Species and operads in combinatorics and semantics

December 10th and 11th, 2020

Program

Abstracts

Participants

Program

Thursday 10th

9h15– 9h30	Welcoming
9h30–10h10	Sophie Raynor
10h25–10h40	Coffee break
10h40–12h30	Dominique Manchon
12h30–13h30	Lunch break
13h30–15h20	Samuel Mimram
15h20–15h35	Coffee break
15h35–16h15	Jovana Obradovic
16h15–16h30	Coffee break
16h30–17h10	Muriel Livernet

Friday 11th

9h30–10h10	Chaitanya Leena Subramaniam and Cédric Ho Tanh
10h10–10h25	Coffee break
10h25–11h05	Cécile Mammez
11h05–11h20	Coffee break
11h20–12h00	Zeinab Galal
12h00–13h15	Lunch break
13h15–13h55	Hugo Paquet
13h55–14h10	Coffee break
14h10–14h50	Nicolas Behr
14h50–15h05	Coffee break
15h05–15h45	Federico Olimpieri
15h45–16h00	Coffee break

Abstracts

Sophie Raynor
An operadic approach to compact closed categories

Compact closed categories are categories in which every object has a strict dual. For example, for any commutative ring R, the category of finitely generated projective R-modules and module homomorphisms is compact closed. I'll explain how there is a sense in which duality means we can forget about the direction of morphisms, and how we can use modular operads to make this precise.

Dominique Manchon
Formalisme des espèces, exemples, et application aux structures algébriques

La notion d'espèce, due à André Joyal, consiste en des familles d'objets mathématiques indexées par tous les ensembles finis, de manière à ce que deux objets de la famille indexés par deux ensembles de même cardinal soient isomorphes. Nous présenterons trois exemples en détail : l'espèce P des ordres partiels, l'espèce A des arbres enracinés, et l'espèce T des topologies, qui présentent une structure algébrique très riche. Nous définirons la notion d'opérade dans ce formalisme, nous rappellerons les deux structures d'opérade NAP et Pré-Lie sur A, et nous présenterons plusieurs structures d'opérade sur P. Nous conclurons par la notion de ProP à roues, qui nécessite d'élargir le formalisme aux bi-espèces.

Samuel Mimram
An introduction to denotational semantics of logic

In order to gain a better understanding of the meaning and structure of proofs in logic, it is quite useful to study their semantics, which consists in interpreting them as mathematical structures. I will present this point of view, motivated by the Curry-Howard correspondence between proofs and typed programs. We will see that the study of semantics has allowed reaching a fine grained approach to logic, in particular with the advent of linear logic, and that logic has in turn enabled the emergence of ubuiquitous structures, through the study of the categorical properties of its semantics.

Jovana Obradovic
Minimal models for graphs-related operadic algebras

We construct explicit minimal models for the (hyper)operads governing modular, cyclic and ordinary operads. Algebras for these models are homotopy versions of the corresponding structures. This is joint work with Batanin and Makl.

Muriel Livernet
Applying rigidity theorem and structures theorems to species combinatorics

In this talk, through various examples, we will show that rigidity and structure theorems – a generalisation to operads of classical results in algebraic topology such as Leray's theorem and the Cartier-Milnor-Moore's theorem, give us powerful tools to understand the combinatorics of species. Dans cet exposé, à travers un certain nombres d'exemples, nous montrons comment les généralisations aux opérades des théorèmes classiques de topologie algébrique (Leray et Cartier-Milnor-Moore) nous donnent des outils puissants pour comprendre la combinatoire de certaines espèces.

Chaitanya Leena Subramaniam and Cédric Ho Tanh
The opetopic nerve of operads

Opetopes are geometrico-logical shapes built out of the operations and relations involved in the grafting of planar rooted trees. The category of opetopes admits a description by generators and relations, and has several nice properties — for example, it is a (direct) Reedy category, and all of its morphisms are monomorphisms. Categories of algebraic structures can often be fruitfully studied and generalised by means of a fully faithful "nerve" functor embedding them into a presheaf category. We show how the presheaf category of opetopic sets admits both a nerve functor from the category of coloured planar operads as well as a (different) nerve functor from the category of small categories.

Cécile Mammez
Algebraic structures on walks of graphs

One of the goals of this in progress work made in collaboration with Foissy, Giscard and Ronco is to describe algebraically the reconstruction of any walk of a given graph from simple cycles and self-avoiding walks. There exists a combinatorial construction due to Giscard, Thwaite and Jaksch which uses Lawler's loop-erasing procedure and the nesting product $\odot$ described by Giscard. Unfortunately the product $\odot$ does not satisfy classical relations such that the associative relation or the Lie relation. So, we have created a co-pre-Lie coproduct from Lawler's loop-erasing procedure on walks and extended it into Hopf algebras. This talk aims at explaining those new Hopf algebras. We will first remind the Lawler's loop erasing procedure and the product $\odot$. Then we will detail the construction of the co-pre-Lie coproduct on walks and the underlying Hopf algebras. Finally, we will explain how consider any walk as a special walk called cactus.

Zeinab Galal
Profunctorial finiteness spaces

Finiteness spaces were introduced by Ehrhard as a refinement of the relational model of linear logic. A finiteness space is a set equipped with a class of finitary subsets which can be thought of being subsets that behave like finite sets. A morphism between finiteness spaces is a relation that preserves the finitary structure. This model allows for a finer analysis of the computational aspects of the relational model and it provided a semantical motivation for differential linear logic and the syntactic notion of Taylor expansion. In this talk, I will present a bicategorical generalization of this construction where the relational model is replaced with the model of generalized species of structures introduced by Fiore and the finiteness property now relies on finite presentability.

Hugo Paquet
Kits, groupoids and linear logic

I will present the construction of a new model based on groupoids and profunctors between them. It can be seen as a refinement of the model of generalised species of structures by Fiore et al. The objects in this model are groupoids equipped with what we call a ”kit”: a family of subgroups of endomorphisms for each object. The kit can be used to cut down the category of presheaves associated with a groupoid. The morphisms are certain profunctors which appropriately connect the kit on each side. The resulting bicategory is a model of classical linear logic. In particular, it induces a Kleisli bicategory which is Cartesian closed, and whose morphisms can be seen as analytic functors between the restricted presheaf categories. Unlike for ordinary generalised species, these functors are also stable, meaning that they are finitary and satisfy a ”minimal data property”. This new model thus provides a new categorical form of stable domain theory, as previously considered by several authors. This is joint work with Marcelo Fiore and Zeinab Galal.

Nicolas Behr
Combinatorics via Rule-Algebraic Methods

Building upon the rule-algebraic stochastic mechanics framework, I will present a new approach to computing multi-variate generating function expressions in combinatorics. This approach is applicable for combinatorial structures which can be described as some initial configuration together with a generator (ideally uniform) whose repeated applications render the structures of increasing sizes. Unlike in species theory, computations in this approach are based upon the notion of rewriting rules, their sequential compositions and the so-called rule algebras (which encode information on the combinatorics of sequences of rewriting steps). I will introduce a computational strategy for determining multi-variate generating functions describing joint distributions of pattern counts in a species, namely via a form of ODE system obtained from the computation of certain commutators (of rules in the generator with rules implementing pattern counts). Some concrete results for the species of planar rooted binary trees will be presented for illustration.

Federico Olimpieri
Intersection Type Distributors

Building on previous works, we present a general method to define proof relevant intersection type semantics for pure lambda calculus. We argue that the bicategory of distributors is an appropriate categorical framework for this kind of semantics. We first introduce a class of 2-monads whose algebras are monoidal categories modelling resource management, following Marsden-Zwardt's approach. We show how these monadic constructions determine Kleisli bicategories over the bicategory of distributors and we give a sufficient condition for cartesian closedness. We define a family of non-extentional models for pure lambda calculus. We then prove that the interpretation of lambda terms induced by these models can be concretely described via intersection type systems. The intersection constructor corresponds to the particular tensor product given by the considered free monadic construction.

Participants

Matteo Acclavio
Nathanael Arkor
Jean-Christophe Aval
Nicolas Behr
Thibaut Benjamin
Philippe Biane
Vincent R.B. Blazy
Wadoud Bousdira
Antonio Bucciarelli
Félix Castro
El Mehdi Cherradi
Vikraman Choudhury
Jules Chouquet
Camille Combe
Christophe Cordero
Pierre-Louis Curien
Frédéric Dabrowski
Bérénice Delcroix-Oger
Gérard Duchamp
Jacques Duparc
Alen Đurić
Uli Fahrenberg
Justine Falque
Wenjie Fang
Marcelo Fiore
Antoine Genitrini
Samuele Giraudo
Giulio Guerrieri
Nohra Hage
Hugo Herbelin
Peter Hines
Cédric Ho Thanh
Eric Hoffbeck
David Janin
Arthur Jaquard
Matthieu Josuat-Vergès
Marie Kerjean
Guillaume Laplante-Anfossi
Christian Lavault
Jérémy Ledent
Paul Lessard
Maxime Lucas
Kenji Maillard
Cécile Mammez
Dominique Manchon
Damiano Mazza
Paul-André Melliès
Hugo Moeneclaey
Philippe Nadeau
Lê Thành Dũng (Tito) Nguyễn
Rémi Nollet
Federico Olimpieri
Luc Pellissier
Vincent Pilaud
Pierre Pradic
Darine Rammal
Colin Riba
Luigi Santocanale
Thomas Seiller
Léo Stefanesco
Dario Stein
Lutz Strassburger
Christine Tasson
Christophe Tollu
Yannic Vargas
Lionel Vaux Auclair
Noam Zeilberger