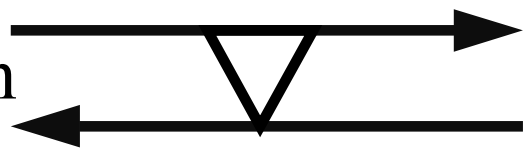
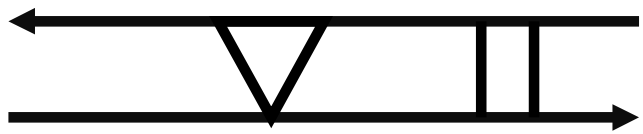
Category theory

morphism 

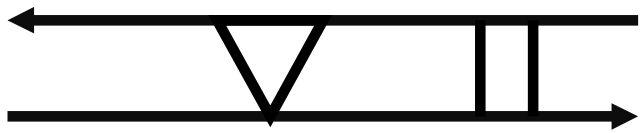
- relationships between nets
- simulates
- specifies
- universal construction

functor 

- relationships between net classes
- embeds
- underlays
- adjunction 

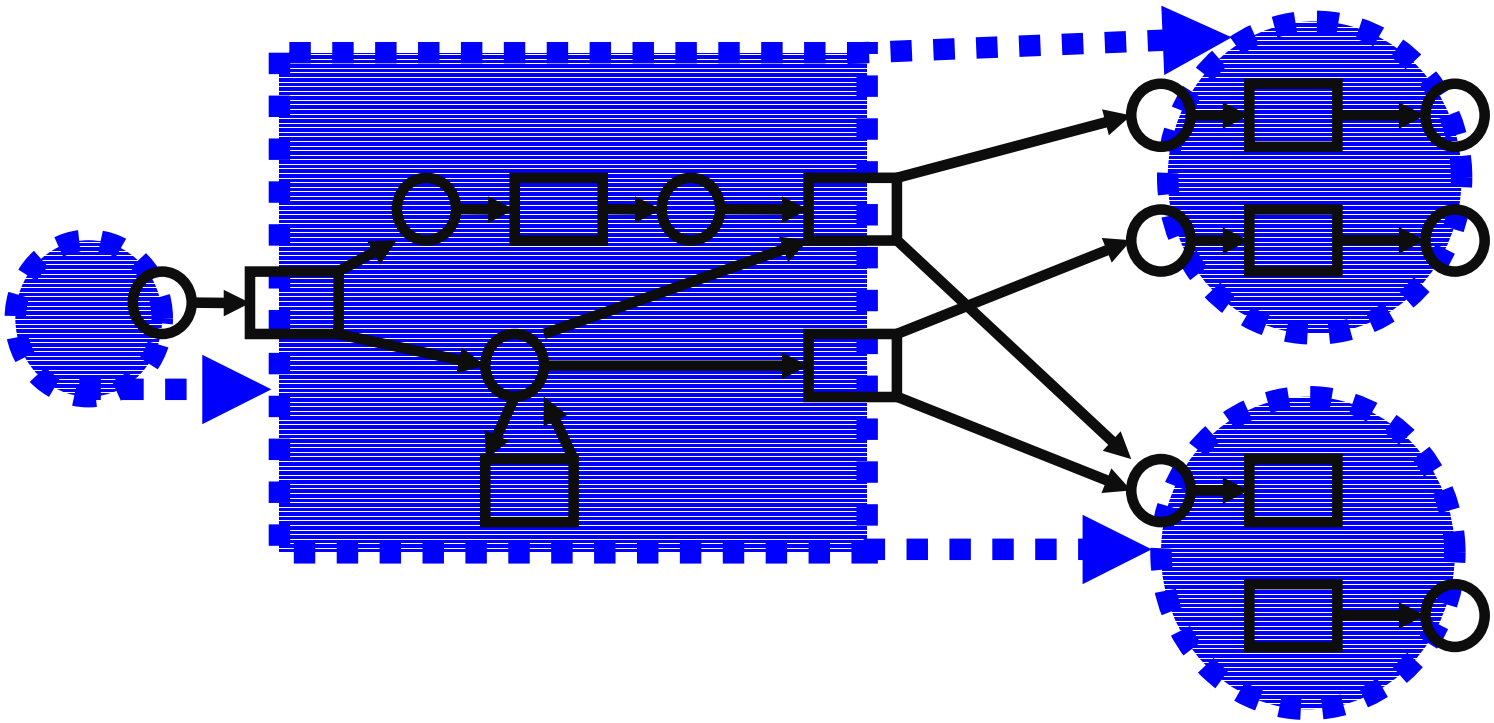
1S  SETP

- built on sets with partial maps
- subcategory of multi sets
  - restriction on morphisms
- base may get infinite
- model resources as multi sets do - but
  - all universal constructions
  - morphisms retract to base set

PTNET  1S

- place transition nets as usual
  - multiple arcs
  - weak occurrence rule
- morphisms are from 1S supporting
  - folding compatible with transition occurrence
  - clustering preserving vicinity

Clustering in PTNET



Clustering in PTNET

- f: N $\rightarrow$ N'
- origins of a place form place bordered subnet
- origins of **0** dito: garbage component
- origins of a transition
  - transition bordered subnet (up to garbage)
  - proper port transitions

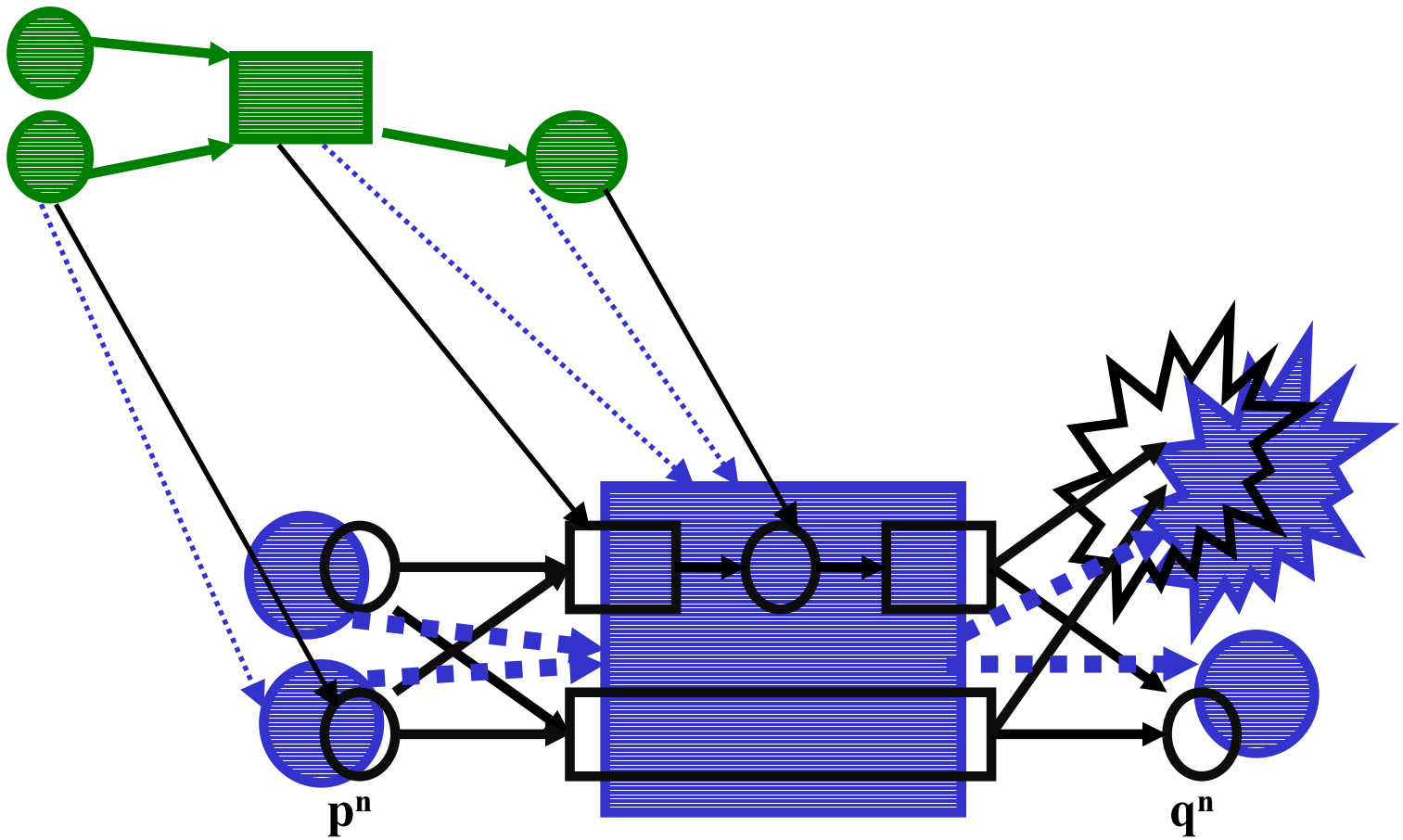
Invariants in PTNET

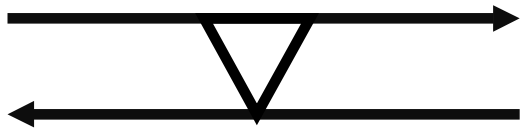
- f: N $\rightarrow$ N'
- place invariant
  - moves in reverse direction
  - equivalent with morphism to single place net
- transition invariant
  - moves in same direction
  - equivalent with morphism from T system

PPNET

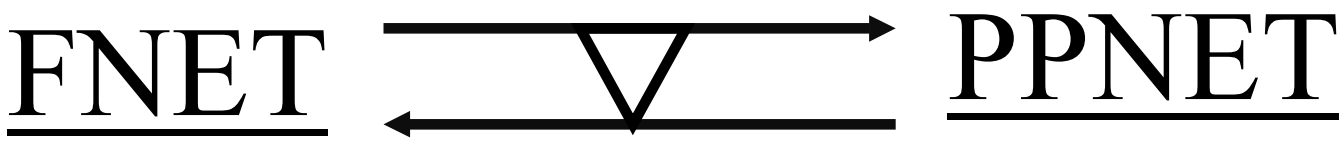
- fix: place preserving (pp) morphisms
- simplifications
- all universal constructions exist
- pushouts
  - compose subnets with interface
  - connect to graph transformation systems

PTNET → PPNET



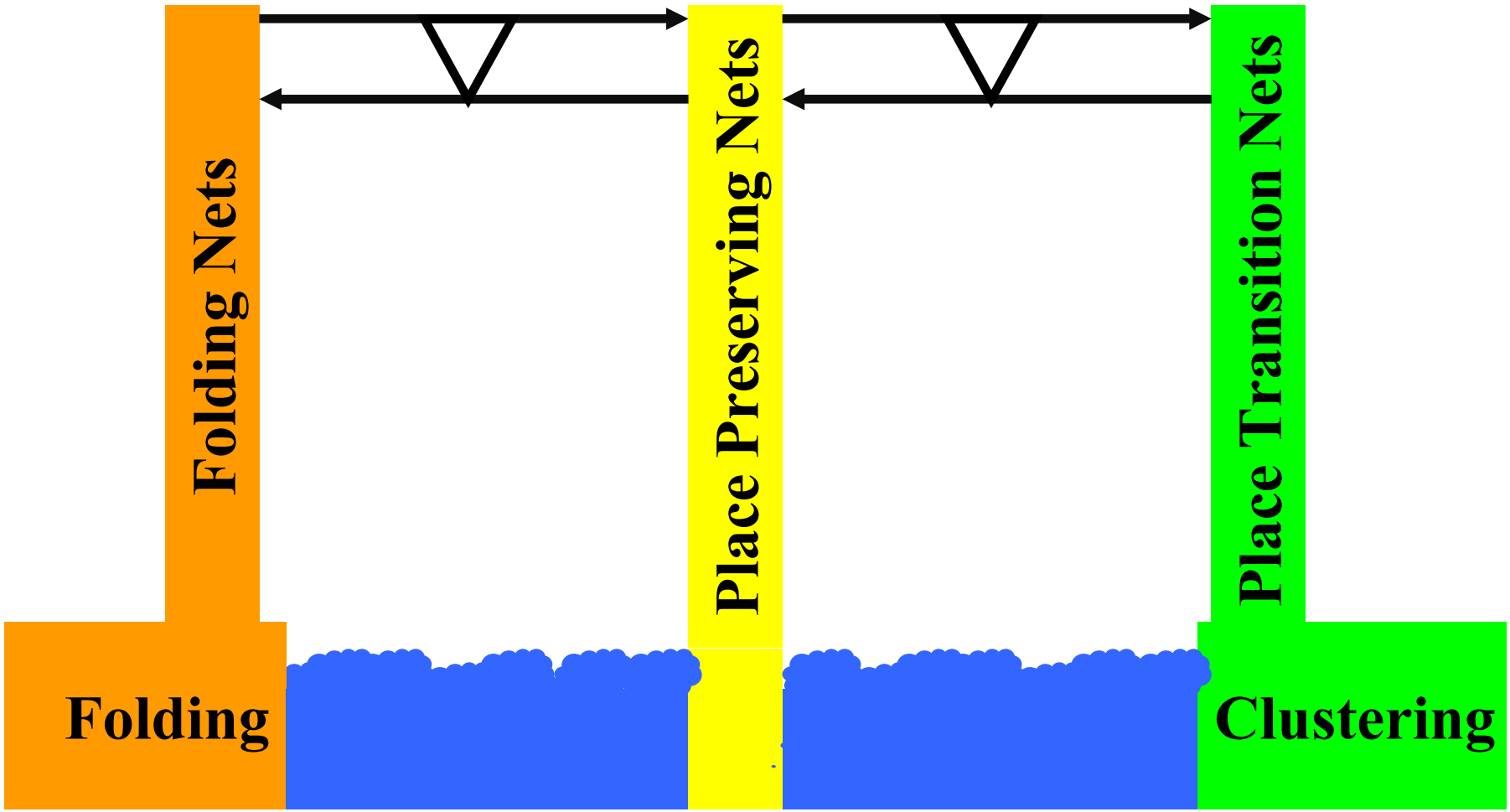
PPNET  PTNET

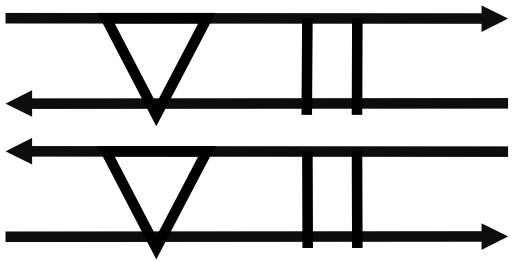
- PPNET can simulate PTNET
  - simple construction
  - computationally reasonable
  - natural transfer of properties by adjunction
- is central category
  - simple but powerful
  - connected to all others



- FNET can simulate PPNET and PTNET
  - similar construction
  - adjunctions compose
- bridge from clustering to folding

The Bridge


Folding Nets
Place Preserving Nets
Place Transition Nets
Folding
Clustering

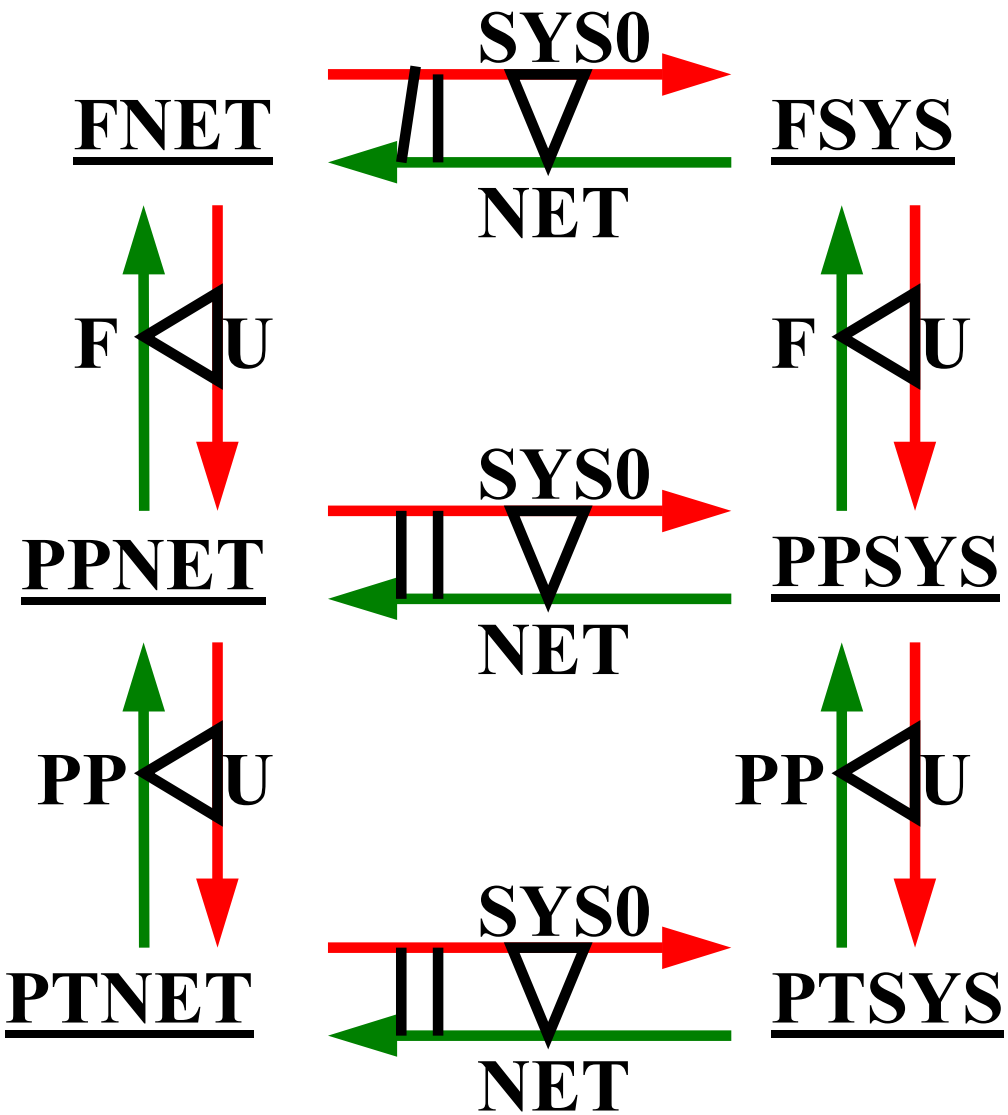
CPPNET  PPNET

- Coloured PP Nets are
  - unitary foldings in PPNET
  - preserving environment of each transition
- universal constructions
- nearly equivalent to CPN
  - no typing
  - unfolding restrictions
  - but categorical machinery

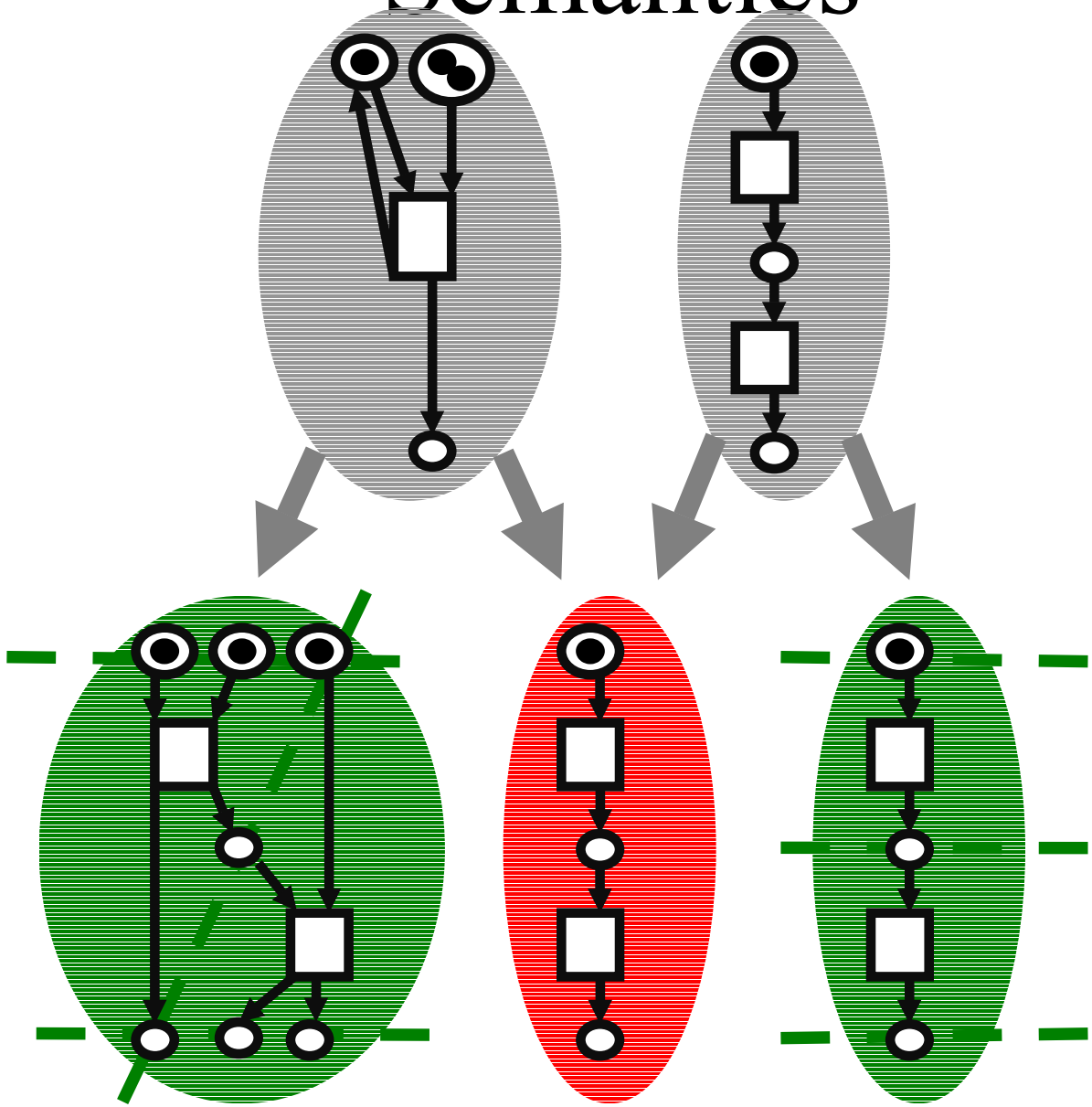
Behaviour

- system is a net with an initial marking
- morphisms
  - map initial marking
    in the initial marking of the destination
  - transfer enabledness
  - simulation
- universal constructions
  - initial marking plus construction in *NET

Behaviour

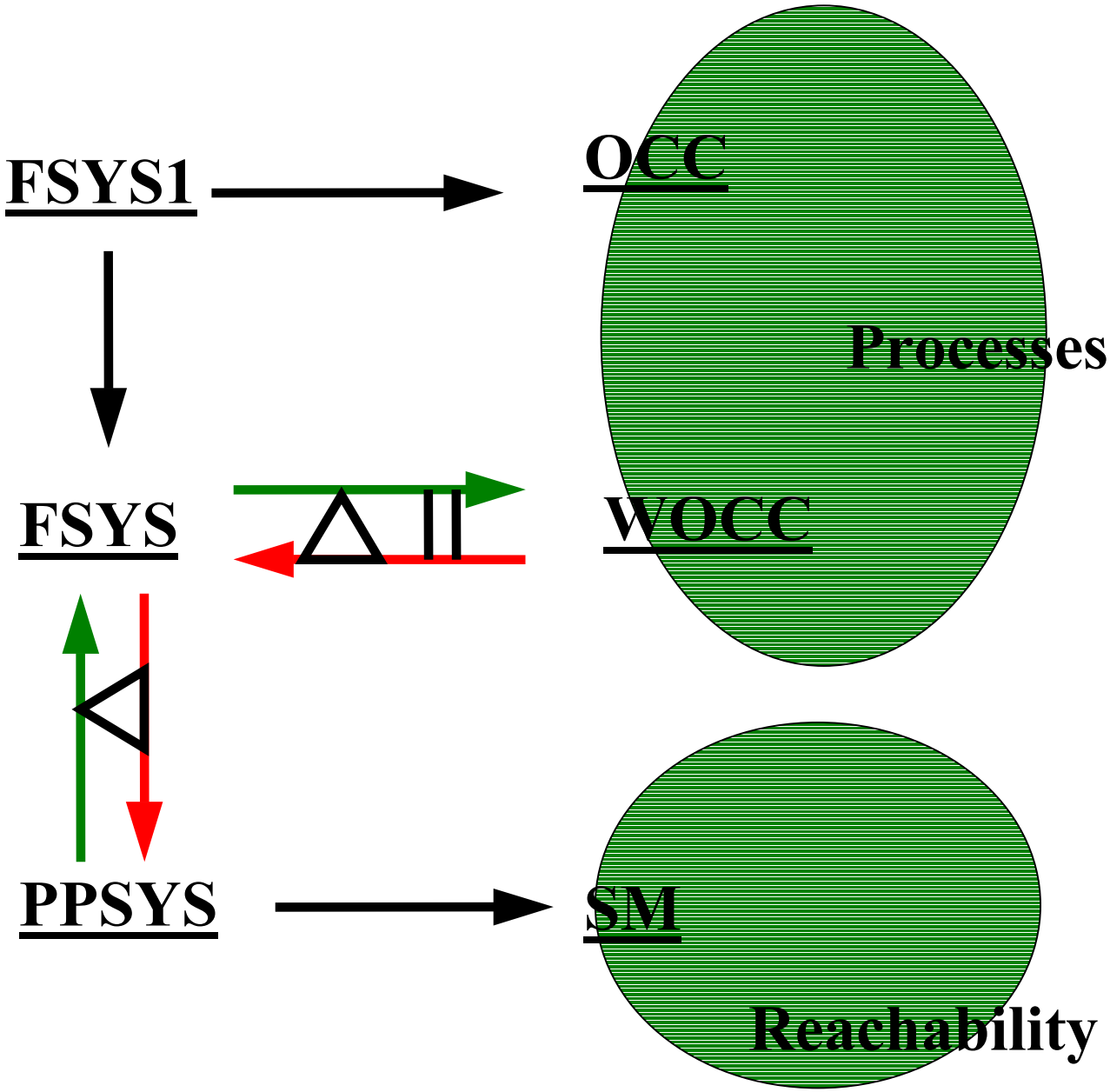

SYS0
FNET
FSYS
NET
F
U
F
U
SYS0
PPNET
PPSYS
NET
PP
U
PP
U
SYS0
PTNET
PTSYS
NET

Semantics



processes **reachability** **processes**

Semantics



3 Axes of Variation