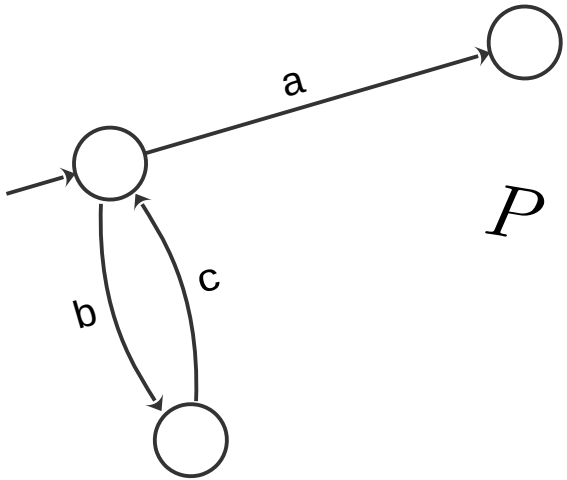
Formalism: Process Algebras

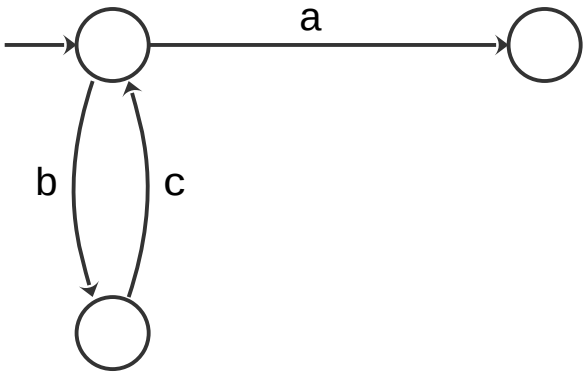
CTCT Short Talk. Paper: *“A process algebra with global variables”*



$$P \stackrel{\text{def}}{=} (a \parallel b) + (c \parallel d).P$$

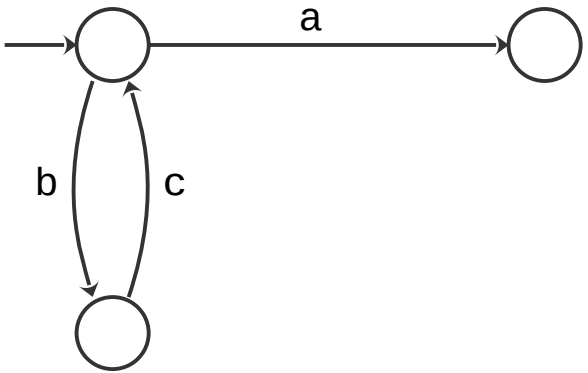
$$\varphi \wedge \langle T \rangle \psi$$

Concurrent System Model:
Labeled Transition Systems



Concurrent System Model:
Labeled Transition Systems

- Behaviour described as transitions between states



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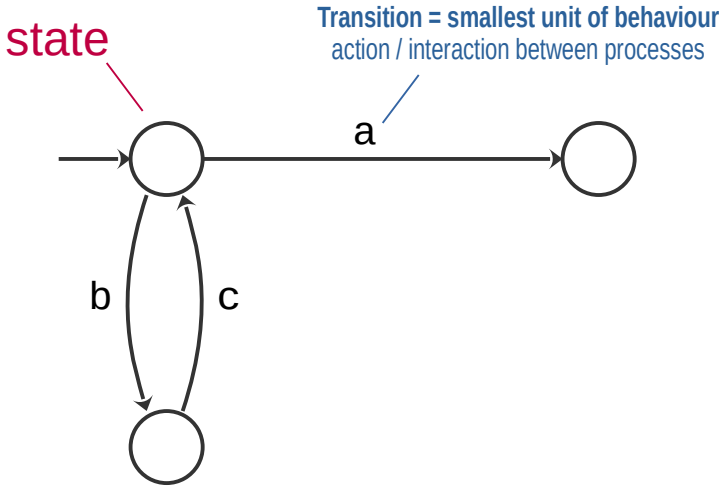

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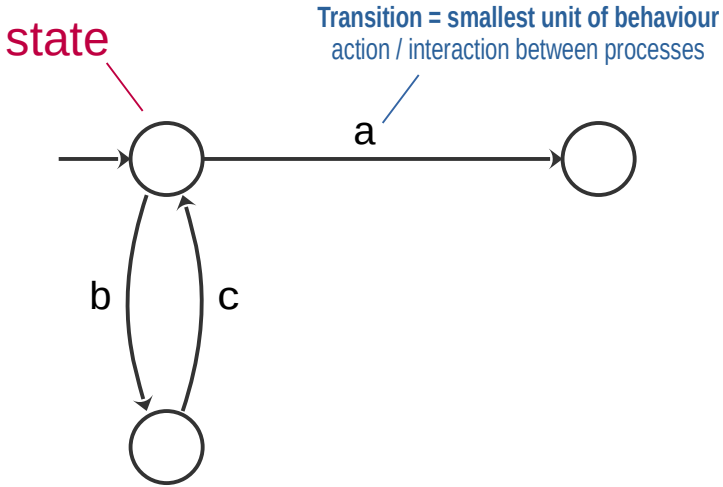

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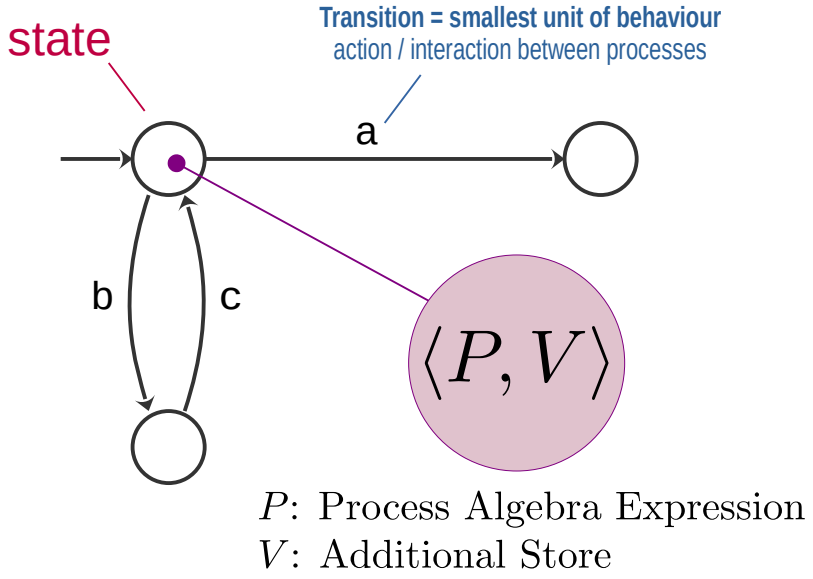

Concurrent System Model:
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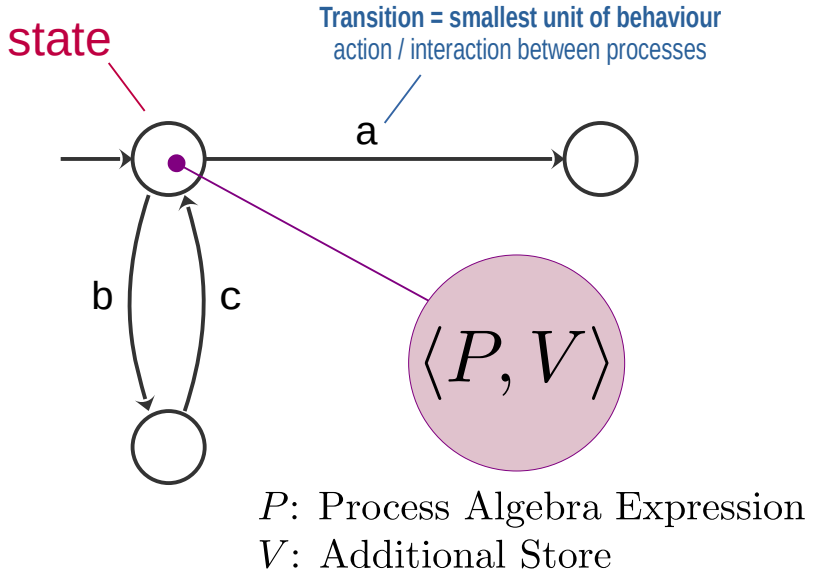
- Behaviour described as transitions between states
- Where comes the process algebra in?
  - Process algebra expressions give the states and the possible transitions



Process Algebra Expressions

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Primitives

λ

abstract actions

$assign(v, d)$

variable assignments

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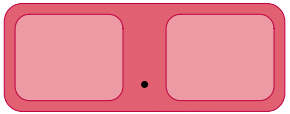
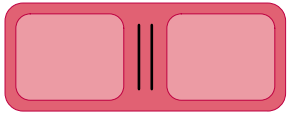
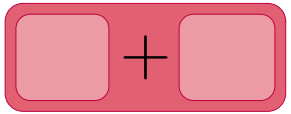


sequential composition



parallel composition



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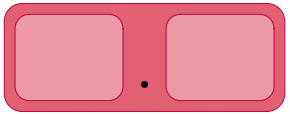

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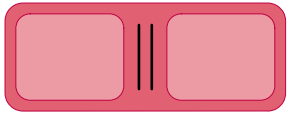

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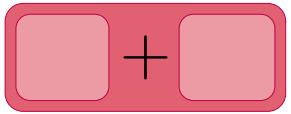

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Recursive Definitions / “Calls”

$\langle \text{name} \rangle \stackrel{\text{def}}{=}$ 

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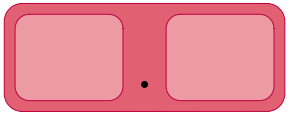

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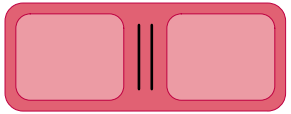

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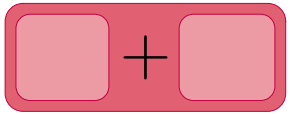

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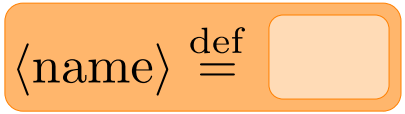
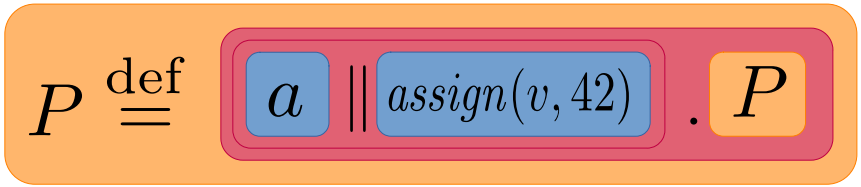


$\langle \text{name} \rangle$



$P \stackrel{\text{def}}{=} a \parallel assign(v, 42) \,.\, P$

”Assign 42 to v and perform action a in parallel, then repeat.”

Analysis Tools

e.g. to check bisimilarity of expressions etc.

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Algebraic laws & equational reasoning

Commutativity of choice

$$P + Q = Q + P$$

e.g.

Right-distributivity of choice and sequentialization

$$(P + Q).R = P.R + Q.R$$

$\Longrightarrow$ directly analyze expressions

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Hennessy-Milner logic

Classical connectives of logic

$$\vee, \wedge, \neg$$

special connectives to inspect future transitions

$$[T]\varphi, \langle T \rangle \varphi$$

$\Longrightarrow$ analyze transition system states

Pros & Cons (Opinion)

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+ **abstracts** from details, **focuses** on communication and synchronization

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- no direct graphical modeling

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- interleavings instead of true concurrency

Pros & Cons (Opinion)

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+ **abstracts** from details, **focuses** on communication and synchronization

+ induced transition systems visualize expressions

+ slighty closer to actual programming languages than purely graphical formalisms

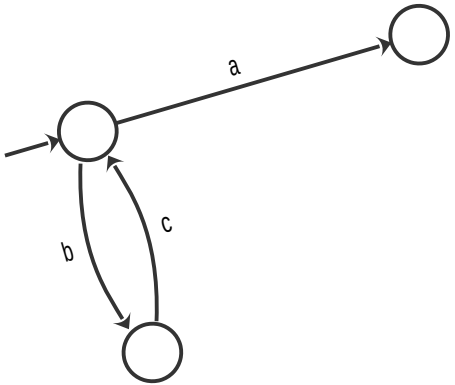
- no direct graphical modeling

- states only modeled implicitly (intermediate states easier to model in e.g. petri nets)

- interleavings instead of true concurrency

- not as close to real programming languages, like formalisms of active objects / actors (e.g. ABS)

Thank you for listening!



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Any questions?

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