On the complexity of active P systems

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Question

" What is the efficiency of P systems with active membranes and electrical charges where evolution and communication rules are forbidden?"

— Păun, G., Rozenberg, G., Salomaa, A. (eds.): The Oxford Handbook of Membrane Computing. Oxford University Press (2010)

Preliminary answer

One can construct a membrane system in polynomial time for every 3SAT instance, which system will decide that the given instance is satisfiable or not.

Reminder

Our toolbox consists of

- dissolution rules:

$$[a]_h^\alpha \to b,$$

- division rules for elementary membranes:

$$[a]_h^{\alpha_1} \to [b]_h^{\alpha_2}[c]_h^{\alpha_3},$$

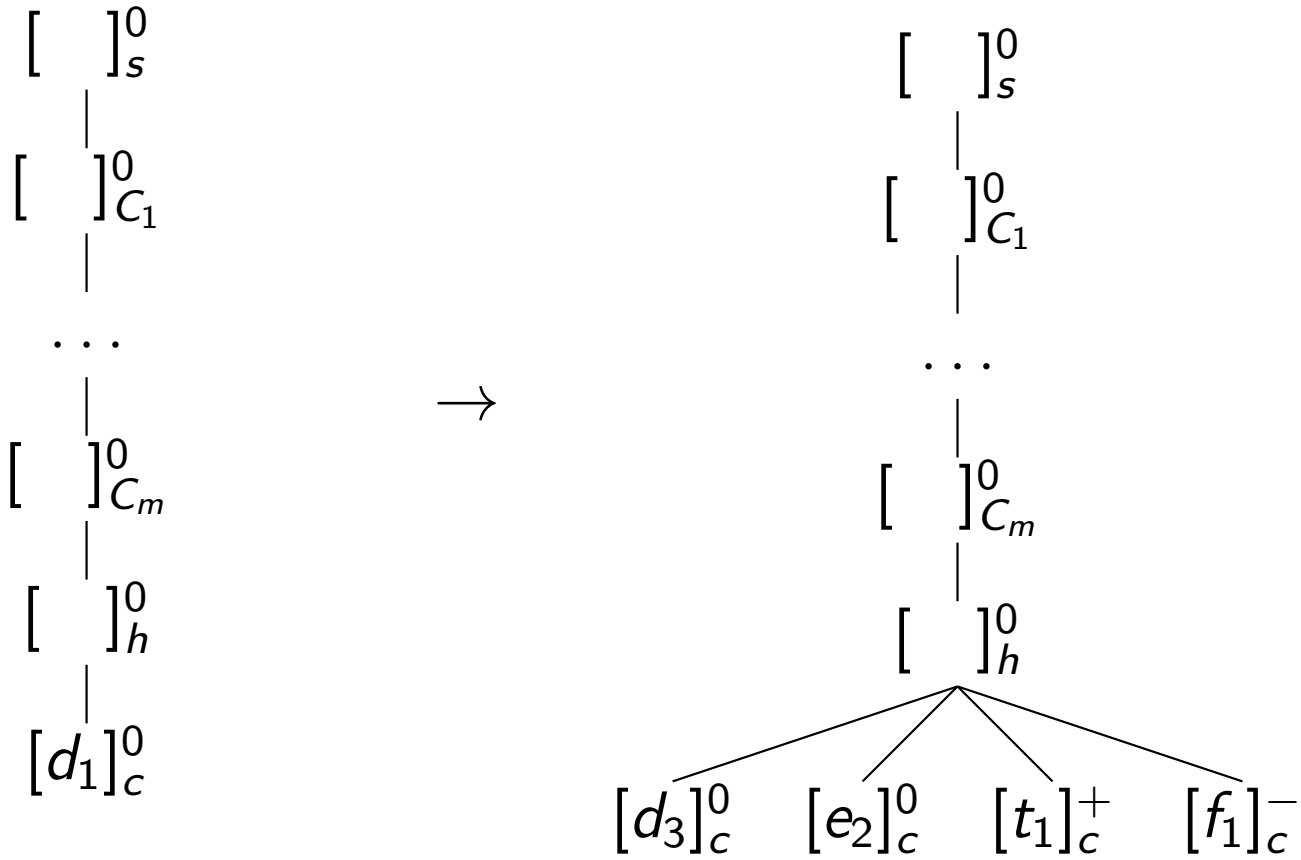
- division rules for non-elementary membranes:

$$\left[\left[\quad\right]_{h_1}^{\alpha_1}\cdots\left[\quad\right]_{h_k}^{\alpha_1}\left[\quad\right]_{h_{k+1}}^{\alpha_2}\cdots\left[\quad\right]_{h_n}^{\alpha_2}\right]_h^{\alpha} \to$$
$$\left[\left[\quad\right]_{h_1}^{\alpha_3}\cdots\left[\quad\right]_{h_k}^{\alpha_3}\right]_h^{\beta}\left[\left[\quad\right]_{h_{k+1}}^{\alpha_4}\cdots\left[\quad\right]_{h_n}^{\alpha_4}\right]_h^{\gamma}.$$

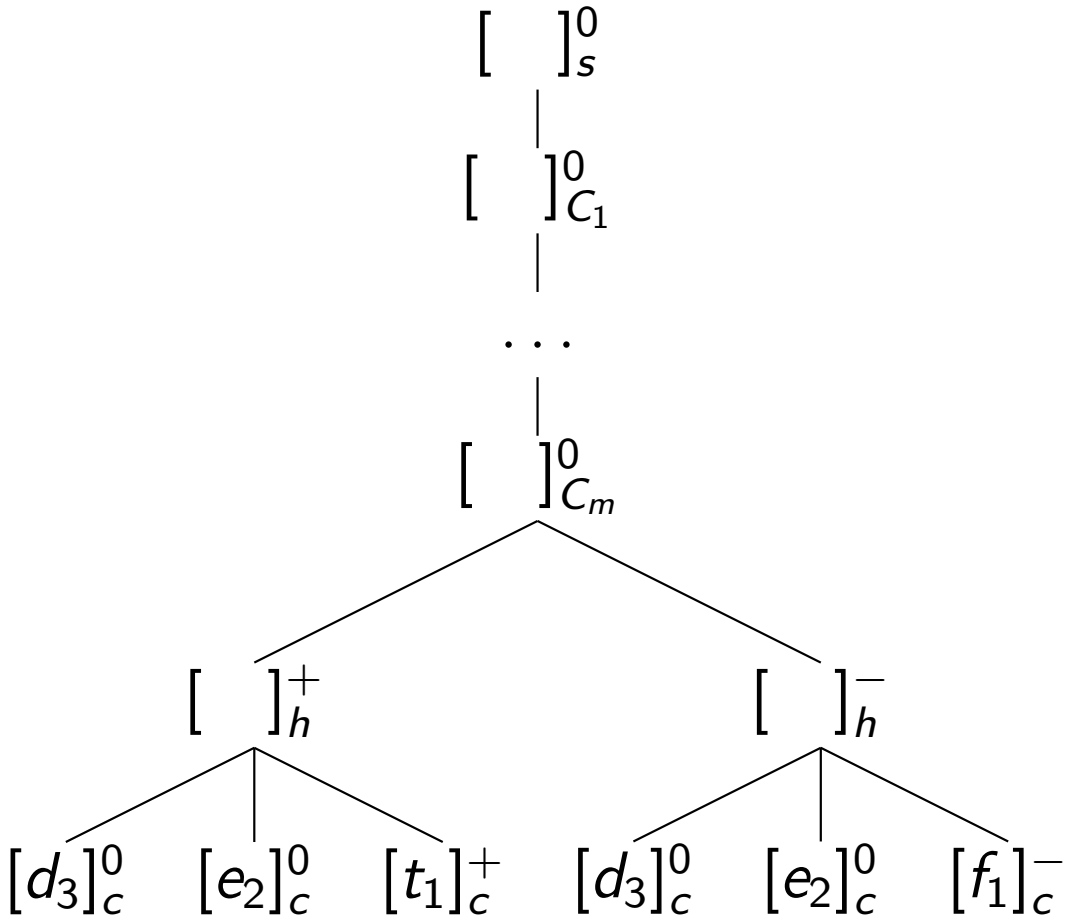
Reminder

The rules are applied in a maximal parallel manner, “from bottom-up”, in one step.

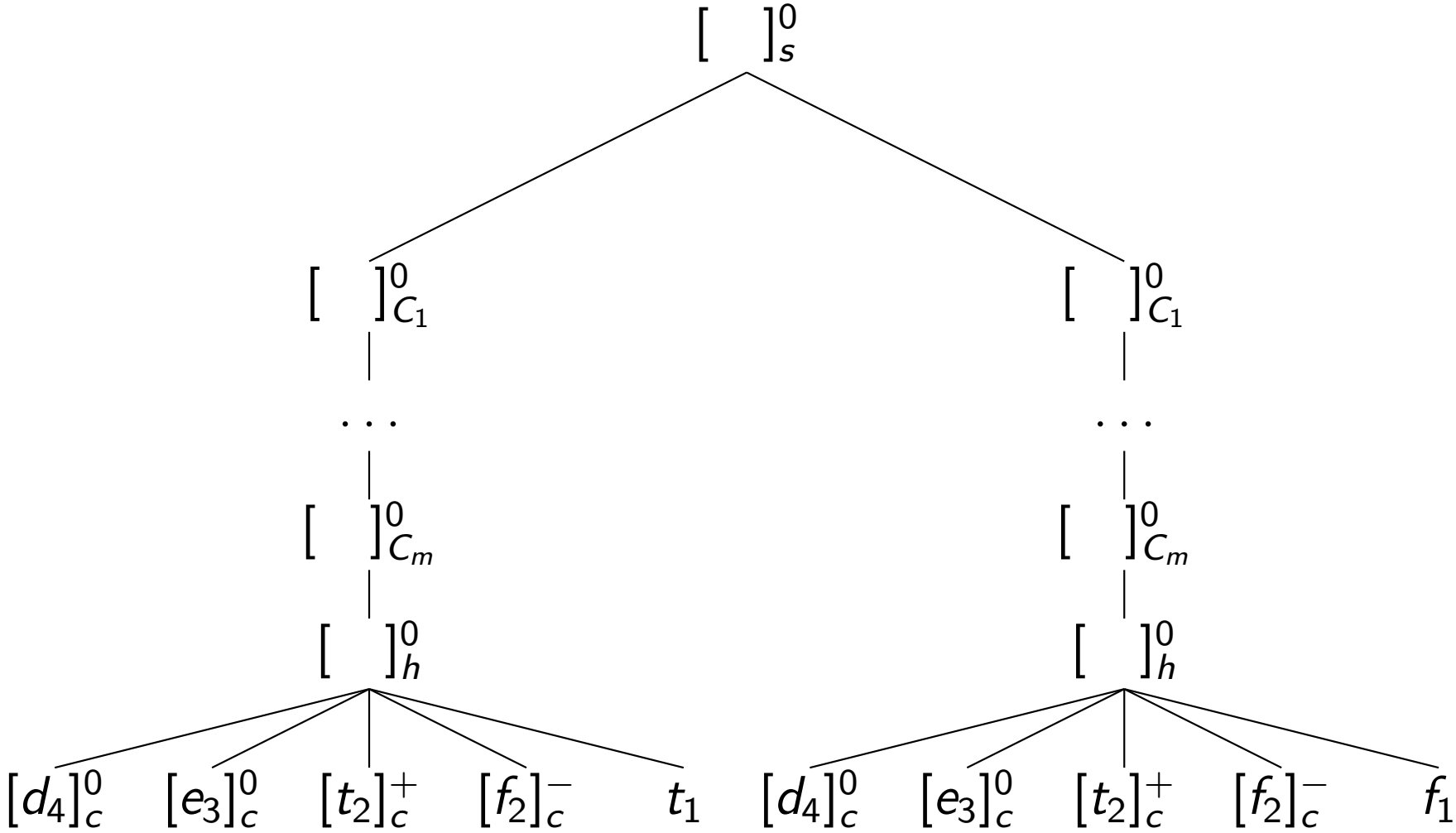
Initial state and the first few steps



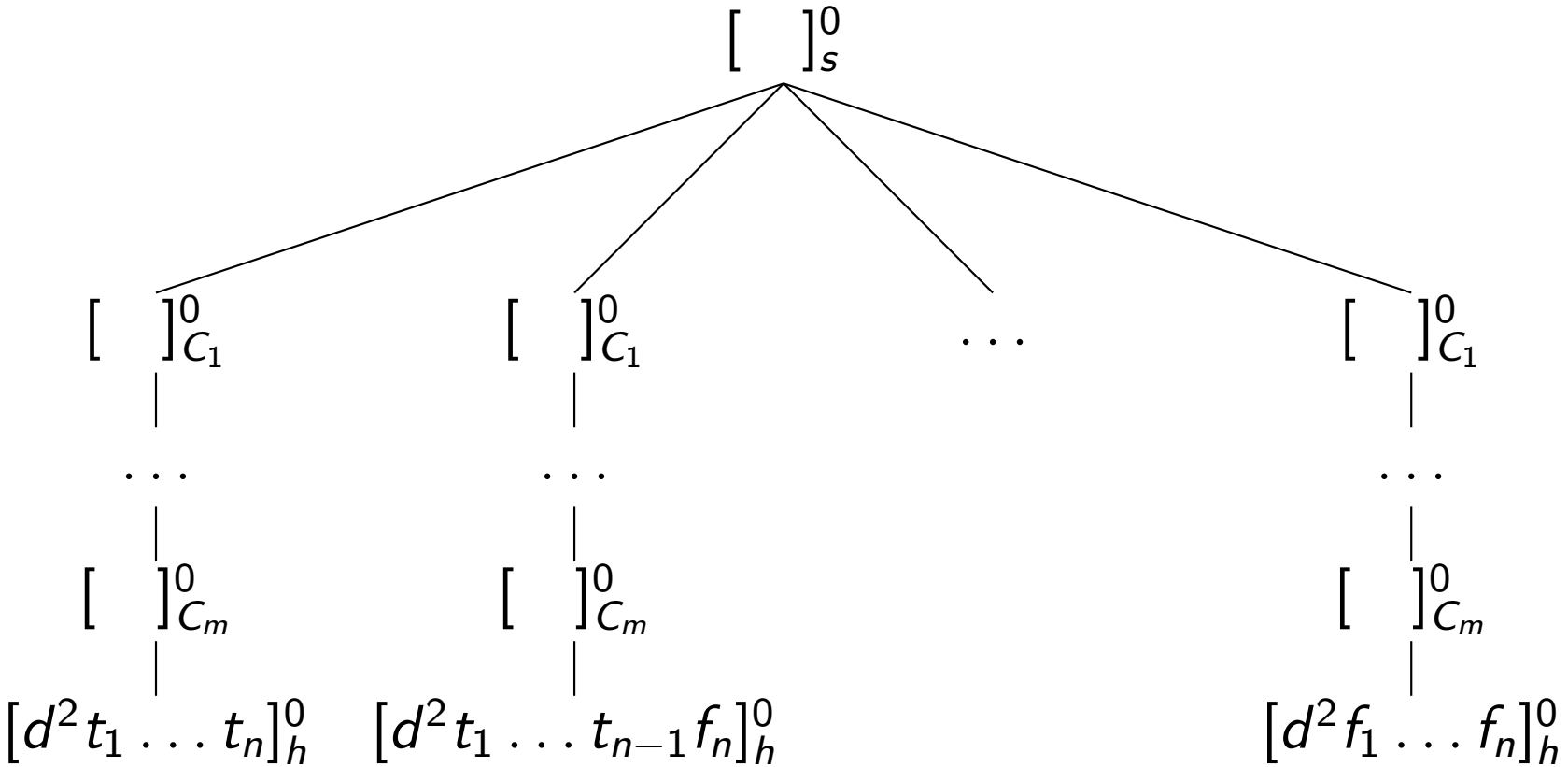
First few steps



First few steps



Intermediate state



Evaluation - example

Let $C_i = x_1 \vee \neg x_2 \vee x_3$ be our clause.

- $[t_1]^0_{C_i} \rightarrow t_1$
- $[f_2]^0_{C_i} \rightarrow f_2$
- $[t_3]^0_{C_i} \rightarrow t_3$

Thank you for your attention!