Fuzzifying P Systems

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- The essence of fuzzy set theory is that elements belong to a set with a membership degree, which is a number that (certainly!) belongs to the unit interval.
- Fuzzy set theory is considered by many as a way to simplify the man-machine communication.
- Nevertheless, fuzzy set theory is useful to describe everyday experiences.

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- Living systems are inherently “fuzzy” (in the broad sense of the word).
- Ergo, fuzzy P systems may provide a new way to view and study things.

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- Thus, P systems can be fuzzified by substituting crisp data with fuzzy data.

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- Multi-fuzzy sets are the mathematical structures we need.

Formalities

- Suppose that X is a (fixed) universe, then a *multi-fuzzy set* is a function $A : X \to \mathbb{N}_0 \times \mathrm{I}$, where $\mathbb{N}_0$ is the set of all positive integers including zero and I is the unit interval $[0, 1]$. The expression $A(x) = (n, i)$ denotes that the degree to which x occurs n times in the multi-fuzzy set is equal to i.

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- Starting from a multi-fuzzy set A, we can define the following two functions: the *multiplicity* function $A_m : X \rightarrow \mathbb{N}_0$ and the *membership* function $A_\mu : X \rightarrow I$. Obviously, if $A(x) = (n, i)$, then $A_m(x) = n$ and $A_\mu(x) = i$.

P Systems with Fuzzy Data

A P system with fuzzy data is a construct

$$\Pi_{\mathrm{FD}} = (O, \mu, w^{(1)}, \ldots, w^{(m)}, R_1, \ldots, R_m, i_0, \lambda)$$

where

- $w^{(i)} : O \rightarrow \mathbb{N}_0 \times \mathrm{I}$, $1 \leq i \leq m$, are functions that represent multi-fuzzy sets over O associated with each region i;

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- $\lambda \in [0, 1]$ is a threshold parameter, which is used in the final estimation of the computational result.
- All other components are similar to the “crisp” case.

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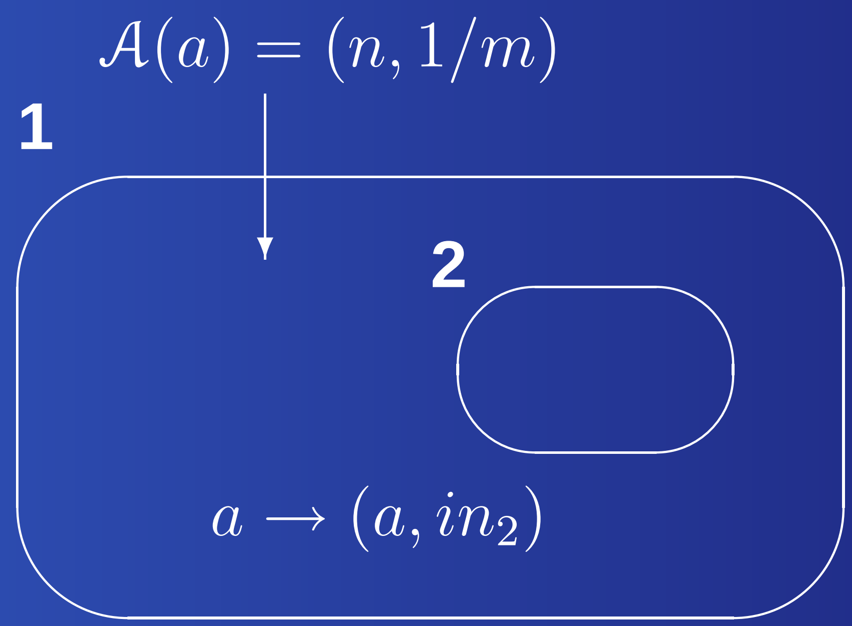
- the initial results may not be the result of some fuzzification process!
- Ergo, we can compute real numbers in an unexpected way!

An example



The output of the system above is the number n/m.

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- Trail-and-error machines are hypermachines!
- The human mind according to Lucas, Penrose, Kugel, Bringsjord and others is a hypermachine.
- Computing real numbers is a step towards hypercomputation.
- P systems are interactive, thus, according to Wegner, they are hypermachines.

That's all!

I thank the speaker and all of you! Please send me questions and/or suggestions to `apostolo@ocean1.ee.duth.gr`.