APPLIED MATHEMATICS

Algorithms in game theory
supervisor: prof. RNDr. Katarína Cechlárová, DrSc.
study form: full time
Annotation: The doctoral student will have an opportunity to get ackwainted with the newests trends in the area of Computational Social Choice and solve the newest open problems in voting theory, resource allocation or matching under preferences. We intensively use the language and methods of graph theory; the most relevant areas of theoretical computer science are the design and analysis of exact and approximate algorithms and the analysis of their computational complexity. The topic is suitable also for graduates in Informatics.

Measures of divergence of generalized measures
supervisor: doc. RNDr. Ondrej Hutník, PhD.
consultant: Mgr. Jozef Kiseľák, PhD.
study form: full time
Annotation: The classical definition of Shannon entropy (more generally, an f-divergence covering the Kullback–Leibler divergence) for a probabilistic measure is the core of information theory as well as statistical physics (here known as the Gibbs or Boltzmann entropy). Probabilistic measure is additive by definition, which makes its usage impossible in many situations, where interactions of objects are allowed. There are many attempts for defining an entropy and divergence for non-additive set functions, especially for the discrete case (when the basic set is finite). The aim of this thesis is to study an entropy (and related contexts) in continuous case for which some properties of discrete entropy do not hold (for example the entropy can be negative, or the entropy is not invariant to some coordinate transformation). Finding some relationships with the classical non-additive integrals (except the Choquet integral) and generalized integrals based on super level measures is expected. The maximum entropy principle for non-additive measures seems to be also challenging. Applicant's knowledge in area of mathematical modeling using numerical methods is welcome.

Applications of set-theoretical knowledge on ideals in topology
supervisor: doc. RNDr. Ondrej Hutník, PhD.
consultatnt: RNDr. Jaroslav Šupina, PhD.
study form: full time
Annotation: An ideal on natural numbers is a system of subsets of natural numbers closed under subsets, finite unions, containing finite sets and not containing the whole set of natural numbers. It is a measure of smallness of sets of natural numbers, therefore it has found its traditional place in set theory from the first half of the 20th century. Since the power set of natural numbers with Baire topology is homeomorphic to Cantor set, an ideal is identified with the set of all real numbers. Thus, the set-theoretical research is accompanied by the topological one. A famous survey paper on ideals is [2]. The proposed research of dissertation will deal with a usage of this huge system of intensively developed knowledge in ideal versions of selected traditional notions in topology. We expect a deeper understanding of convergences and selection principles. These notions are recently studied very intensively, see for example [1], [3-7]. A study of relationships between cardinal characteristics of ideals related to these objects introduced in [3-6] seems to be challenging.