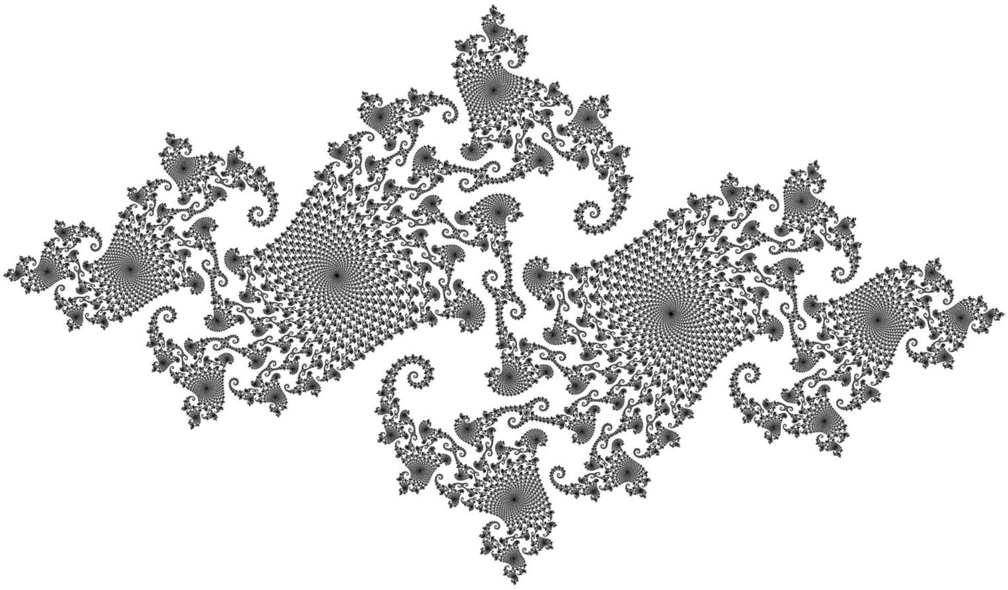

The Students in Undergraduate Mathematics & Statistics

UNDERGRADUATE MINI CONFERENCE

Nine speakers, three days.
Snacks and hot beverages will be present.

JULY 24th to JULY 26th, 3:00pm - 5:00pm

CLE C112

For more information, join our facebook group
"SUMS - Students in Undergraduate Math and Stats (UVic)",
or email us at **sums@uvic.ca**!

SUMS UNDERGRADUATE MINI CONFERENCE

SPEAKING SCHEDULE & ABSTRACTS

Tuesday, July 24th, 3:00-3:20

Zachary Adams

Excitable media, with applications to neuroscience.

Abstract. Excitable media are dynamical systems that are characterized by (i) a "resting state" that is assymptotically stable; (ii) an "excited state" through which the system passes if a sufficiently large perturbation is applied, and (iii) a "refractory state" through which the system passes on returning to the resting state from the excited state. Generally, excitable media can be realized as systems of two variables with dynamics on different time scales (that is, one variable changes much more quickly than the other). The classic example of an excitable medium is human nervous tissue, in which cells are excited from their resting state in response to electrochemical impulses. In this talk we explore the behaviour of abstract excitable media using discrete models of cellular automata and continuous models of PDE. We will demonstrate, analytically, the existence of propagating wave solutions to PDE modeling excitable media in one spatial dimension.

Tuesday, July 24th, 3:30-3:50

Etienne Leclerc

The trouble with the second cloud.

Abstract. In this talk we will discuss some of the difficulties of climate modelling and the assumptions that have been made to solve them. I then will describe my study of the quasi-equilibrium theory of Arakawa & Schubert.

Coffee Break

"Do good math jokes exist? Under the Axiom of Choice, sure – but finding an explicit example is impossible."

KEYNOTE SPEAKER

Tuesday, July 24th, 4:15-5:00

Kieka Mynhardt

Snarks.

They sought it with thimbles, they sought it with care;
They pursued it with forks and hope;
They threatened its life with a railway-share;
They charmed it with smiles and soap.

Abstract. An edge colouring of a graph is an assignment of labels (colours) to the edges of a graph such that adjacent edges are assigned different colours. It is clear that if the maximum degree of the graph is k, and v is a vertex of degree k, then at least k colours are needed to colour the edges incident with v. A famous result by the Russian mathematician Vadim Vizing states that $k + 1$ colours will always be enough to colour the edges of the whole graph. Graphs whose edges can be coloured with its maximum degree number of colours are called Class one graphs and the rest are called Class two graphs.

A *snark* is a 3-regular (every vertex has degree 3) class two graph that satisfies some additional requirements, depending on whose definition one follows. They have been studied since the 1880's, when the Scottish physicist Peter Tait proved that the Four Colour Theorem is equivalent to the statement that no snark is planar. The popular science writer Martin Gardner gave them the name "snark" in 1975. The name, taken from the elusive creature in Lewis Carroll's poem *The Hunting of the Snark*, reflects the scarcity of examples in the years after Tait defined them. The smallest and earliest known example of a snark is the Petersen graph, discovered in 1898. Due to their connection with the Four Colour Theorem (Four Colour Conjecture, at the time), much attention was given to the pursuit of new examples of snarks (with the hope of finding a planar one, perhaps), but a second example was not discovered until 1946. Since then, more examples have been discovered, including infinite families. I will discuss early examples and infinite families of snarks and their connections to well-known results and conjectures in graph theory, and mention some modern advances.

"Take a positive integer N. No wait, N is too big; take a positive integer k."

Wednesday, July 25th, 3:00-3:20

Nathaniel Butler

Smooth, nowhere-analytic functions.

Abstract. A *smooth, nowhere-analytic function* is a function on the real line that can be differentiated infinitely many times, but has no "good" taylor series. That is, if you pick any point and expand your function into a taylor series at that point, the series won't converge to the function in any neighborhood of the point. I intend to give a couple examples of such functions, as well as a few of their general properties.

Wednesday, July 25th, 3:30-3:50

Douglas White

An interesting class of transformations.

Abstract. Lots of interesting science is done by poking stuff and seeing what happens, rather than statically observing. The same is true in math: even the most interesting structures are often dull in comparison to observing what happens when the structure is "poked" or transformed. I will discuss an interesting example from linear algebra.

Coffee Break

KEYNOTE SPEAKER

Wednesday, July 25th, 4:15-5:00

Daniel Hudson

A leisurely introduction to K-theories
(a.k.a. what is Dan thinking about all day?)

Abstract. Topological K-theory was defined by Atiyah and Hirzebruch in the late 1950's, and was naturally extended to C*-algebras later on. The dual theory, K-homology, was then defined. Eventually, Kasparov defined KK-theory which combines K-theory and K-homology. While KK-Theory for C*-algebras is somewhat difficult to define, there is a much simpler definition for compact manifolds using something called *correspondences*. In this talk, I will introduce the basics of correspondence theory and some of the operations that one can do with them. If time permits, I will briefly discus a project I have been working on with H. Emerson on a specific class in $\widehat{\mathtt{kk}}_*(\mathbb{T}^d, \widehat{\mathbb{Z}}^d)$ called the *Fourier-Mukai correspondence*, and the duality it introduces between $\mathrm{K}_*(\mathbb{T}^d)$ and $\mathrm{K}_*(\widehat{\mathbb{Z}}^d)$. Prerequisites for this talk will be modest, only requiring a brief background in topology (know what a homeomorphism is), linear algebra (know what a basis is), and enough patience to bear with me.

"What does the B in Benoit B. Mandelbrot stand for? Benoit B. Mandelbrot."

Thursday, July 26th, 2:30-2:50
Matthew Lewis
Parallel preserving bijections in $\mathbb{R}^2$ *are affine.*

Abstract. I will be proving that any bijection on the plane preserving straight lines must be of the form $Ax + b$ for some matrix A and vector b. I will do so using concepts from affine geometry and abstract algebra, however it will be presented in such a way as to be aproachable for anyone with a basic understanding of mathematics. My proof will be primarily based on the proof given in Foundations of Projective Geometry by Robin Hartshorne, however with a significant number of alterations so as to make the proof digestable by a general audience.

Thursday, July 26th, 3:00-3:20
Tyler Schulz
Curves with area in $\mathbb{R}^2$.

Abstract. While there are many constructions of continuous curves that fill out an entire region (such as the Hilbert curve), most of these constructions fail to be injective, and therefore aren't very "curve-like" in the end. In this talk, I wish to present three constructions of Osgood curves - simple curves in $\mathbb{R}^2$ with positive area - given by Osgood, Sierpiński, and Knopps. Each construction was devised to account for a shortcoming of the previous construction, and bring us closer to what we'd hope to see when we hear about a "curve with area." Despite the counter-intuitive nature of the problem, the constructions are quite straightforward, and effectively illustrate some of the bizarre aspects of real analysis using methods accessible to students who may be new to the topic.

Thursday, July 26th, 3:30-3:50
Dayton Preissl
Confinement properties in magnetized plasmas and the Vlasov-Maxwell system.

Abstract. Stuck between the N-body problem and magnetohydrodynamics lies the Vlasov-Maxwell system, that under certain conditions (or physical assumptions), governs the collective motion of particles in a "collision-less" plasma. I will introduce the transport equation and how we obtain the more specific Vlasov equation as well as discuss the self consistent electromagnetic fields determined by Maxwell's equations. Proofs of existence and uniqueness using the Glassy-Strauss assumption of compact support in the particle momentum distribution functions in the absence of external fields have been completed in the past. The goal is to use variations of these proofs in the presence of an external field, looking at the asymptotic behavior as the applied field becomes arbitrarily large.

Coffee Break

"What's the value of a contour integral around Western Europe? Zero. All the Poles are in Eastern Europe."

KEYNOTE SPEAKER

Thursday, July 26th, 4:10-4:55

Chris Eagle

Geometric decompositions of $\mathbb{R}^3$

Abstract. Is it possible to write $\mathbb{R}^3$ as a disjoint union of lines, no two of which are parallel? Can we make all of the lines pass through the unit sphere? How about a disjoint union of circles, or other shapes? In this talk I will present a very flexible technique for answering these questions and many more like them. Along the way I will introduce the method of transfinite recursion, which is one of the most widely applicable tools from modern set theory. I will aim to make the talk accessible to anyone who has completed Math 122.

"What do you call a torus with a translation invariant measure? A Lebuesgal."