

14th Graduate Colloquium in Mathematics

École polytechnique fédérale de Lausanne

The organizing committee welcomes you at EPFL for the 14th edition of the Graduate colloquium. This event gives students the opportunity to present their work in a relax environment while making contacts with people from different universities. Many thanks to Mrs. Maroussia Schaffner Portillo for dealing with the website and the administration, Mrs. Sarah Goob and staff at Birkhäuser for sponsoring the prize for the best talk and Prof. Jacques Sesiano who kindly agreed to be our keynote speaker. This event is organised by the CUSO, without whose support the colloquium would not take place. Special thanks to Igor Malinovic and Rosalie Chevalley for their advice and support.

Léo Belzile and Maxime Gheysens



CONFÉRENCE UNIVERSITAIRE
DE SUISSE OCCIDENTALE



Abstracts

Affine Cartesian codes, 20 minutes

Hiram López, Université de Neuchâtel

AREA: Coding theory

In this talk we will give an introduction to linear codes and we will see some of its applications. Then we will give a brief introduction to affine Cartesian codes, a family of linear codes that depends of a finite Cartesian product of subsets of a finite field and we will compute its basic parameters using commutative algebra: size, length and minimum distance.

Tropical geometry in Nagata's conjecture and sandpile models, 45 minutes

Nikita Kalinin, Université de Genève

AREA: Algebraic geometry, combinatorics

Nagata's conjecture is about minimal degree of a planar algebraic curve, passing through a given set of points with big multiplicities. Sandpile model is a graph where sand grains is distributed and we move them back and forth following the rule that if at a vertex the number of sand grains is bigger than its valency, it distributes the sand to the neighbors.

Tropical geometry suddenly emerges in the second problem, producing beautiful pictures. Also, it can be applied to the first problem and gives some (not the best) estimate. We are going to discuss these two unrelated topics which can serve as an introduction to tropical geometry.

A Generalised Additive Model for non-stationary GEV distributions, 20 minutes

Yousra El-Bachir, École polytechnique fédérale de Lausanne

AREA: Statistics

We propose a simple statistical model to deal with temporal non-stationarity of extreme data. For instance, we combine a Generalized Additive Model (GAM) to capture trend and seasonality, and a Generalized Extreme Value (GEV) distribution to model extreme data. This mixture is based on setting a GAM form to the parameters of the GEV. In this new framework, the parameters are indeed no longer vectors but functions. We illustrate the strong performance of this model with an application to environmental data.

From tilings to buildings, 45 minutes

Thibaut Dumont, École polytechnique fédérale de Lausanne

AREA: Group theory

I will attempt to explain and draw some tilings of Euclidean spaces. Then I will describe their role in the theory of buildings initiated by Tits. Buildings play an important role in group theory and consist in tiled spaces glued together to form monstrous structures.

Cryptosystems based on Algebraic Geometry: elliptic and Edwards curves, 45 minutes

Giulia Bianco, Université de Neuchâtel

AREA: Cryptography

After a general overview on the world of cryptography we will focus on the applications of algebraic geometry. In particular we will see how the additive group on an elliptic curve is a good environment for creating an efficient and secure cryptosystem. We then briefly discuss a recent form of elliptic curves - the so called Edwards curves - which provide optimal computational efficiency and good security against certain types of crypto attacks.

Riemann hypothesis and applications to sums of arithmetic functions, 45 minutes

Alexandre Peyrot, École polytechnique fédérale de Lausanne

AREA: Number theory

In this talk, we will introduce different types of zeta functions and see why they play an important role in number theory. We will be led to stating the Riemann hypothesis in various settings and discover some of its consequences.

An application of coding theory in enumerative combinatorics, 45 minutes

Alberto Ravagnani, Université de Neuchâtel

AREA: Coding theory

Computing the number $n_q(k)$ of invertible $k \times k$ matrices with zero trace and entries in a finite field $\mathbb{F}_q$ is a classical problem in enumerative combinatorics. The standard way of computing $n_q(k)$ involves the Bruhat decomposition of the general linear group $\mathrm{GL}_k(\mathbb{F}_q)$ and the theory of q -analogues. We show a connection between the problem of computing $n_k(\mathbb{F}_q)$ and the theory of rank-metric codes, providing in particular an elementary recursive description of $n_k(\mathbb{F}_q)$.

Incidence variety in Hilbert scheme of points of complex plane, 45 minutes

Yi-Ning Hsiao, Université de Genève

AREA: Topology, algebraic geometry

The Hilbert schemes of n points $X^{[n]}$ on the complex plane parametrizes its 0-dimensional subschemes of colength n . They are irreducible smooth varieties and have been widely studied. Several incidence varieties were introduced as tools to study the Hilbert schemes of points:

- the nested Hilbert schemes in $X^{[n]} \times X^{[n+1]}$,
- Nakajima's incidence varieties $X^{[n]} \times X^{[n+k]}$ for $k \in \mathbb{N}^*$.

In this talk, we will define a new type of incidence variety $X^{[n,n+r]}$ in the product $X^{[n]} \times X^{[n+r]}$. It has similar properties as in the case of $X^{[n]}$ and an additional Grassmannian bundle structure over strata of certain grading.

The mathematics of the game of Go, 45 minutes

Thibault Pillon, Université de Neuchâtel

AREA: Combinatorics, game theory

The game of Go, originating from Asia, is the most ancient combinatorial game we know. Although its rules are very simple, its combinatorial depth is immense. At a time where computer supremacy extends to almost every games, the Game of Go is still dominated by the human mind. During this talk, I'll introduce the rules of the game, and use it as an application of the theory of partisan games, as developed in the 70's by Berlekamp, Conway and Guy. In particular, we'll show how game positions give rise to the so-called Conway's surreal numbers.

Schedule

Thursday February 12, 2015			
10:30	10:50	Hiram López, UNINE	<i>Affine cartesian codes</i>
11:00	11:45	Nikita Kalinin, UNIGE	<i>Tropical geometry in Nagata's conjecture and sandpile models</i>
12:00	12:20	Yousra El-Bachir, EPFL	<i>A generalised additive model for non-stationary generalised extreme value distributions</i>
12:30	14:00	Lunch break	
14:00	14:45	Thibaut Dumont, EPFL	<i>From tilings to buildings</i>
15:00	15:45	Giulia Bianco, UNINE	<i>Cryptosystems based on algebraic geometry: elliptic and Edwards curves</i>
16:00	16:30	Coffee break	
16:30	17:15	Prof. Jacques Sesiano, EPFL	<i>Partage par transvasements</i>
19:30		Conference dinner at Café Romand	

Friday February 13, 2015			
9:30	10:15	Alexandre Peyrot, EPFL	<i>Riemann hypothesis and applications to sums of arithmetic functions</i>
10:30	11:00	Coffee break	
11:00	12:00	Alberto Ravagnani, UNINE	<i>An application of coding theory in enumerative combinatorics</i>
12:00	13:30	Lunch break	
13:30	14:15	Yi-Ning Hsiao, UNIGE	<i>Incidence variety in Hilbert scheme of points of complex plane</i>
14:30	15:15	Thibault Pillon, UNINE	<i>The mathematics of the game of Go</i>
15:30		Sarah Goob	Birkhäuser Prize

The dinner will take place at Le Café Romand at 19:30, Place Saint-François 2.

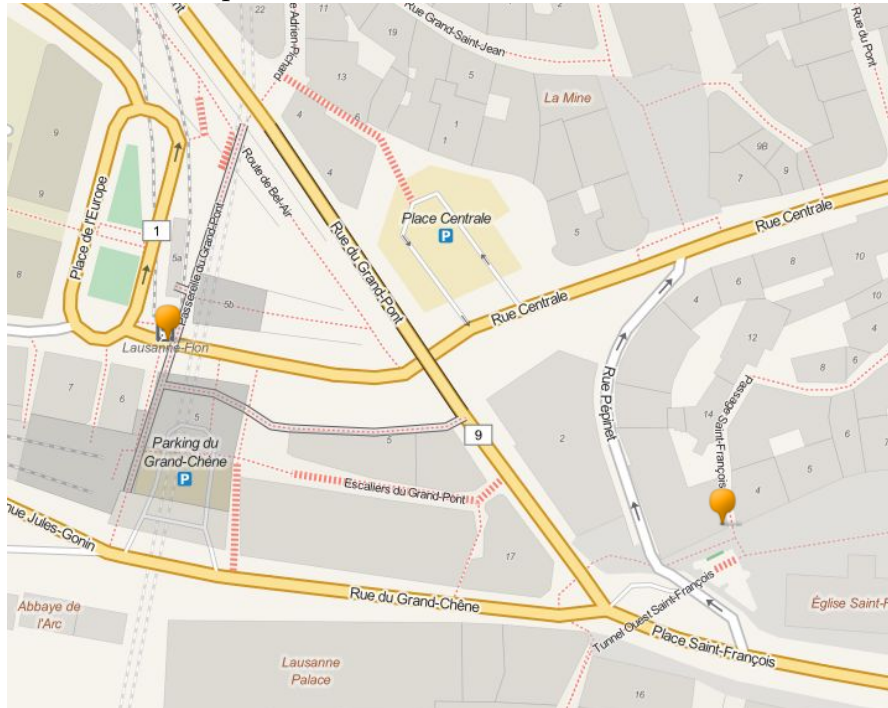


Figure 1: Directions from Lausanne-Flon metro station to Le Café Romand

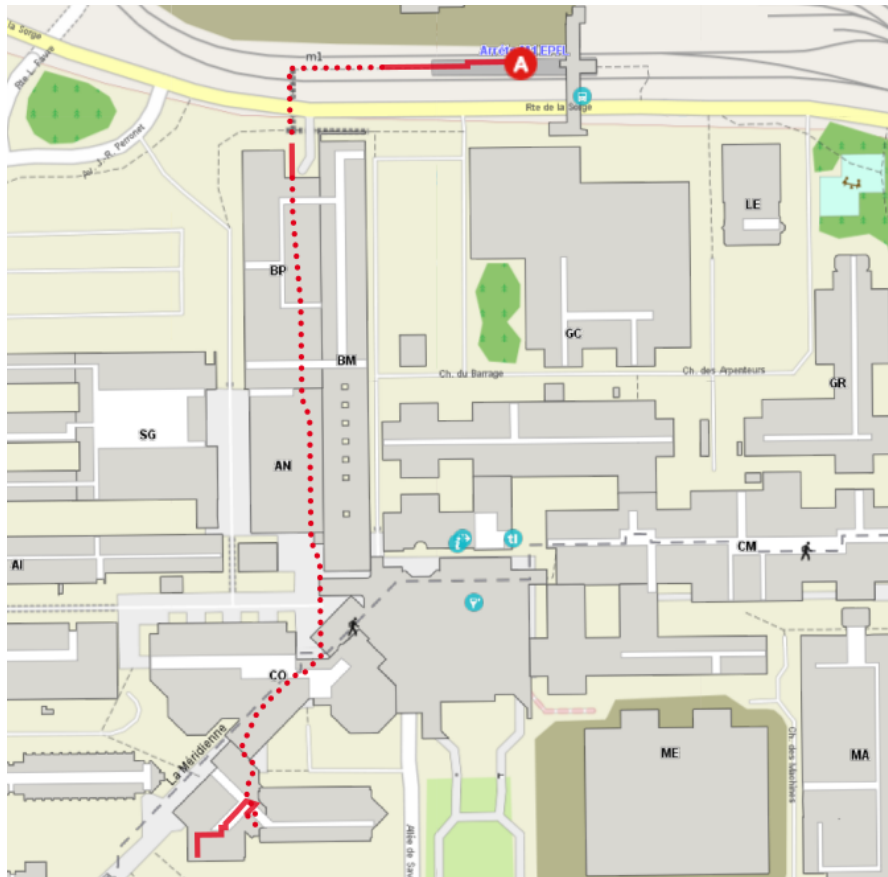


Figure 2: Directions from EPFL metro station to room ELA2