ANU/Macquarie Category Theory Workshop

Haydon- Allen Building, Room HA G050

11th – 12th February 2013

	Day 1
9:30	Scott Morrison
10:20	Ignacio Lopez Franco
11:10	Michael Johnson
12:00	Lunch
14:00	James Borger
14:50	Vigleik Angeltveit
15:30	Afternoon Tea
16:00	Steve Lack
16:50	Dominic Verity
17:40	Finish

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11th February 2012

Speakers, Titles and Abstracts

- Scott Morrison
    - Title: Khovanov homology as a 4-category
    - Abstract: Khovanov homology is a functorial invariant of links and link cobordisms. In fact, with a suitable framework for higher categories, we can interpret it as a 4-category, and then define vector space valued invariants of 4-manifolds.
- Ignacio Lopez Franco
    - Title: What is the Frobenius-Perron dimension in a tensor category?
    - Abstract: TBA
- Michael Johnson
    - Title: Spans, spans, spans, and the monad of anchored spans
    - Abstract: We review several instances of the use of spans in a category with pullbacks, and introduce the monad of anchored spans. A study of the algebras for this monad leads to a further use of spans and a theorem with important applicaitons.
- James Borger
    - Title: Generalized symmetries in categories of algebras (following Tall-Wraith, Bergman-Hausknecht,...)
    - Abstract: It makes sense to speak about a group acting on an object in any category. It also makes sense for monoids, and conversely a monoid is the most general structure that can act on an object in a general category. But for categories C of algebraic objects such as vector spaces, commutative rings, Lie algebras, etc, where the objects are sets equipped with operations, there is a more general notion of symmetry object: it is an object of the original category C that represents a comonad. In some cases, these generalized symmetry objects can be built out of more traditional symmetry objects, such as groups and Lie algebras. This is the case with vector spaces, where a generalized symmetry object is the same as an associative algebra. In

other cases, such as commutative Q-algebras, such a statement is conjectured but not proved. But in other cases, there are genuinely new symmetry structures, which can explain certain exotic constructions, such as Witt vectors. I'll discuss these generalized symmetries for a number of different algebraic categories.

- Vigleik Angeltveit
    - Title: The topological Hochschild homology of Thom spectra as cyclotomic spectra.
    - Abstract: One can construct a symmetric monoidal category of spectra by finding a way to internalise the external smash product. There is a corresponding category of "spaces", Quillen equivalent to the usual category of spaces but with a more interesting symmetric monoidal structure that mirrors the smash product of spectra. In this setting many constructions commute with passing to spectra. For example, taking the cyclic bar construction (in spectra) of a Thom spectrum is the same as taking the Thom spectrum of the cyclic bar construction (in "spaces"). What's new is that we can exploit an equivariant version of this to construct topological Hochschild homology of Thom spectra as genuine equivariant spectra with certain extra structure. This is part of work in progress with Blumberg, Gerhardt, Hill and Lawson.

- Steve Lack
    - Title: Triangulations, orientals, and skew monoidal categories.
    - Abstract: It has long been known that triangulations of convex polygons are closely related to bracketings of n-ary products. I will talk a little about the history of this subject, and how it relates to certain coherence problems in category theory. The tensor product of abelian groups is not associative in the strict sense, but it is associative up to natural isomorphism. Similarly the group Z of integers is not a unit (identity) for the tensor product, but it is so up to natural isomorphism. Mac Lane showed that in situations such as this, in order to show that all diagrams which are built up out these natural isomorphisms must commute, it suffices to check five particular diagrams (including the famous pentagon). The resulting structure is called a monoidal category.

- Dominic Verity
    - Title: The aim of this talk is to discuss the homotopy coherence properties of adjunctions between quasi-categories.
    - Abstract: Taking as our lead the theory of the "walking adjunction" Adj of 2-category theory, we generalise to categories enriched in quasicategories and show that this same 2-category plays a similar role in this new context. Specifically, using insights drawn from the calculus of string diagrams we give an explicit presentation of Adj as a simplicially enriched category. We then use this to show that if C is any quasicategory enriched category and u is a right adjont 0-arrow in C, in some suitable sense to be discussed, then this data may be completed to give a simplicially enriched functor A->C. Furthermore, we show that the space of all such exensions is contractible.

      That adjunctions of quasicategories may be completed up to enriched functors on A in this way contains, in its very essence, the adjunction data discussed by Jacob Lurie. Such enriched functors encapsulate both the coherent monad and the coherent comonad generated by such an adjunction and provide the building blocks upon which to found a formal theory of such things along the lines established by Street in the 2-categorical context.

      This talk will be introductory in nature, so in particular it will contain no proofs and lots of agitated hand waving.

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11th – 12th February 2013

	Day 2
9:30	Anthony Licata
10:20	Lars Hesselholt
11:10	Ross Street
12:00	Lunch
14:00	Mark Weber
14:50	Michael Batanin
15:30	Afternoon Tea
16:00	Richard Garner
16:50	Mitchell Buckley
17:40	Finish

ANU/Macquarie Category Theory Workshop

12^{th} February 2012

Speakers, Titles and Abstracts

- Anthony Licata
  - Title: Heisenberg algebras, Hecke algebras, and graphical calculus
  - Abstract: If we have a collection of functors each of which admits a biadjoint, then the natural transformations between such functors can be organised into a 2-category described by a graphical calculus of planar diagrams. In particular examples this leads to graphical categorifications of various important objects from representation theory. In this talk we will illustrate this process in a basic but still fairly rich example : we will categorify the Heisenberg algebra by studying induction and restriction functors between Hecke algebras.

- Lars Hesselholt
  - Title: The big de Rham-Witt complex
  - Abstract: TBA
- Ross Street
  - Title: Monads and monoidal structures
  - Abstract: The remarkable fact about algebraically constructing a category A from a nice category X is that the forgetful functor U:A-->X has a left adjoint F -| U and the category A can be reconstructed as the category X^T of Eilenberg-Moore algebras for the monad T=UF on X. The Kleisli category X_T is equivalent to the full subcategory of X^T consisting of the free algebras TX; the adjunction F -| U restricts to an adjunction F_T -| U_T:X_T-->X which generates the same monad T=U_T F_T. From the point of view of the 2-category (or bicategory) Cat of categories, the constructions taking (X,T) to X^T and X_T are dual: the first is a limit and the second a colimit. The talk will be about obtaining monoidal structures on X^T$ and X_T when X is monoidal. We will explain this old work explicitly and then, inspired by a recent paper of Marek Zawadowski (JPAA 2012), from a bicategorical perspective.
- Mark Weber

- Title: Structured colimits and polynomial functors (joint work with Michael Batanin)

  Abstract: For various constructions in algebra, geometry, homotopy theory and higher category theory, one has some combinatorial ingredients which determine both the nature of the colimits that play a role in the calculations, and the algebraic structure enjoyed by the resulting constructions. In this talk it will be explained how the theory of polynomial functors and of 2-dimensional monad theory can be used to organise such constructions and their ingredients more conceptually. Applications to the modular envelope of a cyclic operad will be discussed.

- Michael Batanin

  - Title: Homotopy theory of algebras of polynomial monads

  - Abstract: This is joint work with Clemens Berger (Nice, France). Stefan Shwede and Brook Shipley showed that the category of monoids in a cofibrantly generated monoidal model category which satisfy one additional axiom (the monoid axiom) can be equipped with a transfered model structure. Fernando Muro obtained a similar transfer result for nonsymmetric operads and there are several results about model structures for other categories of operads (symmetric operads, properad, PROPs etc.) under more restrictive conditions. All those categories are examples of categories of algebras over polynomial monads. We show that the result of Shwede-Shipley can be generalised to any category of algebras of a polynomial monad satisfying a condition of existence of polynomial formula for coproduct of an algebra and free algebra. Categories of monoids, nonsymmetric operads and many other satisfy this condition. Moreover, this condition is necessary in appropriate sense. We use a theory of structured colimits developed by Michael Batanin and Mark Weber as a main tool in our analysis of existence of transfered model structure. This theory also allows us to clarify an important question about left properness of this transfered model structure.

- Richard Garner

  - Title: Free cocompletions

  - Abstract: Many kinds of mathematical structure (e.g., sheaves, manifolds, schemes) can be described as formal glueings-together of certain atomic entities. Category theory gives precise form to the passage from the atomic entities to the glueings via the theory of free cocompletions. We give a survey of the machinery and of the kinds of structure it can capture.

- Mitchell Buckley
    - Title: TBA

      Abstract: