

Mathematics B.Sc., Thesis Topics 2026
University of Debrecen, Institute of Mathematics

Applications of vector analysis

Thesis supervisor: Dr. Ágota Figula

Topic description: Vector analysis is a fundamental mathematical tool widely used in physics and engineering to describe spatial phenomena such as electromagnetic fields, fluid flow, and force systems. This thema focuses on the theoretical foundations of vector calculus (gradient, divergence, and curl) and explores their applications in selected real-world problems.

Investigation of the Walsh system via computer algebra tools

Thesis supervisor: Dr. György Gát

Additional information: Basic programming knowledge of MATLAB/MAPLE/R software packages is required

Topic description: Characterization of kernel functions for various summation methods concerning locally constant orthonormal function systems.

Knot theory

Thesis supervisor: Dr. Márk Oláh

Additional information: The topic has already been assigned.

Topic description: In topology, a knot is defined as an embedding of the 1-sphere into three-dimensional Euclidean space. The primary objective of knot theory is to classify these embeddings up to ambient isotopy, an equivalence relation that formalizes the continuous spatial deformation of the knot without allowing self-intersection. To accomplish this classification, we construct topological invariants (like the knot group and algebraic polynomials) that remain constant under certain (Reidemeister) moves.

Latin squares

Thesis supervisor: Dr. Ágota Figula

Topic description: A Latin square of order n is an $n \times n$ matrix with entries from the set $\{1, 2, \dots, n\}$ with the property that every element of $\{1, 2, \dots, n\}$ appears exactly once in each row and column. The purpose of this thema is to discuss the occurrence and the role of Latin squares in different areas.

Numerical approximation of matrix eigenvalues

Thesis supervisor: Dr. Borbála Fazekas

Topic description: The aim of this work is to demonstrate numerical methods for determining upper and lower bounds for eigenvalues.

Numerical methods for nonlinear equations

Thesis supervisor: Dr. Borbála Fazekas

Topic description: The aim of this work is to demonstrate numerical methods for nonlinear equations. We are interested in methods which are not covered by the basic numerical analysis courses.

Numerical methods for the solution of Kepler's equation

Thesis supervisor: Dr. Gergő Nagy

Additional information: The topic has already been assigned.

The ice cream shop location problem

Thesis supervisor: Dr. Zoltán Boros

Topic description: Finding the equilibrium states for several ice cream makers, assuming that each of them looks for a position that maximizes his/her income, is a classical problem in applied game theory. We consider this problem for positions taken at a point from an interval as well as for positions chosen from a finite set.

Tomography

Supervisor: Dr. Ábris Nagy

Topic description: Tomography is a discipline, where images of cross-sections of a body are produced in order to reveal the inner structure of the body. During a CT-scan, x-ray beams penetrate through the human body and the change of intensities of these beams are measured. Then the inner structure is revealed with the help of mathematical computations. However, tomographic examinations can be applied not just for the human body, but structures made of metal, or a piece of rock, or even the Earth's atmosphere. The mathematical problem is to reconstruct an unknown distribution of a physical quantity with the knowledge of the values of its line integrals. The discrete version of this problem is when we wish to find an unknown finite point set in the plane having only the number of elements contained by a finite set of lines. Discrete tomography deals with the solution of this problem, where methods of combinatorics and graph theory arise naturally. The reconstruction of binary matrices by their line and column sums is a special topic where several different solution methods can be applied.