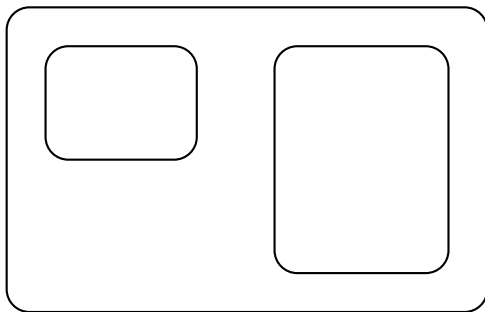# P Systems with States: Polymorphism on Steroids

Artiom Alhazov, Rudolf Freund,
Sergiu Ivanov, Marion Oswald

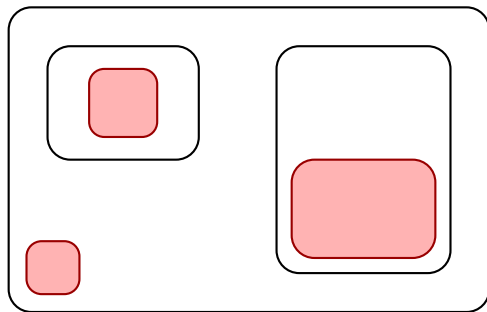BWMC14

# P Systems with States

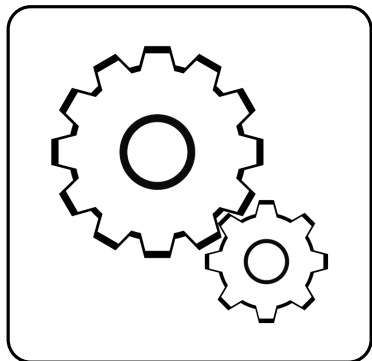Usually — no explicit state

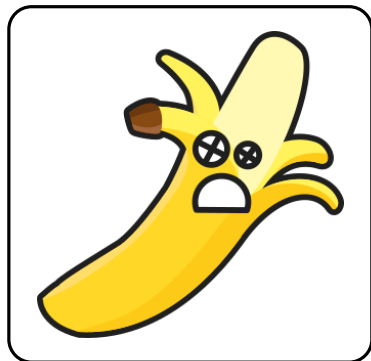# P Systems with States

Usually — no explicit state



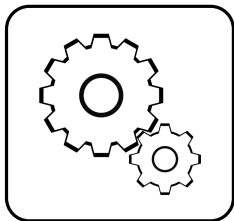Consider some parts as state

# States: Halting



state = evolve

state = halt

# States: Toxicity



state = evolve
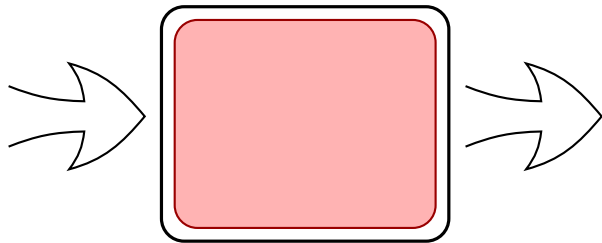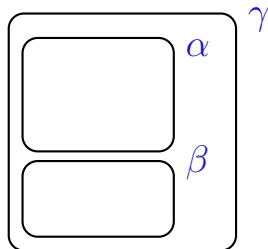


state = halt



state = toxic
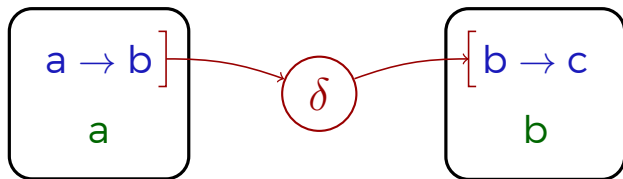
States: P Automata

Acceptance by final states.

# Membrane Annotations as States

- polarisation
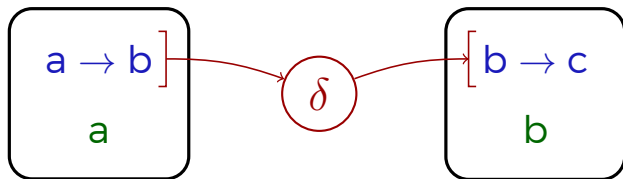
- permeability

- energy

- . . .



$$\text{State} \,=\, (\alpha, \beta, \gamma)$$

# States as Control on Rules



- ▶ graph control
- ▶ label selection
  - ▶ complete graph
- ▶ time-varying systems
  - ▶ periodicity

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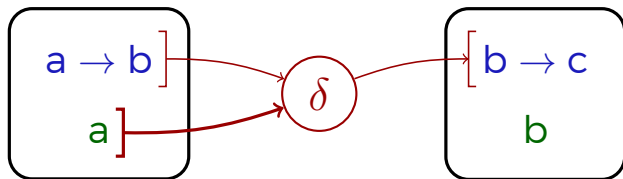
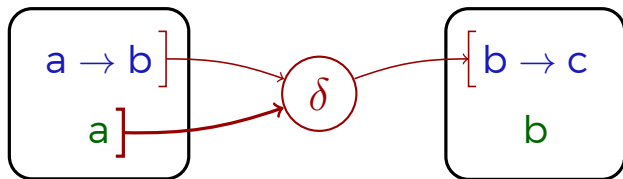(no dependence on membrane contents)

# States as Control on Rules



- ▶ graph control
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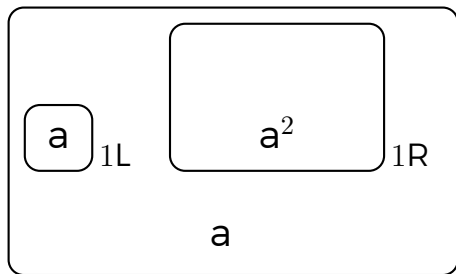
- ▶ polymorphic P systems

(new state depends on rules and membrane contents)

# Polymorphism: Superexponential Growth

| step | skin |
|------|------|
| 0    | a    |

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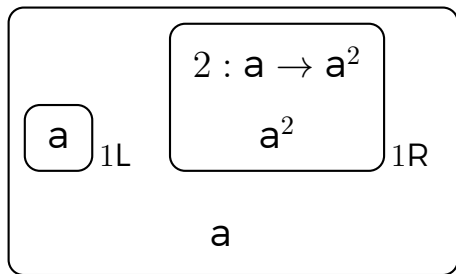
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# Polymorphism: Superexponential Growth
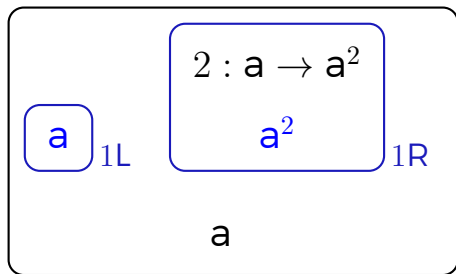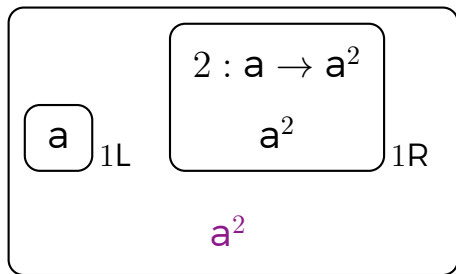
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$$2 : a \rightarrow a^2$$

$a^2$

a $_{1L}$

$_{1R}$

$a^2$

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| step | skin |
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| 1 | $a^2$ |



$$2 : a \rightarrow a^2$$

$a^4$ (labeled 1R)

a (labeled 1L)

$a^2$
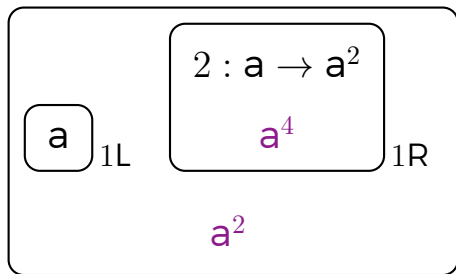
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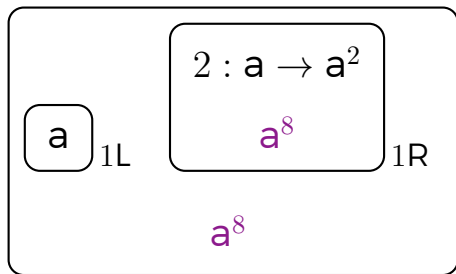
| step | skin |
|-----:|------|
| 0 | a |
| 1 | $a^2$ |
| 2 | $a^8$ |

# Polymorphism: Superexponential Growth

| step | skin |
|-----:|------|
| 0 | a |
| 1 | $a^2$ |
| 2 | $a^8$ |
| 3 | $a^{64}$ |
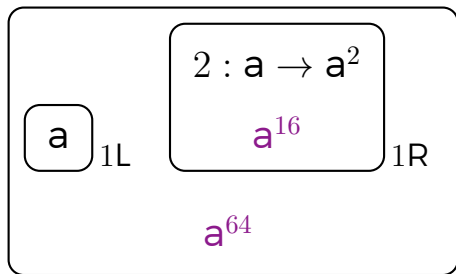
# Polymorphism: Superexponential Growth

| step | skin |
|-----:|------|
| 0 | $a$ |
| 1 | $a^2$ |
| 2 | $a^8$ |
| 3 | $a^{64}$ |
| 4 | $a^{1024}$ |
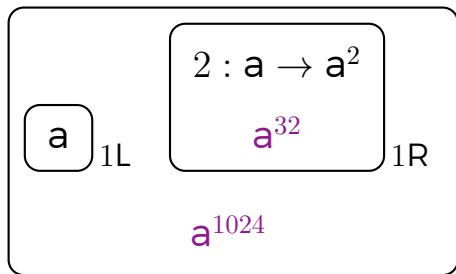
# Polymorphism: Superexponential Growth

| step | skin |
|------|------|
| 0 | $a$ |
| 1 | $a^2$ |
| 2 | $a^8$ |
| 3 | $a^{64}$ |
| 4 | $a^{1024}$ |
| n | $a^{2^{\frac{n(n+1)}{2}}}$ |
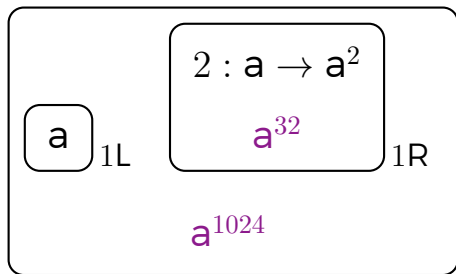
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  - even the derivation mode!

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- Practical applications?
  - parameters depending on states may be easy to implement