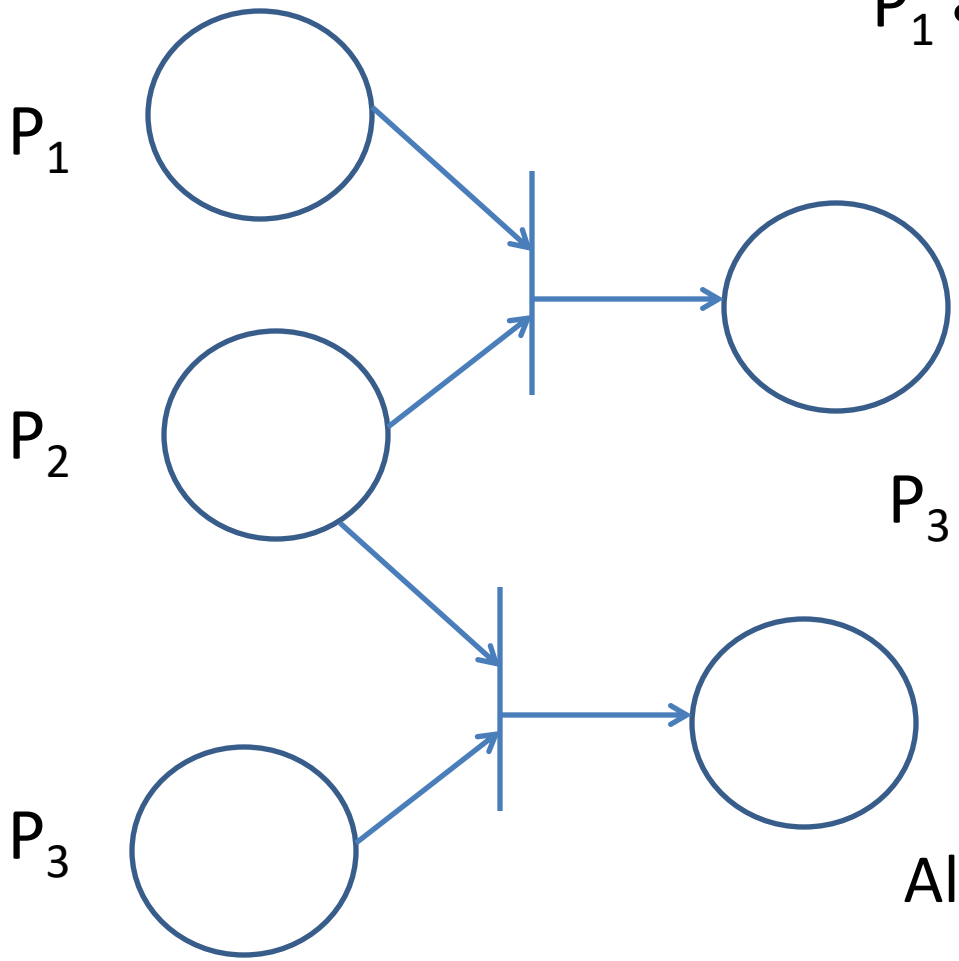
- Conflict



P_1 and P_2 have tokens, but not P_3 then t_1 is fired.

P_3 and P_2 have tokens, but not P_1 then t_2 is fired.

All have tokens, then conflict.

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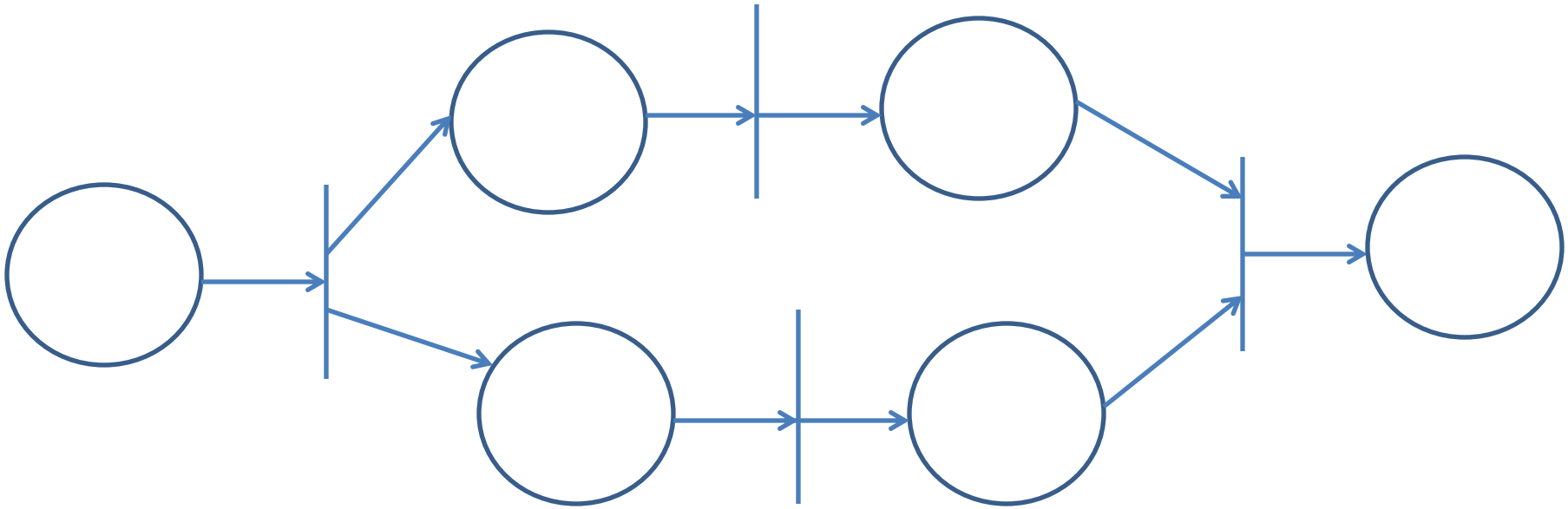
- Concurrency



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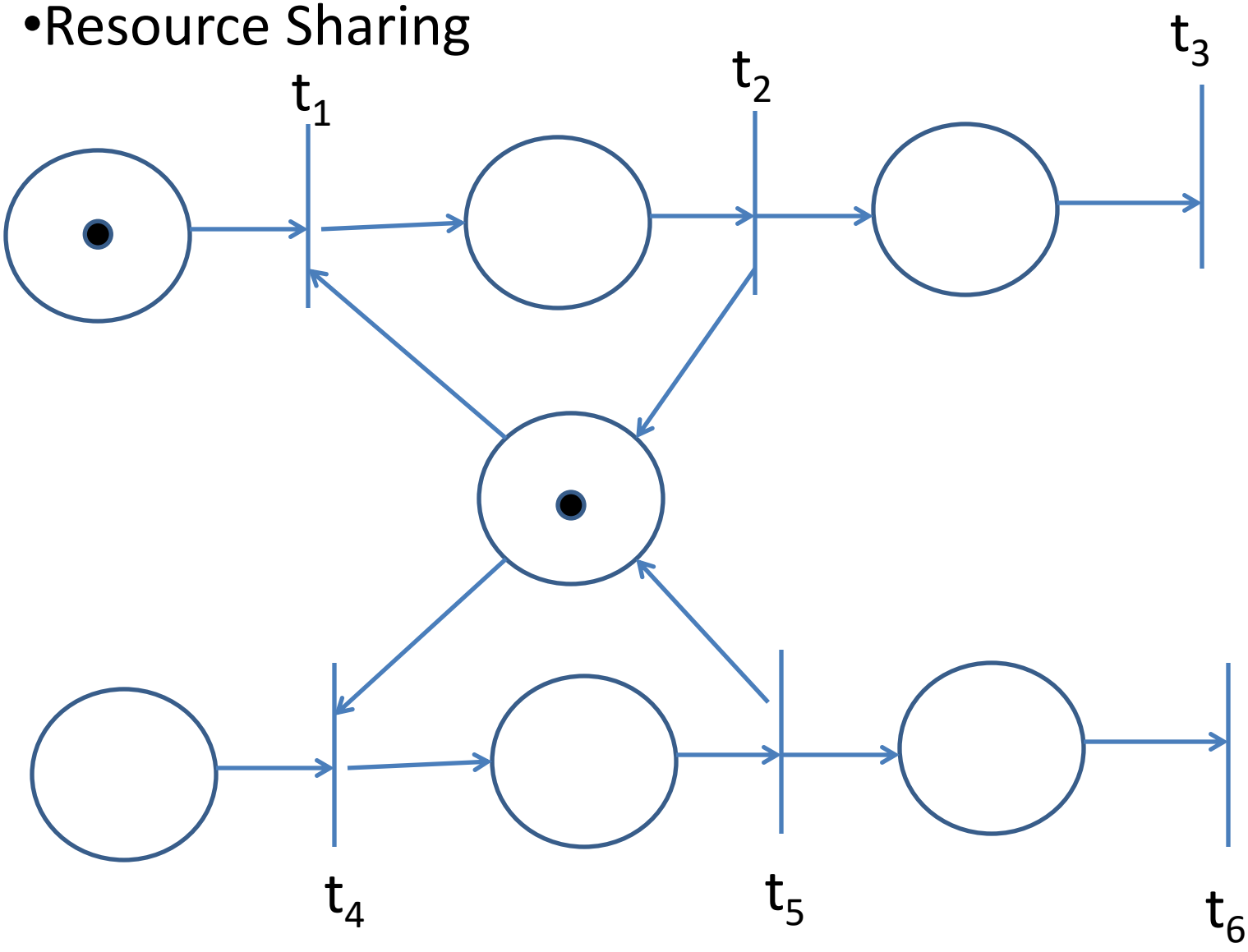
- Resource Sharing



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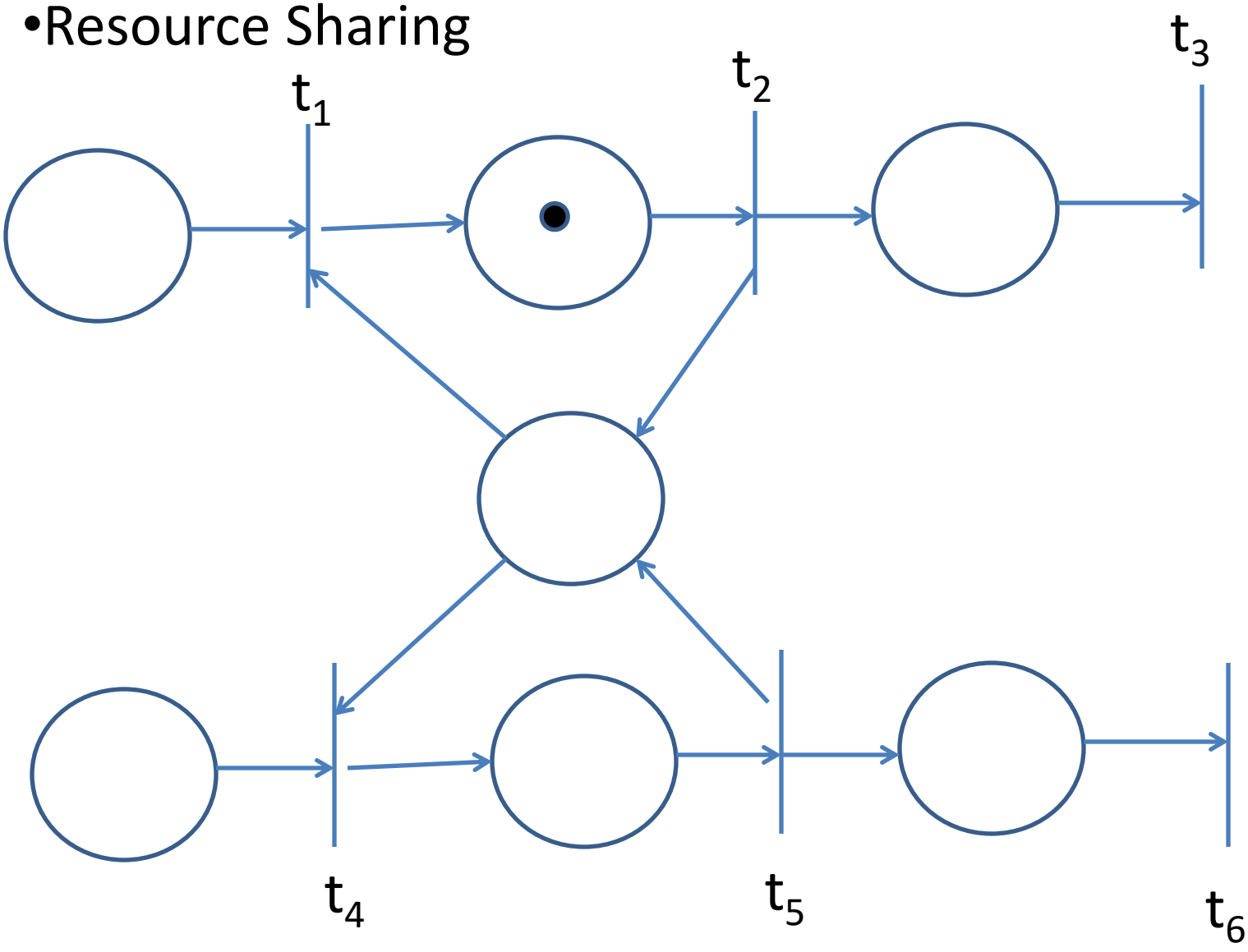

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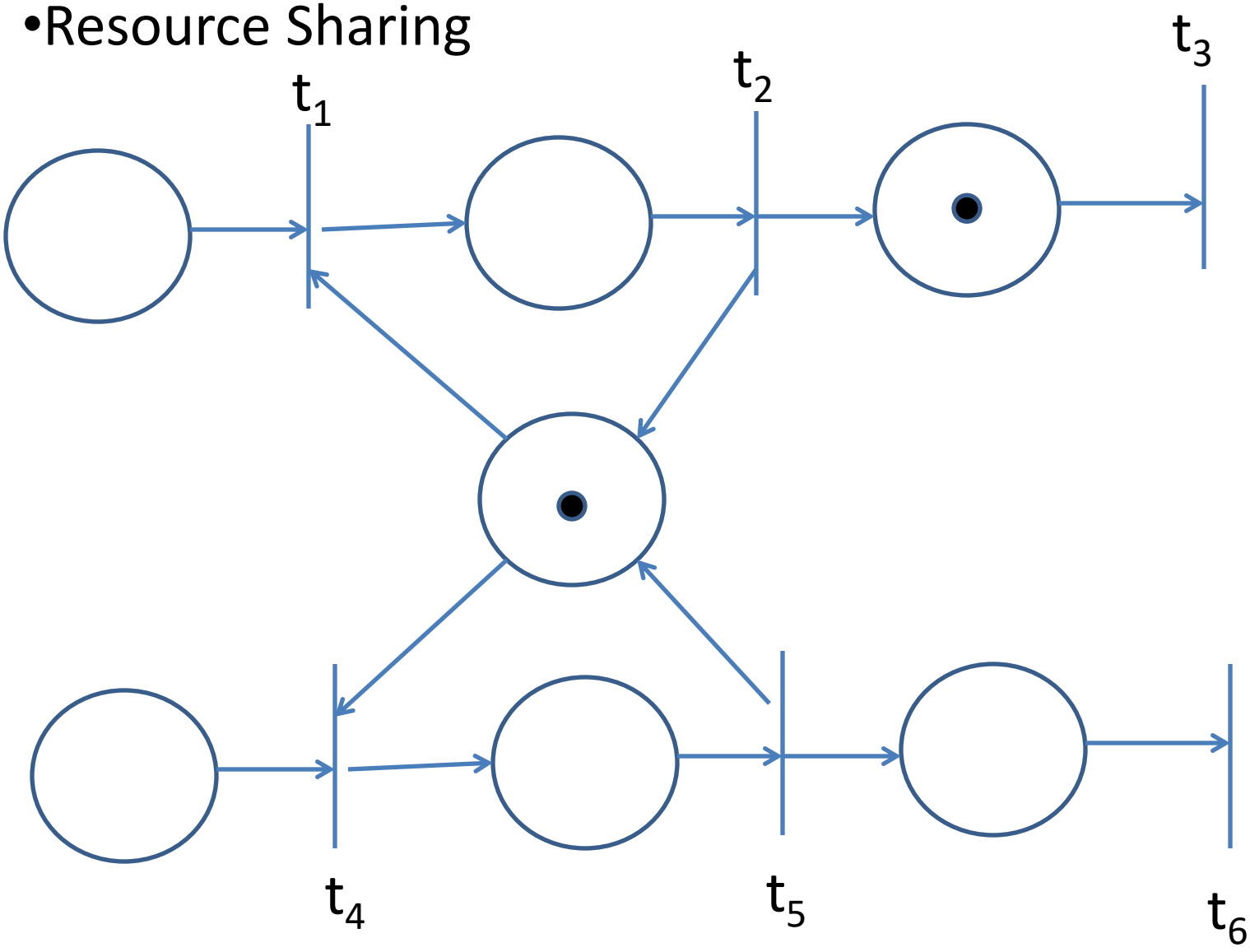

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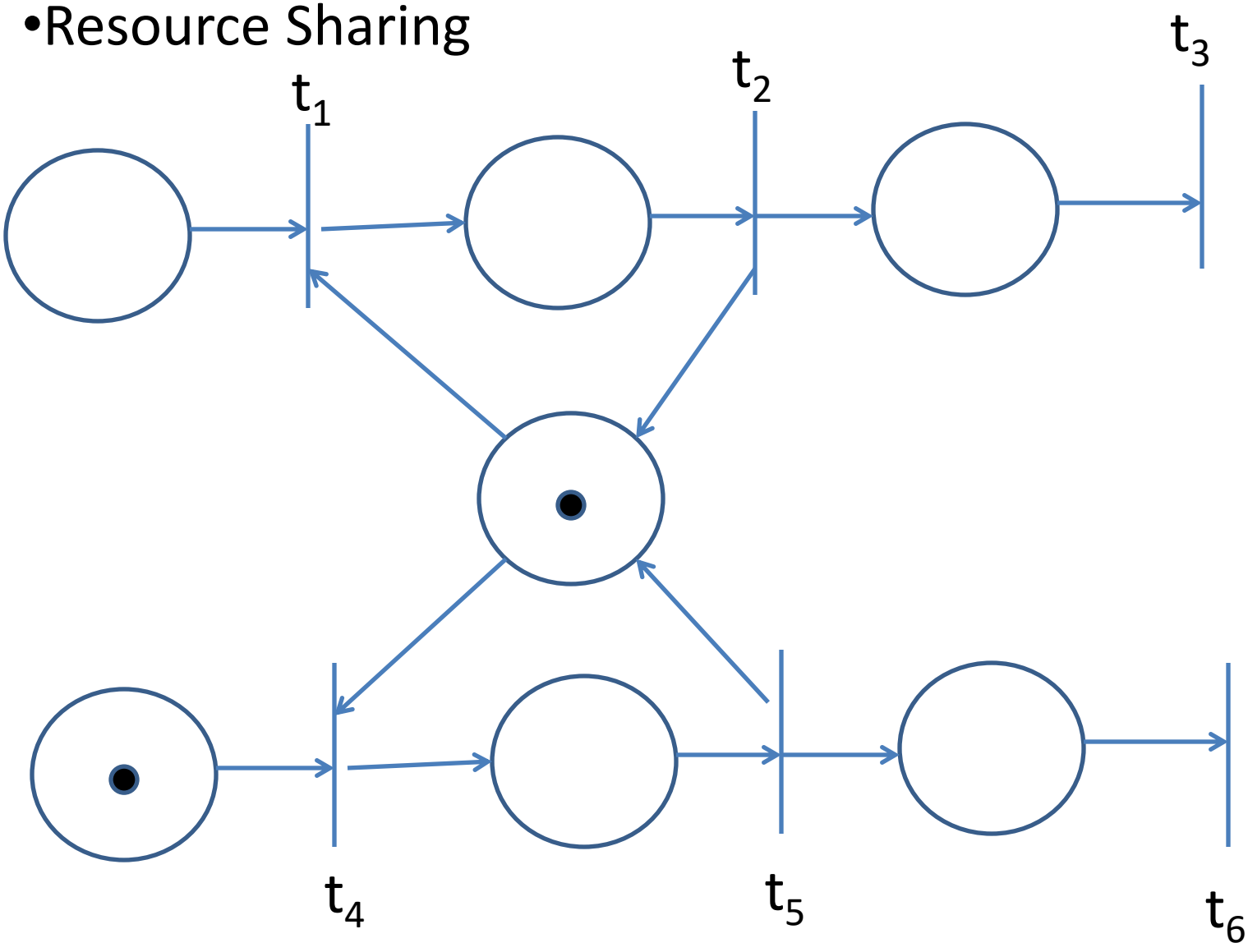
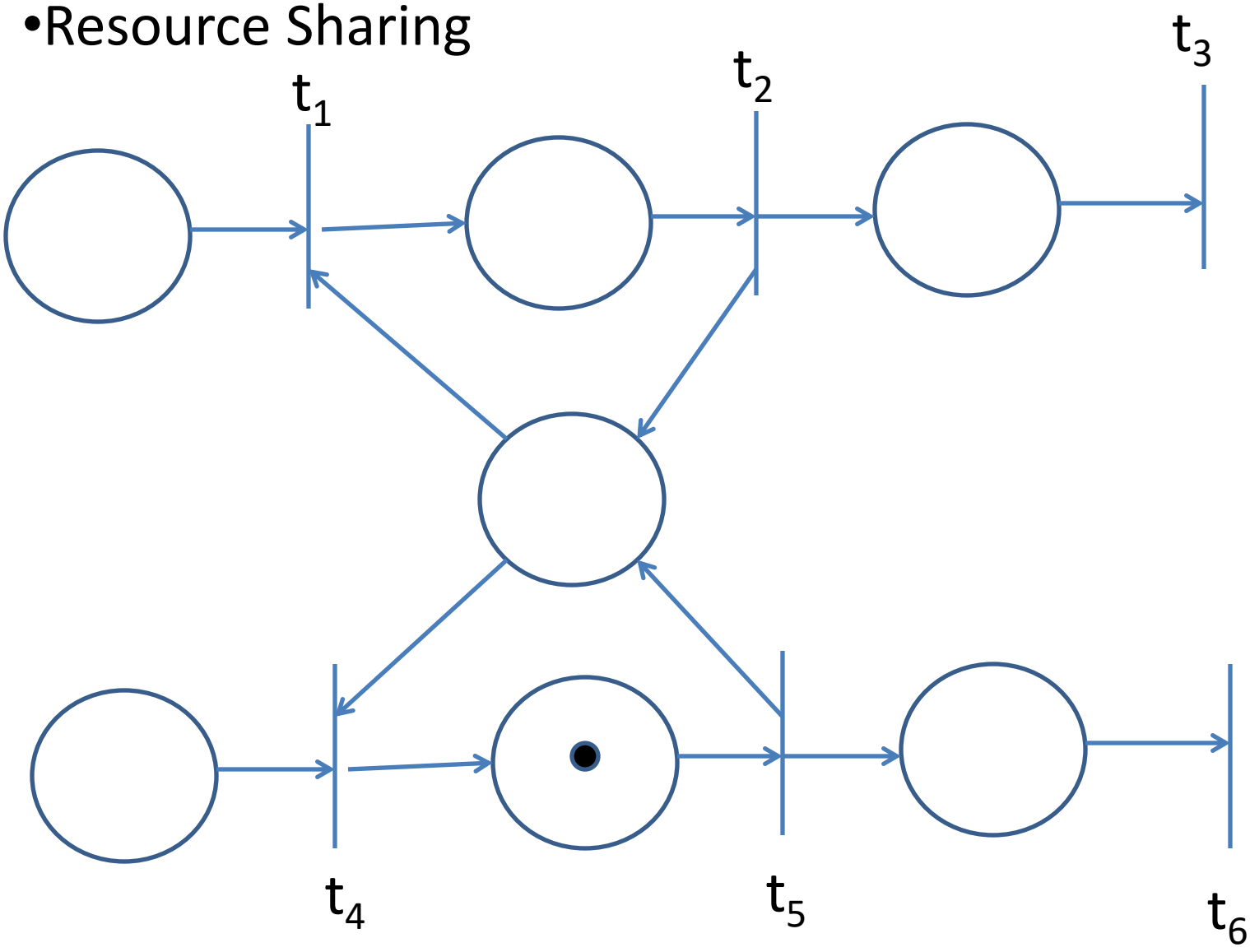


Petri Nets

- Resource Sharing



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- Resource Sharing