28th Victorian Algebra Conference

4–5 Nov 2010

Monash School of Mathematical Sciences

Participants

- Ms Natalie Aisbett .... The University of Melbourne
- Mrs Nadiya Al Dhamri .... La Trobe University
- Dr Burzin Bhavnagri .... Swinburne University of Technology
- Dr Graham Clarke .... Royal Melbourne Institute of Technology
- Dr John Cossey .... Australian National University
- Dr Daniel Delbourgo .... Monash University
- Dr James East .... University of Sydney
- Dr Murray Elder .... University of Queensland
- Dr Graham Farr .... Monash University
- Dr Barry Gardner .... University of Tasmania
- Dr John Groves .... The University of Melbourne
- Mr Nazer Halimi .... The University of Queensland
- Prof Kathy Horadam ...... Royal Melbourne Institute of Technology
- Mr Joshua Howie .... The University of Melbourne
- Dr Deborah Jackson .... La Trobe University
- Dr Marcel Jackson .... La Trobe University
- Mr Matthew Kotros .... The University of Melbourne
- Dr Kristine Lally .... Royal Melbourne Institute of Technology
- Dr Antonio Lei .... Monash University
- Dr Robert McDougall .... Central Queensland University
- Dr Eric Mortenson .... University of Queensland
- Dr Todd Niven .... La Trobe University
- Dr Arun Ram .... University of Melbourne
- Dr Asha Rao .... Royal Melbourne Institute of Technology
- Dr Lawrence Reeves .... The University of Melbourne
- Dr Victor Scharaschkin .... The University of Queensland
- Dr Tim Stokes .... University of Waikato
- Dr Douglas Stones .... Monash University
- Mr Tharatorn Supasiti .... The University of Melbourne
- Dr Don Taylor .... University of Sydney
- Dr Ian Wanless .... Monash University
- Dr Craig Westerland .... The University of Melbourne

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Infinite partition monoids

James East 9:30am Thu

An intuitive notion of the complexity of an algebra A (eg a group, ring, semigroup, etc) is its rank, ie the minimal size of a generating set. However, if A is uncountable, then any generating set has size $|A|$, so rank does not tell us anything. All is not lost though, since many other properties of generation can be formulated to distinguish simpler algebras from more complicated ones. Here are two:

- Bergman's Property – for any generating set U of A there is a natural number n such that any element of A can be written as a product (etc) of at most n elements from U. (In other words, the length function is bounded with respect to any generating set.)

- Sierpinski rank – this is defined to be the least integer n (if it exists) such that any countable subset of A is contained in an n-generated subalgebra.

For example, the symmetric group on any infinite set satisfies Bergman's property, and has Sierpinski rank 2. I'll discuss these concepts, and others, in the context of infinite transformation semigroups and partition monoids.

** Morning Tea 10:30-11am **

Relative hyperbolicity of groups and relative quasiconvexity of subgroups

Matthew Kotros 11am Thu

Relatively hyperbolic groups first appeared in the 1987 seminal paper "Hyperbolic Groups" by Gromov, in which the theory of hyperbolic groups — finitely generated groups exhibiting negatively curved (or δ-hyperbolic) geometry — was developed. Relatively hyperbolic groups are, in a sense, negatively curved away from a collection of peripheral subgroups. They generalise hyperbolic groups and geometrically finite Kleinian groups. Relatively quasiconvex subgroups generalise quasiconvex subgroups of hyperbolic groups – subgroups playing a central role in the theory hyperbolic groups.

In this talk, I will introduce relatively hyperbolic groups and relatively quasiconvex subgroups, and discuss properties of relatively quasiconvex subgroups that are analogous to those of quasiconvex subgroups in the non-relative setting. In particular, I will discuss the existence of a Cannon-Thurston map that arises when considering such subgroups.

Right P-comparable semigroups

Nazer Halimi — 11:30am Thu

There exists an analogy between the structure of ideals of a cone in a group and the structure of ideals of a Dubrovin valuation ring in a simple Artinian ring. By using a pair of prime ideals, which is called a prime segment, one can investigate the ideal theory of Dubrovin valuation rings as well as the ideal theory of cones in right orderable groups. There is a remarkable classification theorem for prime segment of the above structures.

In this talk, I will define the notion of a Right P-comparable semigroup to generalize this classification theorem to semigroups with weaker conditions.

Natural duality for the product of independent algebras

Nadia Al Dhamri — noon Thu

This talk concerns the existence of natural dualities between certain kinds of algebraic structures. We examine a notion of *independence* for equational classes of algebras and show that the existence of dualisability is preserved under taking direct products in the case of independence. This is used to established dualities for some familiar semigroups.

** Lunch 12:30-2pm **

Comparison Semigroups

Tim Stokes — 2pm Thu

Transformations of a set naturally form into semigroups under composition, but other operations make sense. In this talk I characterize algebras of transformations on a set under the operations of composition and the pointwise switching function defined as follows:

$$(f,g)[h,k](x) := \begin{cases} h(x) & \text{if } f(x) = g(x) \\ k(x) & \text{otherwise.} \end{cases}$$

The same characterization holds for partial transformations under composition if the quaternary operation is suitably extended to them. When zero and identity elements are added (modelling the empty and identity functions), the resulting signature is rich enough to express many previously considered operations on semigroups of partial transformations.

On the asymptotic dimension of metric spaces

Tharatorn Supasiti 3pm Thu

In 1993, Gromov introduced the notion of asymptotic dimension of metric spaces, which is coarse invariant (or invariant under quasi-isometries for geometric group theorist). Aside from application in geometric group theory, it is interesting in its own right. In general, it is relatively easy to find an upper bound on the asymptotic dimension, if it exists. However, the harder problem is in finding a lower bound. In this talk, I will describe a cohomological method used to tackle this problem.

** Afternoon Tea 3:30-4pm **

Closure properties for logspace computable groups

Murray Elder (with Gillian Elston and Gretchen Ostheimer) 4pm Thu

I pick up from where I left off at the AustMS conference and expand the class of groups having normal forms computable in logspace.

The Odd Intersection Property

Victor Scharaschkin 4:30pm Thu

Let A be a finite set, and let S be a collection of subsets of A. We say that S has the odd intersection property (OIP) if there exists a set $B \subseteq A$ such that $|B \cap T|$ is odd for each T in S. Wright used this property to characterise sets of integers whose elements are all quadratic non-residues mod p, for infinitely many p. He raised the question of the number of sets with the OIP, as a function of $|A|$. We answer this question.

Soluble products of finite groups

John Cossey 5pm Thu

Suppose A and B are subgroups of a group G. We say that G is the product of A and B if $G = AB = \{ab : a \in A, b \in B\}$. A natural question to ask is whether properties of G can be deduced from properties of A and B. There is an extensive literature on this question. Many properties have been considered – see for example the book of Amberg Franciosi and de Giovanni – and further restrictions on the products have also been considered. I will concentrate on one particular property. Suppose that G is soluble. Then A and B are certainly soluble but A and B soluble is not enough to ensure that G is soluble and so we may ask the following questions:

What further conditions on A and B will ensure that $G = AB$ is soluble?

If G is soluble, can we bound the derived length $d(G)$ of G in terms of invariants of A and B?

If $d(G)$ is bounded, can we find the best possible bound?

I will concentrate on the second and third questions. There is quite a lot known about possible bounds but except in some special cases very little is known about best possible bounds. I will survey what is known and discuss some of the problems that we still know little about.

** Conference Dinner 6:30pm– **

The conference dinner will be at "Nights of Kabul", 39 Portman St, Oakleigh from 6:30pm on Thursday evening. We will be having their $40 banquet. Students will be subsidised, so they only pay half price. The restaurant is licensed or BYO.

Transport to the dinner will be by car-pooling or bus 900 from Monash's bus loop (alight at Oakleigh Station). The restaurant is a short walk from Oakleigh train station, which has regular services to and from the city centre until around midnight.

Root data for complex reflection groups

Don Taylor 9:30am Fri

A root datum, defined over the integers, can be thought of as the root system and dual root system of a finite Weyl group with an explicit pairing defining the duality. They occur naturally in the classification of connected reductive groups. By replacing the integers by the ring of integers of a suitable algebraic number field one obtains a generalised root datum whose "Weyl group" is a finite complex reflection group. I will describe a few properties of these root data; in particular, every finite complex reflection group arises in this way.

** Morning Tea 10:30-11am **

L-functions of elliptic curves

Daniel Delbourgo 11am Fri

I'll quickly explain how to prove the "exceptional zero conjecture" over certain non-abelian field extensions of the rationals. I'll also explain how this helps our understanding of the arithmetic of elliptic curves.

Elementary divisors and p-adic Hodge Theory

Antonio Lei (with David Loeffler, Sarah Zerbes) 11:30am Fri

Denote by $H(\Gamma)$ the algebra of $\mathbb{Q}_p$-valued distributions on $\mathbb{Z}_p$. It is a ring that admits the theory of elementary divisors. I will explain how to relate the Dieudonne module and the Wach module of a crystalline representation via $H(\Gamma)$-elementary divisors, which are defined in terms of the Hodge-Tate weights of the representation.

Idempotent conjectures

Burzin Bhavnagri noon Fri

We discuss the idempotent conjectures beginning with a long standing conjecture of Irving Kaplansky. A simple case in which the conjecture is true helps to show the real numbers as a field are representational consistent. This is a better result than last year when I showed some lens spaces are representational consistent. This leads to the problem of whether a circle can be given a field structure that can be shown to be consistent.

** Lunch 12:30-1:30pm **

On Cayley graphs and semigroups

Graham Clarke (with Luo and Hao) 1:30pm Fri

We look at the way the algebraic structure of certain semigroup and subset pairs affects the Cayley graphs determined by those pairs. In particular we determine, for a completely simple semigroup, when the Cayley graph is a disjoint union of complete graphs.

An elementary approach to the Koethe Conjecture

Robert McDougall (with N. McConnell) 2pm Fri

The Koethe Conjecture was first published in 1930 and remains open after 80 years of attempts through a variety of different equivalent propositions. In this presentation we show how using an elementary approach to demonstrate that polynomial rings over nil rings are quasiregular wasn't completely successful either (so no need to alert the media) but does give a useful insight into the challenge and subtlety of nil rings in the polynomial environment.

Hecke-type double sums, Appell-Lerch sums, and mock theta functions (I)

Eric Mortenson (with Dean Hickerson) 2:30pm Fri

We state and prove a formula, which expresses Hecke-type double sums in terms of Appell-Lerch sums and theta functions. Not only does our formula prove the classical Hecke-type double sum identities such as those found in works of Andrews, Kac and Peterson, and Polishchuk, but once we have the Hecke-type sum forms for Ramanujan's mock theta functions our formula also proves the identities for the second, fifth, sixth, seventh, eighth, and tenth order mock theta functions. In particular, our formula gives a new proof of the mock theta conjectures for the fifth order functions as well as a new proof of Hickerson's identities for the seventh order functions. Our formula also evaluates all positive-level string functions associated with admissable representations of the affine Lie Algebra $A_1^{(1)}$ as introduced by Kac and Wakimoto.

** Afternoon Tea 3-3:30pm **

Maltsev digraphs and digraph colouring

Todd Niven (with Marcel Jackson) 3:30pm Fri

Digraphs admitting a Maltsev operation are known to have polynomial time homomorphism problem. In this talk we give a graph theoretic classification of those digraphs that admit Maltsev operation and discuss some other nice properties that these digraphs share.

Rings in which every infinite subset contains distinct elements x, y with $xy = 0$

Barry Gardner 4pm Fri

Bernhard Neumann showed that every infinite subset of a group contains a pair of commuting elements if and only if the group is finite modulo its centre. By analogy one might hope to see some connection between the rings of the title and the property of being finite modulo the annihilator. It is relatively straightforward to show that under the rather drastic requirement of satisfying the identity $xx = 0$ the rings of the title are precisely those which are finite modulo the annihilator, but then it turns out that the restriction is not so drastic after all.

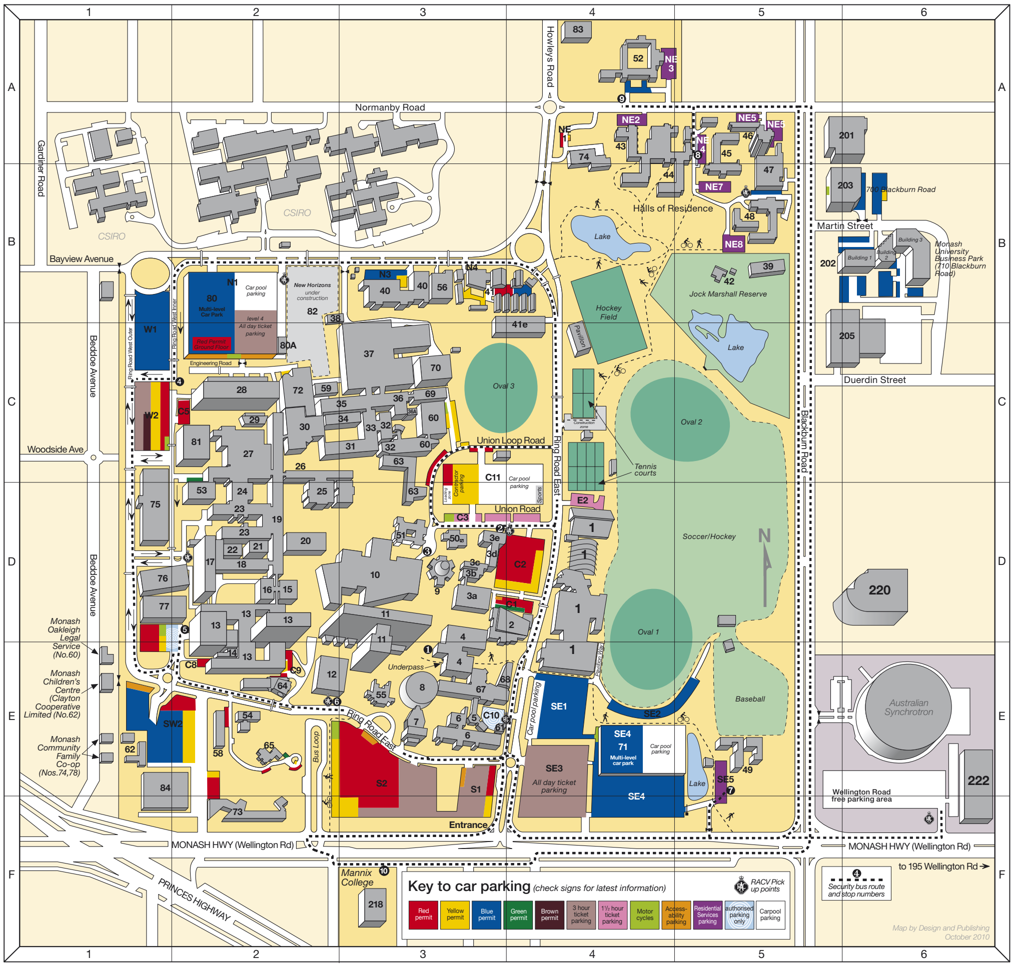
Constrained representations of semigroups.

Marcel Jackson (with Tim Stokes) 4:30pm Fri

It is an essentially trivial fact that every semigroup is isomorphic to a semigroup of partial functions on a set, and also that any composition closed set of partial functions on a set is a semigroup. Similar statements hold if "partial function" is replaced by "function" or by "binary relation".

A more challenging situation occurs when one is required to represent a semigroup as a semigroup of partial functions (or binary relations), subject to the constraint that idempotent elements (or possibly some designated subset of the idempotent elements) are represented as restrictions of the identity function. Situations of this kind are quite widely encountered, yet present a surprisingly difficult challenge: not only are there unrepresentable semigroups, the representable semigroups can be extremely difficult to characterise.

Monash University Clayton campus



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MONASH University

All talks are in lecture theatre S15, building 29.
Morning/Afternoon tea is in room 342, building 28.
Computer Access is in room 344, building 28.
There are toilets on every floor of building 28.

Victorian Algebra Conference, Monash Clayton, 4–5 Nov 2010

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