Science Atlantic

Computer Science
Mathematics & Statistics | Conference

Conference Program
October 12-14, 2012

AARMS

Mount Allison
UNIVERSITY

Sackville, New Brunswick

Mount Allison University Campus Map

1. Sackville Curling Club
2. Wallace McCain Student Centre (WMSC)
3. Sir James Dunn Building & Wu Centre
4. Flemington Building 5. Avard Dixon Building

Parking

Parking in Sackville is free on the street and in campus lots. Street parking is limited to 2 hours, so we suggest you park in a campus lot. No permit is needed for daytime parking. On Friday these lots will be busy, but the two best choices are the lot on Lansdowne St near the playing fields and the large lot at King St and Main St.

From the Organizing Committee

Welcome to the 2012 Science Atlantic Mathematics, Statistics and Computer Science Conference! Sackville is a wonderful place to visit in October. We hope you will get a chance to explore and get to know our town.

We have three days of activities organized for this weekend:

- Mathematics and ACM Programming Competitions on Friday
- Three invited speakers will speak in plenary sessions on Friday and Saturday
- Contributed papers and posters will be presented on Saturday
- The AARMS mini-conference on the combinatorial theory of groups and Hopf algebras is on Sunday
- The conference banquet is on Saturday at lunch
- Awards for contest winners and the best contributed talks will be given on Saturday following the Blundon Lecture

Please consult the schedule in this program for more details.

We are pleased to thank many individuals and organizations for their help organizing the conference. They really are too numerous to list here, but we especially thank our student volunteers, competition and contributed presentation judges, Yuri Bahturin for organizing the AARMS session, and faculty at all participating universities for preparing teams for competitions and mentoring students presenting their research.

The conference is only possible because of the financial assistance of numerous sponsors including Science Atlantic, AARMS, Pearson Canada, Wiley Canada, Joey's Restaurant, and the Dean of Science and Provost & Vice President, Academic & Research at Mount Allison University.

If there is anything we can do to help make your meeting productive and enjoyable please ask me or any member of our department.

Andrew Irwin
Head, Department of Mathematics & Computer Science

Weekend Program
Friday, October 12

Time	Event
10:30 - 2:30	Registration - WMSC 130
11:30 - noon	Programming Competition Briefing - Flemington 116
12:00 - 5:00	ACM Programming Competition - Dunn
2:00 - 5:30	Mathematics Competition - Dunn 308
2:30 - 3:00	Joint Committee Meeting - Dunn 106
3:00 - 5:00	Committee Meetings - Dunn 111 & 106
5:00 - 6:00	Competitors' Pizza Party - University Club
6:00 - 7:00	Registration - Dunn 104
7:00 - 8:30	Sedgwick Lecture: Dr. Anne Condon, UBC –Wu Centre
8:30	Reception - Owens Art Gallery

Saturday, October 13

Time	Event
8:00 - 10:00	Registration - Dunn 104

	Dunn 106	Dunn 108	Dunn 113
8:30	Megan Robichaud	Patrick Murray	Shannon Ezzat
8:50	Amber Corkum	Justin Boutilier	Michael Deveau
9:10	Simon McConnell	Ryan Oulton	Adam Gardner
9:30	Kara Allan	Sophie DeViller	Darien DeWolf
9:50	Ashley Arsenault	Chris Van Bommel	Jonny Lomond
10:10	Ben McAdam	Jenna Young	Nicholas Parsons

10:30 -11:00	Coffee Break - Dunn, 1st floor
11:00 - noon	Field Lecture: Dr. Debbie Dupuis - Wu Centre
12:30 – 1:45	Luncheon - Sackville Curling Club

	Dunn 108	Dunn 113
2:00	Anthony Delaney	Melanie Foerster
2:20	Dylan Day	Neil Spencer
2:40	Sylvere Kwatirayo	Abdullah Al-Shaghay
3:00	Mohammad Iqbal	

3:30 - 5:00	Blundon Lecture: Dr. Dror Bar-Natan Awards & Closing - Wu Centre

Sunday, October 14

AARMS Session
Combinatorial Theory of Groups and Hopf Algebras
8:00am - 2:00pm - Avard Dixon 118

8:00 Alexander Olshankskii, Vanderbilt University
8:55 Olga Kharlampovich, City University of New York
9:45 Coffee Break
10:15 Alexi Miasnikov, Stevens Institute
11:10 Eduardo Martinez-Pedrosa, Memorial University
11:50 Mikhail Kotchetov, Memorial University
12:15 Coffee/Pizza Break
12:45 Shannon Ezzat, University of Cantebury
1:10 Charles Paquette, University of New Brunswick
1:35 Yuri Bahturin & Jonathan Lomond, Memorial University

Network and computer access
Wireless access to the Internet is available throughout the campus, but you must log in. Your individual user id and password are printed on the back of your name tag. The computers in Dunn 102 are available for you to use as well.

Information for presenters
All presentation rooms are equipped with Windows computers and white boards. If you are using an electronic presentation (powerpoint or pdf only please) bring your files on a USB stick to the registration room (Dunn 104) during registration (Friday evening or Saturday morning). Once your files are uploaded, you will be able to check your presentation using the computers in Dunn 102. You will not be able to use your own computer in the meeting room as this can take a considerable amount of time and create delays which cascade throughout the day.

Plenary Speakers

Sedgwick Lecture: Dr. Anne Condon, University of British Columbia

Some Why's and How's of Programming DNA Molecules

Programs that execute within cells or that create intricate structures at nano-scale resolution are now a reality---designed and implemented using DNA molecules. As the scale and variety of DNA programs expands, a rich theory of molecular programming is emerging.

Why might we program molecules? Molecular programming offers the promise of understanding and changing our world at staggeringly small scales, with applications to disease diagnosis and therapeutics. It also prompts us to broaden our views of computation and its role in producing order and complexity in living systems.

How can we program molecules? At a low level of abstraction, DNA programs are sequences of A,C,G and T bases that comprise DNA molecules, and changes in the pattern of complementary A-T and C-G base pairs reflect the execution of a program. Sets of chemical reactions provide a useful model for reasoning at a higher level about the capabilities and limitations of molecular programs.

Field Lecture: Dr. Debbie Dupuis, HEC Montreal

Modelling Daily Maximum Temperature: A Series of Statistical Challenges

Heat waves are a serious threat to society, the environment and the economy. Estimates of the recurrence probabilities of heat waves may be obtained following the successful modelling of daily maximum temperature, but working with the latter is difficult as we have to recognize, and allow for, not only a time-trend, but seasonality in the mean and in the variability, as well as serial correlation. Furthermore, as the extreme values of daily maximum

temperature have a different form of non-stationarity from the body, additional modelling is required to completely capture the realities. In this talk, we will demonstrate how each statistical challenge can be faced. As a result, we gain a better understanding of how daily maximum temperature, along with the length and intensity of heat waves, has changed over 50 years.

Blundon Lecture: Dr. Dror Bar-Natan, University of Toronto

The Hardest Math I've Ever Really Used

What's the hardest math I've ever used in real life? Me, myself, directly - not by using a cellphone or a GPS device that somebody else designed? And in "real life" - not while studying or teaching mathematics?

I use addition and subtraction daily, adding up bills or calculating change. I use percentages often, though mostly it is just "add 15 percents". I seldom use multiplication and division: when I buy in bulk, or when I need to know how many tiles I need to replace my kitchen floor. I've used powers twice in my life, doing calculations related to mortgages. I've used a tiny bit of geometry and algebra for a tiny bit of non-math-related computer graphics I've played with. And for a long time, that was all. In my talk I will tell you how recently a math topic discovered only in the 1800s made a brief and modest appearance in my non-mathematical life. There are many books devoted to that topic and a lot of active research. Yet for all I know, nobody ever needed the actual formulas for such a simple reason before.

Hence we'll talk about the motion of movie cameras, and the fastest way to go from A to B subject to driving speed limits that depend on the locale, and the "happy segway principle" which is a the heart of the *least action principle* which in itself is at the heart of all of modern physics, and finally, about that funny discovery of Janos Bolyai's and Nikolai Ivanovich Lobachevsky's, that the famed *axiom of parallels* of the ancient Greeks need not actually be true.

Contributed Talks

An Irreducibility Criterion of A. Cohn

Abdullah Al-Shaghay, Dalhousie University – Dunn 113, 2:40pm

This talk explores an interesting irreducibility criterion, which is attributed to Arthur Cohn, for a particular subset of polynomials belonging to the ring **Z**[x]. I hope to discuss the significance of the theorem, examples of applying the theorem, and a conjecture which is closely related to the theorem.

Markov Chains and MRSA

Kara Allan, UNB Fredericton – Dunn 106, 9:30am

MRSA is a serious problem in most hospitals throughout the world. It is spread primarily by health care workers. This talk focuses on the model that I have been building since last summer to represent the spread of this disease. I use a stochastic SIS model and Markov Chains with the population divided into patients and healthcare workers. The patients are further divided by rooms. I assume that there is no contact between patients, so that the healthcare worker is acting as the vector for transmission between patients. I will be studying the distribution of the time to extinction to understand the effects of intervention by healthcare workers.

Supersymmetric Quantum Mechanics of the Kratzer Potential

Ashley Arsenault, University of PEI – Dunn 106, 9:50am

Supersymmetry is a mathematical concept which arose from Quantum Field Theory. However, its development led to investigations of its applications in other areas of physics. Notably, its utility in traditional quantum mechanics was so fruitful that it led to the birth of an entire new field, which we call supersymmetric quantum mechanics, or SUSY QM (pronounced Suzy-Cue-Em). Supersymmetric quantum mechanics is a powerful tool that, in some cases, allows us to solve the difficult Schrödinger equation with much more ease than our traditional analytical methods. It is

also useful for generating new solvable potentials, along with their corresponding energy spectra and set of wave functions. It is a method of choice for establishing solutions to generalized potentials which can be applied to a number of real-world physical systems. One of the simplest and most common of these generalized potentials, and yet one which thus far lacks much recognition and understanding, is the Kratzer potential: a one-dimensional potential dependent solely on distance, and two scaling parameters. An important example of the manifestation of this potential in nature is the hydrogen atom, whose analytical solution is highly complex. SUSY QM, however, simplifies this problem greatly, and paired with the generality of the Kratzer potential, provides a straightforward solution to a vast number of real systems.

An Optimized Formulation of Decision Tree Classification Algorithm

Fateha Bappee, St. FX -

An effective input dataset, valid pattern-spotting ability, good discovered pattern evaluation is required in order to analyze, predict and discover previously unknown knowledge from a large data set. The criteria of significance, novelty and usefulness need to be fulfilled in order to evaluate the performance of the prediction and classification of data. Thankfully data mining, an important step in this process of knowledge discovery extract hidden and non-trivial information from raw data through useful methods such as decision tree classification. But due to the enormous size, high-dimensionality and heterogeneous nature of the data sets, the traditional decision tree classification algorithms sometimes do not perform well in terms of computation time. This paper proposes a parallel strategy to optimize the performance of decision trees in order to reduce the computation time for inducing the tree and classify data. Experiments on four benchmark data sets suggest significant improvement in computation time by incorporating parallel strategy in the classification algorithm.

Cops and Robbers with Partial Information

Justin Boutilier, Acadia University – Dunn 108, 8:50am

Cops and Robbers is a vertex-to-vertex pursuit game played on some graph, G. The original game is played with full information and has only one cop and one robber. This talk will explore a modified version of the original game with k cops and partial information. There are two types of information providing devices, those placed on edges and those placed on vertices. Since the information may or may not indicate the robber's direction in addition to his position, the problem can be divided into four cases. This talk will explore the number of cops required for given information levels in all four cases. Explicit relationships for determining the number of cops will be introduced and the focus will be on select classes of graphs, mainly products. The schemes for placing the devices and the strategies the cops must follow to apprehend the robber will also be discussed.

Variance of the WSRT Statistic for Dependent Data

Amber Corkum, Acadia University – Dunn 106, 8:50am

The Wilcoxon Signed Rank Test (WSRT) can be used to test for trend in time series data. The test statistic, denoted by T+ can be calculated for independent and for dependent processes. We are interested in the distribution of T+, which is different for each sample size and for each dependency structure in the data process. In this talk we will present the derivation of the exact variance of T+ in the case of independent data, and then extend these results to the case of dependent data. Specifically, we will derive formulas for the exact variance of T+ when the sample data follow AR(1) and MA(1) processes. Finally, we will confirm that our method is accurate through Monte Carlo simulations.

Using Image Processing to Count Apple Mites

Dylan Day, Acadia University – Dunn 108, 2:20pm

The current method for estimating the apple mite population in an orchard involves manually counting a sample of mites under a microscope; a time consuming and tedious task. This talk introduces a potential method to streamline the process by using image processing techniques to count the number of mites in a high resolution digital image. The talk will include a discussion of various object recognition algorithms used as well as a brief look at the Monge-Kantorovich distance and its application in comparing colour histograms.

C4.5 Decision Tree Pruning

Anthony Delaney, Mount Allison University – Dunn 108, 2pm

A pruning technique for decision trees generated using the C4.5 algorithm is presented. The C4.5 algorithm generates decision trees to be used in classification of new data entries by examining pre-existing data. It is known to be easily misled by errors in training data and to have a tendency to pick up statistically weak patterns. By using a statistically rigorous pruning technique it may be possible to create a tree that has greater classification accuracy when confronted with a set of data that has label noise. Evaluation was done comparing C4.5 with the modified classifier on several data sets.

Characterizations of Completeness and the Archimedean Property

Michael Deveau, Acadia University – Dunn 113, 9:30am

In undergraduate real analysis, students learn that the real numbers are a complete field, informally, a field that has no "holes". To express this formally, the existance of suprema is often taken as an axiom. However, as we demonstrate, the property of completeness can be characterized in many different ways, some of which might be surprising to the average student.Similarly, the Archimedean Property (which states that every number has a natural number exceeding it) can be characterized by the validity of slight modifications to several famous theorems from real analysis, rather

than then by the definition given above. We present a simple example of a characterization for completeness, and then prove a somewhat surprising result that is true only in non-Archimedean fields.

Grundy Oriented Colouring

Sophie DeViller, Acadia University – Dunn 108, 9:30am

To properly colour the vertices of a simple graph, one can use the Greedy colouring algorithm. The Greedy Colouring Algorithm assigns to vertex v of G the least indexed colour not already used on the neighbours of v. The maximum number of colours used in any application of the Greedy colouring algorithm is called the Grundy number. Grundy colouring is well-studied for undirected graphs and will be defined here for oriented graphs. In this presentation two possible definitions for Grundy Oriented Colouring will be explored. Results for the Grundy number in comparison to simple graphs as well as comparisons between the two possible definitions will be investigated.

On Commutation Semigroups of Dihedral Groups

Darien DeWolf, Dalhousie University – Dunn 113, 9:30am

For G a group and g in G, we define mappings pg(G) and lg(G) from G into G by pg(x)=[x,g] and lg(x)=[g,x]. We let P(G) and L(G) denote the subsemigroups of the set of all mappings from G to G generated by {pg: g in G} and {lg: g in G}, respectively. P(G) and L(G) are called the right and left commutation semigroup of G, respectively. In this paper we will give explicit formulas for the orders of both P(G) and L(G) where G is a dihedral group.

Representation Growth - An Introduction

Shannon Ezzat - Dunn 113, 8:30am

Representation growth is a method of studying certain infinite groups in an indirect way. For each n, we count how many n-dimensional irreducible representations (homomorphisms into

invertible n-dimensional complex matrices) exist and then study this sequence of numbers. This talk will give a friendly, non-expert overview of the subject, especially focusing on representation growth of nilpotent groups.

Relations Between Cousins of Tricyclic Curves

Melanie Foerster, Dalhousie University – Dunn 113, 2:00pm

A curve generated by a fixed point on a circle that is rolling along the outside of a stationary circle is an epicycloid. Epicycloids are parametric curves of the form

$$x = (a+b)\cos(t) - b\cos\left(\frac{a+b}{b}t\right)$$
$$y = (a+b)\sin(t) - b\sin\left(\frac{a+b}{b}t\right)$$

where a is the radius of the stationary circle, and b is the radius of the rolling circle. These curves are reminiscent of curves created by Spirographs. If a third circle is added, that is, if there is a fixed point on a circle that is rolling around a second circle, and the second circle is then rolling around a stationary circle, the resulting curve shall be called a tricycloid. A tricycloid is a curve of the form

$$x = \sin(at) + \sin(bt) + \sin(ct)$$
$$y = \cos(\mathrm{at}) + \cos(bt) + \cos(ct)$$

The relation between four families of tricyclic curves will be discussed in this presentation. In particular, the families $x = \sin(at) + \sin(bt) + \sin((a \pm b)t)$
$y = \cos(at) + \cos(bt) + \cos((a \pm b)t)$

and

$$x = \sin(at) + \sin(bt) - \sin((a \pm b)t)$$
$$y = \cos(at) + \cos(bt) + \cos((a \pm b)t)$$

which shall be called cousins, will be examined using a series of Maple animations.

Surfaces, Covering Spaces and Residual Finiteness

Adam Gardner, Memorial University – Dunn 113, 9:10am

The fundamental group is a powerful tool to study topological spaces using group theory. An example of the power of this tool is the study of covering spaces, which shows many links between properties of topological spaces and properties of their fundamental groups. Two important properties to help understand groups are residual finiteness and the related concept of residual p-finiteness; I generalize a criterion for a group to be residually finite to a criterion for a group to be residually p-finite.

An Agent that Learns to show us what it hears and tell us what it sees

Mohammed Shameer Iqbal, Acadia University – Dunn 108, 3pm

The objective of our research is to build an intelligent agent using deep learning RBMs that can "show us what it hears and tell us what it sees". The architecture of this agent is composed of two deep learning RBM networks - meant to simulate two human sensory modalities. One is designed for the recognition and the reconstruction of visual images, and the other is designed for the recognition and the reconstruction audio sounds. The two deep learning networks are tied together at the top by a shared BM or RBM layer. All learning is unsupervised. Our goal is to train the networks such that when fed an audio signal of a letter, the agent will generate an image of that letter to let us know what it is thinking. Conversely, when provided an image of a letter, the agent will generate the sound of a letter. Furthermore, the image of part of a letter or a noisy letter is also able to generate a sound close to the audio signal of that letter.

A Case Study of Adaptive Traffic Light Control Using VANET

Sylvere Kwatirayo, Université de Moncton – Dunn 108, 2:40pm

VANET technology offers a real opportunity for better car traffic management in urban area by reducing traffic jam and improving safety. Conventional traffic signal with fixed or slightly variable cycles setting does not present an efficient solution to continuously

growing car traffic in particular in urban area. Adaptive Traffic Light Control (ATLC) using VANET is a growing trend and several research works were published in the literature. Unfortunately, most of these works used simulated traffic flow and hypothetical intersection architectures which may not reflect the reality of urban area, therefore results obtained from these works have limited benefits. In this paper, we present a case study based on a specific intersection in the city of Moncton with real traffic data, and propose a new adaptive traffic signal control algorithm. Our results show a substantial improvement of traffic flow and average waiting time in comparison with fixed optimal cycles time currently used by the city of Moncton and with previous adaptive solutions.

Growth of infinitely generated Free Group actions.

Jonny Lomond, Memorial University – Dunn 113, 9:50am

In this talk we will present the definition of the growth of a group action, and extend this definition to the case of infinitely generated and groups. We will present the growth functions of infinitely generated free groups and monoids acting on themselves, as well as the necessary and sufficient conditions for a given function to be the growth function of a free act. This research was performed under the supervision of Yuri Bahturin, Summer 2012, and supported by an NSERC USRA.

A Search for Fast Matrix Multiplication Algorithms

Ben McAdam, University of PEI – Dunn 106, 10:10am

Matrix multiplication is one of the most important mathematical operations in modern computing, with wide applications in science and engineering. While the naive method of multiplying two n by n matrices uses n^3 multiplications, in 1968 Volker Strassen found an algorithm which found the product using only 7 multiplications for 2 by 2 matrix multiplication, as compared to 8. A Strassen-type algorithms uses only 1, 0 or -1 as coefficients. Recent research by Seunghyun Oh and Byung-Ro Moon has found 4 new families of

Strassen-type algorithms for the 2 by 2 case through the use of genetic search algorithms. A new search algorithm will be outlined which uses techniques from linear algebra and properties of symmetry to provide a comprehensive search of every possible Strassen-type algorithm for the 2 by 2 case.

Tidal Energy

Simon McConnell, Acadia University – Dunn 106, 9:10am

Tidal energy is an emerging renewable energy resource in the province of Nova Scotia. This presentation will look at how much power could be generated and how many turbines could be deployed at various locations in the Bay of Fundy with minimal environmental impact. The concept of reduction in flow will be used to assess the environmental impact and the amount of power will be calculated using a mathematical model.

Ambush Cops and Robbers

Patrick Murray, Acadia University – Dunn 108, 8:30am

The game of Cops and Robber is a vertex to vertex pursuit game played on a graph. In this talk we will discuss a variation of the game called Ambush Cops and Robbers. We will begin with a brief introduction to the original game, defining what it means for a graph to be "copwin" and will discuss a classical example of such graphs. Next we will introduce the variation and discuss some initial results of the new game. In particular we will discuss the results of the variation as played on trees, and present the "ambush copnumber" for various forms of trees.

Edge-deletion game

Ryan Oulton, University of New Brunswick – Dunn 108, 9:10am

After an introduction to some Combinatorial Game Theory terminology, I will introduce the rules of a new combinatorial game played on various graphs. I will relay common strategies found

throughout the game, and prove the result of the complete graphs Kn.

Counting Fine Gradings on Simple Lie Algebras

Nicholas Parson, Memorial University – Dunn 113, 10:10am

Known classification results allow us to find the number of (equivalence classes of) fine gradings on matrix algebras and on classical simple Lie algebras over an algebraically closed field *FF* (assuming chr(FF) $\neq 2$ in the Lie case). The computation is easy for matrix algebras and especially for simple Lie algebras of type B_r (the answer is just *r*+1), but involves counting orbits of certain finite groups in the case of Series *A*,*C* and *D*. For $X \in \{A, C, D\}$, we determine the exact number of fine gradings, $N_X(r)$, on the simpler Lie algebras of type X_r with $r \leq 50$.

Sample Size Determination Based on Wilcoxon's Rank Sum Test for FDR-Control in Microarray Experiments

Megan Robichaud, Acadia University – Dunn 106, 8:30am

Sample size determination is often an important step in planning a microarray study. The usual normality assumption for microarrays between two groups is untenable. We propose a sample size determination method based on Wilcoxon's rank sum test for a specified number of true rejections while controlling the false discovery rate at a desired level. The application of the proposed method is shown using a real-life data set.

Checking Equivalence of Subset-Groupings with Applications to Design Theory

Neil Spencer, Acadia University – Dunn 113, 2:20pm

Given a finite set A, there are many ways to break the set up into subset-groupings (e.g. partition). This talk will present a method for checking whether two subsets-groupings of A are equivalent. The focus will be upon checking equivalence of subset groupings (in particular, spreads) of the set A= PG(p-1,2).

Planar Triangulations and the Domination Chain

Christopher van Bommel, St. FX – Dunn 108, 9:50am

A dominating set of a graph is a subset of vertices such that each vertex of the graph is in the set of adjacent to a member of the set. An irredundant set of a reflexive graph is a subset of vertices such that each vertex of the graph has a private neighbour, that is each vertex is adjacent to a vertex adjacent to no other vertex in the set. A graph is called well-dominated if all minimal dominating sets are the same size and well-irredundant if all maximal irredundant sets are the same size. In this talk, we discuss a characterization of the well-dominated and well-irredundant planar triangulations, based on a result of Finbow, Hartnell, Nowakowski, and Plummer.

Graph Security Using Two Different Detecting Devices

Jenna Young, Saint Mary's University – Dunn 108, 10:10am

Work has been done in the past and is still being done today on the topic of metric dimension and graph security. In the past the work that has been done used only one type of detecting device in a given facility. We will call those detecting devices listeners and they guard all vertices that are a unique distance away. We will introduce the idea of a second type of detecting device called watchers. Watchers are able to guard the vertex on which they are located along with all adjacent vertices. We look into combining the two devices to see the effect on the metric dimension of a graph. We apply this to cycles, grids, stars and tree graphs. We look at an algorithm designed to minimize the total number of detecting devices needed and show that it is NP-compete. Two identical copies of a graph are also considered and upper and lower bounds are set for listening devices.

AARMS Mini-Conference Speakers

Bi-Lipschitz embeddings of groups

ALEXANDER OLSHANSKII, Vanderbilt University, USA – 8:00am

My talk will be based on resent joint results with Denis Osin. We show that every group H of at most exponential growth with respect to some left invariant metric admits a bi-Lipschitz embedding into a finitely generated group G such that G is amenable (respectively, solvable, satisfies a non-trivial identity, elementary amenable, of finite decomposition complexity, etc.) whenever H is. The basic definitions will be given. Then we will briefly discuss some applications to subgroup distortion, compression functions of Lipschitz embeddings into uniformly convex Banach spaces, Følner functions, and elementary classes of amenable groups.

Group actions on trees

OLGA KHARLAMPOVICH, City University of New York, USA – 8:55am

I will talk about results extending Bass-Serre theory to R-trees and arbitrary Λ-trees.

Definable sets in free and hyperbolic groups

ALEXEI MIASNIKOV, Stevens Institute, USA – 10:15am

I will talk about the structure of definable sets in a free or a torsion-free hyperbolic group G. Recall, that a subset of n-tuples in G is definable if it is the truth set in G of some first-order formula with n free variables. In our joint work with Olga Kharlampovich we give a natural description of definable sets in G, which allows us to solve several old open problems.

Coherence and Negative Sectional Curvature in Complexes of Groups

EDUARDO MARTINEZ-PEDROSA, Memorial University – 11:10am

A group is coherent if finitely generated subgroups are finitely presented. We examine a condition on a simply connected 2-complex X ensuring that if a group G acts properly on X then is coherent. This extends a coherence criterion of D. Wise on free actions on 2-complexes

with negative sectional curvature. Our extension of this result involves a generalization of the notion of combinatorial sectional curvature, a version of the combinatorial Gauss-Bonnet theorem to complexes of groups, and requires the use of ℓ^2-Betti numbers. This is joint work with D. Wise of McGill University.

Applications of Hopf algebras to the study of gradings

MIKHAIL KOTCHETOV**,** Memorial University – 11:45am

The Cartan decomposition of a semisimple Lie algebra with respect to a Cartan subalgebra can be regarded as a grading by a free abelian group (the root lattice). Gradings on Lie algebras by various abelian groups arise in the theory of symmetric spaces, Kac-Moody algebras, and colour Lie superalgebras. In the 1960s, V. Kac classified all gradings by cyclic groups on finite-dimensional simple Lie algebras over complex numbers. We will discuss recent progress in the classification of gradings on simple Lie algebras by arbitrary groups. In particular, we will concentrate on Hopf - algebraic methods that allow us to "transfer" gradings from one algebra to another over an arbitrary field.

Representation Growth and the Constructive Method

SHANNON EZZAT, University of Canterbury, New Zealand – 12:45pm

Representation growth is a branch of asymptotic group theory in which groups are studied indirectly by counting its complex irreducible representations. This talk will explore representation growth of finitely generated nilpotent groups and give some results obtained by using a constructive method, as opposed to the more prevalent Kirillov orbit method. This talk is based on the paper “Counting Irreducible Representations of the Heisenberg Group Over the Integers of a Quadratic Number Field” recently submitted for publication.

Representations of infinite quivers and Auslander-Reiten theory

CHARLES PAQUETTE, University of New Brunswick – 1:10pm

Let k be a field and Q be an infinite (but strongly locally finite) quiver. In this talk, I will describe the Auslander-Reiten theory of the category of finitely presented representations of Q, and in particular, I will provide a

complete description of its Auslander - Reiten quiver. This is joint work with R. Bautista and S. Liu.

Some problems in the theory of group actions

YURI BAHTURIN & JONATHAN LOMOND, Memorial University – 1:35pm

We discuss the current status of some problems designated as open in the paper Yuri Bahturin and Alexander Olshanskii "*Actions of Maximal Growth*", Proc. London Math. Soc. **101**(2010), 27 - 72.

Come aboard CUMC 2013

The Canadian Undergraduate Mathematical Conference is one of the biggest conferences in North America aimed at the undergraduate mathematics students. Each year this event brings together over a hundred of young mathematicians with a variety of research interests. It is the Université de Montréal, sitting on top of Mount Royal, who will have the honor of welcoming Canadian students for the 20th edition of this great réunion that will be held from July 10th to July 14th 2013 at Université de Montréal.

The conference offers a unique opportunity to acquire a first experience in research for students. By means of meetings and conferences, the CUMC suggests an occasion to create links between students from different Canadian universities, links which those students will benefit from throughout their mathematical career. The event also offers the occasion to promote different mathematical fields and offers an unique opportunity to meet key persons working in the main fields of applications, among which physics, economy, informatics, statistics, the multiple engineering sciences and actuarial science are represented.

The conference is a very fruitful experience for young talented mathematicians to get out of their usual working context and meet to speak about their common interests. It is an event exempted of competitions and we believe that such a context encourages exchange and diversity, which is essential for the development of mathematics across the country.

We look forward to meeting you in Montréal next summer! Travel support is available through the Atlantic Association for Research in the Mathematical Science (AARMS). For more information, you can visit us at http://cumc.math.ca/ , or send an e-mail at communication@cumc.math.ca.

Report
---

1) A description of the event and the activities that made it up.

The Mathematics, Statistics, and Computer Science Science Atlantic conference is an annual meeting in the Atlantic Provinces, hosted by a different university each year in a roughly 10 year cycle. There are two primary activities: student competitions in mathematics and computer science and research presentations. On Friday roughly 90 students participated in a written mathematics contest and a programming contest. On Saturday we had about 30 oral presentations based on undergraduate and graduate research projects. Over the two days we hosted three plenary speakers who presented engaging expositions of mathematics, computing, and statistics. A meeting brochure is attached to this email.

2) The number of participants (regional and national/international)

There were 110 student (regional participants) and 50 faculty (regional as well) at the Science Atlantic portion of the meeting. We had three plenary speakers who were from Canada, but outside the Maritimes (Montreal, Toronto, Vancouver).
The AARMS workshop on Sunday had about 18 participants with about 6 national/international participants.

3) Resulting publications.

There were no conference proceedings.

4) Scientific highlights.

For the Science Atlantic portion, we had three excellent educational talks by our plenary speakers. Debbie Dupuis presented a discussion of a statistical analysis of temperature changes from climate records. Dror Bar Natan's talk on the "hardest math I've ever really used" illustrated practical applications of mathematics. Anne Condon introduced us to the challenges and opportunities of programming with DNA molecules.

Mount Allison UNIVERSITY

Science Atlantic Mathmatics, Statistics, and Computer Science Conference 2012
Budget

		BUDGET				ACTUAL	
	Revenue	**#**	**Amount**	**Total**		**#**	**Total**
Registration Fees							
	Students	100	$ 30	$ 3,000		115	$ 3,000.00
	Faculty	60	$ 120	$ 7,200		50	$ 5,217.39
	Total Registration Fees			$ 10,200			$ 8,217.39
Other revenue							
	Science Atlantic Math Committee			$ 2,000			$ 1,500.00
	Science Atlantic CS Committee			$ 2,000			$ 1,500.00
	Contribution from Host Institution			$ 2,000			$ -
	Sponsorship (prizes and coffee breaks)			$ 500			$ 500.00
	AARMS Contribution			$ 4,000			$ 1,001.30
	Total other revenue			$ 10,500			$ 4,501.30
Total Revenue				$ 20,700			$ 12,718.69

Revenue notes

1. *Actual revenue and expenses are exclusive of HST.*
2. *Science Atlantic contribution is lower than budget because prizes are paid directly to students, but were included in our initial budget.*
3. *Books were received from publishers as non-cash donations.*

	Expenses	**#**	**Amount**	**Total**		**#**	**Total**
Invited Speakers							
	Sedgwick - A Condon			$ 1,500			$ 328.94
	Blundon - D. Bar Natan			$ 1,000			$ 523.31
	Field - Debbie Dupuis			$ 1,000			$ 649.52
	Speaker Gifts						$ 180.00
	Total Invited Speakers			$ 3,500			$ 1,681.77

Food Services							
	Pizza Party	100	$ 15	$ 1,500			
	- Pizza						$ 463.67
	- Drinks, etc						$ 80.88
	- University Club						$ 86.00
	Speaker Dinner - Friday						$ 91.62
	Reception	150	$ 15	$ 2,250			
	- Food						$ 1,940.57
	- Bar Services						$ 112.00
	Snacks for Competitors	100	$ 5	$ 500			$ 183.06
	Coffee Saturday morning	125	$ 5	$ 625			$ 423.72
	Coffee Saturday afternoon	125	$ 5	$ 625			$ 225.23
	Luncheon on Saturday	150	$ 25	$ 3,750			
	- Curling Club Rental						$ 194.08
	- Catering - Joey's Restaurant					150	$ 4,100.23
	- Centerpieces, decorating, etc						$ 362.72
	Coffee for AARMS Session Sunday	40	$ 4	$ 160			$ 108.95
	Total Food Services			$ 9,410			$ 8,372.73
Other Expenses							
	Poster Session Costs	10	$ 20	$ 200			$ -
	Printing, Supplies & Assistants			$ 2,000			$ 1,522.90
	Student Prizes			$ 1,000			$ 250.00
	Student Travel (MUN support + hotel)			$ 2,500			$ 1,447.38
	Internal cost recovery						$ (556.09)
	Total Other Expenses			$ 5,700			$ 2,664.19
Total Expenses				$ 18,610			$ 12,718.69
BALANCE				$ 2,090			$ (0.00)