ROUEN, Université de Rouen, 27-29 Septembre 2017

MOUSTIC

Discrete Structures Days

Contacts : {jean-baptiste.bardet,jean-gabriel.luque}@univ-rouen.fr

Ce projet est cofinancé par l'Union européenne.
L'Europe s'engage en Normandie
avec le Fonds européen de Développement Régional (FEDER)

Program

Wednesday 27 September

9h45–10h15 Welcome of the participants and Coffee.

* First session :

10h15-11h15 Bernard Leclerc, *Discrete dynamical systems, representation theory and cluster algebras*

11h15-11h30 Break

11h30-12h30 Arnaud Lefebvre, *TBA* (Text algorithms)

12h30–14h00 Lunch.

* Second session :

14h00–15h00 Jean-Francois Marckert, *Some news concerning coalescing processes*

15h00–16h00 Viviane Pons, *TBA* (Algebraic Combinatorics)

16h00–16h15 Break

16h15-17h15 Jean-Baptiste Gouéré, *TBA* (Stochastic Geometry)

Thursday 28 September

* Third session

9h15–10h15 Sylvain Lombardy, *Two-way representations and weighted automata*

10h15–10h30 Break

10h30–11h30 Elena Pribavkina, *Reachability problems in finite automata*

11h30-12h30 Hacène Belbachir, *Combinatorial and arithmetic properties for a class of Appell polynomials*

12h30–14h00 Lunch

* Fourth session

14h00–15h00 Philippe Duchon, *Simulation à mémoire finie de lois de probabilités*

15h00–16h00 Irène Marcovici, *Probabilistic cellular automata with memory two*

16h00–16h15 Break

16h15–17h15 Samuele Giraudo, *Operads, pros, and combinatorial constructions*

17h15–18h15 Dieter Mitsche, *The model of random hyperbolic graphs*

Friday 29 September

* Fifth session

9h15–10h15 Alejandro Maass, *T.B.A* (Dynamic Systems)

10h15–10h30 Break

10h30–11h30 Loick Lhote, *Analyses of multiple GCD algorithms*

11h30-12h00 Frédéric Paccaut, *Necessary and sufficient conditions for existence and uniqueness of invariant measures for a class of variable length markov chains.*

Abstracts

Hacène Belbachir USTHB (Alger)

Combinatorial and arithmetic properties for a class of Appell polynomials

Abstract We present some explicit formulas for a certain class of Appell polynomials using a determinantal approach in terms of Bernoulli-Euler polynomials and of Bernoulli-Genocchi polynomials. The proposed class of polynomials includes those of Euler and Genocchi ones. We also derive an expression of the ordinary generating function using a specific linear transformation over sequences. Finally we give some explicit formulas for the power sums and alterning power sums.

Philippe Duchon Labri (Bordeaux)

Simulation à mémoire finie de lois de probabilités

Résumé La question de la simulation exacte de lois de probabilités sur les réels est généralement étudiée sous un modèle "arithmétique" où on calcule de manière exacte sur des réels. Dans cet exposé, on se place au niveau "bit à bit", et on se demande ce qui peut être simulé si on n'a qu'une mémoire finie. On est alors naturellement amené Ã considérer des automates qui tirent à pile ou face et qui écrivent des mots, qu'on espère infinis, et qu'on interprète comme le développement de réels ; la question est alors de savoir quelles distributions sont simulables de la sorte.

Le modèle est essentiellement celui considéré par Knuth et Yao en 1976, et pour lequel ils ont montré un résultat intrigant : si une loi simulable a une densité qui est une fonction analytique sur un intervalle, alors cette densité est en fait polynomiale sur le même intervalle - ce qui exclut de fait de nombreuses lois usuelles. En 2001, Vatan a annoncé (malheureusement sans preuve complète) un résultat qui caractérise les distributions polynomiales simulables sur [0,1] comme étant celles dont la densité ne s'annule pas en un point irrationnel.

Je démontrerai deux résultats sur le sujet : d'une part, une généralisation du résultat de Vatan, caractérisant toutes les distributions simulables dont la densité est polynomiale par morceaux ; d'autre part, un théorème de classification qui permet, à partir d'un automate, de dire s'il simule une loi à densité, ou à atomes, ou une loi plus "méchante" - ou un mélange de ces cas.

Samuele Giraudo IGM (Marne-la-Vallée)

Operads, pros, and combinatorial constructions

Abstract. Operads and pros are algebraic structures mimicking the composition of operators with several inputs and possibly several outputs. Endowing combinatorial sets with the structure of an operad or a pro provides an original point of view on the underlying objects. This provides, among others, strategies to strike enumerative problems. In particular, operads and pros lead to the definition of generalized formal power series, coming with a bunch of natural products. For this reason, constructing operads or pros involving combinatorial objects is worthwhile. We explicit here some constructions of operads and pros involving families of combinatorial objects.

Bernard Leclerc LMNO (Caen)
Discrete dynamical systems, representation theory and cluster algebras
Abstract. During the years 1980-90 several families of discrete dynamical systems arose in mathematical physics, in the area of integrable models coming from the Yang-Baxter equation : the Q-systems, T-systems and Y-systems. These are very explicit systems of algebraic equations associated with Dynkin diagrams. After reviewing the definition of these systems and the connections between them, I will explain their interpretation in terms of representation theory of quantum groups. I will also discuss more recent connections with the combinatorics of cluster algebras, which led to the proof of several conjectures proposed by physicists (Zamolodchikov, Ravanini-Tateo-Valleriani, Kuniba-Nakanishi-Suzuki) about 20 years ago.

Sylvain Lombardy Labri (Bordeaux)
Two-way representations and weighted automata
Abstact. A two-way automaton is a very natural model : it is a Turing Machine that cannot write. In 1959, two articles (resp. by Shepherdson, and Rabin and Scott) proved that two-way automata are not more powerful than one-way finite automata (NFA). More recently, two-way automata has been reconsidered ; on the one hand, they can be much more concise than NFA, on the other hand, for transducers (that can write on an output tape) or weighted automata (that compute a weight – probability or cost for instance), two-way automata are strictly more powerful than one-way automata. We shall present two-way weighted automata, and show that, like one-way weighted automata, they can be associated to matrix representations, and they realize series which are fix points of some systems of equations. We shall see that these systems can be solved in some particular cases in order to get explicit descriptions of the behaviours of these automata as Hadamard product of rational series.

Loïck Lothe GREYC (Caen)
Analyses of multiple GCD algorithms
Abstract. In this talk, we will introduce two multiple Gcd algorithms that are natural extensions of the usual Euclid algorithm, and coincide with it for two entries. The plain (or naive) algorithm was proposed by Knuth and performs successive calls to the classical Euclid Algorithm. The Brun algorithm performs Euclidean divisions, between the largest entry and the second largest entry, and then re-orderings. This is the discrete version of a multidimensional continued fraction algorithm due to Brun. We will present the average–case analyses of the plain and the Brun algorithms. Both analyses are very similar and we will prove that the mean number of Euclidean divisions is linear with respect to the input size. However, we show that the role of the dimension is different according to the algorithm. The method relies on dynamical analysis, and is based on the study of the underlying dynamical systems.

J.F. Marckert LABRI (Bordeaux)

Some news concerning coalescing processes (based on N. Broutin (Paris 6) - JFM, M. Wang (Bath) - JFM)

Abstract. Consider at time 0, a family of n particles with mass 1. These masses coalesce according to the following rule : each pair of masses (m, m') coalesces when a random clock following an exponential distribution with parameter $K(m, m')$ rings, where the kernel K is the main parameter of the model. When coalescence occurs the pair of mass (m, m') is replaced by a single mass $m + m'$, and the clocks are updated.

When the kernel is additive ($K(m, m') = m+m'$) or multiplicative ($K(m, m') = mm'$) these processes possesses some combinatorial representations which allows one to prove scaling limit for the evolution of mass distribution when n goes to +infinity (Aldous, Pitman, Chassaing, Louchard, Bertoin...)

The aim of this talk is to present "old" combinatorial encodings of these processes, as well as new ones. We will see that minor modifications of the encodings allows to get much richer combinatorial environments, allowing to get new asymptotic results.

Irène Marcovici Institut Élie Cartan (Nancy)

Probabilistic cellular automata with memory two

Abstract. A central question on probabilistic cellular automata (PCA) is to study equilibrium behaviours. An equilibrium is characterized by an invariant measure, that is, a probability distribution on the configuration space, which is left invariant by the dynamics. When the invariant measure is unique and attractive, the PCA is said to be ergodic, meaning that during its evolution, it eventually forgets about its initial condition. Assessing the ergodicity of a PCA is algorithmically undecidable, even for the simplest class of PCA. Furthermore, apart from some specific cases, we have generally no explicit description of the invariant measures of PCA. I will present some new results concerning PCA with memory two, that were motivated by the study of models coming from statistical physics (8-vertex model, TASEP...). We characterize PCA with memory two having an invariant measure with a product form or a Markovian form, and by exploring a family of PCA presenting a phenomenon of multi-directional reversibility, we also exhibit some other cases where the invariant measure is exactly computable. This is a joint work with Jérôme Casse.

Dieter Mitsche Laboratoire J.A.Dieudonné (Nice Sophia-Antipolis)

The model of random hyperbolic graphs

Abstract. Random hyperbolic graphs (RHG) were proposed rather recently (2010) as a model of real-world networks. Informally speaking, they are like random geometric graphs where the underlying metric space has negative curvature (i.e., is hyperbolic). In contrast to other models of complex networks, RHG simultaneously and naturally exhibit characteristics such as sparseness, small diameter, non-negligible clustering coefficient and power law degree distribution. We will give a slow pace introduction to RHG, explain why they have attracted a fair amount of attention and then survey most of what is known about this promising infant model of real-world networks.

Elena Pribavkina Ural Federal University (Yekaterinburg)
Reachability problems in finite automata
Abstract. Reachability problems are recurrent in many different fields including dynamical systems, software engineering, algebra, game theory, etc. In general the reachability problem consists in deciding whether a certain configuration of a system can be reached from a given one. In this talk we will focus on questions of this type for finite automata. Even for such a basic object one easily encounters non-trivial problems. Namely, we will consider the following naturally arising questions.

* Synchronization. Given an automaton, decide whether some state can be reached from every state of the automaton by reading some word w over the input alphabet. What is the computational complexity of this problem ? What is the optimal length of w ? Is it possible to efficiently compute or estimate this value ?
* Primitivity. Given an automaton, decide whether there exists a word w over the input alphabet such that every state can be reached from every state by reading w. The same questions as in the previous case can be asked again.
* Road Coloring Problem. Given a digraph, design a coloring of its edges such that the resulting automaton is synchronizing. Does it always exist ? Can we efficiently find it ? How many synchronizing colorings exist ?

Frédéric Paccaut LAMFA (Amiens)
Necessary and sufficient conditions for existence and uniqueness of invariant measures for a class of variable length markov chains.
Abstract Variable length markov chains are defined using probabilised context trees. For the VLMC the tree of which is "shift-invariant", we give necessary and sufficient conditions in terms of the probability distribution of the contexts to ensure existence and uniqueness of an stationary measure. We will also discuss the general case.

GRR Project

Modèles aléatoires et OUtils STatistiques, Informatiques et Combinatoires