

You are invited to the 63rd edition of the **PRAGUE COMPUTER SCIENCE SEMINAR**

ONDŘEJ KUŽELKA

First-Order Model Counting and Sampling

The lecture will be followed by a discussion

October 16, 2025

4:15pm

**Auditorium S5, MFF UK
Malostranské nám. 25,
Praha 1**

ABSTRACT

Why are some combinatorial structures easy to count and sample, while others are not? For example, the number of permutations is given by a simple factorial, and there are efficient textbook algorithms to generate permutations uniformly at random. But what if we ask instead: how many graphs on n vertices satisfy a given property or what if we want the permutations to satisfy some additional constraints? Is there a systematic way to identify which such counting and sampling problems are tractable? First-order model counting (FOMC) and its sampling variant (FOMS) provide a unifying framework for addressing a non-trivial subset of these questions. In FOMC, we ask how many structures over a finite domain satisfy a given first-order sentence, and FOMS extends this to sampling such structures. Following the seminal results of Van den Broeck (2011) and Van den Broeck, Meert, and Darwiche (2014), which showed that the two-variable fragment is tractable for FOMC, larger polynomial-time solvable classes have been identified in the past decade and extended to FOMS. In this talk, we will survey these developments and illustrate applications: automating routine counting in combinatorics and probability (such as the classic Secret Santa problem, which asks in how many ways n people can exchange gifts so that nobody receives their own), building a database of “interesting” combinatorial integer sequences, and providing new insights into classical problems in algorithmic game theory.

ABOUT THE PRAGUE COMPUTER SCIENCE SEMINAR

The seminar takes place once a month on Thursdays at 4:15pm (mostly excluding June to September, and December) alternately in the buildings of Faculty of Electrical Engineering, Czech Technical University in Prague, Karlovo nám. 13, Praha 2 and Faculty of Mathematics and Physics, Charles University, Malostranské nám. 25, Praha 1. Its program typically consists of a one-hour lecture followed by a discussion. The lecture is based on an (internationally) exceptional or remarkable achievement of the lecturer, presented in a way which is comprehensible and interesting to a broad computer science community. The lectures are in English.



Ondřej Kuželka is an assistant professor in the Intelligent Data Analysis Group at the Faculty of Electrical Engineering, Czech Technical University in Prague (CTU), where he earned his PhD more than a decade ago. Before returning to his alma mater, he spent two years with the DTAI group at KU Leuven and three years at Cardiff University as a post-doctoral researcher. His research interests include logic in artificial intelligence (which falls in the area nowadays somewhat fashionably called “neurosymbolic artificial intelligence”), enumerative combinatorics, and machine learning. His contributions in these fields earned him an invited talk in the Early Career Track at IJCAI 2023 and a nomination for the GAČR President’s Award in 2025.

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