



**Seminar Hora Informaticae**

**Institute of Computer Science, Prague**

Tuesday, November 7, 2023, 14.00 – 15.30 (2 - 3:30 PM) CET

Meeting room 318, Address: Pod Vodárenskou věží 2, Prague 8

ZOOM Meeting ID: 954 7823 4977 , Passcode: 712564

ZOOM: <https://cesnet.zoom.us/j/95478234977?pwd=dXoyekFHbDJ0MkNrTjVVS3F2STZqUT09>



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**Jiří Šíma (Institute of Computer Science, CAS):**

### **Chomsky-Like Neural Network Hierarchy**

The computational power of neural networks (NNs) depends on the Kolmogorov complexity of their weight parameters. We will present a Chomsky-like hierarchy for NNs with  $\alpha$  analog neurons ( $\alpha$ ANN), which complements the analysis for realistic models between integer (finite automata) and rational weights (Turing machines). We achieved the separation of the first two levels 1ANN, 2ANN of this hierarchy and proved its collapse to 3ANN. This research also motivated the definitions of two new interesting concepts that will be introduced in the lecture. Namely, we will define a periodic number in positional system with non-integer radix and digits. We will present a new notion of a C-simple problem which is a conceptual counterpart to the standard complexity-theoretic definition of C-hard problems, e.g. NP-hard problems. (This is a joint work with Petr Savický, Petr Jančar, and Martin Plátek).

#### References:

Jiří Šíma: Subrecursive neural networks. *Neural Networks* 116:208-223, 2019.

Jiří Šíma: Analog neuron hierarchy. *Neural Networks* 128:199-218, 2020.

Jiří Šíma, Petr Savický: Quasi-periodic  $\beta$ -expansions and cut languages. *Theoretical Computer Science* 720:1-23, 2018.

Jiří Šíma: Stronger separation of analog neuron hierarchy by deterministic context-free languages. *Neurocomputing* 493:605-612, 2022.

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**Jiří Šíma** is a senior scientist from the Department of [Theoretical Computer Science](#), Institute of Computer Science of the Czech Academy of Sciences. His main research interests are mathematical theory of computational models, neural networks and theoretical computer science.

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**HORA INFORMATICAЕ** (meaning: TIME FOR INFORMATICS) is a broad-spectrum scientific seminar devoted to all core areas of computer science and its interdisciplinary interfaces with other sciences and applied domains. Original contributions addressing classical and emerging topics are welcome. Founded by Jiří Wiedermann, the seminar is running since 1994 at the Institute of Computer Science of the Czech Academy of Sciences in Prague.

<https://www.cs.cas.cz/horainf>