Petri Nets: Tutorial and Applications

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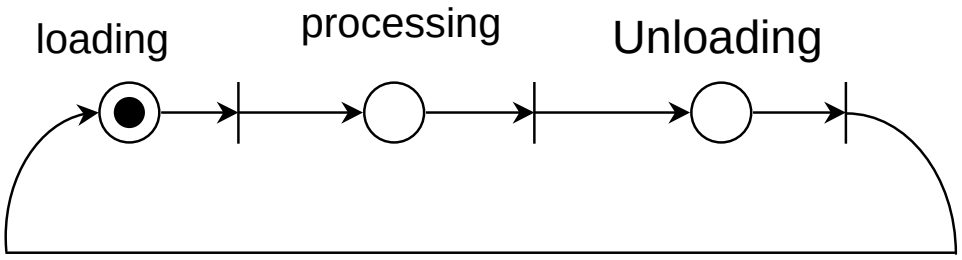
Petri Nets -- Graphic Tool

- A bipartite directed graph containing places (circles), transitions (bars), and directed arcs (places <--> transitions).



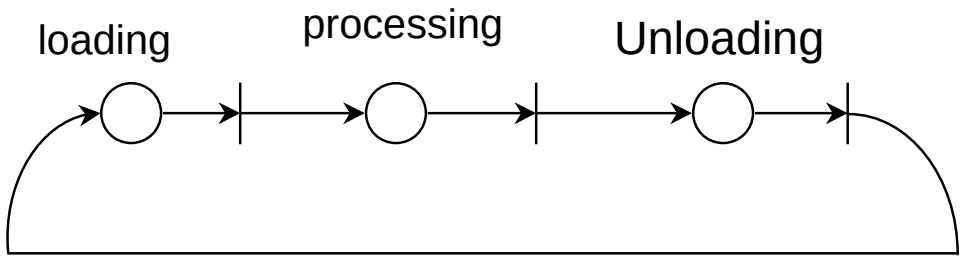
Places -- buffers, locations, states

Transitions -- events, actions

Tokens -- parts

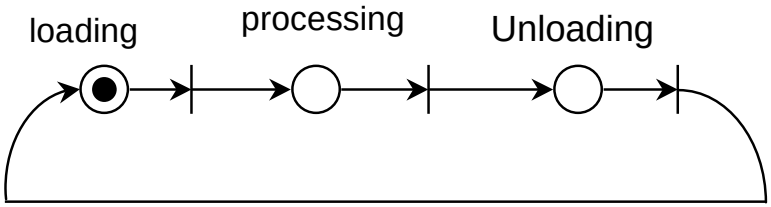
Dynamics

- Enabling Rule:
  - » A transition *t* is enabled if every input place contains at least one token
- Firing Rule:
  - » Firing an enabled transition
    - – removes one token from each input place of the transition
    - – adds one token to each output place of the transition



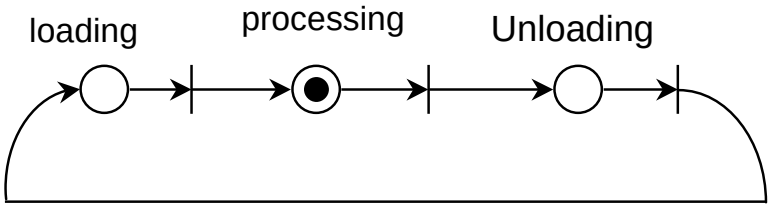
Dynamics

Initial State:



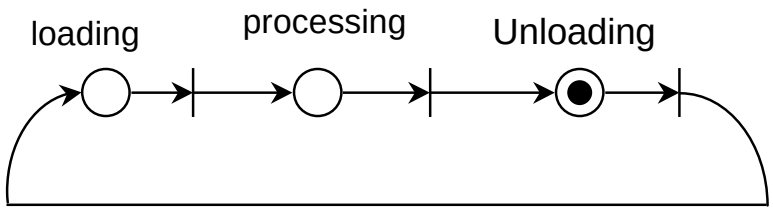
t1

State after t1 is fired:



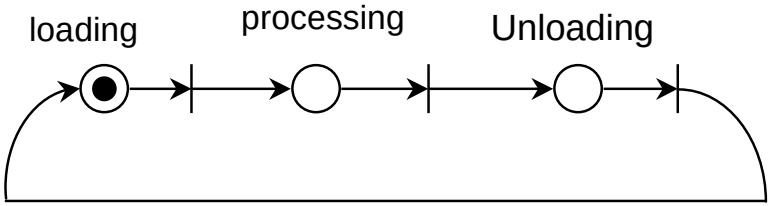
t2

State after t2 is fired:



t3

State after t3 is fired:

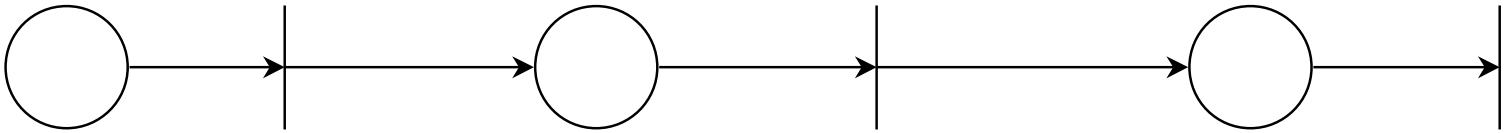


Basic Constructs

- Sequential actions
- Dependency
- Conflict (decision, choice)
- Concurrency
- Cycles
- Synchronization - (mutually exclusive actions, resource sharing, communication, queues)

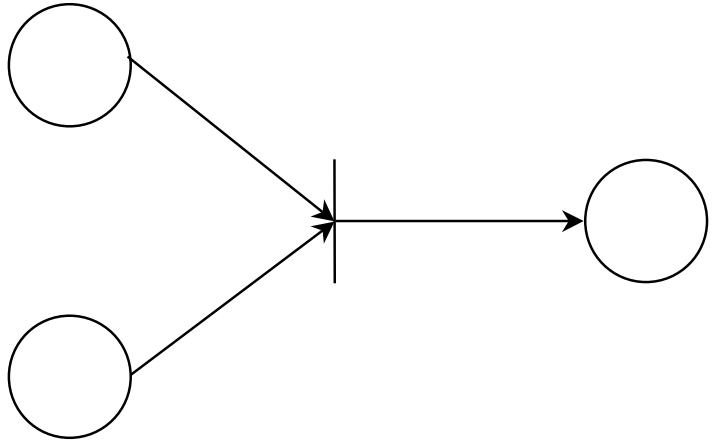
Sequential Actions

Each action is a transition.



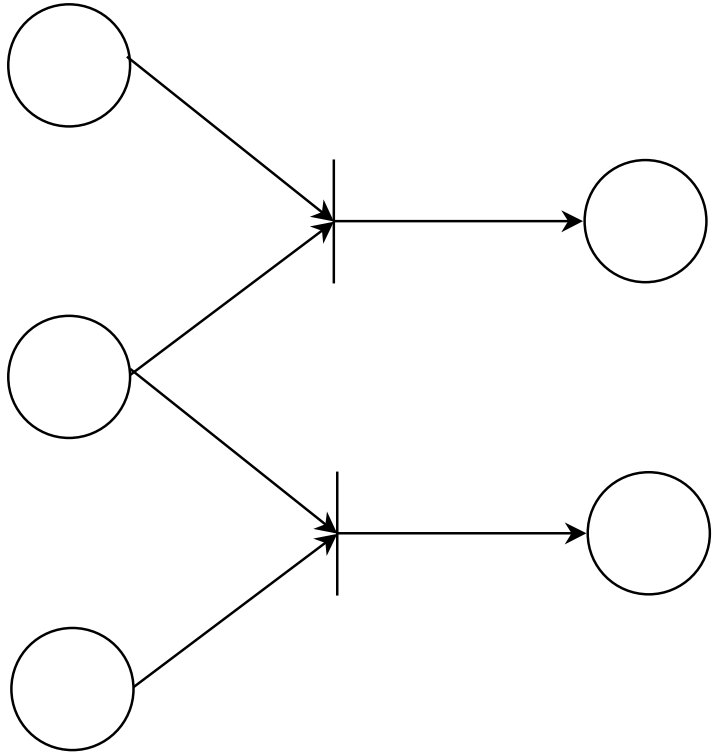
Dependency

A transition requires two inputs.



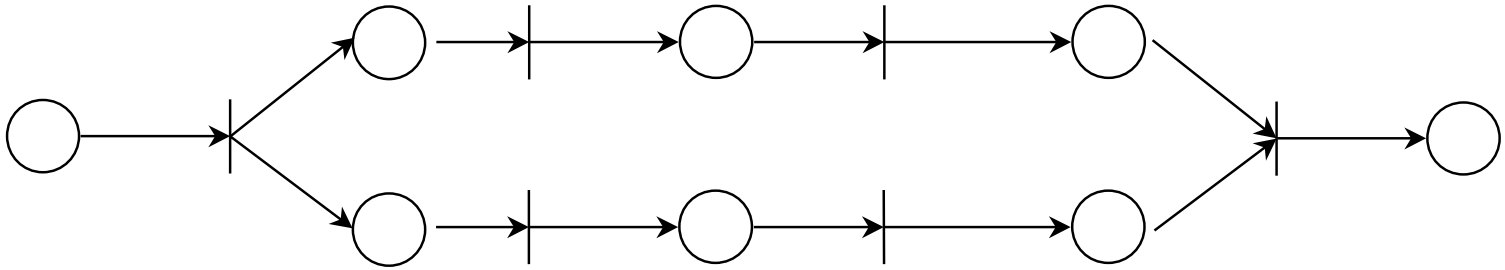
Conflict Construct

Only one of the two transitions can fire.

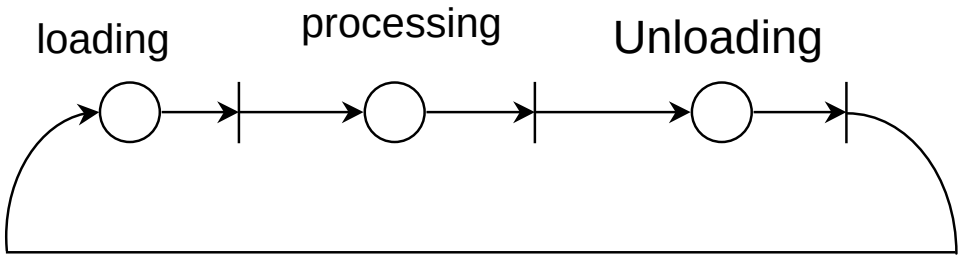


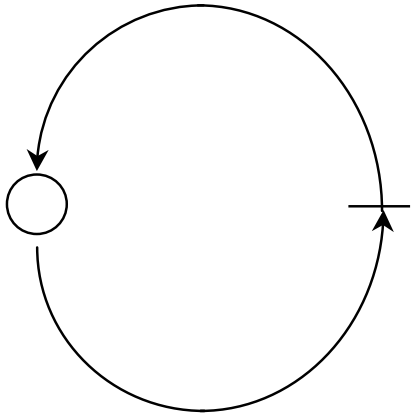
Concurrency Construct

These two sequences can occur simultaneously.



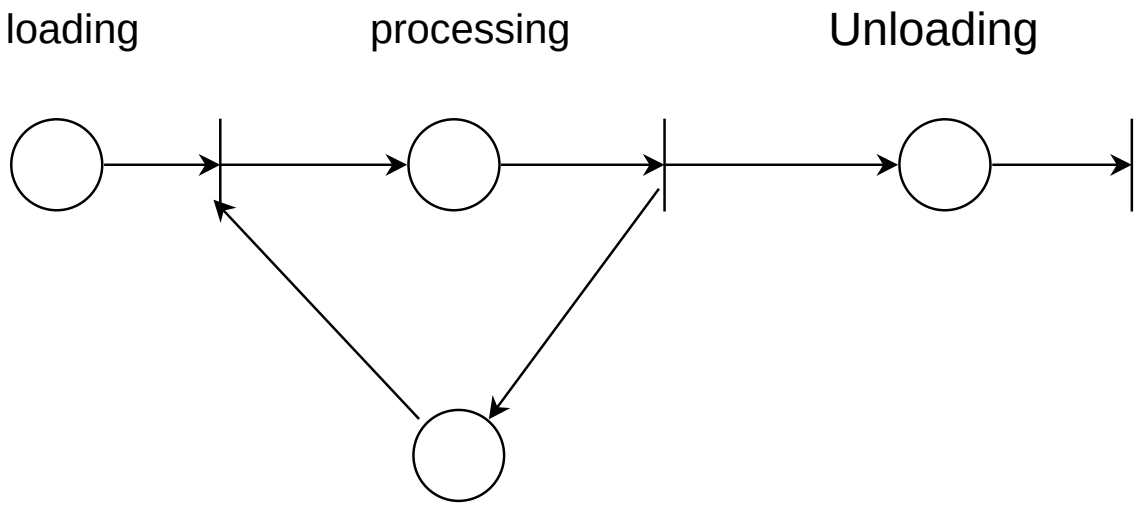
Cycles



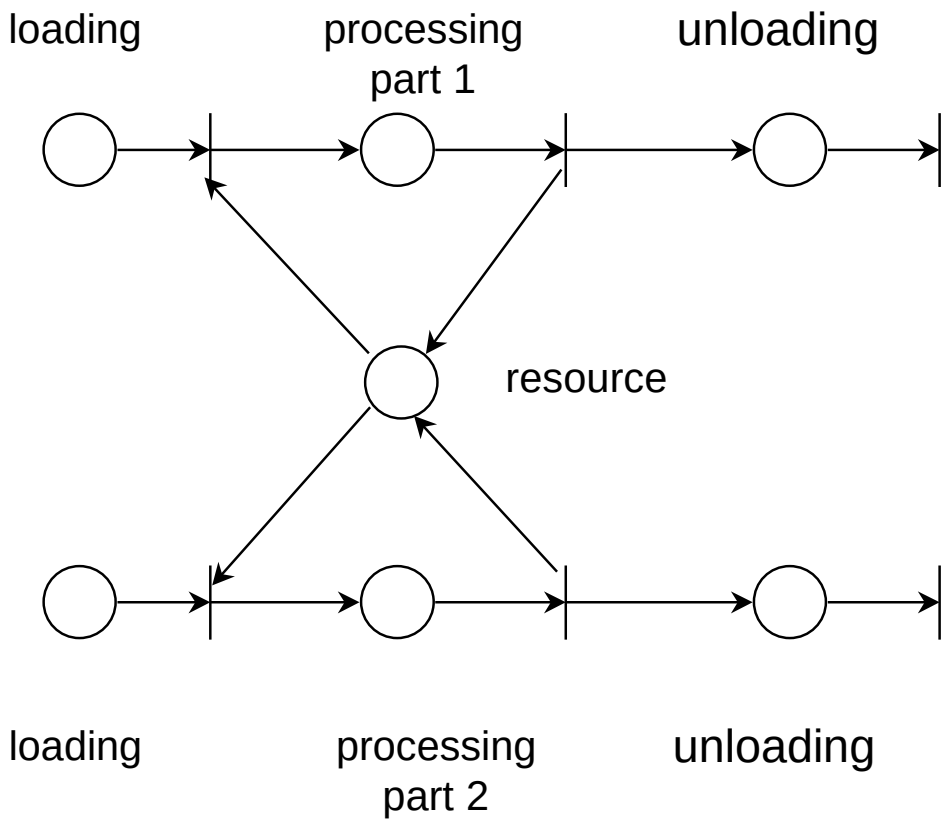


Synchronization

Machine can process one part at once.



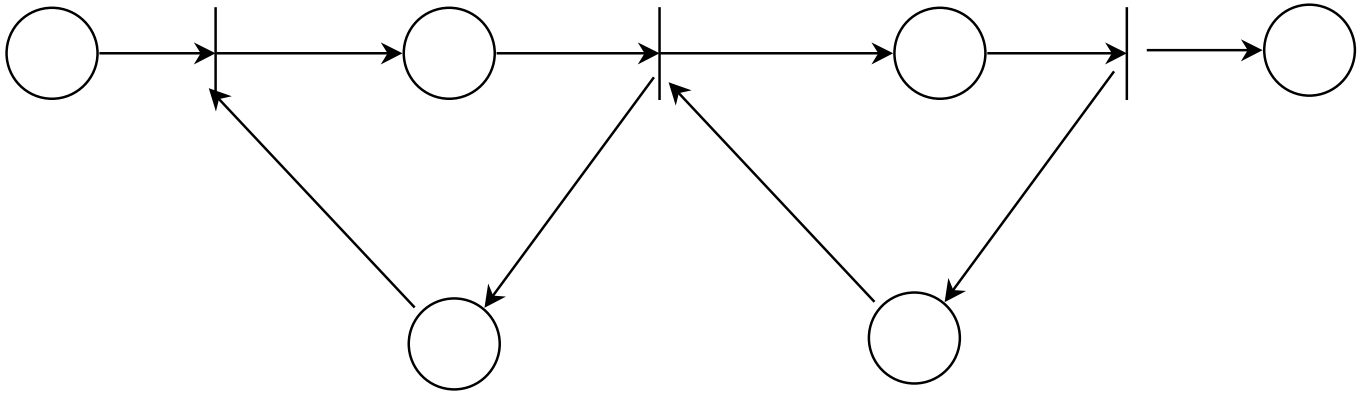
Resource Sharing



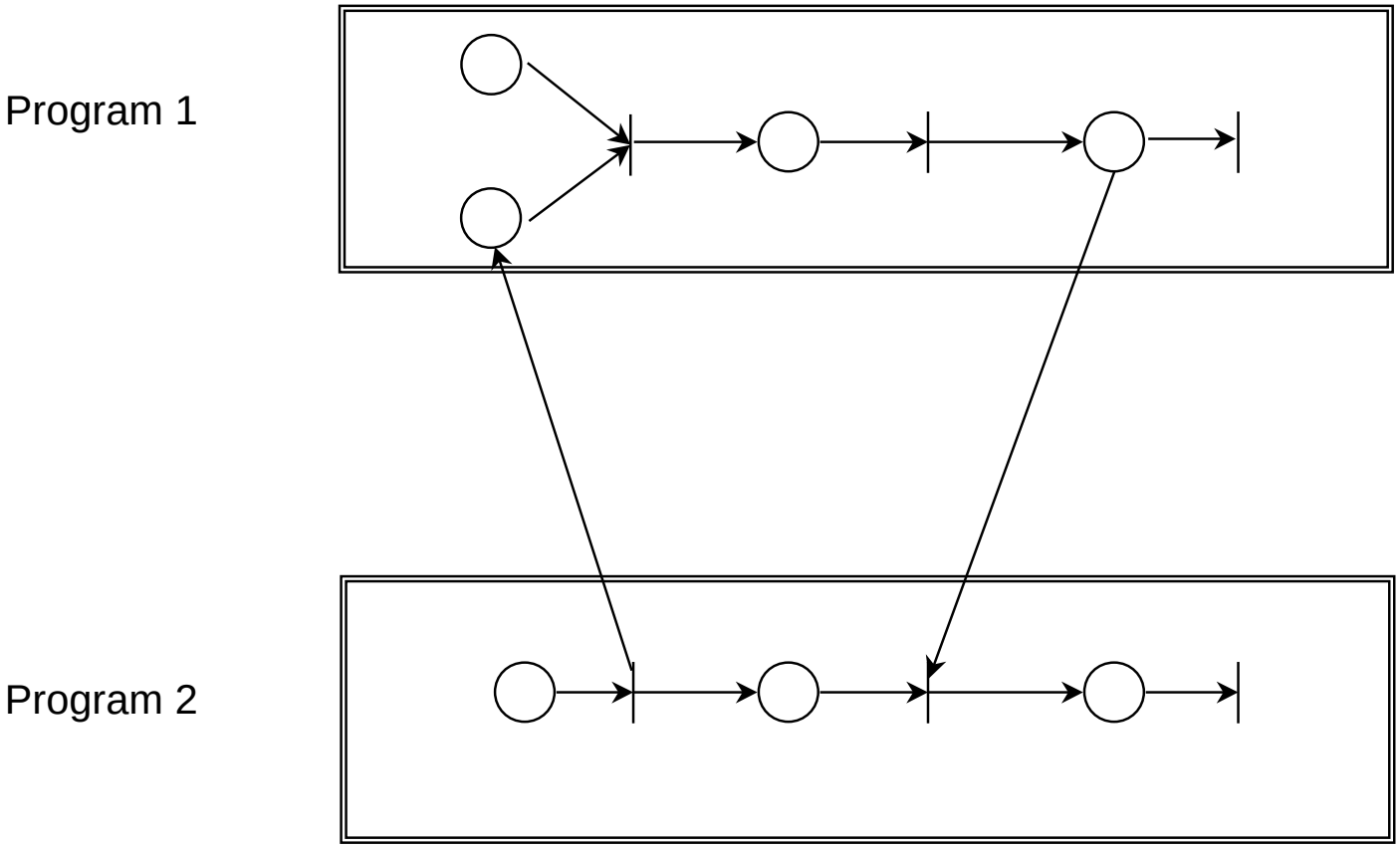
One worker for two machines.
The worker can work at one machine at a time.

Buffer (Queue)

The buffer can hold a limited number of parts.

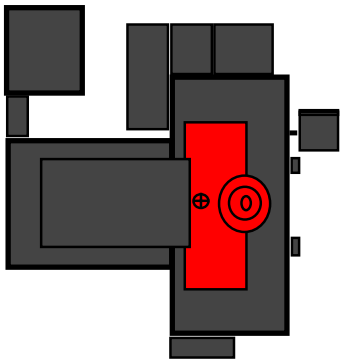


Communication

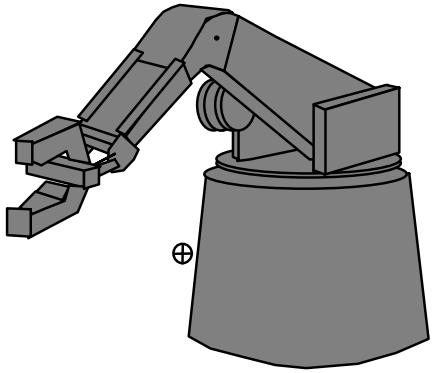


An Example

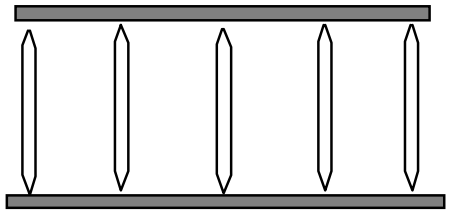
Machine 1



Robot

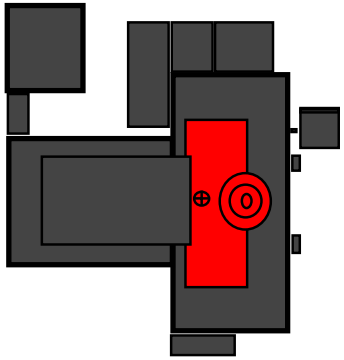


Buffer



Machine States:
Loading
Processing
Waiting for unloading
Unloading

Buffer State:
Space availability



Machine 2

Put It Together