Summer School of International Laboratory of Decision Choice and Analysis

Lecture 1. **Alexander V. Lotov "Big Data: Learning and Choice Supported by Approximate Data Enveloping and Visualization"**

Wednesday, 4 June
16:00 – 18:00

Chief researcher of Computing Centre of Russian Academy of Sciences, Professor of Lomonosov Moscow State University

Areas of expertise: Multi-objective optimization, approximation and visualization of the Pareto frontier, approximation of multidimensional convex bodies, perturbations of multi-dimensional convex sets, environmental decision making, reachable sets of dynamic systems.

Abstract

The lecture is devoted to an approach to supporting the human exploration and learning the Big Data as well as human choice of interesting (may be, preferable) data entities. It is assumed that data are given in the form of multi-dimensional points. The method is based on approximation of the envelope (convex hull) of Big Data. Approximation is aimed at visualization of the envelope. Visualization is provided by interactive animation of various collections of two-dimensional slices of the envelope. In the case of selecting a small number of preferable entities from Big Data, the method is transformed into a multi-objective problem, and the Edgeworth-Pareto hull of the Big Data envelope is approximated. Its two-dimensional (bi-objective) slices are usually visualized in the form of decision maps, which give an image of the Pareto frontier of the Big Data envelope, including the tradeoff rates. By this, the deliberate identification of the goal at the Pareto frontier of the envelope is supported. The goal is used for selecting a small number of the preferable entities from Big Data. Examples of interactive animated exploration of Big Data by using the Interactive Decision Maps technique are given.

For online visualization of the Big Data envelope by a large number of its two-dimensional slices, one needs a simple polyhedral approximation of the envelope, that is, polytope with a small number of vertices and hyperplanes. We describe a method of polyhedral approximation of the convex bodies that effectively uses optimization tools and results in simple approximations. It is important that the approximation method is scalable: the complexity of the convex hull approximation does not depend on the number of data entities, but only on the form of the convex hull and its dimension.

The method can be used for visualization of Dynamic Big Data. In this case, the Big Data envelope as well as its two-dimensional slices depend on time. Their consecutive display results in animation of the slices. By this, dynamics of Big Data is visualized.

Lecture 2. **Sergiy Butenko "Clique Relaxations in Networks: Theory, Algorithms, and Applications"**

Thursday, 5 June
17:00 – 18:40

Associate Professor and Donna and Jim Furber `64 Faculty Fellow in Industrial and Systems Engineering, Ph.D., University of Florida

Dr. Butenko's research concentrates mainly on global and discrete optimization and their applications. In particular, he is interested in theoretical and computational aspects of continuous global optimization approaches for solving discrete optimization problems on graphs. Applications of interest include network-based data mining, analysis of biological and social networks, wireless ad hoc and sensor networks, and energy.

Abstract

Clique relaxation models that were originally introduced in the literature on social network analysis are not only gaining increasing popularity in a wide spectrum of complex network applications, but also keep garnering attention of mathematicians, computer scientists, and operations researchers as a promising avenue for fruitful theoretical investigations. This lecture discusses the origins of clique relaxation concepts and provides an overview of recent developments in theory behind them, algorithms for solving the corresponding optimization problems, and selected real-life applications of the models of interest.

The lectures take place at Room K-9 (Building №9).