Mathieu Anel, Eric Finster, Georg Biedermann, André Joyal   Cotopological towers of topoi and Goodwillie towers

We shall explain first how to explicitly describe the left exact generation of an infinity-topos E generated by a map f in E. We shall then apply this to the construction of a tower of left exact localizations associated to any left exact localization. We recover this way the towers produced in Goodwillie calculus and Weiss orthogonal calculus.

Steve Awodey   An algebraic fibrant replacement for cubical sets

As the title says...

Michael Barr and John Kennison   On contractible simplicial objects and homotopies

John and I have been looking at what it means for a simplicial object to be contractible and found that the three definitions you will find are not equivalent despite claims in the literature to the contrary (one, regrettably, by me). During this study we have also found a new and useful take on the homotopy relation.

Tai-Danae Bradley, Martha Lewis, Jade Master, Brad Theilman   Modeling Language and Translations Categorically

The categorical compositional distributional (DisCoCat) model of meaning developed in 2010 by Coecke, Sadrzadeh, and Clark has been successful in modeling various aspects of meaning. However, it fails to model the fact that language can change. We give an approach to DisCoCat that allows us to represent language models and translations between them, enabling us to describe translations from one language to another, or changes within the same language. We unify the product space representation of Coecke et. al. and the 2013 functorial description of Kartsaklis et. al. in a way that allows us to view a language as a catalogue of meanings. We formalize the notion of a lexicon in DisCoCat, and define a dictionary of meanings between two lexicons. All this is done within the framework of monoidal categories. We give examples of how to apply our methods, and give a concrete suggestion for compositional translation in corpora.

Phillip Bressie   Globular PROs as Cartesian-Duoidal Enriched Monoidal Categories

Tom Leinster's work on globular operads has provided one of many potential definitions of a weak omega-category. This is done through the language of globular operads, which are monoids in the monoidal category of collections with respect to the (pasting) composition tensor product. In my talk, I plan to show how this theory of globular operads can then be extended into a theory of globular PROs via categorical enrichment over the category of collections. I will first briefly recount Leinster's description of the category of collections. Next I will describe cartesian-duoidal categories, which are essentially a category with two compatible monoidal structures, one of which is a categorical product. Then I shall show that the category of collections is cartesian-duoidal and explain how enrichment over this category provides a suitable notion of a globular PRO. Time permitting, I will further unpack the motivation for this construction, that of describing how the contractions Leinster describes can be applied to the context of globular PROs, giving a convenient framework to describe the omega-categorification of your favorite algebraic theory.

Christoph Dorn and Christopher Douglas Combinatorial Cobordisms

We present a new algebraic theory of higher categories, called "associative n-categories", which arises from a combinatorial analysis of framed (stratified) manifolds. On one hand, this allows use to understand coherence data of weak n-categories in fully algebraic terms and sheds new light on the topic of semi-strictification (in particular motivating a strengthened version of the Simpson conjecture). On the other hand, the algebraic structures involved have direct geometric interpretation as manifold diagrams, which makes associative n-categories a comfortable setting for discussing geometric questions (such as the cobordism or homotopy hypothesis).

Brendan Fong and David Spivak Hypergraph categories as cospan algebras

Hypergraph categories are symmetric monoidal categories in which morphisms can be represented by string diagrams in which strings can branch and split: diagrams that are reminiscent of electrical circuits. As such they provide a framework for formalising the syntax and semantics of circuit-type diagrammatic languages. This structure has been independently rediscovered many times, in contexts as diverse as concurrency theory, databases, signal flow graphs and linear algebra, graph rewriting, and circuit theory. Nonetheless, despite its utility, the definition has the perhaps intriguing property that hypergraph structure does not transfer along equivalence of categories. In this talk I will motivate the definition by providing an alternative conceptualisation of a hypergraph category as a so-called cospan algebra: a lax symmetric monoidal functor (Cospan_L,+) --> (Set,x), where L is some set and Cospan_L is a category where morphisms are cospans between L-labelled finite sets. In particular, the category of cospan algebras is equivalent to the category of strict hypergraph categories.

Nick Gurski and Daniel Schaeppi The bar construction as cofibrant replacement

The bar construction is a classical tool for fattening up a module (or pair of modules) that has a simple description and is often easy to manipulate. One often thinks of the bar construction as providing a good functorial cofibrant replacement, but we discovered when working with the Joyal model structure that all the statements of this fact we could find in the literature required a simplicial model structure. I will give a more general, enriched version of this kind of result and explain how you can use it to replace some homotopically bad colimits with better ones.

Gregory Henselman-Petrusek Functoriality in Topological Models

Novel topological models of mathematical, scientific, and engineering systems have proliferated over the past three decades, spurring the growth of substantial new fields of study in both pure mathematics and the sciences. A majority of work in these fields involves an essential categorical component; indeed, applications of functoriality are widely recognized as the principle contributions of topological methods to applied science. This brief survey will give a critical summary of categorical structures in topological models, and outline some of the core analytical capabilities they enable.

Michael Horst Free Picard Categories

We will discuss a construction for free Picard categories generated by groupoids, and we will justify this terminology by demonstrating a suitable adjunction with the forgetful functor. We will close by outlining applications to categorified group cohomology.

Michael Lambert The Calculus of Fractions in a Cosmos of Internal Categories

In the case that a set of arrows of a small category admits a right calculus of fractions, the resulting localization has a tractable description. That the arrows are represented as equivalence classes of certain spans has been instrumental in our work on the exactness of an internal colimit functor in the 2-category of small categories. Thus, to pursue an abstract 2-categorical generalization of these exactness results, we look for an account of the calculus of fractions in certain 2-categories with structure sufficient for the definitions to make sense. In this talk, we shall outline an approach to localization in a 2-category of categories internal to some suitably exact 1-category. In particular, we shall see how the localization can be constructed using only exactness conditions, in the case that the object of arrows to be inverted satisfies a suitably adapted version of the axioms for a right calculus of fractions.

JS Lemay Why FHilb is not an interesting differential category

Differential categories provide an axiomatization of the basics of differentiation and categorical models of differential linear logic. In categorical quantum mechanics, compact closed categories are one of the principle studied notions, in particular the category of finite dimensional Hilbert spaces FHilb. On the other hand, compact closed categories provide "degenerate" models of linear logic. In this talk, we will explain why the only differential category structure on FHilb is the trivial one. This follows from a sort of “incompatibility” between the compact closed structure and differential category structure similar to the Stone-von Neumann theorem which states that there are no finite-dimensional representations of the Weyl algebra (in the characteristic zero case). That said, there are interesting non-trivial examples of compact closed differential categories, which we will also discuss.

Arthur J. Parzygnat and Benjamin P. Russo Non-commutative disintegration

Classical conditional probabilities and disintegrations can be formulated diagrammatically in a category of measure spaces and transition kernels. Combining this with the functor taking transition kernels to positive operators on C*-algebras, a notion of non-commutative disintegration and conditional probability can be made for states on C*-algebras. Just as in the classical measure-theoretic case, disintegrations are unique a.e. when they exist. However, unlike the classical case, the existence of non-commutative disintegrations is not guaranteed even on finite-dimensional matrix algebras. We will state some general existence and uniqueness results as well as illuminating examples. This is joint work with Benjamin P. Russo (Farmingdale State College SUNY).

Dorette Pronk and Laura Scull Conditions to Simplify the Bicategory of Fractions Construction

The bicategory of fractions constructions construction is an important localization technique for bicategories. However, in general it has two draw-backs: the homs in the resulting bicategory are not small and the pasting of 2-cells is rather technical. Also, the fact that 2-cells are only defined as equivalence classes complicates working with them. In this talk I will present conditions on the arrows to be inverted in order to obtain an equivalent bicategory that has small hom-categories and conditions on the original bicategory that will result in canonical representatives for the 2-cells and a simpler construction for horizontal composition.

Amit Sharma Symmetric monoidal categories and Γ-categories

A Γ-category is a functor from the category of finite based sets and basepoint preserving functions Γop to the category of all (small) categories Cat. We construct a model category structure on the category of Γ-categories ΓCat, which is symmetric monoidal closed with respect to the Day convolution product. The fibrant objects in this model category structure are those Γ-categories which are often called special Γ-categories. The main objective of this research is to establish a Quillen equivalence between a natural model category struc- ture on the category of (small) permutative categories and strict symmetric monoidal functors Perm and our model category structure on ΓCat. The weak equivalences of the natural model category structure are equivalences of underlying categories. In the paper [1], Segal defined a functor from the category of (small) symmetric monoidal cat- egories into ΓCat which can be described as a nerve functor for symmetric monoidal categories. The right adjoint K of our Quillen equivalence is a thickening of Segal's nerve functor. We construct a permutative category \L called Leinster's category, having the universal property that each Γ-category extends uniquely to a symmetric monoidal functor along an inclusion functor ε : Γop → \L. The left adjoint L' of our Quillen equivalence is a composite functor composed of the symmetric monoidal extension functor indicated above followed by a homtopy colimit functor. In the paper [2], Mandell had shown that Segal's nerve functor (followed by the ordinary nerve functor) induces an equivalence between a homotopy category of Perm, obtained by inverting those strict symmetric monoidal functors which induce a weak homotopy equivalence of simplicial sets upon applying the nerve functor, and a homotopy category of Γ-spaces ΓS obtained by inverting pre-stable equivalences which are those maps of Γ-categories which induce a degreewise weak homotopy equivalence of simplicial sets upon applying an E∞-completion functor. The objective of Mandell's work is to understand the relation between connective spectra and Γ-spaces obtained by applying the Segal's nerve functor to symmetric monoidal categories whereas our objective is to construct a model category of symmetric monoidal categories which is symmetric monoidal closed.

References:

[1] G. Segal, Categories and cohomology theories, Topology 13 (1974) 293–312.

[2] M. A. Mandell, An Inverse K-theory functor, Doc. Math 15 (2010) 765–791.

David I. Spivak and Brendan Fong Regular categories as double functors

The 2-category of regular categories is a reflective subcategory of a category whose objects are lax monoidal double functors from Cospan to Poset. This gives a new graphical language for regular categories, in which composition diagrams are hypergraphs.

Martin Szyld Sigma limits and applications

Sigma limits in 2-categories [1] interpolate between lax and pseudolimits, but unlike them they satisfy: any weighted sigma limit admits an expression as a conical sigma limit. This fact allows to extend two classical results which involve (conical) limits to 2-dimensional category theory as follows:

- A characterization of Cat-valued flat pseudofunctors as (sigma) filtered (sigma) colimits of representables [1].

- A limit lifting theorem for the 2-category of algebras of a 2-monad [2].

I will explain the basic concepts involved in the statements above, and mention other intended applications of these limits.

References

[1] Descotte M.E., Dubuc E.J., Szyld M., Sigma limits in 2-categories and flat pseudofunctors, Advances in Mathematics 333 (2018).

[2] Szyld M., A general limit lifting theorem for 2-dimensional monad theory, Journal of Pure and Applied Algebra 222 (2018).

Remy Tuyeras Category theory for genetics

In this talk, I will define a class of limit sketches that can be used to reason about the mechanisms of genetics. The models for these limit sketches should be seen as analytic tools that establish a link between the data and the logic of the sketches. We will see how one can use these models to produce conclusions about a set of observations. In particular, we will see that different types of mechanisms can be studied by changing the category in which the models land.

Felix Wellen and Egbert Rijke Abstract facts on formally étale maps

Mahmoud Zeinalian and Manuel Rivera The rigidification functor and the fundamental group

I will describe the relationship between three functors: the rigifidication functor (the left adjoint of the homotopy coherent nerve functor) from simplicial sets to simplicial categories , the cobar functor from differential graded coalgebras to differential graded algebras, and the based loop space functor from pointed spaces to topological monoids. Then I will deduce the following fundamental observation, which (to our knowledge) has not been spelled in the literature of classical algebraic topology: the fundamental group of a path connected space may be recovered from the algebraic structure of its singular chains.