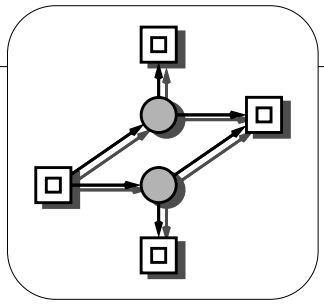

BrandenburgTechnical
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FUNLITE -

A PARALLEL PETRI NET SIMULATOR

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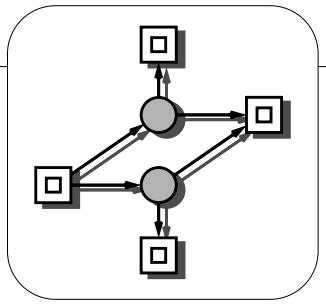
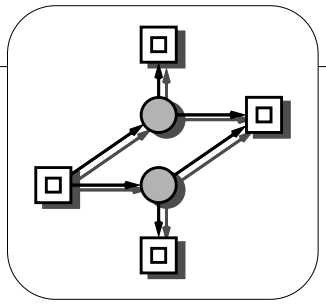


INTRODUCTION:

- Provably error-free control software for manufacturing systems
- Live 1-bounded hierarchical Place/Transition nets
- Parallel Petri Net simulator to simulate the tokenflow of a Petri Net
- Goals:
  - fast execution speed
  - low memory consumption
  - low communication overhead
- Transputer system (T9000 & C104)
  INMOS C (CSP model of parallel programming)



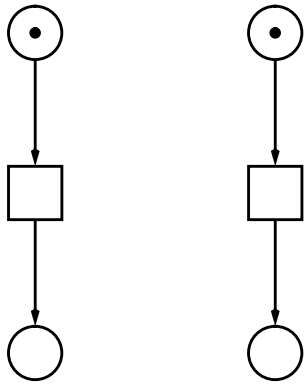
PRELIMINARIES:

- **Simulation of the tokenflow:**

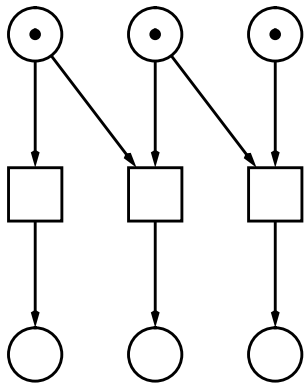
  - the control code is assigned to the transitions
  - the execution of a transition is atomar!

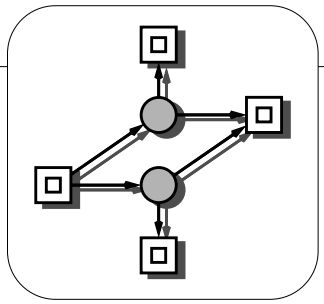
- **Problems:**

Parallelity



Conflict resolution





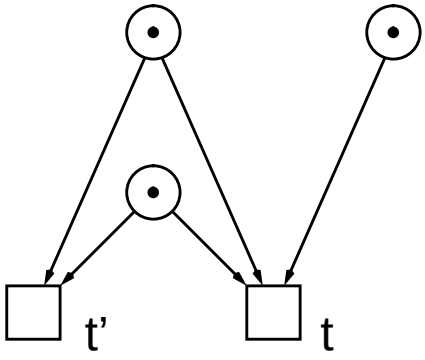
THE SEQUENTIAL PETRI NET SIMULATOR

- **Main problem:**
  speed of the transition enabling test

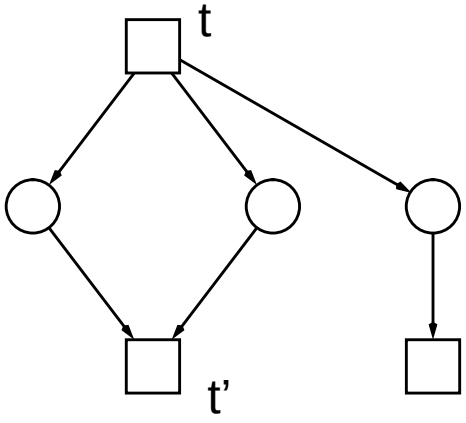
- **The counter method:**
  - one counter for each transition representing the number of unmarked pre-places
    i.e. counter(t) == 0 $\Rightarrow$ t enabled
  - after the firing of t, we only have to consider

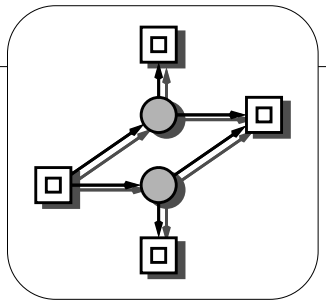
    t, $({}^\bullet t)^\bullet$ and $(t^\bullet)^\bullet$

- For each transition t' in $({}^\bullet t)^\bullet$ we increase the counter of t' by the number of common pre-places with t



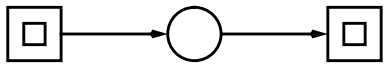
- For each transition t' in $(t^\bullet)^\bullet$ we decrease the counter of t' by the number of common places between the pre-places of t' and the post-places of t



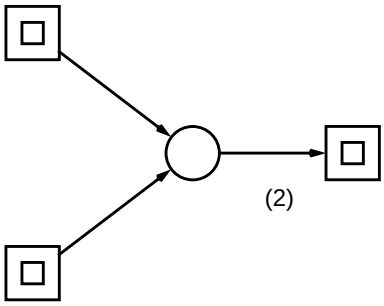


COMMUNICATION PLACES:

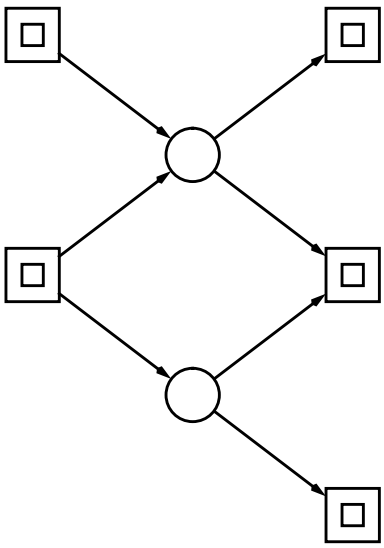
- **Post-communication places**

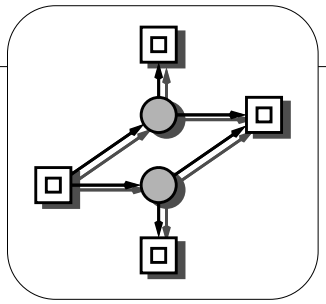


- **Pre-many-to-1 communication places**



- **Pre-many-to-many communication places**





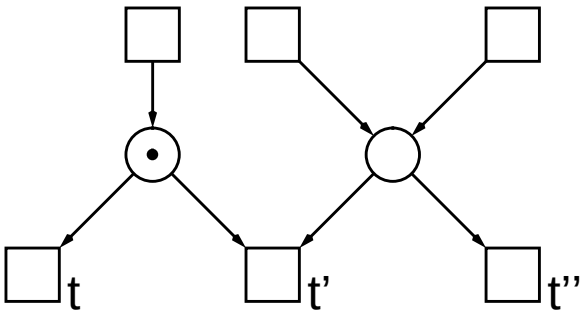
LOCKSETS:

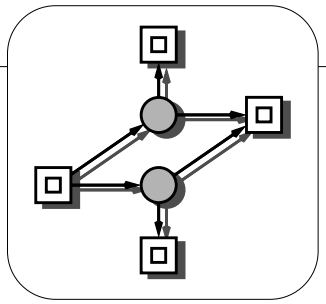
- **Goals:**
  - simple conflict resolution
  - atomar allocation of more than one token

- **Locksets:** (disjointed sets of many-to-many communication places)

  Definition: *A lockset l is a minimal set of many-to-many communication places such that holds:*

  If there are transitions $t,t' \in T$ with $^\bullet t \cap {}^\bullet t'$ contains many-to-many communication places of l then the lockset l contains all many-to-many communication places of $^\bullet t \cup {}^\bullet t'$.





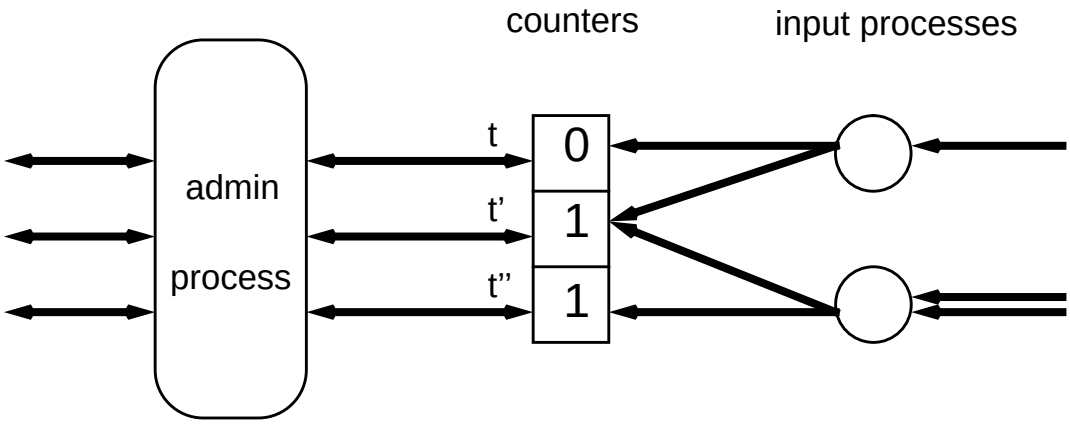
IMPLEMENTATION:

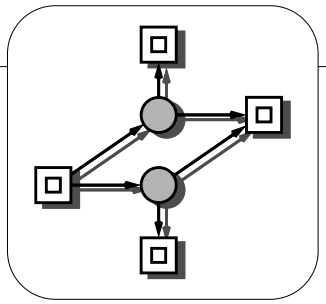
- A lockset l is implemented by:

  - For each transition t with a many-to-many communication place in l we introduce a counter representing the number of missing communication place tokens.

  - For each place p in l we generate an input process which waits for an arriving token and updates the counters of the corresponding transitions

  - An administration process which reacts on token requests from subnets





CONCLUSION:

- fast and simple conflict resolution
- fast transition enabling test
- minimal network traffic
- low memory consumption

⇒ suited for small systems