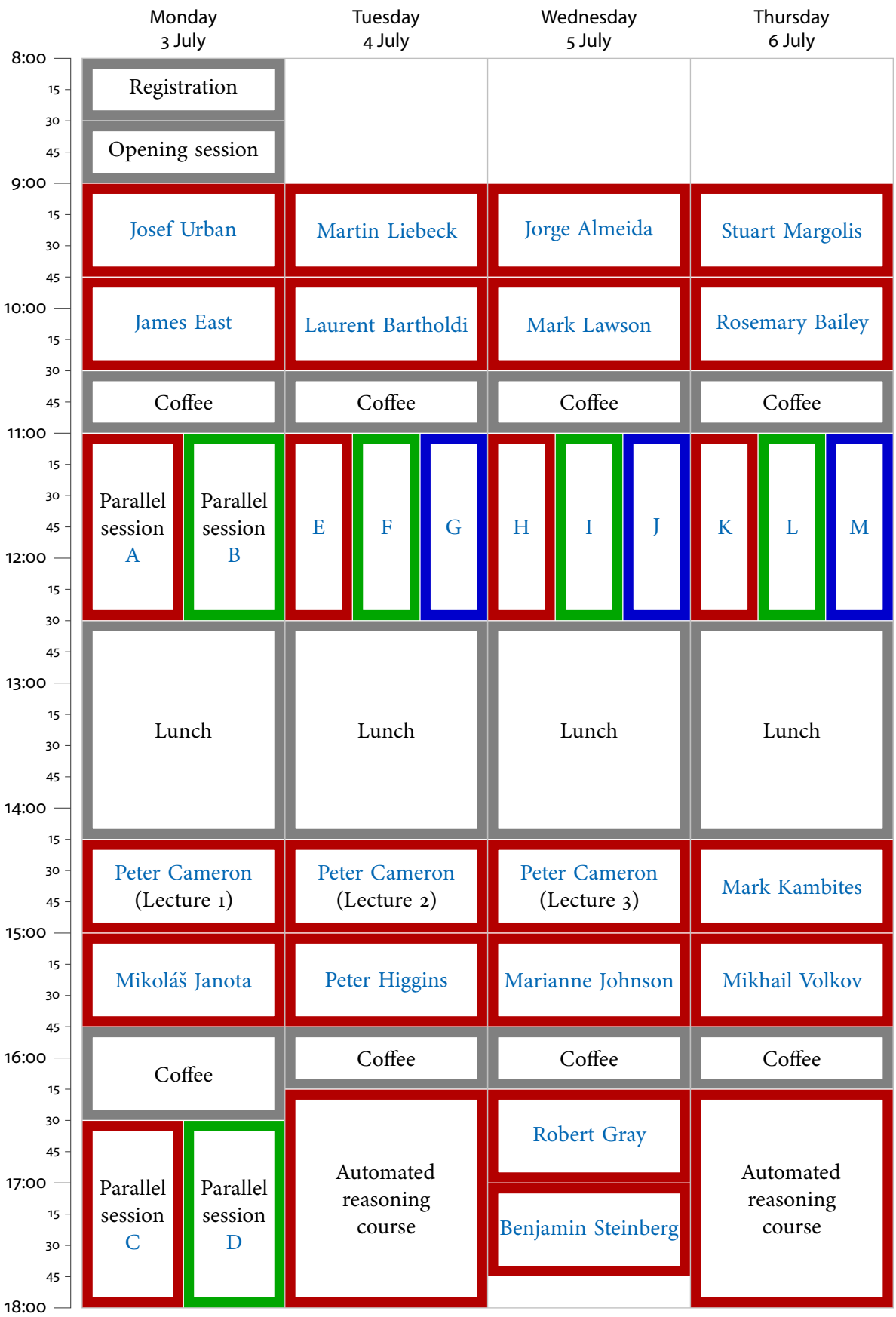
Conference on

Theoretical and Computational Algebra

2023

BOOK OF ABSTRACTS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Registration
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Josef Urban
James East
Coffee
Parallel session A
Parallel session B
Lunch
Peter Cameron (Lecture 1)
Mikoláš Janota
Coffee
Parallel session C
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Automated reasoning course
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Mikhail Volkov
Coffee
Automated reasoning course

Lecture course

Peter Cameron (Invited lectures)
University of St Andrews

Monday 3 July, 14:15–15:00; Tuesday 4 July, 14:15–15:00; Wednesday 5 July, 14:15–15:00 · Main auditorium

Permutation groups and transformation semigroups

I have been working on this topic for fifteen years now, since being introduced to it by João Araújo. His thesis is that, rather than the situation where semigroup theorists simply reduce their problem to group theory and hand it over to the group theorists, it is much better to have a dialogue between the two areas. Typically, an argument combining group and semigroup theory (and maybe combinatorics) is needed to establish strong results about semigroups, but in addition, semigroups suggest exciting new areas of permutation group theory to work on.

The key concept in permutation group theory is primitivity, going back to the work of Galois: a permutation group is primitive if it preserves no non-trivial partition of its domain. The O'Nan–Scott Theorem together with the classification of finite simple groups gives us a lot of information about primitive groups. But open problems remain.

I will begin with a run through primitivity, multiple transitivity, and some of the related concepts to have arisen recently. Then I will turn to concepts specifically related to transformation semigroups. These fall into two classes:

Synchronization: This topic begins in automata theory, motivated by the Černý conjecture. The most general form for which we have strong results is this: for which permutation groups G of degree n is it true that, for any non-permutation f, the semigroup generated by G and f contains a map of rank 1? This is equivalent to saying that G preserves no non-trivial weakly perfect graph.

Regularity and idempotent generation: For which permutation groups G is it the case that, if f is any map of rank k, then $\langle G, f\rangle$ is regular, or is idempotent-generated? If $k > 2$ this property resembles multiple transitivity. But for $k = 2$, the property for regularity is exactrly equivalent to primitivity, whereas idempotent generation is equivalent to a strengthening of primitivity called the road closure property. Work is in progress to understand this.

Invited talks

Jorge Almeida
University of Porto

(Invited talk)

Wednesday 5 July, 09:00–09:45 · Main auditorium

Taming the pseudovariety DAb

Schützenberger started in the mid 1970's the investigation of pseudovarieties of finite semigroups whose regular $\mathcal{D}$-classes are subsemigroups, motivated by their relevance in formal language theory according to Eilenberg's correspondence. In our present work, we focus on the special case DAb, where such subsemigroups are Abelian groups. Steinberg and the speaker introduced a strong form of decidability for pseudovarieties called tameness. Besides standard algorithmic properties such as the word problem for relatively free algebras over a suitable signature, it involves a purely topological property: for the finite systems of equations of interest (which depend on the sought applications), the solutions modulo the pseudovariety in the chosen signature are dense in the set of all solutions in the free profinite semigroup. The purpose of this talk is to establish that the pseudovariety DAb is tame. The main ingredient is a normal form for pseudowords over DAb.

(Joint work with M. Kufleitner and J. Ph. Wächter)

Rosemary Bailey
University of St Andrews

(Invited talk)

Thursday 6 July, 09:45–10:30 · Main auditorium

Designs for half-diallel experiments

In some experiments, the experimental units are all pairs of individuals who have to undertake a given task together. If all such pairs are used exactly once each, then the set of pairs forms a triangular association scheme. If there are n individuals then there are $N = n(n-1)/2$ such pairs. The corresponding Bose–Mesner algebra has three common eigenspaces. One consists of the constant vectors (it has dimension 1); one consists of linear combinations of the indicator vectors of individuals, constrained so that the entries sum to zero (it has dimension $n-1$); the third is the orthogonal complement of these two (it has dimension $N-n$).

In classical work on design of experiments, the experimental units are grouped into b blocks of size k. Again, there are three common eigenspaces. One consists of the constant vectors; one consists of vectors which are constant on each block and whose entries sum to zero; the third is the orthogonal complement of these two.

In both cases, we assume that the variance–covariance matrix C of the responses to the experiment is an unknown linear combination of the matrices of projection onto these eigenspaces.

Two types of block design are particularly important. In *balanced* block designs, the variance of the estimated difference between any two treatments is the same, no matter what the eigenvalues

of C are. In *orthogonal* block designs, the linear combination of responses which gives the best unbiased estimator of any difference between treatments does not depend on what the eigenvalues of C are. Such designs are often said to have *commutative orthogonal block structure*.

In this talk I concentrate on designs for half-diallel experiments. I will give some constructions for balanced designs and some for designs which have commutative orthogonal block structure.

This is joint work with P. Cameron (University of St Andrews) and D. Ferreira, S. S. Ferreira and C. Nunes (Universidade de Beira Interior).

Laurent Bartholdi
Saarland University

(Invited talk)

Tuesday 4 July, 09:45–10:30 · Main auditorium

The domino problem on groups and Schreier graphs

Consider a directed graph with edge labels in a finite set S. The *domino problem* asks, given a finite set of "dots" A and a set of "dominos" $\Theta \subset A \times S \times A$, whether dots can be assigned to the graph's vertices in such a manner that every edge carries an allowed domino, namely

$$(\text{dots at begin, edge label, dots at end}) \in \Theta$$

for every edge.

This problem is a small fragment of the monadic second order logic of the graph, and we are interested in knowing when it is decidable. In particular, the graph could be the Cayley graph of a group G with generating set S, and then a conjecture of Baller and Stein asserts that the domino problem is decidable if and only if G is virtually free. I will describe recent results (partly joint with Ville Salo) proving partial cases of this conjecture, in particular for metabelian groups, and for word hyperbolic groups.

I will also consider Schreier graphs of G-sets for some self-similar groups G, and give examples close to the border between decidability and undecidability of the domino problem.

James East
Western Sydney University

(Invited talk)

Monday 3 July, 09:45–10:30 · Main auditorium

A groupoid approach to regular $*$-semigroups

A cornerstone of inverse semigroup theory is the ESN Theorem, which states that the category of inverse semigroups is isomorphic to the category of inductive groupoids. This was generalised to regular semigroups by Nambooripad in his legendary 1979 memoir. In this talk I will discuss recent joint work with P. A. Azeef Muhammed on the intermediate class of regular $*$-semigroups. These semigroups have an involution, but their idempotents need not commute; key examples include partition, Brauer and Temperley–Lieb monoids. The role of the biordered set of idempotents is played by certain unary algebras of projections, and various categorical structures built on them. Specifically, the category of all regular $*$-semigroups is isomorphic to the category of so-called

chained projection groupoids. Among other things, our groupoid approach leads to natural constructions of the classical maximum fundamental regular $*$-semigroups, and also new free projection-generated regular $*$-semigroups.

Robert Gray
University of East Anglia

(Invited talk)

Wednesday 5 July, 16:15–17:00 · Main auditorium

Membership problems for positive one-relator groups and one-relation monoids

I will present some recent joint with I. Foniqi and C.-F. Nyberg-Brodda in which we investigate the submonoid and rational subset membership problems in one-relation monoids and in positive one-relator groups. This work is motivated by approaches to the word problem for one-relation monoids arising from work of Adian and Oganesian (1987), Guba (1997), and Ivanov, Margolis and Meakin (2001). Here a one-relator group is positive if it admits a one-relator presentation where no inverse symbol appears in the defining relator. Such groups were studied by e.g. Baumslag (1971), as well as by Perrin and Schupp (1984) who proved that a one-relator group is positive if and only if it is a one-relation monoid. I will present several new undecidability results, explain how each of them relates to the word problem for one-relation monoids, and outline some of the new methods we developed to prove our results including an approach that involves finding suitable embeddings of certain trace monoids.

Peter Higgins
University of Essex

(Invited talk)

Tuesday 4 July, 15:00–15:45 · Main auditorium

Algebras defined by equations

In a recent paper with Marcel Jackson we proved that a class of algebras closed under the taking of homomorphisms, direct products, and elementary embeddings can be defined by a list of equations of a type that will be explained.

In this talk we concentrate on how this applies to classes of semigroup, which was the original motivation for the theorem, as many intensively studied semigroup classes are EHP-classes, as we call them, without being varieties, which is to say the class in question is not closed under the taking of arbitrary subsemigroups.

EHP classes include Regular Semigroups, Groups, Left and Right groups, Unions of groups, Cryptogroups, Semilattices of groups, Completely simple semigroups, Monoids, Left-, Right-, and J-Simple semigroups (but not Bisimple semigroups), Inverse, Orthodox, Conventional, and E-solid semigroups. In some cases equational bases are obvious, but not so in others. We examine the link between e-varieties in the sense of Hall and EHP classes consisting of regular semigroups.

There is scope for exploiting automated theorem provers as we are working in first order languages. Indeed we give an example of an EHP basis for completely regular semigroups that was first verified by AI.

Finally we shall introduce a dual to the Birkhoff theorem on varieties as applied to EHP-classes of semigroups closed under the taking of containing semigroups.

Mikoláš Janota (Invited talk)
IST, University of Lisbon

Monday 3 July, 15:00–15:45 · Main auditorium

Automated Combinatorial Solving and Its Applications in Computational Algebra

Computer science develops a number of highly engineered solving techniques for combinatorial problems such as satisfiability (SAT). We will give an overview of these techniques and look at some concrete applications in computational algebra. In the first application, we consider calculating the smallest generating set of finite magma. In the second application, we consider calculating the lexicographically smallest magma isomorphic to a given one.

Marianne Johnson (Invited talk)
University of Manchester

Wednesday 5 July, 15:00–15:45 · Main auditorium

Tropical representations and semigroup identities of plactic-like monoids

This talk concerns several well-studied families of monoids whose elements are combinatorial gadgets of a particular type over a fixed finite alphabet, and whose multiplication can be defined by means of an insertion algorithm. The prototypical example is the family of finite rank plactic monoids: these are infinite monoids arising from a natural combinatorial multiplication (determined by Schensted's insertion algorithm) on semistandard tableaux over a fixed finite alphabet. The finite rank plactic monoids, and many finite rank 'plactic-like' monoids, can be faithfully represented by matrices over the tropical semiring; we construct such representations and utilise these to study semigroup identities satisfied by the finite rank plactic (joint work with Kambites) and plactic-like (joint work with Cain, Kambites and Malheiro) monoids.

Mark Lawson (Invited talk)
Heriot-Watt University

Wednesday 5 July, 10:00–10:45 · Main auditorium

Higher dimensional generalizations of the Thompson groups via higher rank graphs

We show how to construct a family of groups from a family of monoids that generalize free monoids. In the case of free monoids on two or more finite generators, we get back the familiar Thompson groups. The family of monoids that arise should be of independent interest. The motivation for defining this family comes from the theory of C^*-algebras. This is joint work with Alina Vdovina (CCNY) and Aidan Sims (Wollongong).

Martin Liebeck
Imperial College London

(Invited talk)

Tuesday 4 July, 09:00–09:45 · Main auditorium

Computing with conjugacy classes in classical groups

I will discuss some theory and algorithms for performing the following tasks for finite classical groups:

1) writing down conjugacy class representatives
2) computing centralizers
3) solving the conjugacy problem, and
4) finding conjugating elements.

Mark Kambites
University of Manchester

(Invited talk)

Thursday 6 July, 14:15–15:00 · Main auditorium

Subgroups of Special Inverse Monoids

Special inverse monoids are inverse monoids definable by presentations in which all relations have the form $w = 1$). Their study is motivated both intrinsically by a beautiful geometric theory building on ideas of Stephen, and extrinsically by connections to the word problem for one-relator monoids. I will report on ongoing joint work with Robert D. Gray, aimed at understanding the subgroup structure of these monoids.

Stuart Margolis
Bar Ilan University

(Invited talk)

Thursday 6 July, 09:00–09:45 · Main auditorium

On the Minimal Degree of Rhodes Semisimple Semigroups

A finite semigroup is Rhodes semisimple if it admits a faithful completely reducible representation over the field of complex numbers. Rhodes determined these in the 1960s. We compute the minimal degree of a faithful representation of a Rhodes semisimple semigroup by partial and total transformations. This includes the case of all inverse semigroups, and hence our results generalize earlier results of Easdown and Schein on the minimal faithful degree of an inverse semigroup. It also includes well-studied monoids like full matrix monoids over finite fields and the monoid of binary relations (i.e., matrices over the Boolean semiring).

Our answer reduces the computation to considerations of permutation representations of maximal subgroups that are faithful when restricted to distinguished normal subgroups. To illustrate what happens when a finite semigroup is not Rhodes semisimple, we show that the degree of the minimal faithful representation by total functions of the opposite of the full transformation monoid on n elements is 2^n.

This is joint work with Benjamin Steinberg.

Benjamin Steinberg (Invited talk)
City University of New York

Wednesday 5 July, 17:00–17:45 · Main auditorium

The representation theory of the monoid of affine transformations of a vector space over a finite field

The monoid $\mathrm{Aff}(n,q)$ of all affine transformations of the vector space $\mathbb{F}_q^n$ is a naturally occuring monoid that can be viewed from several perspectives: it is the semidirect product of the monoid $M(n,q)$ of $n \times n$ matrices over $\mathbb{F}_q$ with the additive group of F_q^n; it is also an the endomorphism monoid of an independence algebra (the vector space $\mathbb{F}_q^n$ with affine combinations as a collection of binary operations, one for each scalar).

In this talk we consider the representation theory of this monoid over the field of complex numbers. We compute the global dimension of the complex algebra of this monoid using a combination of algebraic and topological techniques. The dramatis personae of this story are Putcha–Okniński's semisimplicity of $\mathbb{C}M(n,q)$, Nico's results on the global dimension of regular monoids (aka the theory of quasihereditary algebras) and Solomon's irreducible representation of the affine general linear group on the top homology of the order complex of the proper part of the lattice of flats of the affine matroid.

Josef Urban (Invited talk)
Czech Institute of Informatics, Robotics and Cybernetics

Monday 3 July, 09:00–09:45 · Main auditorium

Some adventures in learning synthesis of mathematical objects and proofs

I will talk about our adventures in designing feedback loops for learning-based synthesis of explanations for integer sequences in the OEIS (DOI 10.48550/arXiv.2301.11479), learning-based synthesis of instantiation proofs (DOI 10.48550/arXiv.2210.03590), and our recent advances in learning-based proof search.

Mikhail Volkov (Invited talk)

Thursday 6 July, 15:00–15:45 · Main auditorium

Strongly nonfinitely based monoids

We show that the 42-element monoid of all partial order preserving and extensive injections on the 4-element chain is not contained in any variety generated by a finitely based finite semigroup. This gives a first example of a strongly nonfinitely based monoid that is not inherently nonfinitely based monoid, thus solving a 20+ years old problem. The result has numerous implications for the finite basis problem for finite semigroups.

This a joint work with Sergey Gusev and Olga Sapir.

Parallel sessions

Session A

Monday 3 July, 11:00–12:30 · Main auditorium

Chair: Volker Diekert
University of Stuttgart

1) Carl-Fredrik Nyberg Brodda 11:00–11:20
Université Gustave Eiffel
One relation: the story so far

2) Alexei Lisitsa 11:20–11:40
University of Liverpool
New AC-simplifications found by automated reasoning

3) Luís Oliveira 11:40–12:00
CMUP, Dep. Mat., Fac. Ciências, Univ. Porto, Portugal
Weakly generated regular semigroups

4) André Carvalho 12:00–12:20
NOVA University of Lisbon & NOVA Math, Portugal
Algebraic and context-free subsets of subgroups

Session B

Partial actions and partial representations

Organized by: Ganna Kudryavtseva
University of Ljubljana

Monday 3 July, 11:00–12:30 · Living room

Chair: Carlos Santos
NOVA University of Lisbon & NOVA Math

1) Mikhailo Dokuchaev 11:00–11:20
University of Sao Paulo
Group (co)homology related to partial representations

2) William Hautekiet 11:20–11:40
ULB - Université libre de Bruxelles
Partial comodules of groups

3) Ganna Kudryavtseva 11:40–12:00
University of Ljubljana
Hom-set globalization of partial semigroup actions

4) Valdis Laan 12:00–12:20
University of Tartu
Tensor product globalization of partial semigroup actions

Session C

Semigroups of transformations

Organized by: Vítor Hugo Fernandes
NOVA University of Lisbon & NOVA Math, Portugal

Monday 3 July, 16:30–18:00 · Main auditorium

Chair: Vítor Hugo Fernandes
NOVA University of Lisbon & NOVA Math

1) Jörg Koppitz 16:30–16:50
Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, Sofia
Ranks and presentations for order-preserving transformations with one fixed point

2) Teresa M. Quinteiro 16:50–17:10
Instituto Superior de Engenharia de Lisboa & NOVA Math, Portugal
Generators of semigroups of endomorphisms of a finite path

3) Apatsara Sareeto 17:10–17:30
Institute of Mathematics, University of Potsdam, Germany
The rank of the semigroup of order-, fence-, and parity-preserving partial injections on a finite set

4) Tânia Paulista 17:30–17:50
NOVA University of Lisbon & NOVA Math, Portugal
Commutative nilpotent transformation semigroups

Session D

Monday 3 July, 16:30–18:00 · Living room

Chair: Mark Kambites
University of Manchester

1) Trevor Jack 16:30–16:50
Illinois Wesleyan University
Deterministic Logspace Algorithms for Checking Conjugacy in Inverse Semigroups

2) Craig Miller 16:50–17:10
University of York
The heights of Green's posets of semigroups

3) Samuel Herman 17:10–17:30
CUNY Graduate Center
Pointlike sets with respect to ER

4) Volker Diekert 17:30–17:50
University of Stuttgart
Decidability of membership problems for flat rational subsets of $GL(2, \mathbb{Q})$

Session E

Tropical matrix and plactic-like monoids

Organized by: Duarte Chambel Ribeiro
NOVA University of Lisbon & NOVA Math, Portugal

Tuesday 4 July, 11:00–12:30 · Main auditorium

Chair: Carl-Fredrik Nyberg Brodda
Université Gustave Eiffel

1) Alice Clayphan-Taylor 11:00–11:20
University of Manchester
Congruences on 2 × 2 tropical matrices

2) Thomas Aird 11:20–11:40
University of Manchester
Semigroup Identities and Varieties of Plactic Monoids

3) Duarte Ribeiro 11:40–12:00
NOVA University of Lisbon & NOVA Math, Portugal
Tropical representations and identities of the stylic monoid

4) Ricardo Guilherme 12:00–12:20
NOVA University of Lisbon & NOVA Math, Portugal
Generalizing the hypoplactic monoid through quasi-crystals for arbitrary root systems

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Session F

Combinatorial Game Theory — Dicotic Misère Structure

Organized by: Carlos Pereira dos Santos
NOVA University of Lisbon & NOVA Math, Portugal

Tuesday 4 July, 11:00–12:30 · Living room

Chair: Alan J. Cain
NOVA University of Lisbon & NOVA Math

1) Neil A. McKay 11:00–11:20
University of New Brunswick, Saint John, Canada
The scale of ups

2) Richard Nowakowski 11:20–11:40
Dalhousie University, Canada
Absolute Combinatorial Game Theory

3) Rebecca Milley 11:40–12:00
Grenfell Campus, Memorial University of Newfoundland, Canada
Progress on misère dicots: game comparison, canonical forms, and conjugate inverses

4) Carlos Pereira dos Santos 12:00–12:20
NOVA University of Lisbon & NOVA Math, Portugal
Invertible elements of the misère dicotic universe

Session G

Structure and Computation in General Algebras

Organized by: Peter Mayr
University of Colorado Boulder

Tuesday 4 July, 11:00–12:30 · Canteen

Chair: Peter Mayr
University of Colorado Boulder

1) Armin Weiß — 11:00–11:20
Universität Stuttgart
Hardness of equation satisfiability for finite solvable groups

2) Piotr Kawałek — 11:20–11:40
Marii-Curie-Slodowska University in Lublin
A probabilistic approach to solving equations in finite algebraic structures

3) Michael Kompatscher — 11:40–12:00
Charles University, Prague
Algebras with short pp-definitions

4) Bernardo Rossi — 12:00–12:20
Johannes Kepler Universität Linz
Polynomial completeness properties of Mal'cev algebras with (SC1)

Session H

Nilpotency and Geometry in Algebra

Organized by: Wolfram Bentz
Universidade Aberta

Wednesday 5 July, 11:00–12:30 · Main auditorium

Chair: Robert D. Gray
University of East Anglia

1) Peter Mayr — 11:00–11:20
University of Colorado Boulder
Commutator theory for semigroups

2) Csaba Schneider — 11:20–11:40
Universidade Federal de Minas Gerais
The Hilbert series of the invariant algebras of the standard filiform Lie algebras

3) Nora Szakacs — 11:40–12:00
University of Manchester
Geometric properties of inverse semigroups

4) Wolfram Bentz — 12:00–12:20
Universidade Aberta
Extending the congruences of transformation monoids to its products

Session I

Wednesday 5 July, 11:00–12:30 · Living room

Chair: Marianne Johnson
University of Manchester

1) Ana-Catarina C. Monteiro 11:00–11:20
FCUL and CEMAT, Universidade de Lisboa
Formations on Orthodox Semigroups

2) Dmitry Kudryavtsev 11:20–11:40
University of Manchester
Local embeddability into finite semigroups

3) Ambroise Grau 11:40–12:00
University of York
Restrictions and extensions in the endomorphism monoid of an independence algebra

4) Matthew Brookes 12:00–12:20
University of St Andrews
A method to determine coherency of monoids

Session J

Logic and Computation

Organized by: Paulo Guilherme Santos
NOVA University of Lisbon & NOVA Math, Portugal

Wednesday 5 July, 11:00–12:30 · Canteen

Chair: João Araújo
NOVA University of Lisbon & NOVA Math

1) Gilda Ferreira 11:00–11:20
FCUL
System F: the convergent journey of Logic and Computer Science

2) Isabel Oitavem 11:20–11:40
NOVA University of Lisbon & NOVA Math, Portugal
On a shortest proof of φ implies φ

3) Eduardo Skapinakis 11:40–12:00
NOVA University of Lisbon & NOVA Math, Portugal
Implicit complexity and term rewriting systems

4) Paulo Guilherme Santos 12:00–12:20
NOVA University of Lisbon & NOVA Math, Portugal
'Provability Implies Provable Provability' using FLINSPACE

Session K

Combinatorics on Words

Organized by: Conceição Nogueira / Inês Rodrigues
IPLeiria, CMAT / NOVA University of Lisbon & NOVA Math, Portugal

Thursday 6 July, 11:00–12:30 · Main auditorium

Chair: Inês Rodrigues
NOVA University of Lisbon & NOVA Math

1) Manuel Silva 11:00–11:20
NOVA University of Lisbon & NOVA Math, Portugal
Ramsey-type results for infinite words

2) Conceição Nogueira 11:20–11:40
IPLeiria, CMAT
The overlap gap between left-infinite and right-infinite words

3) José Carlos Costa 11:40–12:00
CMAT, Universidade do Minho
Asymptotic behavior of the overlap gap between left-infinite and right-infinite words

4) Francesco Dolce 12:00–12:20
FIT - CTU in Prague
Dendric languages and the Finite Index Basis Property

Session L

With the help of the machine

Organized by: Gilda Ferreira
Universidade Aberta / CMAFcIO

Thursday 6 July, 11:00–12:30 · Living room

Chair: Gilda Ferreira
Universidade Aberta / CMAFcIO

1) José Santos 11:00–11:20
Microsoft
Large Language Models as generic machine learning models

2) Ludwig Krippahl 11:20–11:40
NOVA LINCS
A quick introduction to deep learning

3) Luís Cruz-Filipe 11:40–12:00
University of Southern Denmark
Mathematics and Symbolic AI

4) Hugo Penedones 12:00–12:20
Inductiva Research Labs
AI for scientific computing

Session M

Thursday 6 July, 11:00–12:30 · Canteen

Chair: António Malheiro
NOVA University of Lisbon & NOVA Math

1) Maria Elisa Fernandes 11:00–11:20
Universidade de Aveiro
The number of string C-groups of high rank

2) Inês Legatheaux Martins 11:20–11:40
Universidade de Lisboa
Schur-Weyl dualities for the rook monoid: an approach via Schur algebras

3) Tânia Z. Silva 11:40–12:00
FCUL CEAFEL
A Schur ring approach to supercharacters of groups associated with finite radical rings

4) Maria Loukaki 12:00–12:20
Department of Mathematics & Applied Mathematics, University of Crete
On the common transversal probability in finite groups.

Contributed talks

Thomas Aird
University of Manchester

(Contributed talk)

Tuesday 4 July, 11:20–11:40 · Main auditorium [Session E]

Semigroup Identities and Varieties of Plactic Monoids

In this talk, we discuss what is known about the semigroup identities satisfied by the plactic monoid of rank n. We then investigate how the variety generated by the plactic monoid of rank n interacts with the variety generated by the monoid of $n \times n$ upper triangular tropical matrices. From this, we show that we can construct semigroup identities satisfied by the plactic monoid of rank n, which are shorter than those previously known.

Wolfram Bentz
Universidade Aberta

(Contributed talk)

Wednesday 5 July, 12:00–12:20 · Main auditorium [Session H]

Extending the congruences of transformation monoids to its products

Congruences for transformation monoids were first described in 1952, when Mal'cev determined the congruences of the monoid of all transformations on a finite set. Since then, congruences have been characterized in various other monoids of (partial) transformations, such as the monoid of all injective partial transformations, or the monoid of all partial transformations.

In this talk we show how we can extend these results to products of two such monoids. As it turns out, the congruence structure of the factors is still visible in the congruences of the product, but the variations introduced by having an extra component adds a high level of technical complexity which accounts for the difficulty in achieving this result.

This is a joint work with João Araújo (Universidade Nova de Lisboa/NOVAMATH) and Gracinda M. S. Gomes (Universidade de Lisboa/CEMAT).

Carl-Fredrik Nyberg Brodda
Université Gustave Eiffel

(Contributed talk)

Monday 3 July, 11:00–11:20 · Main auditorium [Session A]

One relation: the story so far

Algebraic objects with a single defining relation have a long and rich history in combinatorial algebra. From one-relator groups, to one-relator Lie algebras, to one-relation monoids and inverse one-relation monoids, these objects have played a central role in the development of new

techniques, conjectures, and counterexamples for the past century. Of particular focus has been the word problem, the problem of deciding whether two words in the generators represent the same element or not. In this talk, I will present an overview of three types of one-relation objects: groups, monoids, and inverse monoids. I will present some of the main theorems, problems, and mysteries connected to the word problem in each area, and some of the fundamental ways that they are all interlinked. I will then present some recent work, over the past 5 years, by various authors to try and develop a general theory of one-relation inverse monoids. This will include joint work with I. Foniqi & R. D. Gray.

Matthew Brookes
University of St Andrews

(Contributed talk)

Wednesday 5 July, 12:00–12:20 · Living room [Session I]

A method to determine coherency of monoids

A monoid is right coherent if every finitely generated subact of every finitely presented right act has a finite presentation. This notion is analogous to that of coherent rings. We show that if a monoid contains a certain configuration of three elements then it is not right coherent. In particular, this demonstrates that infinite transformation and partition monoids are not right coherent. This is joint work with Nik Ruškuc (St Andrews) and Victoria Gould (York).

André Carvalho
NOVA University of Lisbon & NOVA Math, Portugal

(Contributed talk)

Monday 3 July, 12:00–12:20 · Main auditorium [Session A]

Algebraic and context-free subsets of subgroups

Over the years, rational and recognizable subsets of groups have been studied from different points of view and they are natural generalizations of finitely generated and finite index subgroups, respectively. While playing a less relevant role in the literature, their context-free counterparts, respectively algebraic and context-free subsets, also yield interesting results.

In this talk, we will relate the structure of algebraic and context-free subsets of a group G and that of a finite index subgroup H. Then, we will show that a kind of Fatou property, previously studied by Berstel and Sakarovitch in the context of rational subsets and by Herbst in the context of algebraic subsets, holds for context-free subsets if and only if the group is virtually free. Finally, we will exhibit a counterexample to a question of Herbst concerning this property for algebraic subsets.

Alice Clayphan-Taylor
University of Manchester

(Contributed talk)

Tuesday 4 July, 11:00–11:20 · Main auditorium [Session E]

Congruences on 2×2 tropical matrices

We present a classification of the congruences on 2×2 tropical matrices and the similarities of

these to the structure of congruences on $n \times n$ matrices over a field. We further give insight into why our classification of the 2×2 case might not extend to 3×3 tropical matrices.

José Carlos Costa
CMAT, Universidade do Minho

(Contributed talk)

Thursday 6 July, 11:40–12:00 · Main auditorium [Session K]

Asymptotic behavior of the overlap gap between left-infinite and right-infinite words

In a recent paper with C. Nogueira and M. L. Teixeira, we investigated periodicity on infinite words. Given a left-infinite word λ, a right-infinite word ρ and a positive integer n, we define $g(n)$ to be n minus the maximum length of overlaps between the suffix of λ and the prefix of ρ of length n. We proved that the "overlap gap" function g has finite image if and only if λ and ρ are ultimately periodic words with a same root.

Luís Cruz-Filipe
University of Southern Denmark

(Contributed talk)

Thursday 6 July, 11:40–12:00 · Living room [Session L]

Mathematics and Symbolic AI

Symbolic AI is a collective term for the subfields of Artificial Intelligence that aim at modelling knowledge and reasoning. Methods of symbolic AI typically can provide explanations for their conclusions, making them of special interest for applications where being able to understand the results is essential. In this talk we briefly explore the connection between Mathematics and Symbolic AI, and how they can mutually benefit from each other.

Volker Diekert
University of Stuttgart

(Contributed talk)

Monday 3 July, 17:30–17:50 · Living room [Session D]

Decidability of membership problems for flat rational subsets of GL(2, ℚ)

The talk reports on an ongoing work with Pavel Semukhin and Igor Potapov from Liverpool (UK). We address the problem to decide membership for rational subsets in matrix groups. A positive answer is known for $\mathrm{GL}(2, \mathbb{Q})$ and for a subgroup G sitting between $\mathrm{GL}(2, \mathbb{Z})$ and $\mathrm{GL}(2, \mathbb{Q})$ for so-called flat rational sets. This family is an effective relative Boolean algebra which constitutes to date the borderline for decidability.

Mikhailo Dokuchaev
University of Sao Paulo

(Contributed talk)

Monday 3 July, 11:00–11:20 · Living room [Session B]

Group (co)homology related to partial representations

In a joint work with with Marcelo M. Alves and Dessislava Kochloukova we study (co)homology of a group G based on partial representations, i.e. modules over the partial group algebra $\mathbb{K}_{par}G$ over a field $\mathbb{K}$. In particular, we link the partial (co)homology of G with coefficients in an irreducible (resp. indecomposible) $\mathbb{K}_{par}G$-module with the ordinary (co)homology of a subgroup of G. Furthermore, we compare the standard cohomological dimension $cd_{\mathbb{K}}(G)$ (over a field $\mathbb{K}$) with the partial cohomological dimension $cd^{par}_{\mathbb{K}}(G)$ (over $\mathbb{K}$) and show that $cd^{par}_{\mathbb{K}}(G) \geqslant cd_{\mathbb{K}}(G)$, and that there is equality for $G = \mathbb{Z}$.

Francesco Dolce
FIT - CTU in Prague

(Contributed talk)

Thursday 6 July, 12:00–12:20 · Main auditorium [Session K]

Dendric languages and the Finite Index Basis Property

A dendric language is a subset of the free monoid that is factorial — i.e., for any of its elements all its factors are in the language as well — and such that all graphs describing the possible extensions of one of its elements are trees. In a way, they can be seen as a generalization of the well-known Sturmian languages, but the class is much wider and contains several different interesting families of languages.

In this talk we use dendric languages to draw a path from Combinatorics on Words to Algebra of free groups, passing through Theory of Codes.

We give several examples and results of such a class of languages. In particular we focus on some properties connecting the free monoid with the free group, proving that in a recurrent dendric language a finite bifix code is maximal if and only if it is the basis of a subgroup of the free group.

Maria Elisa Fernandes
Universidade de Aveiro

(Contributed talk)

Thursday 6 July, 11:00–11:20 · Canteen [Session M]

The number of string C-groups of high rank

One of the most important facts about abstract regular polytopes is that such a polytope is entirely described by its group of automorphisms, which is a string C-group (a certain smooth quotient of a Coxeter group). I will present my most recent contribution for the theory of abstract regular polytopes (string C-groups). With Peter Cameron and Dimitri Leemans we proved that the number of string C-groups with automorphism group S_n and rank r depends only on $(n - r)$ when $r \geqslant \frac{n+3}{2}$. A consequence of this result is the complete classification of all regular abstract

polytopes for S_n with rank $n-\kappa$ for $\kappa \in \{1, \ldots, 6\}$, when $n \geqslant 2\kappa+3$, which greatly extends previous classifications. The number of regular polytopes of this classification gives the following sequence of integers indexed by κ,

$$\Sigma\kappa = (1, 1, 7, 9, 35, 48).$$

This sequence of integers is new according to the On-Line Encyclopedia of Integer Sequences.

Gilda Ferreira
FCUL

(Contributed talk)

Wednesday 5 July, 11:00–11:20 · Canteen [Session J]

System F: the convergent journey of Logic and Computer Science

In the early 1970s, Jean-Yves Girard, a logician working in prof theory, and John Reynolds, a computer scientist working in programming languages, independently introduced the polymorphic lambda calculus, also known as System F.

This presentation explores various properties of System F and discusses the Russell Prawitz translation of Intuitionistic Propositional Calculus into System F. Within this context, we delve into atomic polymorphism and atomization conversions. The talk emphasizes the interplay between logic and computation through the lens of the Curry-Howard isomorphism.

Ambroise Grau
University of York

(Contributed talk)

Wednesday 5 July, 11:40–12:00 · Living room [Session I]

Restrictions and extensions in the endomorphism monoid of an independence algebra

Endomorphism monoids of independence algebras generalise the notion of full transformation monoids and of linear maps of a vector space. In this talk we will discuss the structure of the subsemigroup $T(A, B)$ of endomorphisms of an independence algebra A whose image is restricted to a subalgebra B and compare it to the known structure of $\mathrm{End}(A)$. We will also study extensions of ideals of $\mathrm{End}(A)$ by giving conditions under which the translational hull of an ideal I is isomorphic to the whole endomorphism monoid.

Ricardo Guilherme
NOVA University of Lisbon & NOVA Math, Portugal

(Contributed talk)

Tuesday 4 July, 12:00–12:20 · Main auditorium [Session E]

Generalizing the hypoplactic monoid through quasi-crystals for arbitrary root systems

The plactic monoid, formally introduced by Lascoux and Schützenberger, can be obtained by identifying words in the same position of isomorphic connected components of a Kashiwara

crystal of Cartan type A. This method enriched the structure of the plactic monoid and allowed its generalization, because the construction still results in a monoid for crystals of another type. In this talk, following joint work with Alan Cain and António Malheiro, we show that the hypoplactic monoid, introduced by Krob and Thibon, admits an analogous approach. For this purpose, we introduce the notion of quasi-crystal associated to a root system. We show that a quasi-crystal gives rise to a weight labelled graph, called quasi-crystal graph, which allows a purely combinatorial description of seminormal quasi-crystals. We define a tensor product of seminormal quasi-crystals that leads to the notion of quasi-crystal monoid. In this framework, we show that the hypoplactic monoid can be obtained by identifying words in the same position of isomorphic connected components of a quasi-crystal of type A, which leads to its generalization, because this construction still results in a monoid for quasi-crystals of another type. We finally present some results for the hypoplactic monoid obtained from a quasi-crystal of type C.

William Hautekiet
ULB - Université libre de Bruxelles

(Contributed talk)

Monday 3 July, 11:20–11:40 · Living room [Session B]

Partial comodules of groups

The notion of partial comodule of a group is dual to that of partial module, of which the main examples are linearizations of partial actions of groups. Since global comodules over a group are exactly vector spaces graded over that group, partial comodules of groups can be seen as a partial analogue of graded vector spaces. In this talk, we will construct simple partial comodules of finite groups and discuss their globalization. Joint work with Eliezer Batista, Paolo Saracco and Joost Vercruysse.

Samuel Herman
CUNY Graduate Center

(Contributed talk)

Monday 3 July, 17:10–17:30 · Living room [Session D]

Pointlike sets with respect to ER

I outline a proof showing that pointlike sets are decidable for the pseudovariety of finite semigroups whose idempotent-generated subsemigroup is $\mathcal{R}$-trivial. Additionally, I will briefly discuss some related conjectures.

Trevor Jack
Illinois Wesleyan University

(Contributed talk)

Monday 3 July, 16:30–16:50 · Living room [Session D]

Deterministic Logspace Algorithms for Checking Conjugacy in Inverse Semigroups

Given two elements of a full inverse semigroup, we will describe deterministic algorithms that decide within logarithmic space whether the elements are conjugate with respect to various notions of semigroup conjugacy.

Piotr Kawałek (Contributed talk)
Marii-Curie-Slodowska University in Lublin

Tuesday 4 July, 11:20–11:40 · Canteen [Session G]

A probabilistic approach to solving equations in finite algebraic structures

The realm of equations over finite algebraic structures hides a spectrum of problems that have remained unsolved for many years. Even if we concentrate solely on finite groups, we still lack a complete description of groups for which a polynomial-time algorithm exists for the equation satisfiability problem. Nevertheless, some of the recent results give hope that such a description can be discovered in the near future. Interestingly, there is a connection of the equation satisfiability problems in groups with the expressive power of deterministic finite automata over those groups (in a non-uniform setting). We examine this connection in order to show a scheme for providing randomized polynomial-time algorithms.

Michael Kompatscher (Contributed talk)
Charles University, Prague

Tuesday 4 July, 11:40–12:00 · Canteen [Session G]

Algebras with short pp-definitions

A primitive positive (pp) formula is a first-order formula that only admits existential quantification and conjunctions. It is well-known that $\mathrm{Inv}(A)$, the set of relations invariant under an algebraic structure A, is closed under pp-definitions. Then, let us say that A has short pp-definition, if $\mathrm{Inv}(A)$ is the pp-definable closure of a finite set of relations, and we can furthermore bound the length of pp-definitions of n-ary relations in $\mathrm{Inv}(A)$ by a polynomial $p(n)$. In this talk, I would like to motivate this notion by applications in theoretical computer science (subpower membership, constraint satisfaction), and present a recent result, stating that finite algebras from residually finite varieties with cube term have short pp-definitions.

This is joint work with Jakub Bulín.

Jörg Koppitz (Contributed talk)
Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, Sofia

Monday 3 July, 16:30–16:50 · Main auditorium [Session C]

Ranks and presentations for order-preserving transformations with one fixed point

We consider the semigroup (no monoid) of all order-preserving full transformations α on an n-element chain $X_n = \{1 < 2 \cdots < n\}$, where p is the only fixed point in α, for some given $p \in X_n$, denoted by $O_{n,p}$. This semigroup is nilpotent. In particular, the semigroup $O_{n,1}$ (i.e. $p = 1$) is already well studied, since it is the maximal nilpotent subsemigroup of the Catalan monoid. But the semigroup $O_{n,p}$ is still not well studied for $p > 1$, except of $p = n$ since $O_{n,n}$ is isomorphic

to $O_{n,1}$. We determine the rank of $O_{n,p}$ (it is $C_{p-1}C_{n-p} - C_{p-2}C_{n-p-1}$) and give a presentation of $O_{n,p}$ in $(C_{n-1} - C_{n-2})$ generators and $(1 + C_{n-1} - C_{n-2})(C_{n-1} - C_{n-2})$ relations. We illustrate the result for $n = 4$.

Ludwig Krippahl
NOVA LINCS

(Contributed talk)

Thursday 6 July, 11:20–11:40 · Living room [Session L]

A quick introduction to deep learning

Deep neural models are increasingly used to tackle complex problems. Especially problems we do not know how to solve explicitly, such as image recognition and generation, chat bots or automated monitoring of social media. This presentation will cover advantages and disadvantages of these large models, take a brief look at how they work and show the importance of improving inductive bias.

Dmitry Kudryavtsev
University of Manchester

(Contributed talk)

Wednesday 5 July, 11:20–11:40 · Living room [Session I]

Local embeddability into finite semigroups

The concept of studying infinite structures by approximating them with finite ones has been investigated through various methods, such as residual finiteness (an algebraic approach based on homomorphisms), pseudofiniteness (a model theory approach) and soficity (a more topological approach). The notion of a structure locally embedding into the class of finite structures (being LEF for short) combines all the aforementioned approaches. In this talk we will be covering various properties and examples of LEF semigroups, seen both as a self-contained class and in relation to LEF groups and the general notion of being LEF.

Ganna Kudryavtseva
University of Ljubljana

(Contributed talk)

Monday 3 July, 11:40–12:00 · Living room [Session B]

Hom-set globalization of partial semigroup actions

We present a new construction of globalization of a partial action of a semigroup on a set, the Hom-set globalization construction. For a semigroup S acting partially on a set, X, we construct a globalization of this partial action as a certain set of partial homomorphisms of S-acts from S^1 to X and show that it is the terminal object in the category of all X-generated globalizations of the given partial action. It is interesting that if S is a group, the Hom-set globalization construction coincides with the tensor product construction, but in the semigroup case the constructions can be far different, with an infinite chain of non-isomorphic objects between them. This is joint work with Valdis Laan.

Valdis Laan
University of Tartu

(Contributed talk)

Monday 3 July, 12:00–12:20 · Living room [Session B]

Tensor product globalization of partial semigroup actions

We consider partial actions of semigroups on sets. These are generalizations of global actions of semigroups and they appear naturally in many places. For example, the additive semigroup of natural numbers acts partially on the set of natural numbers by subtraction.

One important problem is: when can a partial action of a semigroup on a set A be extended to a global action of the same semigroup on a (possibly) bigger set B? In such a case we say that the partial action can be globalized. It turns out that a partial action of a semigroup can be globalized if and only if it is strong.

A semigroup is called firm if it is canonically isomorphic to its tensor square. Using tensor products, one can aslo define firm global and partial actions. Firmness is a condition that was first used for rings and modules and later adopted to the semigroup case. It plays an important role in Morita theory (both for semigroups and non-unital rings).

Every firm and strong partial action of a semigroup can be globalized using a tensor product construction and the resulting global action will be an initial object in the category of all globalizations of the initial partial action. We obtain a globalization functor which is a reflector from the category of firm stong partial acts to the category of firm global acts.

This talk is based on joint research with Ganna Kudryavtseva.

Alexei Lisitsa
University of Liverpool

(Contributed talk)

Monday 3 July, 11:20–11:40 · Main auditorium [Session A]

New AC-simplifications found by automated reasoning

We present recent developments in the applications of automated theorem proving in the investigation of the well-known Andrews-Curtis conjecture [1]. We demonstrate previously unknown simplifications of trivial group presentations from a parametric family $MS_n(w^*)$ [2] for $n = 3, 4, 5, 6, 7$ (subset of well-known Miller–Schupp family [3]). We apply the method developed in [4,5] using both implicational ($n = 3, \ldots, 6$) and equational encoding ($n = 7$) of simplification problems in first-order logic. We discuss the problem of comprehension and generalizations of these proofs in order to obtain a proof for all $n > 1$.

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Maria Loukaki (Contributed talk)
Department of Mathematics & Applied Mathematics, University of Crete

Thursday 6 July, 12:00–12:20 · Canteen [Session M]

On the common transversal probability in finite groups.

Let G be a finite group, and let H be a subgroup of G. We compute the probability, denoted by $P_G(H)$, that a left transversal of H in G is also a right transversal, thus a two-sided one. Moreover, we define, and denote by $tp(G)$, the common transversal probability of G to be the minimum, taken over all subgroups H of G, of $P_G(H)$. We will see that $tp(G)$ satisfies various nice abstract properties like subgroup- and quotient-monotonicity and thus serves as an efficient "detector" of key properties of G. Roughly, this means that the larger $tp(G)$ is, the more normal structure G exhibits and thus determines structural properties of G like nilpotency, solvability and supersolvability. Finally, some related questions are discussed.

Inês Legatheaux Martins (Contributed talk)
Universidade de Lisboa

Thursday 6 July, 11:20–11:40 · Canteen [Session M]

Schur-Weyl dualities for the rook monoid: an approach via Schur algebras

The classical Schur–Weyl duality between the symmetric group S_n and the general linear group $\mathrm{GL}_d(\mathbb{C})$ on the n-th tensor power of a d-dimensional complex space is a fundamental result in representation theory. In essence, it shows that the study of the representations of S_n and the polynomial representations of $\mathrm{GL}_d(\mathbb{C})$ are essentially two sides of the same coin.

Results of J. A. Green (among others) show that the classical Schur–Weyl duality remains true if one replaces the complex field $\mathbb{C}$ by an arbitrary infinite field $\mathbb{F}$. This is largely due to the existence of an equivalence between polynomial representations of $\mathrm{GL}_d(\mathbb{F})$ and representations of Schur algebras. Introduced in a seminal monograph by J. A. Green in 1980, these finite-dimensional algebras provide a natural setting for studying representations of $\mathrm{GL}_d(\mathbb{F})$ and their interactions with those of S_n. For the past forty years, many authors have exploited this approach and enriched our knowledge of the representation theory of these structures, specially in the modular case.

In this talk, we turn our attention to Schur–Weyl dualities that involve the rook monoid R_n. Also known as the symmetric inverse monoid, R_n plays a similar rôle for finite inverse monoids as S_n plays for finite groups. In 2002, L. Solomon established a Schur-Weyl duality between R_n

and the general linear group $\mathrm{GL}_d(\mathbb{F})$ on the n-th tensor power of a d-dimensional $\mathbb{F}$-space, where $\mathbb{F}$ is a field of characteristic zero.

The aim of this talk is to give a new Schur-Weyl duality between R_n and an analog of the classical Schur algebra, which we have named the extended Schur algebra. Our approach will allow us to recover Solomon's result in the language of Schur algebras and to discuss its generalisation for infinite fields.

Peter Mayr
University of Colorado Boulder

(Contributed talk)

Wednesday 5 July, 11:00–11:20 · Main auditorium [Session H]

Commutator theory for semigroups

Commutators have been generalized from groups to arbitrary algebras in many different ways. I will give an overview of the known properties of the binary term condition commutator and higher commutators from universal algebra specialized to semigroups. In particular I will investigate what the derived notions of nilpotence, supernilpotence, and solvability mean and how they relate to classical concepts in semigroup theory.

Neil A. McKay
University of New Brunswick, Saint John, Canada

(Contributed talk)

Tuesday 4 July, 11:00–11:20 · Living room [Session F]

The scale of ups

The main tool used in analyzing all-small games since the 1970s has been the atomic weight theory, which tries to measure a game in terms of the game up. In the 1980s, Conway and Ryba proposed (but did not publish) the uptimal theory, which is finer and more precise than the atomic weight theory. Here, we provide a brief summary of this theory, including its practical application for analyzing specific rulesets and discuss the mathematical structure of the uptimals.

Craig Miller
University of York

(Contributed talk)

Monday 3 July, 16:50–17:10 · Living room [Session D]

The heights of Green's posets of semigroups

For each of the Green's relations $\mathcal{K}$ in $\{\mathcal{R}, \mathcal{L}, \mathcal{H}, \mathcal{J}\}$, the $\mathcal{K}$-height of a semigroup is the height of its poset of $\mathcal{K}$-classes, i.e. the supremum of the lengths of chains of $\mathcal{K}$-classes. We discuss the relationships between these parameters. In particular, for a semigroup S with finite L- and R-heights, we establish a bound on the $\mathcal{J}$-height of S. Moreover, for each $\mathcal{K}$ in $\{\mathcal{R}, \mathcal{L}, \mathcal{H}\}$, given a semigroup S with finite $\mathcal{K}$-height we establish bounds on the $\mathcal{K}$-heights of arbitrary one-sided ideals (in particular, these substructures inherit the property of having finite $\mathcal{K}$-height). By way of contrast, the property of having finite $\mathcal{J}$-height is not closed under ideals, but it is within the class of stable semigroups.

Rebecca Milley (Contributed talk)
Grenfell Campus, Memorial University of Newfoundland, Canada

Tuesday 4 July, 11:40–12:00 · Living room [Session F]

Progress on misère dicots: game comparison, canonical forms, and conjugate inverses

The universe of dicotic games, denoted as D, consists of games where either both players can move or neither player can move. In D, a comparison of games can be performed using an «options only» test, which is then used to define unique reduced games (canonical forms). Moreover, by using the defined canonical forms in D, it is possible to prove that D satisfies the conjugate property: regarding the invertible forms, the inverses can be obtained by swapping the sides of the players.

Ana-Catarina C. Monteiro (Contributed talk)
FCUL and CEMAT, Universidade de Lisboa

Wednesday 5 July, 11:00–11:20 · Living room [Session I]

Formations on Orthodox Semigroups

Formations of finite groups have been extensively explored (see [1], for example), however formations of semigroups have not been object of large study. The first results were obtained by Ballester-Bolinches et al [3] for finite monoids and associated formal languages, and were followed by the work presented in [2], that includes the study of related congruences, generalising results of Therien [8] for varieties of finite monoids, congruences and recognisable languages. In a different direction, there is the work of Branco et al [4]. In the world of many sorted formations these questions are discussed by Llópez and Vidal in [7]. It is natural to consider formations of other classes of semigroups such as inverse. In [5], Gomes and Nobre introduced the concept of formation for inverse semigroups, deducing several properties and, in particular, relations between classes of inverse semigroups and of groups. By a formation of inverse semigroups we mean a class of such semigroups closed for quotients and finite subdirect products. With G. Gomes, we have extended the concept of bivariety introduced in [6], to the concept of formation of orthodox semigroups. In this presentation, inspired by what was done in [5], and after introducing various concepts, we will compare classes of orthodox semigroups, of inverse semigroups and of groups, discussing the property of being formations, bivarieties or varieties. Also, we shall relate formations and f-formations of orthodox semigroups with formations of congruences and formations of idempotent separating congruences.

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Conceição Nogueira (Contributed talk)
IPLeiria, CMAT

Thursday 6 July, 11:20–11:40 · Main auditorium [Session K]

The overlap gap between left-infinite and right-infinite words

In this talk I will present ultimate periodicity properties related to overlaps between the suffixes of a left-infinite word λ and the prefixes of a right-infinite word ρ. I will talk about a result that states that the set of minimum lengths of words x and x' such that $x\lambda_n = \rho_n x'$ or $\lambda_n x = x'\rho_n$ is finite, where n runs over positive integers and λ_n and ρ_n are respectively the suffix of λ and the prefix of ρ of length n, if and only if λ and ρ are ultimately periodic words of the form $\lambda = u^{-\infty}v$ and $\rho = wu^{\infty}$ for some finite words u, v and w. This is a joint work with José Carlos Costa (Universidade do Minho) and M. Lurdes Teixeira (Universidade do Minho).

Richard Nowakowski (Contributed talk)
Dalhousie University, Canada

Tuesday 4 July, 11:20–11:40 · Living room [Session F]

Absolute Combinatorial Game Theory

In this talk, we explore a recent unifying additive theory that applies to standard conventions in Combinatorial Game Theory, including normal-play, misère-play, and scoring-play. Games in an absolute universe satisfy the property of dicotic closure. This implies that if A and B are non-empty sets of forms in the universe, then the form $\{A\|B\}$ is also an element of the universe. When this property holds, the fundamental game comparison problem «Is $G \geqslant H$?» can be solved constructively, meaning that it is possible to compare G with H using only their literal forms.

Isabel Oitavem (Contributed talk)
NOVA University of Lisbon & NOVA Math, Portugal

Wednesday 5 July, 11:20–11:40 · Canteen [Session J]

On a shortest proof of φ implies φ

Related with investigations on simplicity of proofs, we focus on formulas of the form φ implies φ, adopting as framework the Pure Positive Implication Propositional Calculus based on Frege's axiomatization of implication. In this context, we search for a shortest proof of φ implies φ. There might be particular instances of this formula which admit proofs that are shorter than a shortest proof of φ implies φ in general. A first example is the case for φ itself of the form ψ implies ψ. More examples are obtained by means of combinatory logic. This is joint work with Reinhard Kahle and Paulo Guilherme Santos.

Luís Oliveira (Contributed talk)
CMUP, Dep. Mat., Fac. Ciências, Univ. Porto, Portugal

Monday 3 July, 11:40–12:00 · Main auditorium [Session A]

Weakly generated regular semigroups

A regular semigroup S is weakly generated by a subset A if S has no proper regular subsemigroup containing A. A regular semigroup S weakly generated by a A is not generated by A usually, as very often the subsemigroup generated by A is a proper non-regular subsemigroup. In this talk we will consider two classes of regular semigroups, the class $WGI(X)$ of all regular semigroups weakly generated by a set X of idempotents and the class $WG(X)$ of all regular semigroups weakly generated by a set X of elements. Both classes have a free object in the sense that all semigroups in those classes are homomorphic images of the corresponding free object. In this talk we will look to the structure of these objects. We will denote by $WFI(X)$ the free object in $WGI(X)$, that is, the *weakly free idempotent generated* regular semigroup on X, and by $WF(X)$ the free object in $WG(X)$, that is, the *weakly free* regular semigroup on X. Both semigroups are described by presentations with an infinite set of generators and an infinite set of relations. Nevertheless, we can describe a canonical form for the corresponding congruence classes, and then present a solution for the word problem for these presentations. We will see also how the generating sets of these presentations become a "footprint" for the structure of the $\mathcal{D}$-class relation on these semigroups.

Tânia Paulista (Contributed talk)
NOVA University of Lisbon & NOVA Math, Portugal

Monday 3 July, 17:30–17:50 · Main auditorium [Session C]

Commutative nilpotent transformation semigroups

We characterize the commutative nilpotent subsemigroups of maximum order in the full transformation semigroup T_n, using a mixture of algebraic and combinatorial techniques. Although

non-commutative nilpotent subsemigroups of T_n can be much larger, the maximum-order commutative nilpotent subsemigroups turn out to be precisely the maximum-order null subsemigroups of T_n previously characterized by Cameron et al. [1].

References:

[1] Peter J. Cameron, James East, Des FitzGerald, James D. Mitchell, Luke Pebody and Thomas Quinn-Gregson. Minimum degrees of finite rectangular bands, null semigroups, and variants of full transformation semigroups. Preprint, 2021. arXiv: 2110.09701.

Hugo Penedones
Inductiva Research Labs

(Contributed talk)

Thursday 6 July, 12:00–12:20 · Living room [Session L]

AI for scientific computing

Fundamental sciences such as Mathematics, Physics, Chemistry and Biology have a long track record of using computers to help answer open research questions. Impressive results have been achieved using various domain-specific algorithms and systems, some of them exploiting parallelization in large computer clusters. Despite the exponential growth of compute power available in the last decades, progress in some problems has been limited – as the time complexity of the underlying algorithm might also grow exponentially with the input size (e.g. some combinatorial problems, simulations of quantum systems, etc.). Can Artificial Intelligence, in particular Deep Learning, become the new "universal" computational tool to help crack more problems in Science? Recent trends show that it might.

Teresa M. Quinteiro
Instituto Superior de Engenharia de Lisboa & NOVA Math, Portugal

(Contributed talk)

Monday 3 July, 16:50–17:10 · Main auditorium [Session C]

Generators of semigroups of endomorphisms of a finite path

In this talk, we consider the widely studied endomorphisms and weak endomorphisms of a finite undirected path from semigroup generators perspective. We present formulas for the ranks of the semigroups $wEndP_n$ and $EndP_n$ of all weak endomorphisms and all endomorphisms of the undirected path P_n with n vertices.

Duarte Ribeiro
NOVA University of Lisbon & NOVA Math, Portugal

(Contributed talk)

Tuesday 4 July, 11:40–12:00 · Main auditorium [Session E]

Tropical representations and identities of the stylic monoid

The stylic monoid styl_n of finite rank n, introduced by Abram and Reutenauer, is a finite quotient of the plactic monoid of rank n, defined by the action of words on the left of columns of semistandard

Young tableaux by Schensted left insertion. Its elements can be uniquely identified with so-called N-tableaux, and it is presented by the Knuth relations and the idempotency relation on its generators. As a finite $\mathcal{J}$-trivial monoid, it is in some J_k, the pseudovariety in Simon's hierarchy of $\mathcal{J}$-trivial monoids which recognize piecewise testable languages of height k, which is defined by all identities $u \approx v$ such that u and v share the same subsequences of length $\leqslant k$. Blanchet-Sadri has shown that J_k is finitely based if and only if $k \leqslant 3$, while Johnson and Fenner have shown that the variety described by the same identities as J_k is generated by the monoid $U_{k+1}(S)$ of $(k+1)\times(k+1)$ upper unitriangular matrices with entries in a non-trivial, idempotent commutative semiring S, of which the tropical max-plus semiring T is an example.

We exhibit a faithful representation of styl_n as a monoid of upper unitriangular matrices over T. Thus, we show that styln generates the pseudovariety J_n. From this, we obtain the equational theory of styl_n, show that it is finitely based if and only if $n \leqslant 3$, and that its identity checking problem is decidable in linearithmic time. We also solve the finite basis problem for styl_n with involution.

Bernardo Rossi
Johannes Kepler Universität Linz

(Contributed talk)

Tuesday 4 July, 12:00–12:20 · Canteen [Session G]

Polynomial completeness properties of Mal'cev algebras with (SC1)

In the characterization of various types of polynomial completeness for algebras in congruence modular varieties we often encounter conditions that involve congruences, the binary term condition commutator and the centralizer. In this talk, we will discuss the properties of the finite algebras with a Mal'cev polynomial that satisfy a condition known in the literature as (SC1).

In particular, we will show how partial functions that preserve the congruences of a finite Mal'cev algebra with (SC1) can be interpolated by a polynomial function, and we will give a characterization of strictly 1-affine completeness for finite congruence regular Mal'cev algebras.

Part of the work presented in this talk is based on an unpublished manuscript by E. Aichinger and P. Idziak.

Carlos Pereira dos Santos
NOVA University of Lisbon & NOVA Math, Portugal

(Contributed talk)

Tuesday 4 July, 12:00–12:20 · Living room [Session F]

Invertible elements of the misère dicotic universe

The universe of dicotic games, denoted as D, consists of games where either both players can move or neither player can move. In D, a comparison of games can be performed using an "options only" test. Moreover, by using that test, it is possible to prove a characterization of the invertible elements of D.

José Santos
Microsoft

(Contributed talk)

Thursday 6 July, 11:00–11:20 · Living room [Session L]

Large Language Models as generic machine learning models

In this talk, we showcase the power of large language models (LLMs) as generic machine learning models. We'll explore how prompt engineering enables LLMs to solve complex machine learning problems that previously required extensive data collection, labeling, and training of specific models by data scientists. Through carefully crafted prompts, one can leverage LLMs vast pre-trained knowledge to tackle tasks that until very recently demanded substantial time and expertise. This breakthrough significantly streamlines the development process and enables non-experts to harness LLMs for non-trivial machine learning tasks thus democratizing access to advanced AI capabilities.

Paulo Guilherme Santos
NOVA University of Lisbon & NOVA Math, Portugal

(Contributed talk)

Wednesday 5 July, 12:00–12:20 · Canteen [Session J]

'Provability Implies Provable Provability' using FLINSPACE

We study the derivability condition 'provability implies provable provability' using the complexity class FLINSPACE.

Apatsara Sareeto
Institute of Mathematics, University of Potsdam, Germany

(Contributed talk)

Monday 3 July, 17:10–17:30 · Main auditorium [Session C]

The rank of the semigroup of order-, fence-, and parity-preserving partial injections on a finite set

The monoid of all partial injections on a finite set (the symmetric inverse semigroup) is of particular interest because of the well-known Wagner-Preston Theorem. In this presentation, we step forward the study of a submonoid of the symmetric inverse semigroup. We study the monoid of all order-preserving partial injections on an n-element chain such that $|I_i|$ and $|J_i|$ have the same parity for $i \in \{1, ..., k\}$, where $I_1 < I_2 < \cdots < I_k$ (and $J_1 < J_2 < \cdots < j_k$) are the maximal intervals of the codomain of α (and gap of α). We characterize the transformations in that monoid and show that it has a rank $3n - 6$. In particular, we provide a generating set A_n of minimal size and exhibit concrete normal forms for the transformations generated by A_n.

Csaba Schneider
Universidade Federal de Minas Gerais

(Contributed talk)

Wednesday 5 July, 11:20–11:40 · Main auditorium [Session H]

The Hilbert series of the invariant algebras of the standard filiform Lie algebras

Standard filiform Lie algebras are nilpotent Lie algebras of maximal nilpotency class. The algebras of their polynomial invariants are finitely generated and show complicated structure already in small dimensions. I will present some theoretical and computational methods to calculate the Hilbert series of these invariant algebras.

Manuel Silva
NOVA University of Lisbon & NOVA Math, Portugal

(Contributed talk)

Thursday 6 July, 11:00–11:20 · Main auditorium [Session K]

Ramsey-type results for infinite words

In 1928 Frank P. Ramsey proved a theorem in his paper "On a problem of formal logic", which can be viewed as a powerful generalization of the pigeonhole principle and implies that every large combinatorial structure contains some regular substructure. We will discuss ramsey-type results in the context of infinite words. In one of the results, it is proved that the existence of powers or anti-powers is an unavoidable regularity. An abelian version, where we count the frequency of each letter, is conjectured to be true and reveals a surprising connection with the factor complexity function of an infinite word.

Tânia Z. Silva
FCUL CEAFEL

(Contributed talk)

Thursday 6 July, 11:40–12:00 · Canteen [Session M]

A Schur ring approach to supercharacters of groups associated with finite radical rings

We consider the central Schur ring associated with the standard supercharacters of the adjoint group $G(\mathcal{A})$ of a finite radical ring $\mathcal{A}$, and define supercharacters of the subgroup $C_{G(\mathcal{A})}(\sigma)$ consisting of elements fixed by an involution of G that can be defined when $\mathcal{A}$ is endowed with an (anti)involution and has odd characteristic. In particular, we extend known results for unipotent subgroups of the classical finite Chevalley groups.

Eduardo Skapinakis
NOVA University of Lisbon & NOVA Math, Portugal

(Contributed talk)

Wednesday 5 July, 11:40–12:00 · Canteen [Session J]

Implicit complexity and term rewriting systems

In this talk I will briefly introduce the implicit approach to complexity and how to use term rewriting systems to develop and analyse algorithms for classes of functions defined inductively.

Nora Szakacs
University of Manchester

(Contributed talk)

Wednesday 5 July, 11:40–12:00 · Main auditorium [Session H]

Geometric properties of inverse semigroups

Equipping groups with a metric naturally connected to algebraic properties of the group is the idea which led to the development of the vibrant field of geometric group theory, and naturally it has prompted several attempts to be extended to larger classes of semigroups. The class that most naturally lends itself to generalizations is that of inverse semigroups, as their Schützenberger graphs carry a natural geometry which is tied to the structure of the semigroup by Stephen's solution to the word problem. In recent years, there has been a heightened interest in studying this metric both from an algorithmic point of view, as well as in relation to an associated C∗-algebra called the uniform Roe algebra. In the talk, I will give an overview of the theory and present some of these results, which are joint with Pedro Silva, Robert Gray, Diego Martínez and YeongChyuan Chung.

Armin Weiß
Universität Stuttgart

(Contributed talk)

Tuesday 4 July, 11:00–11:20 · Canteen [Session G]

Hardness of equation satisfiability for finite solvable groups

Over twenty years ago, Goldmann and Russell initiated the study of the complexity of the equation satisfiability problem (PolSat) and the NUDFA program satisfiability problem (ProgSat) in finite groups. They showed that these problems are decidable in polynomial time for nilpotent groups while they are NP-complete for non-solvable groups. However, for a long time the case of solvable but non-nilpotent groups remained wide open — in a long sequence of papers, only the case of p-by-abelian groups could be shown to be decidable in polynomial time.

In 2020 Idziak, Kawałek, Krzaczkowski and myself succeeded to show that in groups of Fitting length at least three, PolSat cannot be solved in polynomial time under the condition that the exponential time hypothesis (ETH) holds. Later we extended this result to certain group of Fitting length 2 and considered the related problems of ProgSat and ListPolSat for which, under ETH and the so-called constant degree hypothesis, we can obtained a complete classification in which cases they are in P. In this talk I will explain the ideas for our lower bounds.