Discrete Structures in Algebra, Geometry, Topology, and Computer Science

Organizers: Eva-Maria Feichtner (*University of Bremen, DE)*, Dmitry Feichtner-Kozlov (*University of Bremen, DE)*

Tuesday, July 3, 15:45–17:45, Small Hall

Talks:
Mario Salvetti (*University of Pisa, IT*), **Discrete methods for the topological study of some Configuration Spaces**

Martin Raussen (*Aalborg University, DK*), **Directed algebraic topology and applications**

Louis Rowen (*Bar-Ilan University, IL*), **Structures in tropical algebra**

Discrete methods for the topological study of some Configuration Spaces

Mario Salvetti
University of Pisa, IT

We apply some methods from "discrete topology" to the study of some "Configuration Spaces". In particular, we are interested in (co-) homological computations for configuration spaces associated with Artin and Coxeter groups.

Directed algebraic topology and applications

Martin Raussen
Aalborg University, DK

Directed Algebraic Topology deals with topological spaces in which only a certain system of (directed) paths is allowed. This occurs naturally when the time flow is crucial, e.g. in relativity theory or for concurrent computations. The topological analysis gets far more complicated than in the classical situation; for example, the fundamental group has to be replaced by the fundamental category of a directed space. Nevertheless, it is possible to apply techniques and invariants from classical algebraic topology after modification. For example, it has been shown how to model the space of executions (directed paths) in Higher Dimensional Automata (a particular model for concurrency) by a simplicial complex; this allows to calculate (homological) invariants with important interpretations.

Structures in tropical algebra

Louis Rowen
Bar-Ilan University, IL

The rapidly developing topic called "tropical mathematics", has been based on two main approaches. Primarily, tropical curves have been defined as domains of non-differentiability of polynomials over the max-plus algebra, and also tropical mathematics has been viewed in terms of valuation theory applied to curves over Puiseux series. Unfortunately, semirings such as the max-plus algebra possess a limited algebraic structure theory, and also do not reflect these valuation-theoretic properties, thereby forcing researchers to turn to combinatoric arguments.

The object of this talk is to present an algebraic structure (studied jointly with Z. Izhakian and M. Knebusch) more compatible with algebraic structure theory and valuation theory than the max-plus algebra. We present a "layered" structure, "sorted" by a semiring which permits varying ghost layers, and indicate how it permits a direct algebraic description of tropical varieties, and show how its coordinate semiring reflects the geometric properties. We also discuss factorization of polynomials, linear algebra, properties of the resultant, discriminant, and multiple roots of polynomials.