The amount of data obtained from empirical experiments are often limited. Thus, we have to draw conclusions out of an incomplete information of a studied process. Moreover, limited precision of a sensor or the nature of a problem itself may introduce a noise in a gathered data. The authors of this proposal are particularly interested in the topic of dynamical systems. The datasets related to this subject are most often of the form of time series or vector cloud. The amount of a data and their density determines the resolution of the possible reconstruction of the underlying process.

We are interested in a credible reconstruction of the features of dynamics basing only on its finite sample. A natural strategy is to look for essential elements of dynamics, isolated invariant sets, such like attracting and repelling sets, periodic orbits or saddles. Then we can try to characterize relations between them, that is how trajectories of a system connects them. Extraction of these informations can help us to determine the general behaviour of a studied process and allow to investigate a similarity of two systems. The Conley-Morse theory provides tools for detection of these essential parts of a system and for compact representation of a global dynamics.

The combinatorial approach seems to be the most appropiate, when taking into account the nature of sampled dynamical systems. Developed recently by M. Mrozek theory of multivector fields adapts Conley-Morse theory into algebraic settings of Lefschetz complexes. This theory combine the language of topology, partial orders and graph theory. It allows for combinatorial modelling of continuous dynamical systems. Moreover, the numerical experiments show that it can be successfully applied for topological features reconstruction of a system out of a data with a presence of noise.

However, the observations made during these experiments indicated several weak points of the multivector fields theory. The main goal of this project is to reformulate this theory. First, some of the fundamental concepts for this theory will by simplified. Second, it will be adapted to the broader class of spaces then Lefschetz complexes, namely, the class of finite T_0 topological spaces. Moreover, authors will investigate the possibility for introduction more ideas from the classical theory of dynamical systems into combinatorial settings. Finally, the simplified theory will allow to develop efficient algorithms, that will help to verify its effectivnes.