Newsletter   Spring 2018

Summer School
University of Prince Edward Island
June 4 to 29 2018
Data Analytics

The 2018 AARMS Summer School at UPEI will focus on the theme of Data Analytics. Four courses will be offered:

Functional Data Analysis for Big Data
Dr. Jiguo Cao, CRC in Data Science, Simon Fraser University
Statistical Learning for High Dimensional Data
Dr. Wenqing He, University of Western Ontario
Machine Learning and Data Mining
Dr. Mark Schmidt, University of British Columbia
Foundations in Data Science and Applications
Dr. Osmar Zaiane, University of Alberta

The summer school is intended for graduate students and promising undergraduate students from all parts of the world. Each participant is expected to register for at least two of the four courses. Each course consists of three hours lecture sessions per day for two weeks. These are graduate courses approved by University of Prince Edward Island and we will facilitate transfer credit to the extent possible. For student attendees, the AARMS Summer School will pay the tuition and the accommodation expenses, but will not cover the cost of travel. Note that the accommodation is provided only when a student is taking a course (the night before the first lecture of a course is covered). If a student arrives early or leaves late, the extra accommodation is not covered. In addition, those who will finish their bachelor/master degree in the spring/summer term of 2018 and will enter the graduate school in the fall term of 2018 are also considered students.

The summer school also has a limited number of non-student spots. If you are not a student and would like to take the courses offered at the summer school, you need to pay $600 for each course and cover your accommodation/travel.

To apply for AARMS Summer School 2018, please complete the online application form at aarms.math.ca/summer-school/school2018/ before April 15, 2018. Please note that the evaluation committee of the summer school will review all applications shortly after Apr. 15.

AARMS 2018 Industrial Problem Solving Workshop

The first AARMS 2018 Industrial Problem Solving Workshop (IPSW)will be held this summer, July 3rd to 6th at Dalhousie University in Halifax (for details see https://aarms.math.ca/ipsw2018/). The goal of the IPSW is to bring together industry researchers with young academics to work together on applied mathematical problems. The companies involved in the workshop present their current research problems to the students and academic mentors. During the week, the students work in teams to study the problems, with assistance from the industry representatives and mentors. At the end of the week, the teams present on their progress and discuss next steps.

For the 2018 IPSW at Dalhousie, AARMS has already confirmed the participation of The Black Arcs, an urban analytics firm that designs simulations and visualizations of cities, and QRA, a company that works on the verification of complex systems. Their problems involve a fascinating combination of automated algorithm design and analysis, natural language processing and even tiling. To make progress on these problems, AARMS is looking for interested students and faculty from all areas of the mathematical sciences.

As well, the IPSW will be combined with an industry-networking event that connects skilled researchers in the mathematical sciences with like-minded contacts in industry from across Atlantic Canada to drive new collaborations and support research commercialization

The IPSW and networking event are modelled on similar successful events by CRM, the Fields Institute and PIMS. In particular, PIMS claims that the IPSW is one of their biggest successes, continuing to : foster contacts between academia and industry, often leading to long-term research collaborations; introduce challenging new research areas with a direct bearing on physical problems to academics and their graduate students; develop highly qualified personnel from the participation of graduate students and postdoctoral fellows; provide Canadian industry with new ideas and approaches to solving current technical problems.

If you or your students are interested in participating in the IPSW or networking event, please contact Dr. Richard Karsten (rkarsten@acadiau.ca).

News

AARMS Postdoctoral Fellow: Rosalind Cameron

I am an AARMS Postdoctoral Fellow at Memorial University of Newfoundland, collaborating with David Pike. Since starting my fellowship in the fall we have shown that, for large enough orders, there is a twofold triple system whose 2-block intersection graph is bipartite and connected but not Hamiltonian. We are also investigating the existence of universal cycles of designs. I have been teaching undergraduate courses and trialing different methods for enhancing student participation in lectures such as 'clickers' and occasional group work sessions.

My previous position was at Monash University where I was a Research Fellow after receiving my PhD in early 2017. At Monash I collaborated with Daniel Horsley on various graph decomposition problems. One of our results was to classify, with a finite number of exceptions, when a decomposition of the complete graph into odd m-cycles can be embedded in an m-cycle decomposition of a larger complete graph.

In my work at Memorial we are investigating the 2-block intersection graph (2-BIG) of designs. The 2-BIG of a design T is the graph formed by taking the blocks of T as vertices and connecting two vertices if the corresponding blocks intersect in exactly 2 elements. A Hamilton cycle in a graph is a cycle that visits each vertex exactly once. Such a cycle in the 2-BIG of a twofold triple system (TTS) is equivalent to a cyclic Gray code, which has applications for coding theory. It is known that, with the exception of a few small orders, there is a TTS whose 2-BIG is Hamiltonian and another system whose 2-BIG is connected but not Hamiltonian.

If the 2-BIG of a TTS is bipartite, this is equivalent to the TTS being composed of two Steiner triple systems. For some small orders this condition seemed to be sufficient for the existence of a Hamilton cycle in the 2-BIG, moreover none of the constructions in the literature for TTS with non-Hamiltonian 2-BIG are bipartite. However, we constructed a counter-example of order 331 and embedded this example in larger TTS to obtain our result.

Ordering the blocks of a TTS according to the Hamilton cycle in the 2-BIG results in a minimal change ordering of the design. Another instance of a minimal change ordering is a universal cycle (Ucycle): a sequence on the elements of a TTS so that any three cyclically consecutive elements represent a block of the TTS, and each block is represented exactly once.

The literature includes constructions of Ucycles for many of the feasible cases; however, there are still orders for which it is not known whether there exists a Ucycle.

This summer I will present contributed talks at 'Graphs, groups and more' in Slovenia and 'Combinatorics 2018' in Italy. I have also been invited to present a lecture to the Newfoundland SHAD cohort - an exciting opportunity to speak to gifted high school students about mathematics research.

Tensor Categories and Topological Field Theory

During the week from March 5 to March 9, the AARMS-AAC-mini course `Tensor Categories and Topological Field Theory' took place at the St. John's campus of Memorial University. Professor Christoph Schweigert from the University of Hamburg gave five two-hour lectures on topological quantum field theories and their connections to tensor categories. Professor Schweigert is one of the leading researchers in the field of mathematical physics and has won several prizes for his work. He is an editor of three important journals in the field, namely `Communications in Mathematical Physics,' `Letters in Mathematical Physics,' and `Journal of Mathematical Physics.' In 2006, he was an invited speaker at the International Congress of Mathematicians.

Professor Schweigert lectured on higher categories and their emergence from cobordisms, representations of these categories via vector spaces, and Dijkgraaf-Witten theory. He explained how the evaluation of these representations on concrete manifolds leads to algebraic structures, such as Frobenius algebras and Hopf algebras. He had prepared notes that were handed out during the lectures. Furthermore, also the lectures themselves were recorded. Twenty-two people participated in the mini course, primarily faculty members and graduate students from Memorial University, but also external guests from the University of New Hampshire and Texas A & M University. In addition, the financial support from AARMS made it possible to fund the local accommodation of a graduate student from Dalhousie University in Halifax.

The week-long event also enabled several participants to work on their ongoing joint research projects during the time between the lectures. But for all participants, it was an opportunity to get acquainted to cutting-edge research in a stimulating environment.

Performance RNN: Generating Music with Expressive Timing and Dynamics

Human musical performance is much more than the mathematically accurate execution of pitches and rhythms. Rather, expressive timing and dynamics are an essential part of music. We are used to hearing music generated by computers as being devoid of these human elements but Neural networks can be trained to perform with these very human characteristics. This is demonstrated in the work by Sageev Oore and Ian Simon in the system they call 'Performance RNN': an LSTM-based recurrent neural network designed to model polyphonic music with expressive timing and dynamics. As they put it on their webpage:

Performance RNN generates expressive timing and dynamics via a stream of MIDI events. At a basic level, MIDI consists of precisely-timed note-on and note-off events, each of which specifies the pitch of the note. Note-on events also include velocity, or how hard to strike the note. These events are then imported into a standard synthesizer to create the "sound" of the piano. In other words, the model only determines which notes to play, when to play them, and how hard to strike each note. It doesn't create the audio directly.

The model is trained on the Yamaha e-Piano Competition dataset, which contains MIDI captures of ~1400 performances by skilled pianists. A prior blog post by Iman Malik also found this dataset useful for learning dynamics (velocities) conditioned on notes, while in our case we model entire musical sequences with notes and dynamics.

The Yamaha dataset possesses several characteristics which we believe make it effective in this context:
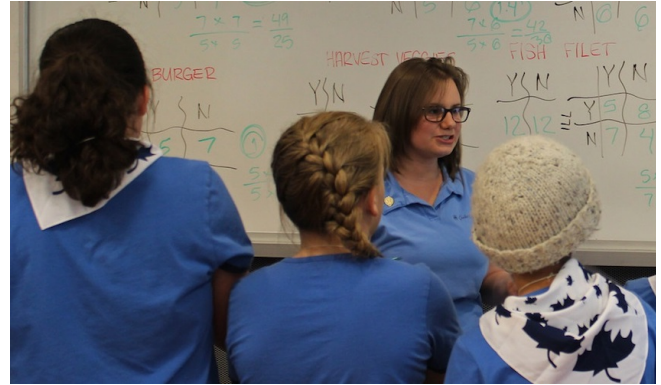
* - Note timings are based on human performance rather than a score.*
* - Note velocities are based on human performance, i.e. with how much force did the performer strike each note?*
* - All of the pieces were composed for and performed on one single instrument: piano.*
* - All of the pieces were repertoire selections from a classical piano competition. This implies certain statistical constraints and coherence in the data set.*

We have also trained on a less carefully dataset having the first three of the above characteristics, with some success. Thus far, however, samples generated by models trained on the Yamaha dataset have been superior.

More information, audio samples and the facility to comment can all be found at:

https://magenta.tensorflow.org/performance-rnn

NSERC PromoScience: Funding Camps for the Girl Guides

Following a successful application to NSERC's PromoScience program AARMS will be partnering with Girl Guides of Canada to organize three provincial-scale events on the campuses of Dalhousie University in Halifax, Memorial University in St. John's, and the University of New Brunswick in Fredericton. We will hold an event once a year starting in 2018 at UNB. These events will be camps of usually two days in duration with an overnight stay, targeted at girls age 9 and older. During each event, girls will participate in mini-workshop sessions aimed at increasing awareness and engagement in Science - Technology - Engineering - Mathematics (STEM) disciplines, taking advantage of the experience of University faculty and staff on each of the three campuses in organizing similar outreach activities in the form of math camps, competitions, and school visits.

The first camp at UNB Fredericton will take place on May 12-13. During this event, approximately 525 girls aged 9-17 will participate in mini-workshop sessions in Science – Technology – Engineering – Mathematics (STEM) disciplines.

FIBONACCI-2018

Registration and abstract submission are now open for the 18th International Conference on Fibonacci Numbers and Their Applications, July 1-7, 2018, at Dalhousie University.

For further information, please see
https://www.fq.math.ca/fibonacci18/

- Karl Dilcher (Dalhousie)

Books For Sale

Almost 2,000 used books from all areas of pure and applied mathematics, including some computer science, statistics, and mathematical physics, are for sale at:

http://www.mathstat.dal.ca/~dilcher/oldbooks.html

This is a fundraiser, and prices are moderate. All proceeds go, in equal parts, to the CMS and to the Dalhousie Department of Mathematics & Statistics.

- Karl Dilcher (Dalhousie)

Recent and Upcoming Events

East Coast Combinatorics Conference
Dalhousie University
May 7, 2018 - May 9, 2018

The 13th ECCC (East Coast Combinatorics Conference) will be held May 7-9, 2018 at Dalhousie University. There will be two plenary speakers, Gary Gordon and Elizabeth McMahon (Lafayette College) both are highly esteemed researchers in areas of combinatorics Dr. Gordon will give the plenary talk, Dr. McMahon will give a public lecture on recreational mathematics. The conference will feature contributed talks by faculty, graduate students, and post-docs. The talks are expected to fill two and a half full days, with approximately 35-50 attendees. One new aspect this year will be two afternoon sessions where the conference participants will break into small groups to work on open problems. Open problems will be solicited in advance and disseminated at the start of the conference.

Public lecture: The Joy of SET: Combinatorics and Geometry
Speaker: Elizabeth McMahon, Department of Mathematics, Lafayette College
Tuesday May 8, 11:00am, Room 319, Chase Building, Dalhousie University
Abstract: The game of SET is deeply mathematical. We will first explore some combinatorics in the game. The deck is an excellent model of the finite affine geometry $AG(4,3)$, so we will use the game to aid in the visualization of the structure of the geometry. We will focus on maximal caps, which correspond to largest possible collections of cards with no sets. There is an interesting structure to

26th Foundational Methods in Computer Science Workshop
Mount Allison University
May 31, 2018 - June 2, 2018

Foundational Methods in Computer Science is an annual workshop that brings together researchers in theoretical computer science and category theory. Past workshops have had discussions on areas such as quantum programming languages, restriction categories, database design, and the differential and resource logics. They have been held at Colgate, Dalhousie, Kananaskis (U of Calgary), Mount Allison, Ottawa, UBC, Spokane, and Portland. The 2018 workshop is informal and interdisciplinary. The scientific program consists of research tutorials and contributed talks. We particularly encourage graduate students to attend FMCS and to present their work.
Confirmed tutorial speakers:
    Kristine Bauer (Calgary)
    Ernie Manes (Massachusetts)
    Robert Pare(Dalhousie)
    Peter Selinger (Dalhousie)

AARMS CRG Annual Meeting: Dynamical Systems and Spatial Models in Ecology
Memorial University
May 31, 2018

The annual meeting for the AARMS CRG on Dynamical systems and spatial models in ecology will take place on May 31, 2018, at the University of New Brunswick, just prior to the Canadian Mathematical Society (CMS) summer meeting (June 1-4). The CRG workshop will support continued collaboration in areas related to integrodifference equations, partial differential equations, population dynamics and will consider specific applications to bacterial aggregation, sea lice, and green crab. Confirmed participants include graduate students, postdoctoral fellows and faculty from Memorial University, the University of New Brunswick and the University of Prince Edward Island, as well as invited guests from other parts of Canada and beyond.

"I must study politics and war that my sons may have liberty to study mathematics and philosophy."   *-- John Adams*