



# On the semantics of EPCs: Efficient calculation and simulation

Nicolas Cuntz and Ekkart Kindler  
University of Paderborn  
Department of Computer Science

---



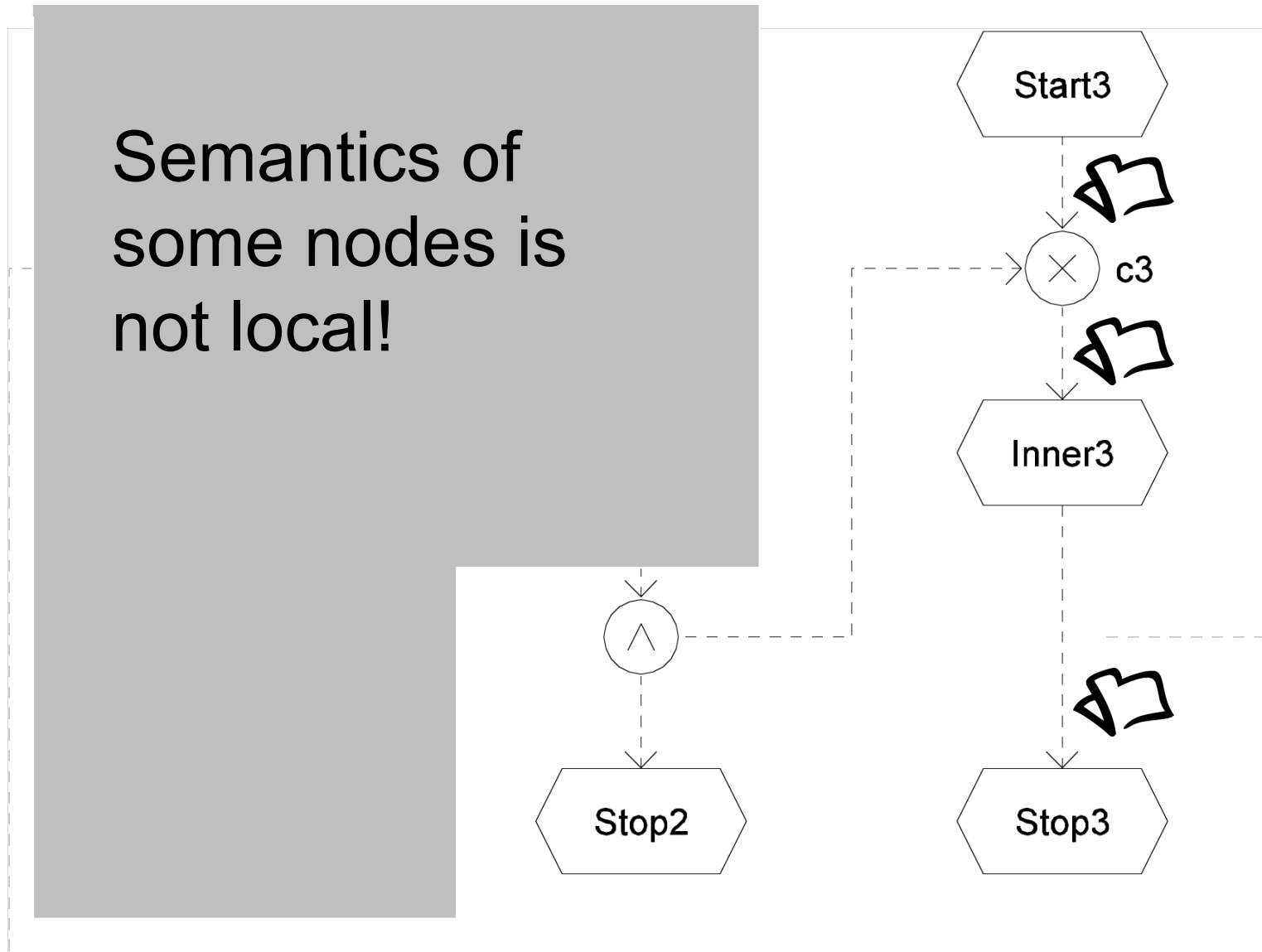
... a sequel of papers:

- A vicious circle.  
*Aalst, Desel, Kindler. EPK 02.*
- A framework for resolving the vicious circle.  
*Kindler. EPK 03 / BPM 04*
- Efficient calculation and simulation.  
*Cuntz, Kindler. EPK 04 / BPM 05*
- Faster simulation for some EPCs.  
*Freiheit, Kindler. EPK 05 (?)*



- A sequel of papers
- **Informal Semantics**
- The vicious circle
- Resolving the vicious circle
  
- Problem
- Solution
- EPCTools

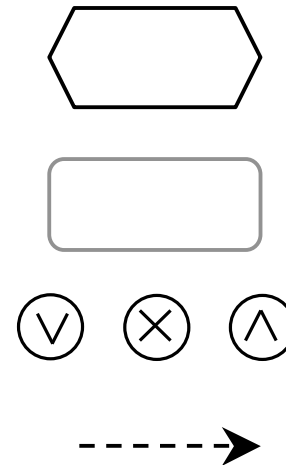
# EPC: An Example





## Syntax

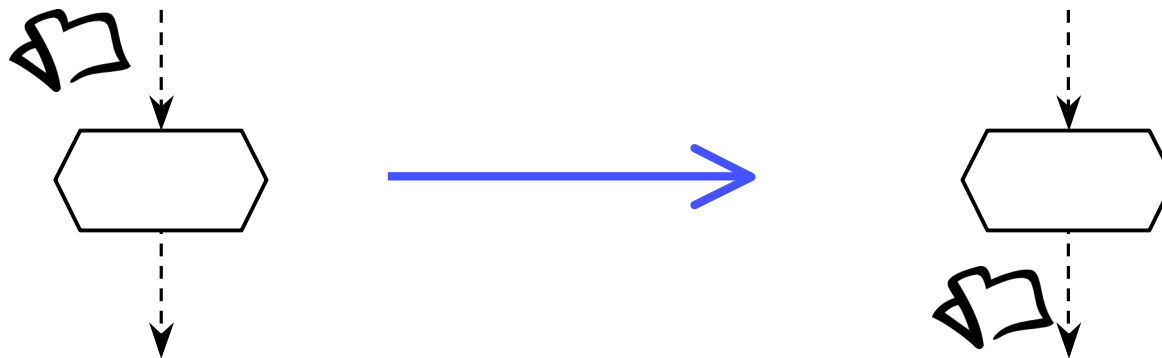
- Events
- Functions
- Connectors
- Control flow

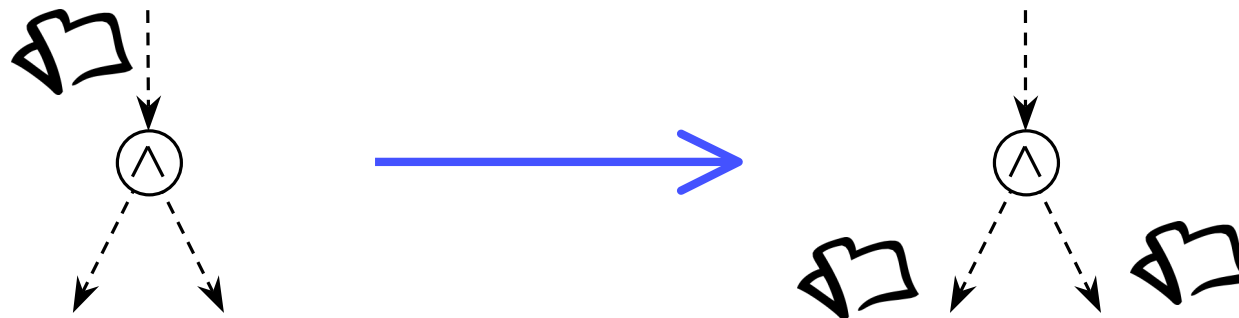


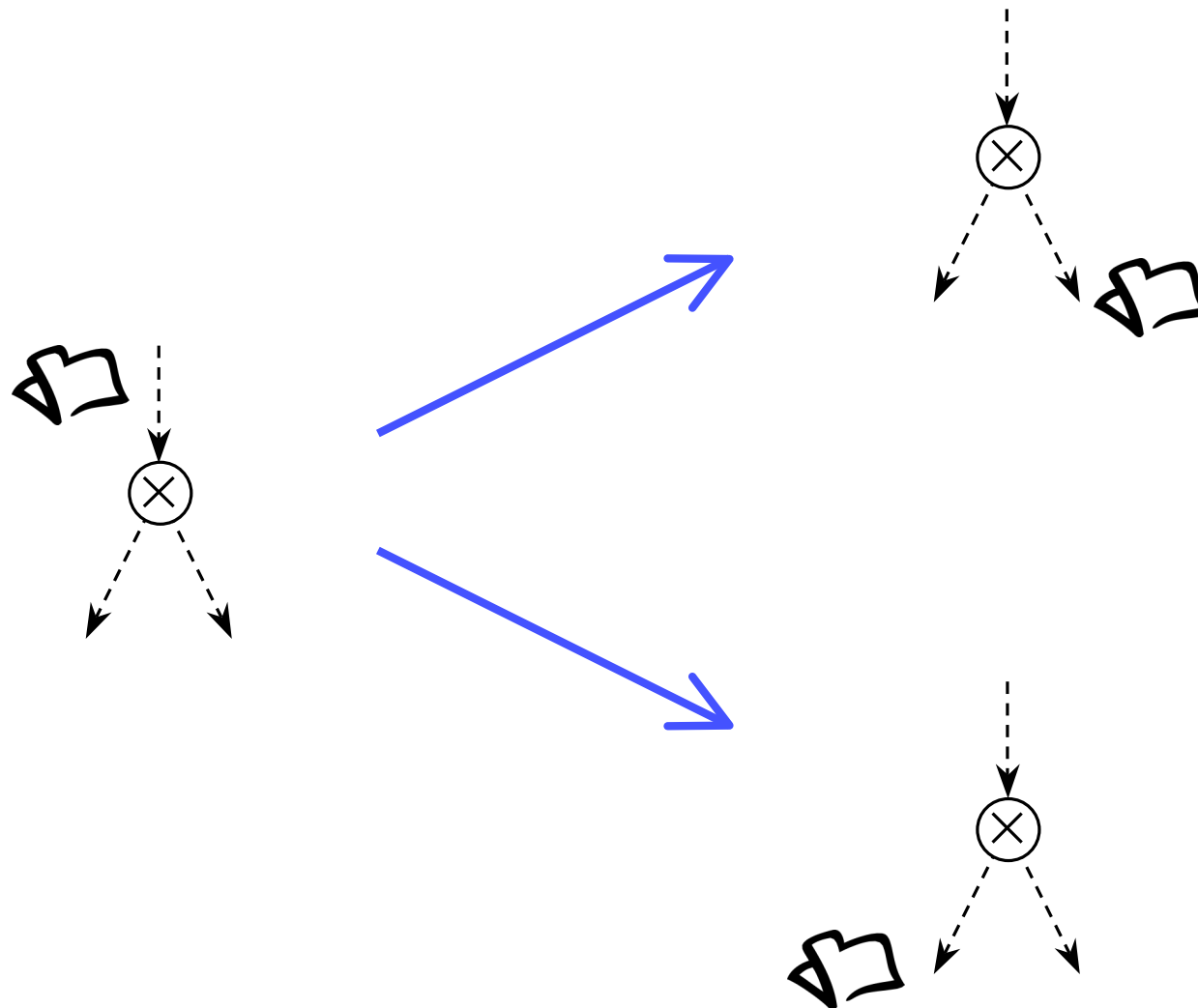
## Semantics

- State: Process folders
- Transition relation:  
Propagation of process folders



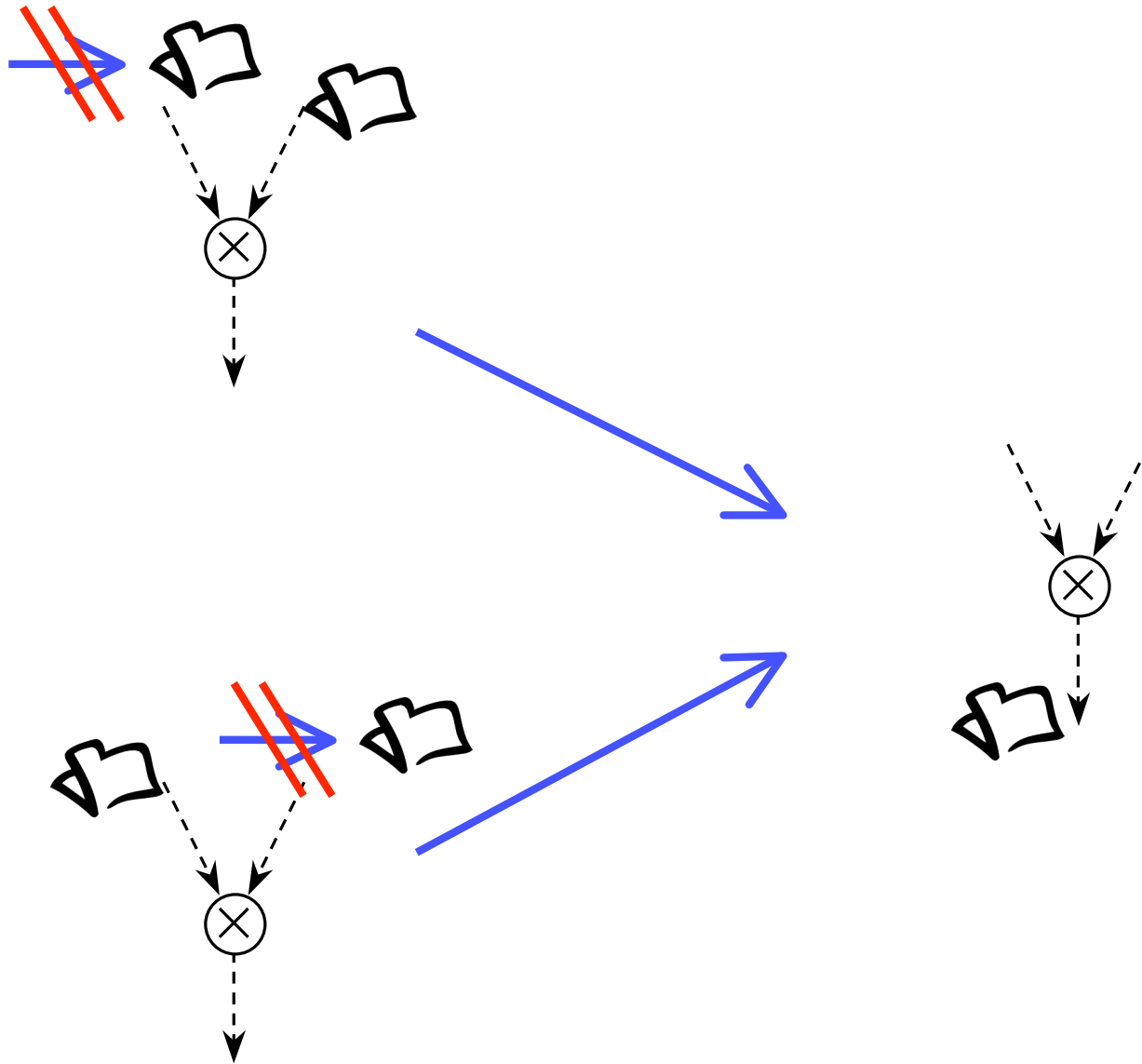








# XOR-Join



# This definition is

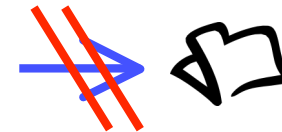


Clear,

simple, and

**wrong.**

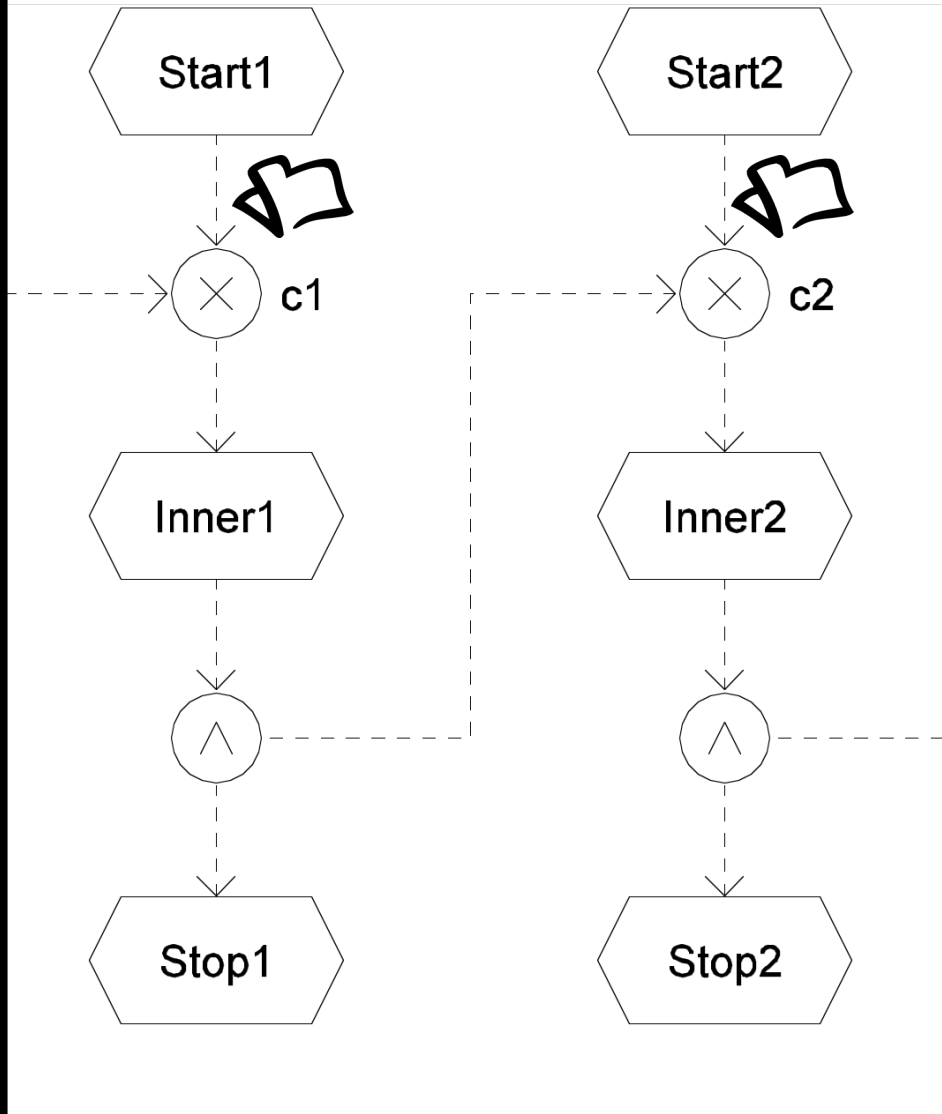
$$\rightarrow = R(\rightarrow)$$



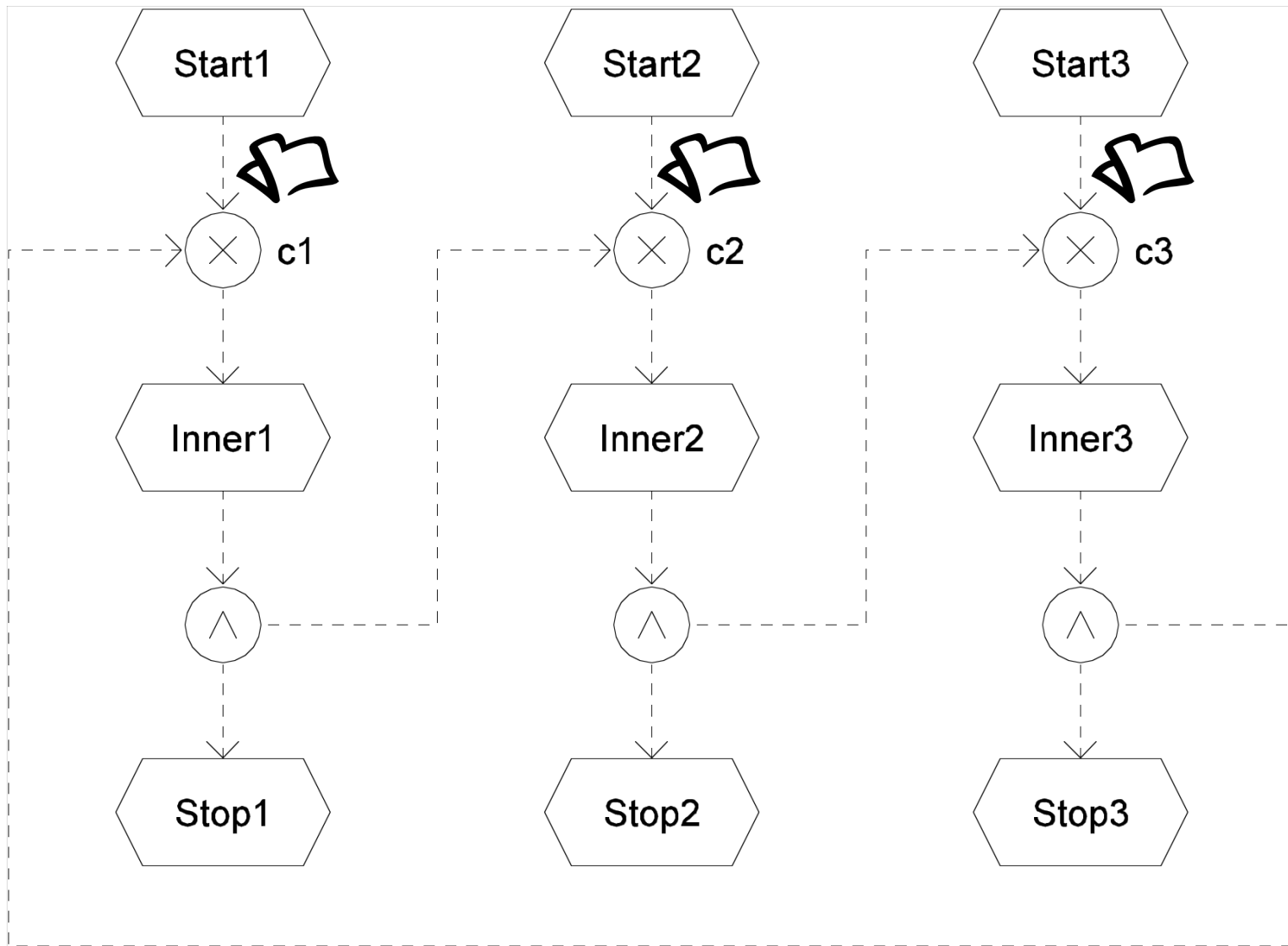


- A sequel of papers
- Informal Semantics
- **The vicious circle**
- Resolving the vicious circle
  
- Problem
- Solution
- EPCTools

# Example



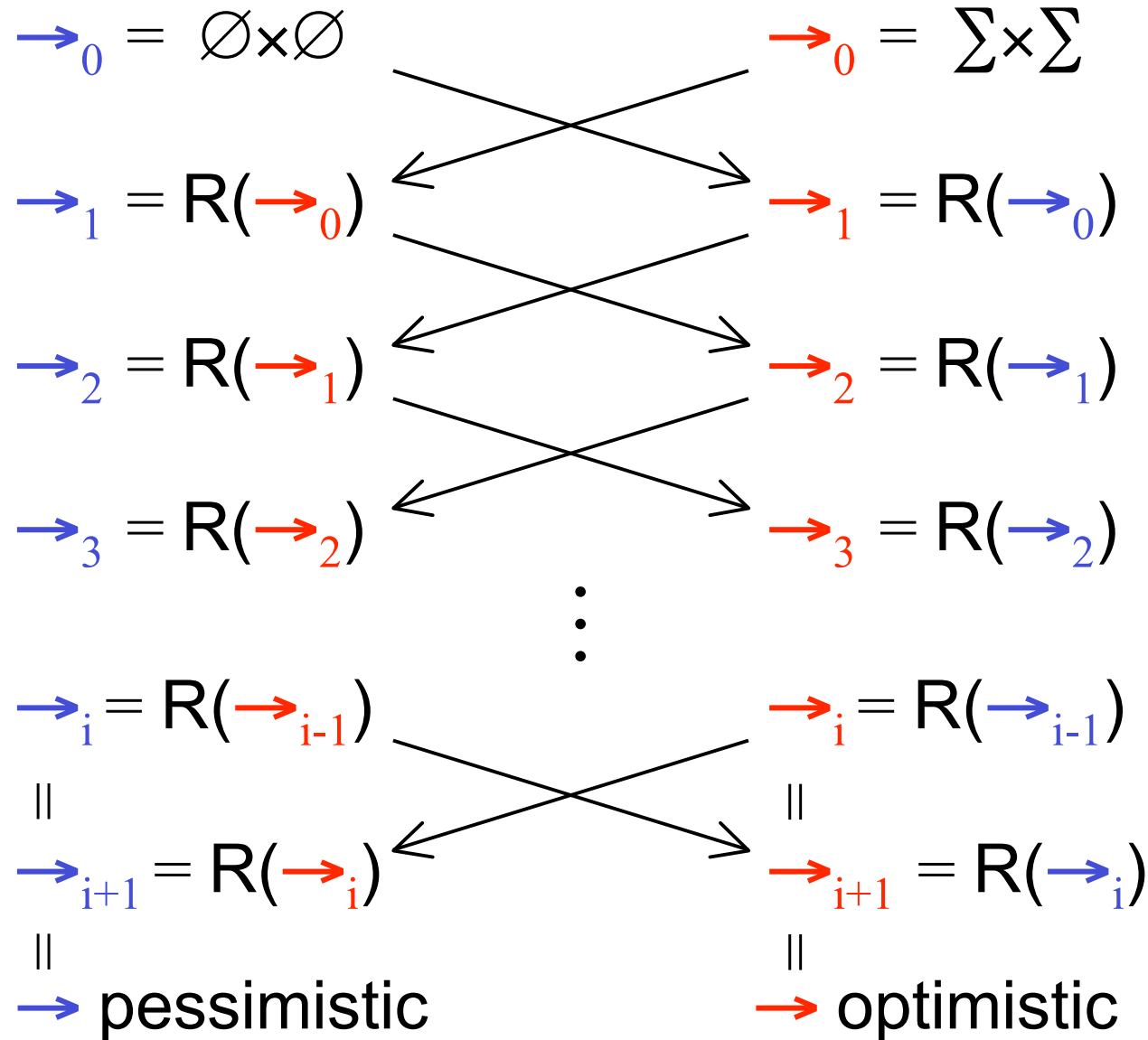
# An example without a semantics





- A sequel of papers
- Informal Semantics
- The vicious circle
- **Resolving the vicious circle**
  - Problem
  - Solution
  - EPCTools

# Fixed-point iteration

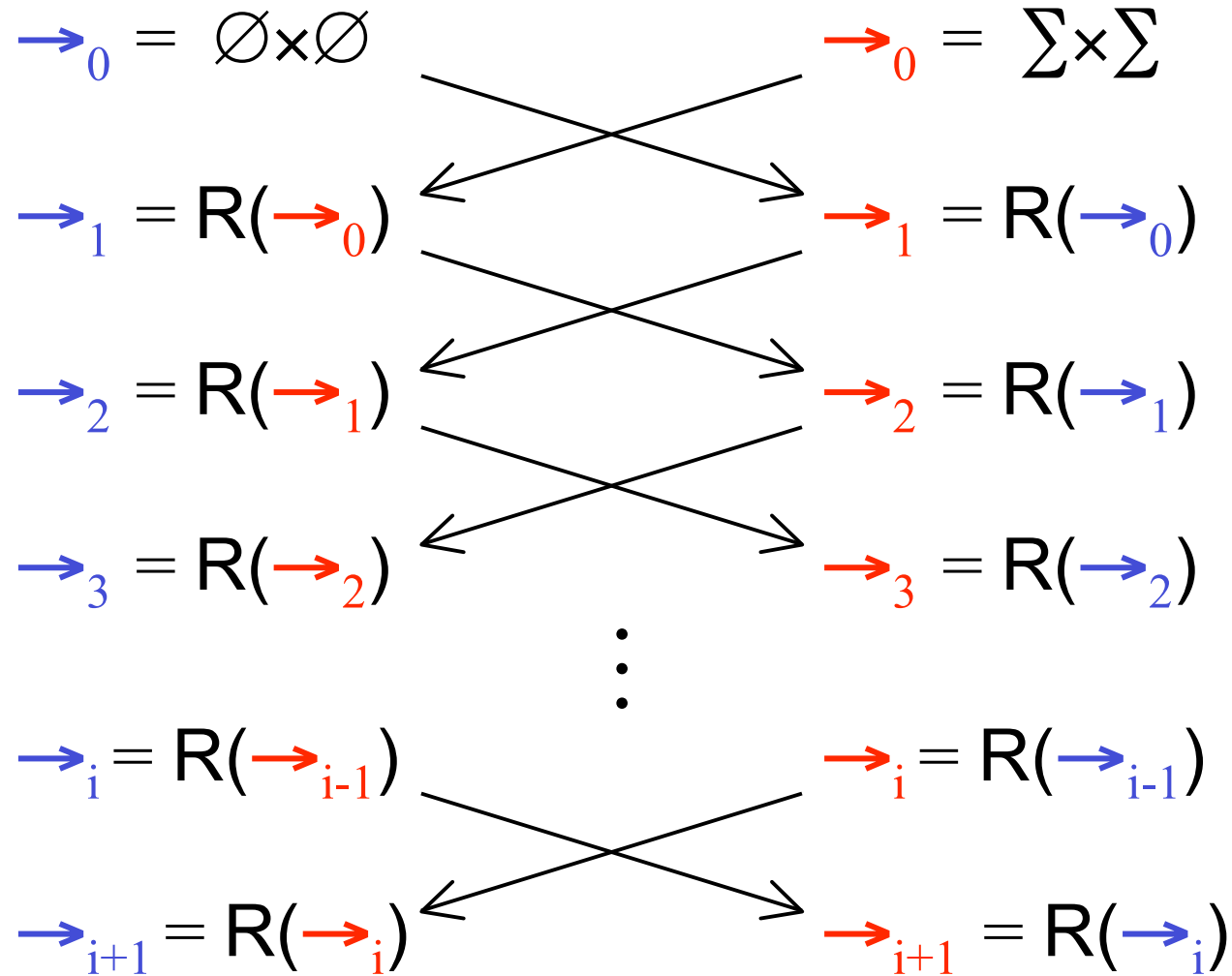




- A sequel of papers
- Informal Semantics
- The vicious circle
- Resolving the vicious circle
  
- **Problem**
- Solution
- EPCTools



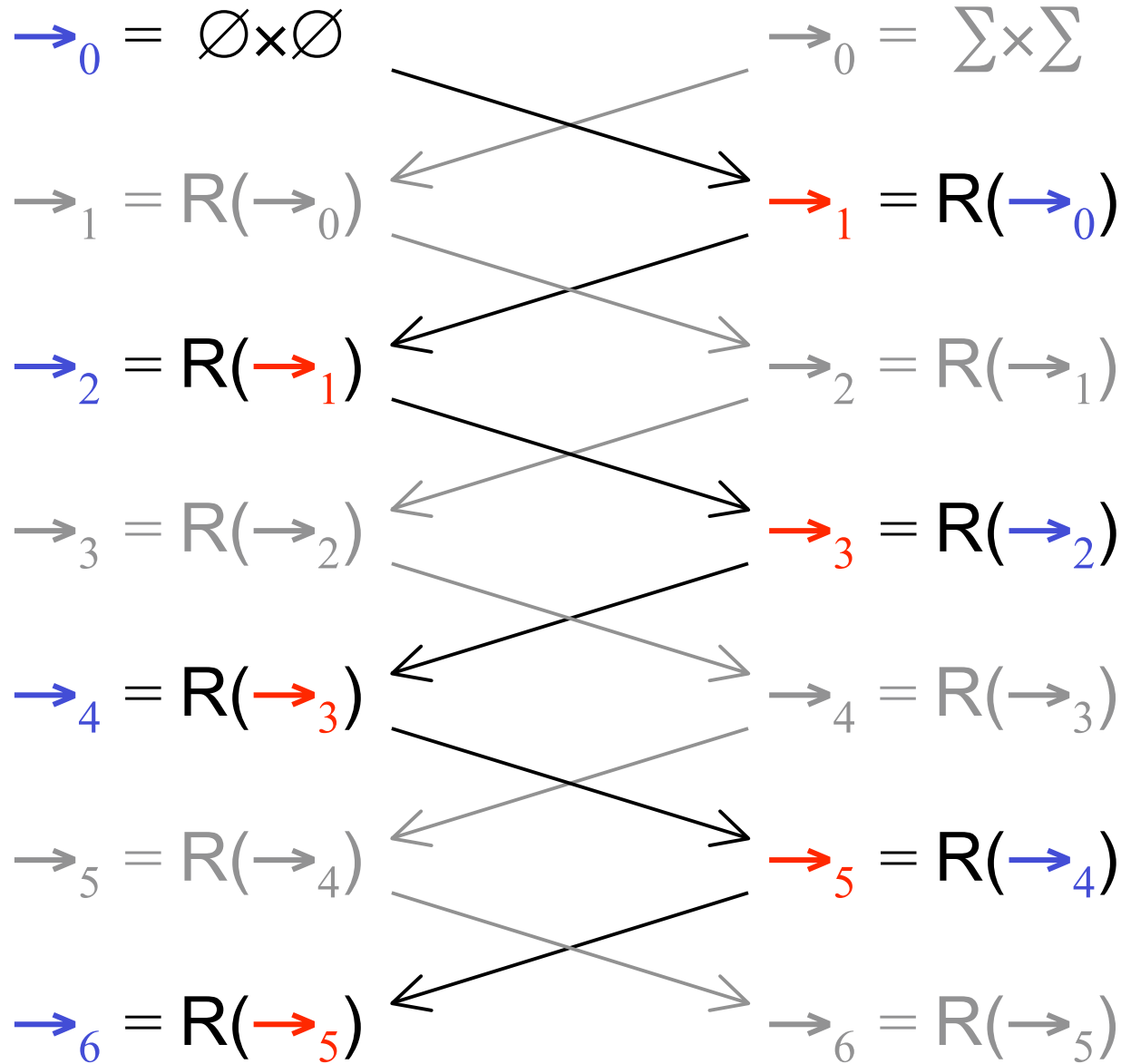
# Efficiency?



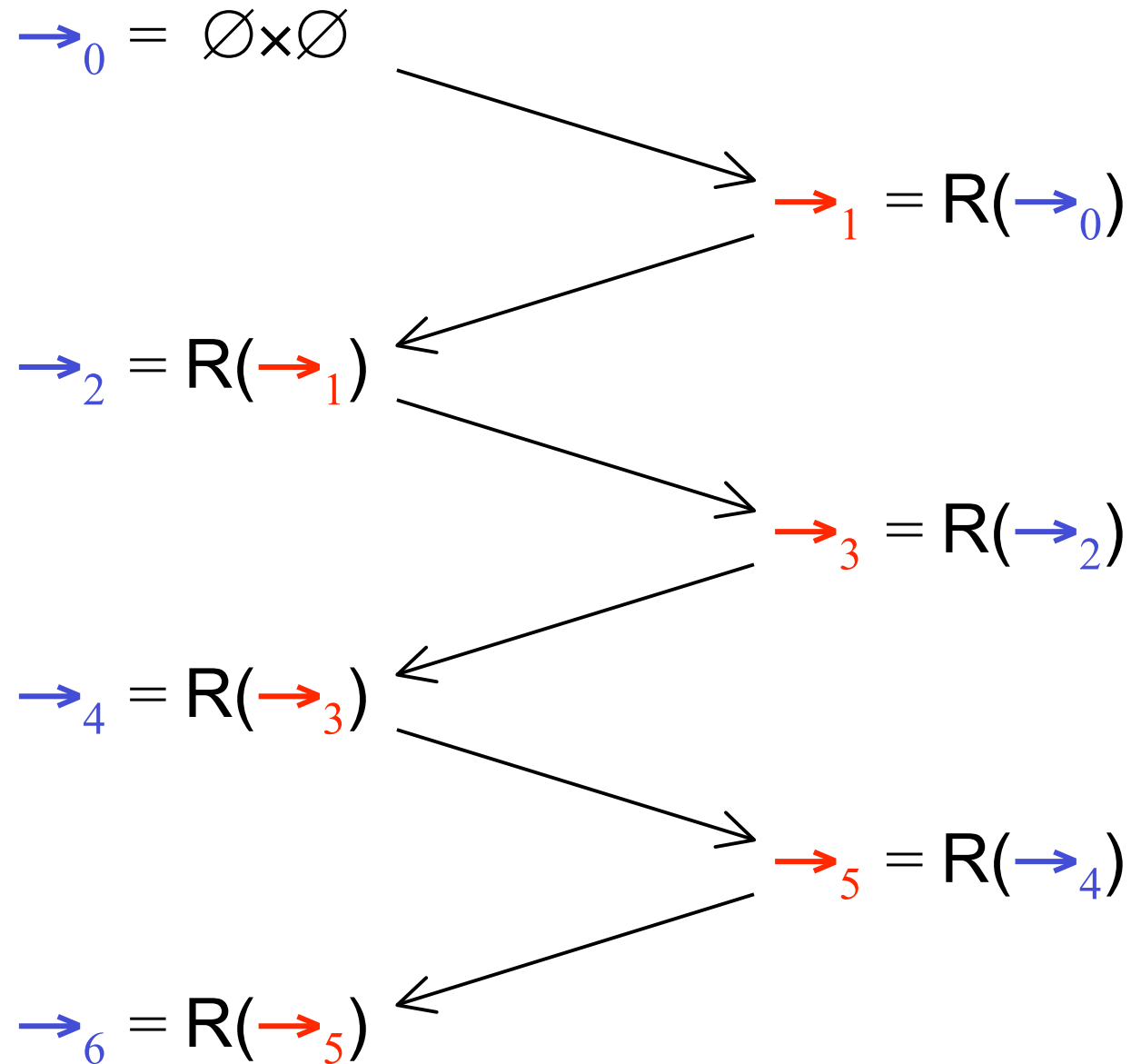


- A sequel of papers
- Informal Semantics
- The vicious circle
- Resolving the vicious circle
  
- Problem
- **Solution**
- EPCTools

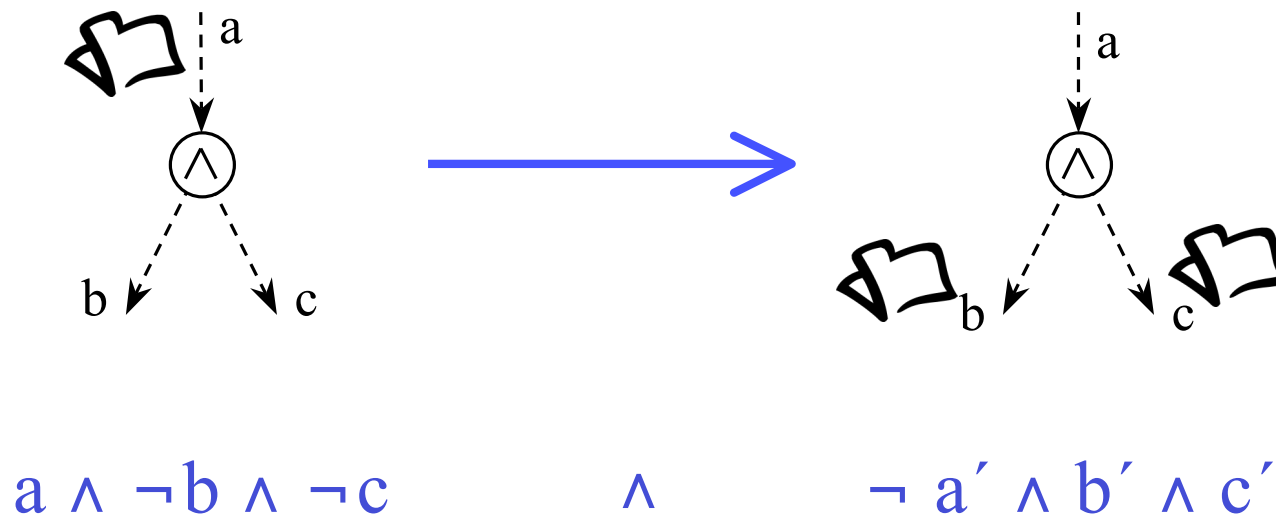
# Efficiency



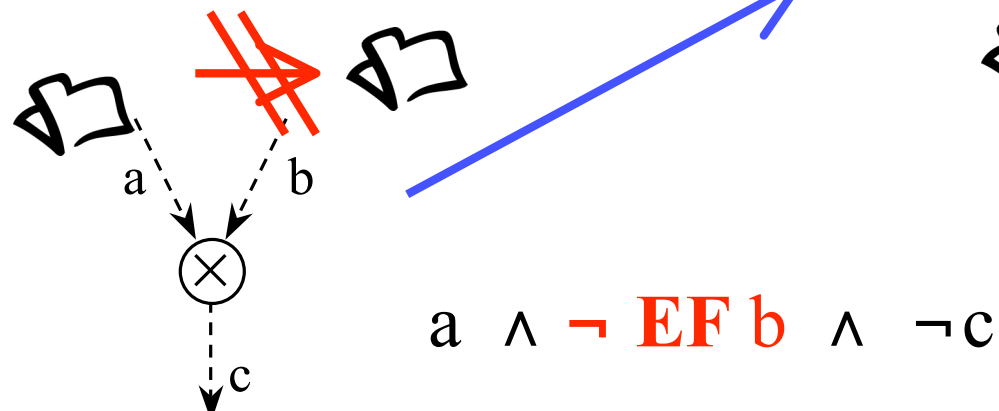
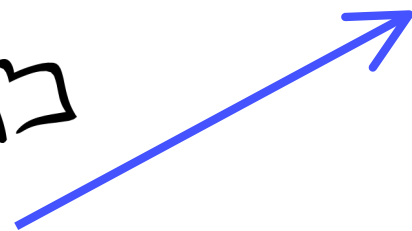
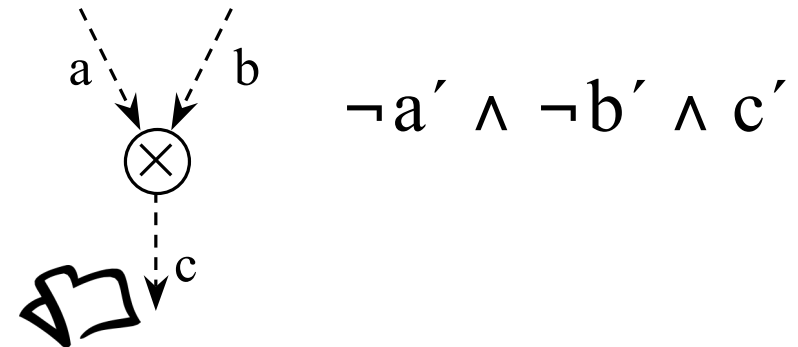
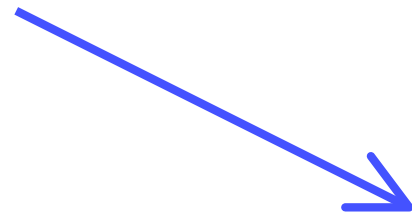
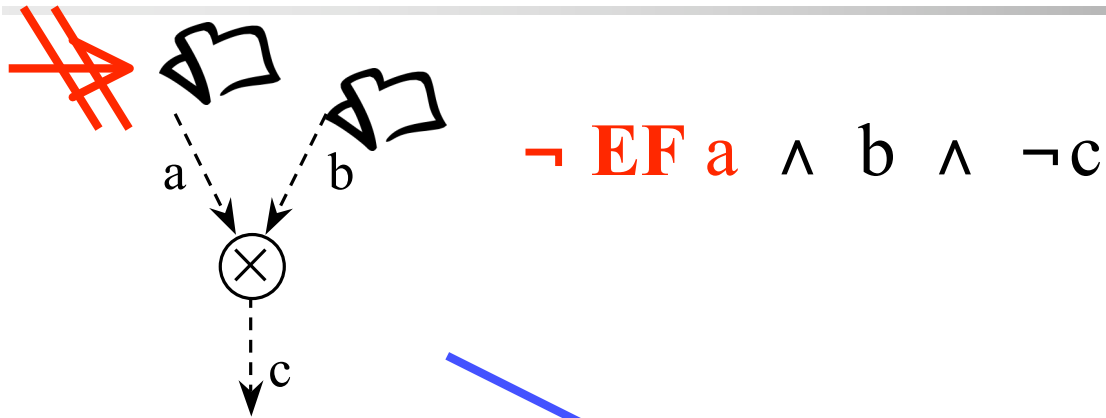
# 1. Calculate on sequence only



## 2. Calculate $\rightarrow_{i+1} = R(\rightarrow_i)$ symbolically



# XOR-Join: $\rightarrow_{i+1} = R(\rightarrow_i)$ symbolically

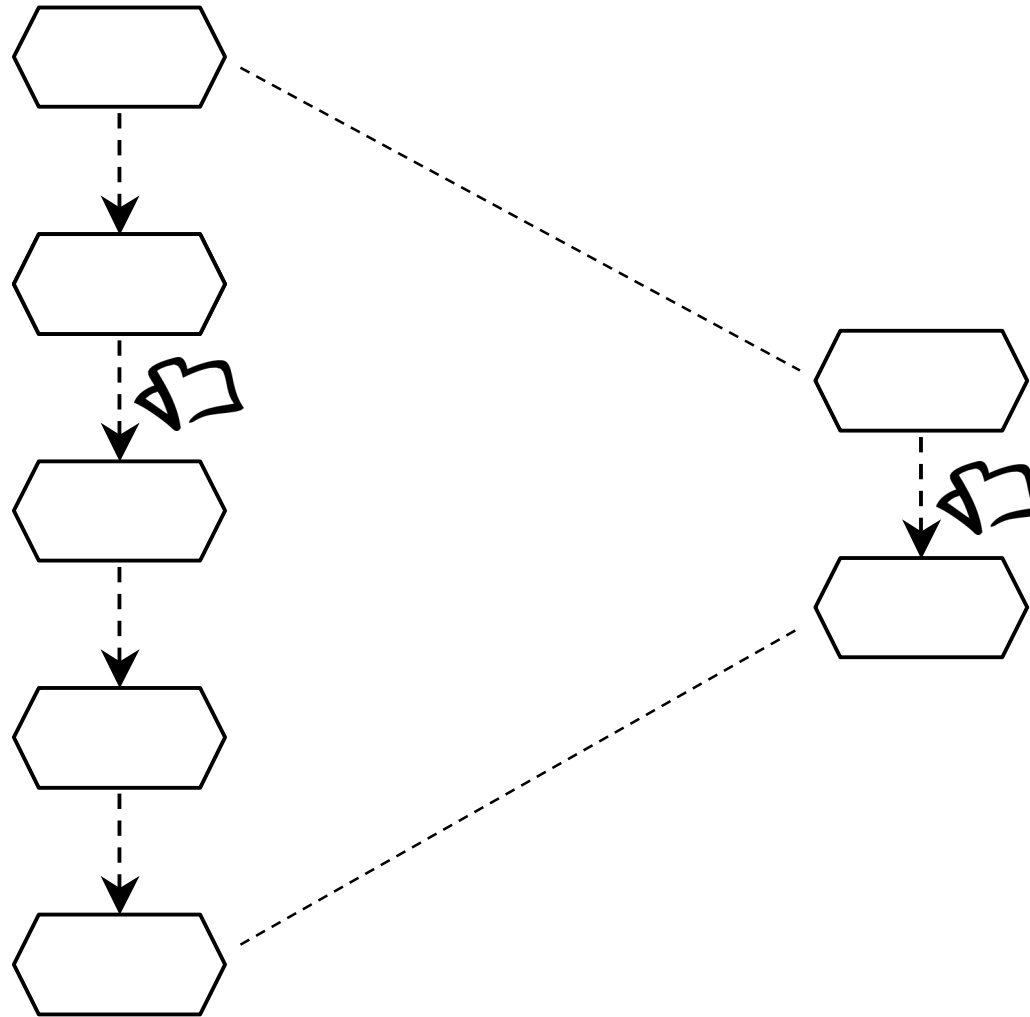


$$[(\neg \mathbf{EF} a \wedge b) \vee (a \wedge \neg \mathbf{EF} b)] \wedge \neg c \wedge \neg a' \wedge \neg b' \wedge c'$$

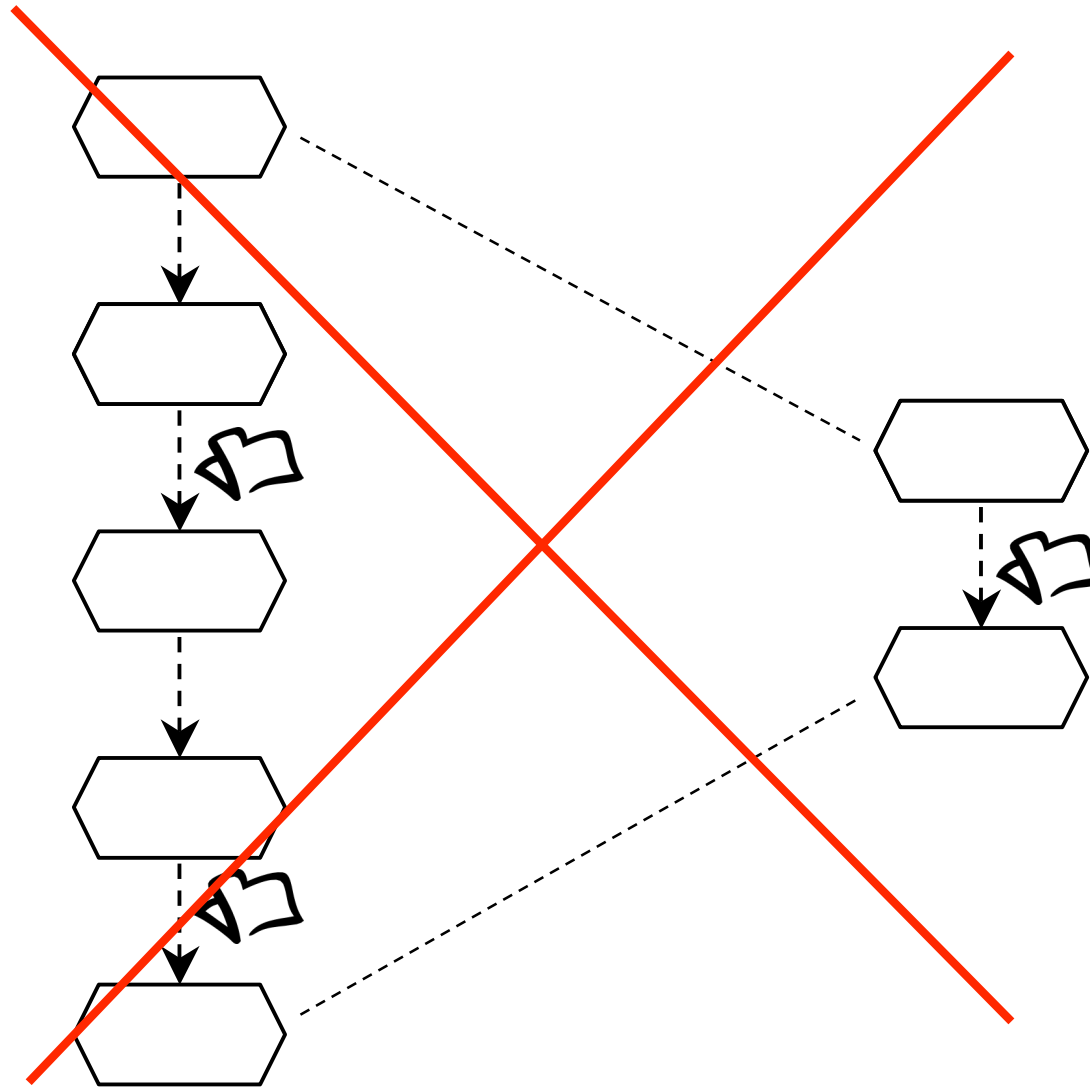


- Calculate  $\rightarrow_{i+1}$  from  $R(\rightarrow_i)$  symbolically
- Reduced Ordered Binary Decision Diagrams
- Partitioning of the transition relations
- Variable order optimisations

# 4. Chain elimination









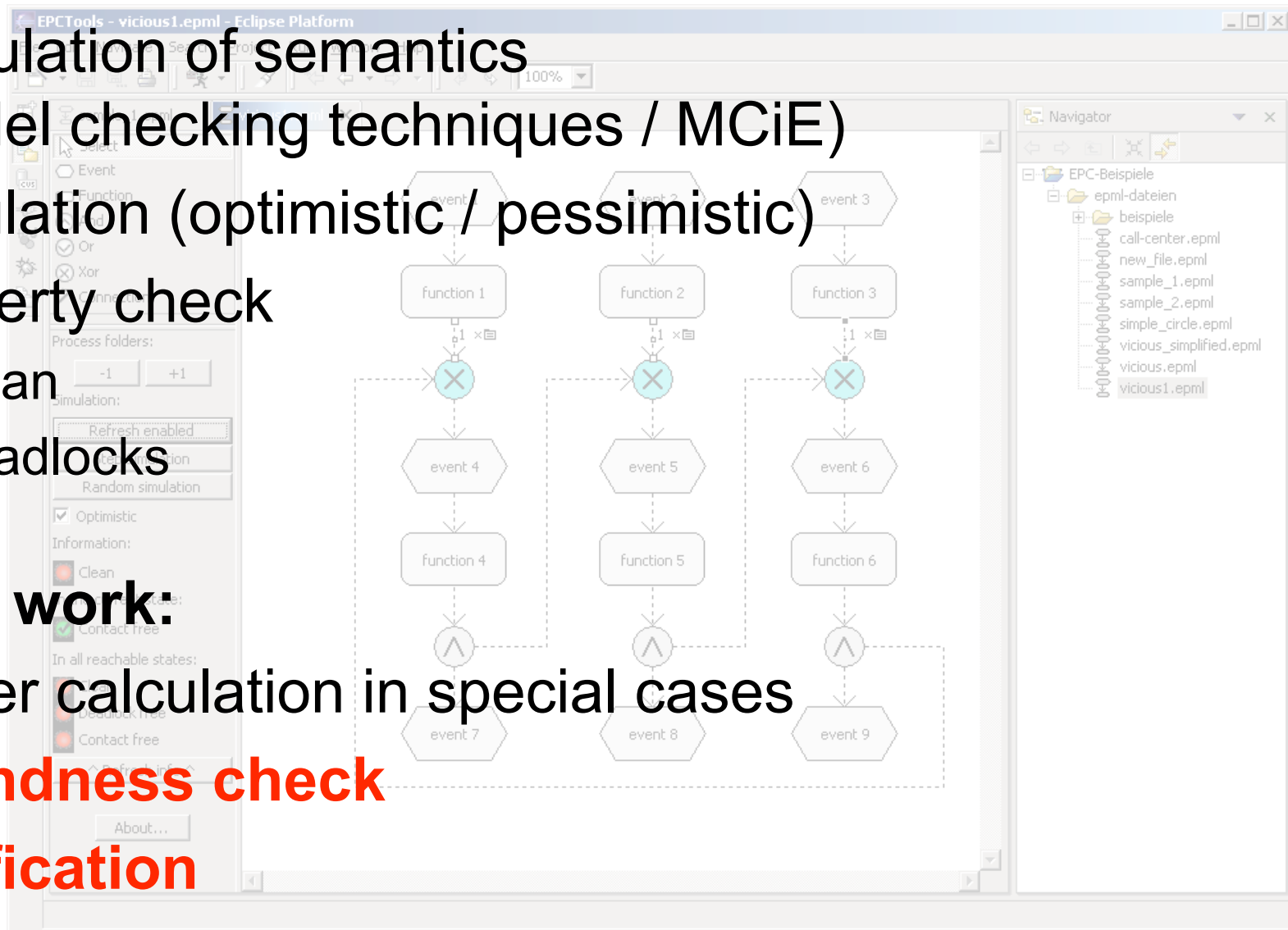
- A sequel of papers
- Informal Semantics
- The vicious circle
- Resolving the vicious circle
  
- Problem
- Solution
- **EPCTools**



- Calculation of semantics (model checking techniques / MCI<sub>E</sub>)
- Simulation (optimistic / pessimistic)
- Property check
  - clean
  - deadlocks

## Future work:

- Faster calculation in special cases
- **Soundness check**
- **Verification**





- A sequel of papers
- Informal Semantics
- The vicious circle
- Resolving the vicious circle
  
- Problem
- Solution
- EPCTools