Barbora Hudcová | Curriculum Vitae

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Education

- **Ph.D. Student** — **Prague**
  Charles University, Faculty of Mathematics and Physics — *2020–ongoing*
  Supervisors: Tomáš Mikolov and Jiří Tůma. I study dynamical systems as possible models of open-ended evolution. I concentrate on studying formal notions of complexity and chaos within discrete systems.
- **MSc. Student, graduated with honors** — **Prague**
  Charles University, Faculty of Mathematics and Physics — *2018–2020*
  Master thesis on "Complexity in Cellular Automata", supervisor: Tomáš Mikolov. I explored the notion of complexity within a class of dynamical systems called cellular automata and presented a novel classification of their dynamics, which can further be used to automatically search for automata with complex behavior. I also presented a novel representation of one-dimensional automata related to their backward dynamics; it can be used to characterize all the automaton's configurations without any preimages.

Work Experience

- **Junior Researcher** — **Prague**
  Czech Institute of Informatics, Robotics and Cybernetics, CTU — *2019–ongoing*
  I am a member of a research team lead by Tomáš Mikolov which conducts research in the field of intelligent systems. Our main goal is to find automated methods of searching for complex systems which could be used for artificial life simulations.

Teaching

Teaching assistant at Charles University, Faculty of Mathematics and Physics:

- Linear Algebra II *2021*
- Linear Algebra I *2020*
- Linear Algebra I *2019*
- Convex Optimization *2018*
- Number Theory Seminar *2018*

Conference and Summer School Participation

- ALIFE 2020 (accepted paper: "Classification of Complex Systems Based on Transients"), online
- Summer School of Centre for Complex System Studies, Utrecht, Netherlands, *2019*
- Summer School on real-world crypto and privacy, Šibenik, Croatia, *2019*

Seminar and Conference Organization

- Main organizer of the AI Seminar at the Czech Institute of Informatics, Robotics and Cybernetics for research groups in the field of AI. *2021–ongoing*
- Main organizer of a four-day conference, the School of Algebra, for the Algebra Department students at the Charles University; taking place every semester. *2018–2019*

Extracurricular

- Participant in an online course Competitive Mathematics organized by the Center for Talented Youth, Johns Hopkins University. This course was offered to five Czech and five Slovak students with a passion for mathematics. As I obtained top results, I was offered a scholarship for a month-long summer program at University of California, Berkeley, to study Civic Leadership, *2012*

Languages

- English (fluent), German (upper intermediate), Chinese (intermediate), Japanese (intermediate).
- English language certificates: FCE (2010) and CAE (2014).
- Chinese language certificates: HSKK, Primary Level (2014) and HSK 3 (2013) (level B1).

Grants

- START Grant, Charles University *04/2021–03/2023*

The funding will cover all traveling expenses and the cost of living during my internships for the next two years.

Publications

[1] Barbora Hudcová, Tomáš Mikolov. Classification of Complex Systems Based on Transients. *Artificial Life Conference Proceedings 32*, 367-375, 2020, 10.1162/isal_a_00260, `https://arxiv.org/abs/2008.13503`.

We present a novel classification of cellular automata dynamics based on their asymptotic growth of average computation time. We demonstrate its usefulness to automatically find cellular automata with complex behavior.

[2] Barbora Hudcová, Tomáš Mikolov. Classification of Discrete Dynamical Systems Based on Transients. *Accepted to ALife Journal, Special Issue*.

We generalize the transient classification method by applying it to other discrete systems — Turing machines and random Boolean networks. In both cases, the method produces clear results and seems to identify a phase transition region. This is confirmed by analytic results in the case of random Boolean networks.

[3] Barbora Hudcová, Tomáš Mikolov. Computational Hierarchy of Elementary Cellular Automata. *Accepted to ALife 2021 conference*.

We study the capability of CA to simulate one another. This notion gives rise to a computational hierarchy which we present for elementary CA. The results show that the most chaotic CA seem to be exactly those incapable of simulating any other automata. This motivates a new notion of "computational chaos" which we present.