

DISCRETE MATHEMATICS

Walks in plane and embedded graphs

supervisor: prof. RNDr. Tomáš Madaras, PhD. (tomas.madaras@upjs.sk)

consultant: RNDr. Juraj Valiska, PhD. (FEI TU Košice)

study form: full time

Annotation: The aim of the research in the presented topic is to study various types of walks, consecutive edges of which are defined by conditions related to the topological representation of graphs, that is, related to plane embeddings, to embeddings into surfaces of higher genera and to prescribed rotation systems, respectively; the general research framework thus defined covers many types of walks studied so far, e.g. A-walks, geodetic (cut-through) and Petrie walks, or W_v paths and cycles. The research will focus on problems of existence of such walks, trails, paths or cycles in graph classes (with using analogies of the connection concept in graphs), examining estimates for their length, applications and algorithmic aspects of their search.

Operations on congruences of algebras

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study form: full time

Annotation: Congruence lattices are one of main topics of research in universal algebra. However, the set of congruences allows to define, besides lattice operations, also other natural operations. For this purpose one can use primitive positive formulas, or, equivalently, valuated graphs. These operations have been used to characterize systems of equivalences that can become systems of congruences for a suitable algebraic structure. Besides this result, the topic is almost untouched. There is a possibility to generalize various results about congruence lattices of algebras.

Generalised graph colourings

supervisor: doc. RNDr. Roman Soták, PhD. (roman.sotak@upjs.sk)

study form: full time

Annotation: To study different chromatic characteristics of graphs, among other things DP-chromatic number and Alon-Tarsi number. To investigate their generalisations corresponding to the list version or its analogues, respectively. To focus on new proof techniques in this area as are Nullstellensatz or else entropy compression.

From proper to strong edge colouring of graphs

supervisor: doc. RNDr. Roman Soták, PhD. (roman.sotak@upjs.sk)

study form: full time

Annotation: To study proper edge colourings of graphs that fulfill stronger conditions for some colours. A strong colouring requires for each colour that vertices of edges of that colour induce a matching. It is known that $\Delta(G)+1$ colours are sufficient for a proper colouring of a graph G . It is conjectured that $1,25 \cdot \Delta(G)^2$ colours are sufficient for a strong colouring of a graph G , but currently the best known upper bound is $1,772 \cdot \Delta(G)^2$ colours. Try to find new upper bounds for the number of colours in a strong colouring for some classes of graphs (regular graphs, bipartite graphs, plane graphs, etc.).