Petri Nets: Tutorial and Applications

Jeffrey W. Herrmann
Edward Lin

November 5, 1997

The 32th Annual Symposium of the Washington Operations Research -
Management Science Council
Washington, D.C.

CIM Lab
Institute for Systems Research
University of Maryland
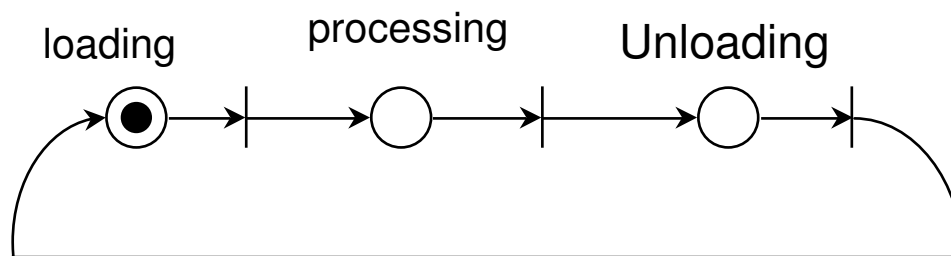College Park, Maryland

Petri Nets -- Graphic Tool

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

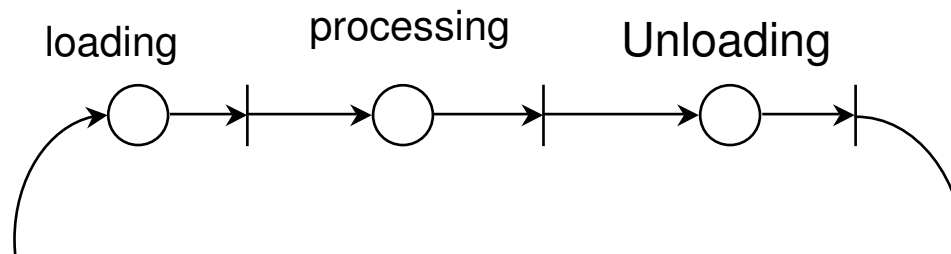loading   processing   Unloading

Places -- buffers, locations, states

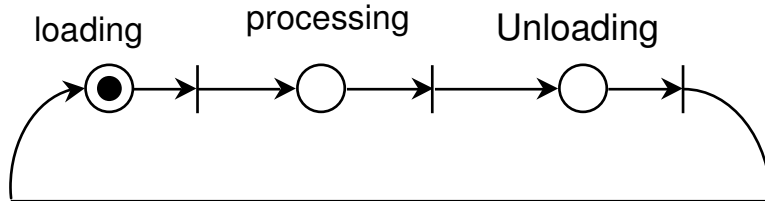Transitions -- events, actions

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
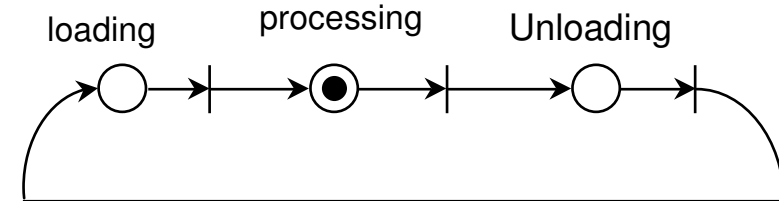   - – adds one token to each output place of the transition

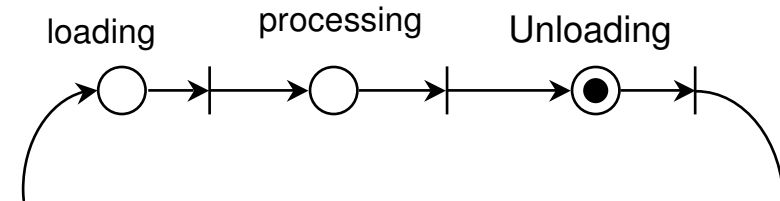loading   processing   Unloading

Dynamics

Initial State:

loading   processing   Unloading

State after t1 is fired:

loading   processing   Unloading

t1 →

↓ t2

State after t3 is fired:

loading   processing   Unloading

State after t2 is fired:

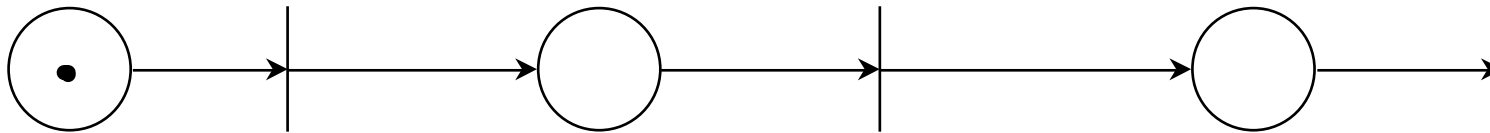loading   processing   Unloading

← t3
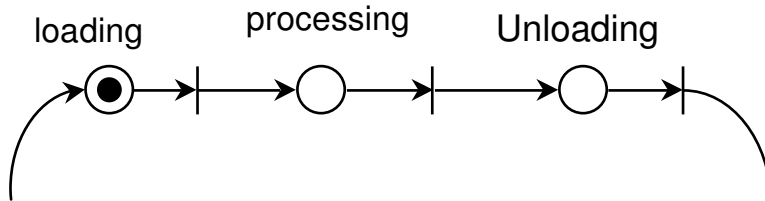
Basic Constructs

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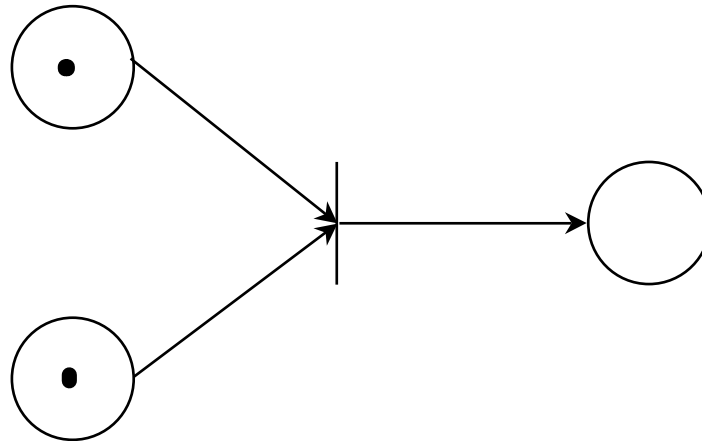- Synchronization - (mutually exclusive actions, resource sharing, communication, queues)

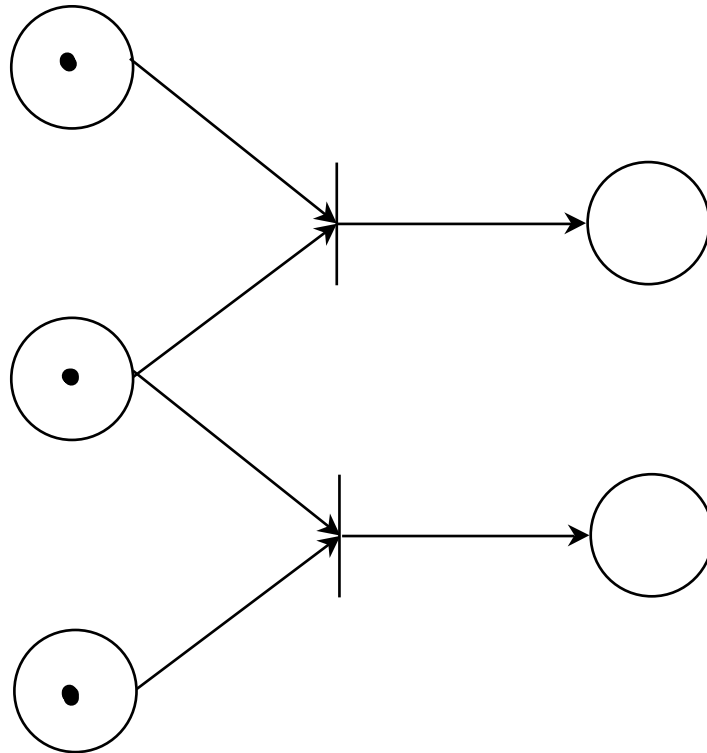# Sequential Actions

Each action is a transition.

Dependency
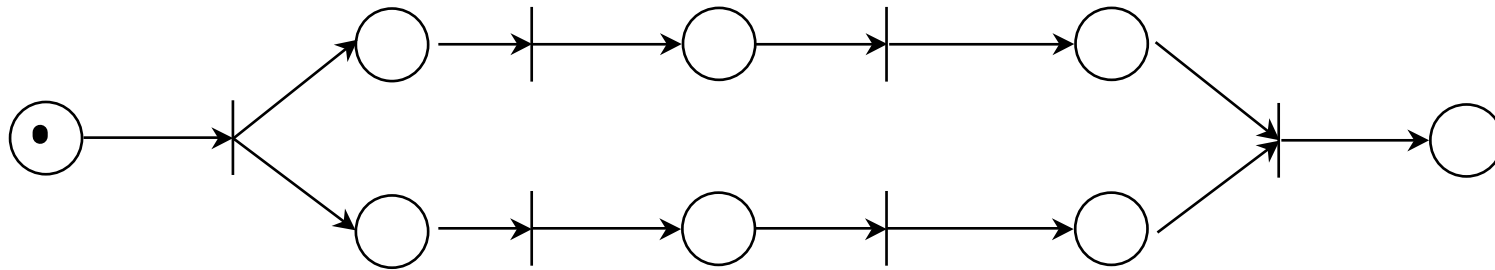
A transition requires two inputs.

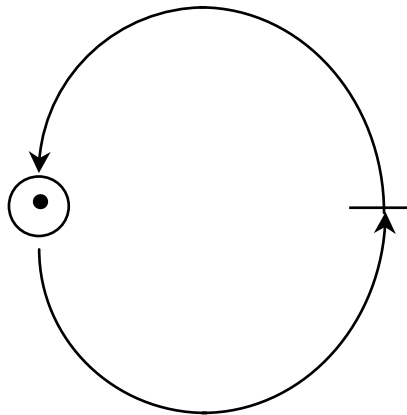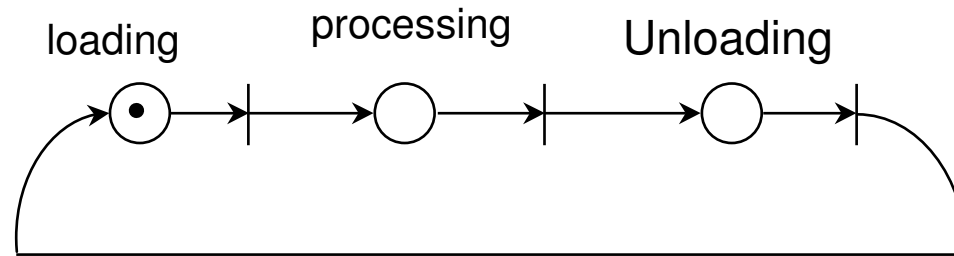Only one of the two transitions can fire.

Concurrency Construct

These two sequences can occur simultaneously.

Cycles

Synchronization

Machine can process one part at once.

loading   processing   Unloading

Resource Sharing

loading   processing part 1   unloading

resource
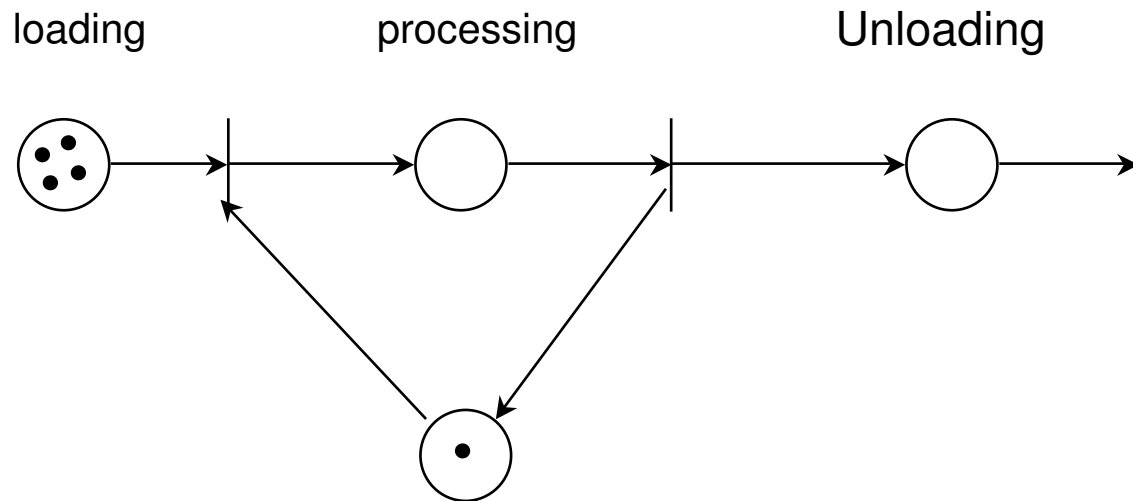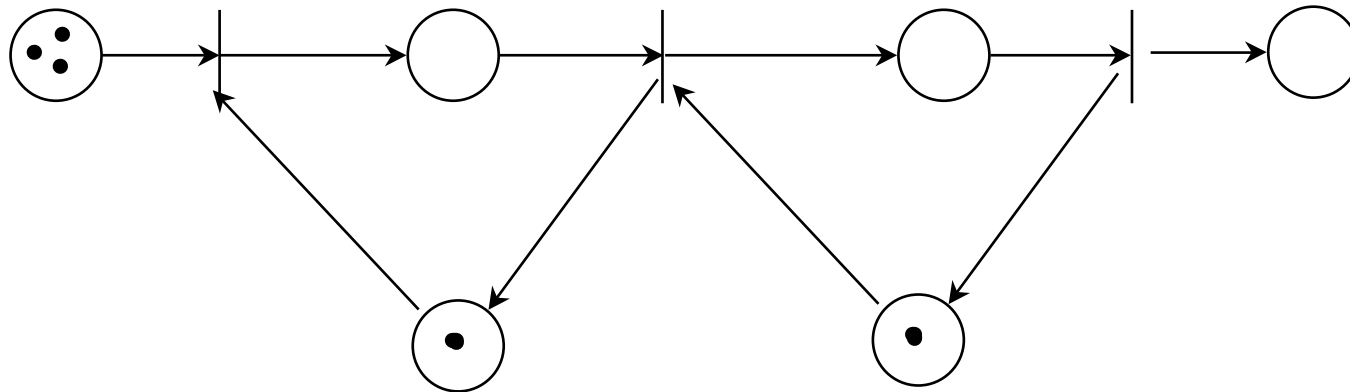
loading   processing part 2   unloading
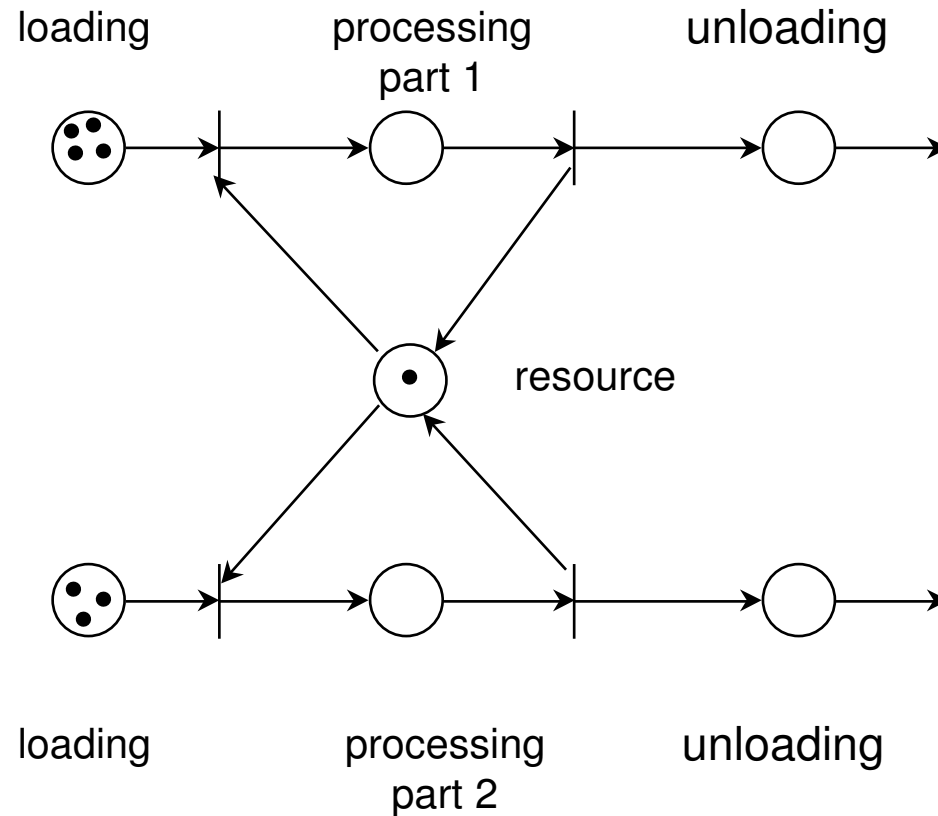
One worker for two machines.
The worker can work at one machine at a time.

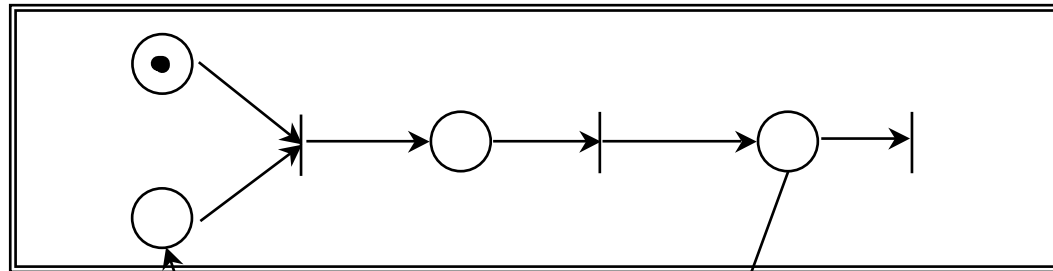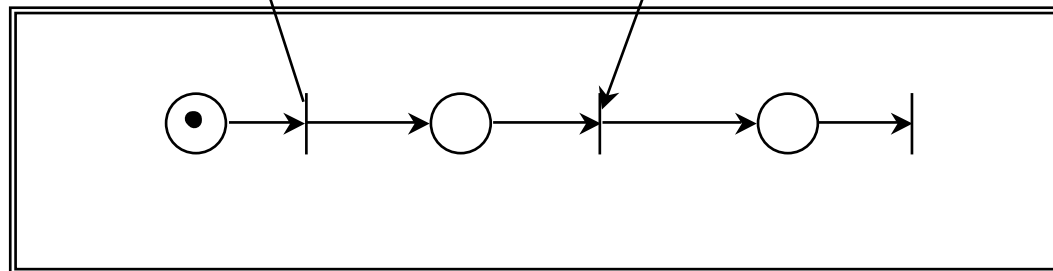# Buffer (Queue)

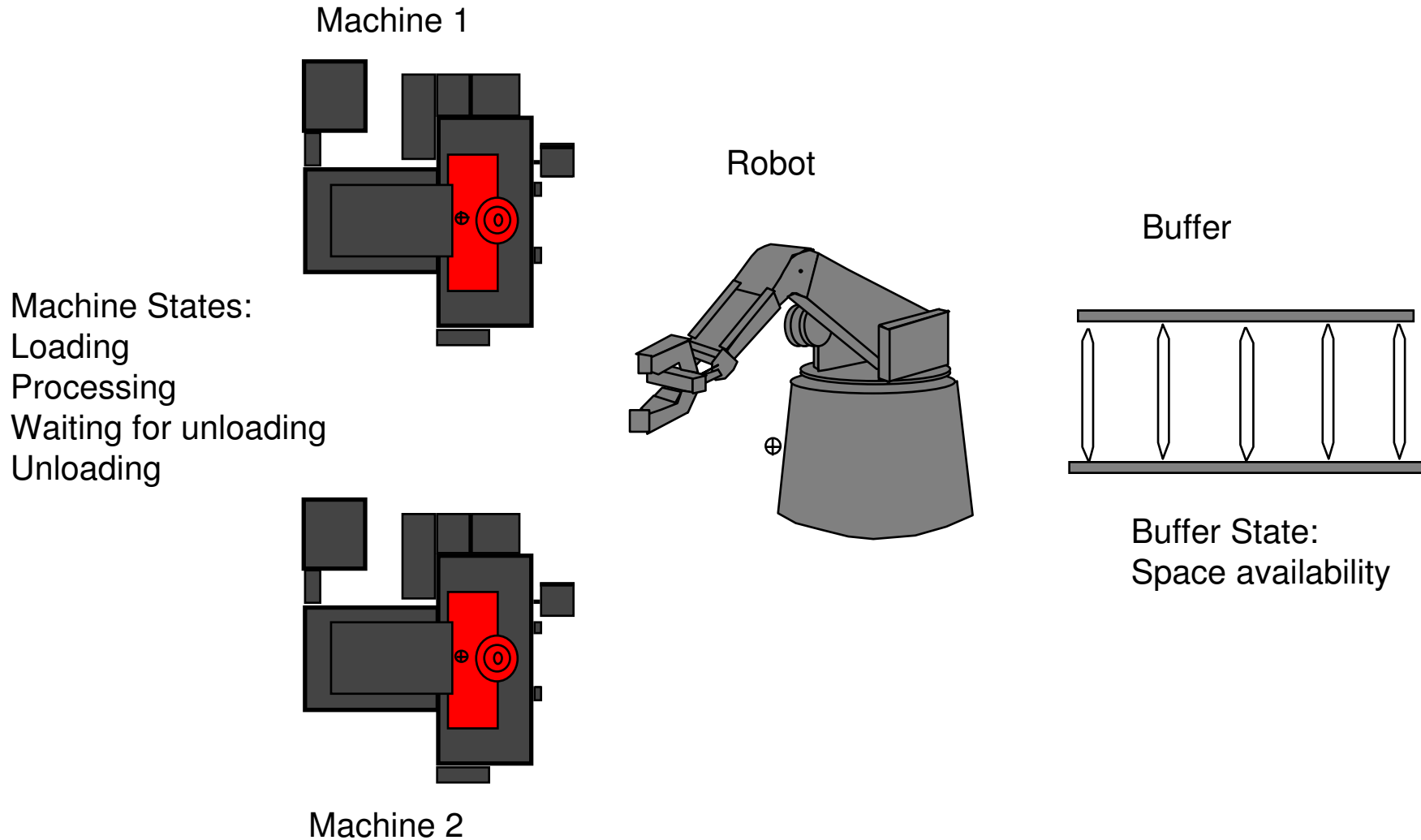The buffer can hold a limited number of parts.

Communication

Program 1

Program 2

An Example

Machine 1

Robot

Buffer

Machine States:
Loading
Processing
Waiting for unloading
Unloading

Buffer State:
Space availability

Machine 2

Put It Together