Atlantic Association for Research in the Mathematical Sciences

Research - Outreach - Community

Newsletter

Summer 2018

Connecting Math to Our Lives and Communities

On April 7, 2018, over 57 youth from Mi'kmaw and African Nova Scotian communities Northeastern Nova Scotia arrived on the campus of St. Francis Xavier University (StFX) to enjoy the annual final celebration day of Connecting Math to Our Lives and Communities, an after school, in-community mathematics outreach program that helps make mathematics meaningful to students while showing them the power of using mathematics as a tool to address problems in our world.

The program is led by Dr. Lisa Lunney Borden from the Faculty of Education, and Drs. Tara Taylor and Robert van den Hoogen in the department of Math, Stats and Computer Science. Ellen Carter, a doctoral student in the Faculty of Education, coordinates the program and works with community members and staff to develop high quality programming that is relevant to community needs and concerns.

Throughout the academic year, StFX students travel to each of these seven communities biweekly to engage youth in meaningful, hands-on investigations of mathematics related to their everyday lives. The final celebration day provides a culminating experience for all participants on campus at StFX. The goal of the program is to have students see the role that mathematics plays in reading and writing the world, and identify themselves as mathematicians in a way that also honors their ways of being.

The 2017-2018 academic year was the third year for this program. Topics included ocean mapping and graphing, historically and culturally situated games of chance, and impacts of climate change and melting polar ice caps as well as programming with a variety of technology, both independently and within the context of the Winter Olympics. Thanks largely in part to the support of AARMS, Connecting Math to Our Lives and Communities has seen tremendous growth since its inception in the 2015-2016 year. The initial year provided 20 sessions reaching 154 students, growing the following year with AARMS funding to 29 sessions reaching 222 students. This year, with a growing positive reputation and increased funding to support programming, four hundred forty-two participants (344 in Mi'kmaq communities, and 98 in African Nova Scotian communities) were served through 37 sessions, with positive feedback from each visit.

Community leader, Stacey Desmond expressed her satisfaction with the program saying, "The children greatly appreciated all the hands on activities that the staff had prepared for them. It was great for them to see role models from our local university. They connected well with the groups. We are looking forward to next year." Similarly, Mary Jane Paulette and Patricia Prosper shared "Connecting Math to Our Lives and Communities Program in Paqtnkek was very successful this past year. It peaked interest from students of all ages including the chaperones. The kids enjoyed creating and playing with battery operated items, especially with the lights. The sphero SPRK+ along with the iPads, and robots were also a delight since many students do not have access to such electronic devices. Being technologically aware by keeping up with electronic devices is a very important aspect in today's society. Games such as Blokus and Kinex were important as well. Very good year spent with Connecting Math to Our Lives and Communities Program. The program was very knowledgeable and contributed to our learning."

Student participants provided feedback throughout the year, and consistently spoke of how fun the program was, and how they were learning both math and the connections of math to the world around them. The final celebration included morning workshops on a wide variety of topics such as teachings from community leaders and elders as well as professors, students, and the youth themselves.

- Lisa Lunney Borden

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News

AARMS industrial Problem Solving Workshop

AARMS held its first Industrial Problem Solving Workshop (IPSW) during the first week of July at Dalhousie University. The four-day workshop was a great success with over 45 participants (6 industry reps, 28 students, 11 faculty) from across Atlantic Canada and 4 students from outside the region as well! At the start of the workshop, five companies presented mathematical challenges connected to their business. Over the following three days, the participants worked in teams of 5-10 to find solutions to these challenges. See https://aarms.math.ca/ipsw2018/ for a description of the workshop, list of participants, problems description and links to the companies.

The problems, and the solutions found, spanned a wide range of mathematical, statistical, and computational approaches. The Black Arcs presented an interesting geometric problem of representing the street map of Sackville NB in a accurate but more readable format. The team presented two different solutions, one based on continuous optimization of the location of the nodes of the graph and another on discrete linear programming. Both hinged on the definition of appropriate fitness functions.

EhEye presented a problem of identifying violent behaviour in surveillance videos. Once again, two approaches were explored. One tracked objects in the video and looked for increases in the velocity of the objects. The second used an array of statistical measures of the video and trained a regression model to detect violence.

A different type of problem was presented by the Fundy Ocean Research Centre for Energy (FORCE). The FORCE problem was focussed on understanding the wake behind an island in Minas Passage, a site being considered for tidal energy development. Students used principal component analysis and image processing techniques to find the bounds of the wake and compare radar observations of the wake to numerical simulations.

QRA's problem drew on methods from what would typically be called pure mathematics, mathematical logic and theoretical computer science. QRA's problem involved improving systems testing their software which uses Satisfiability Modulo Theories (SMT) solvers. The workshop team used a proof-by-induction to establish that one aspect of the software was not performing as expected. "These bugs weren't found by random chance, but rather by the students attempting to prove things about our software, and probing the software when difficulties with the proof were encountered -- proof-directed bug finding!" As a result, QRA "will be making immediate changes to our software as a direct result of what the students found at the workshop" making "our software both more robust, and more capable."

Finally, Stepscan challenged the students to track individuals as they walked across their pressure sensitive floor panels. Students used a variety of metrics based on normal walking patterns and a probabilistic model to predict the most likely candidate for the subsequent step.

The response from those involved in the workshop was extremely positive. The industry reps commented on the importance of establishing "new connections made with instructors and interested students for future collaborations" and pursuing "an Engage grant to further explore the problem." Students commented that: "The IPSW was a great experience and helped me identify skills that I can contribute in an industrial setting" and "This was an excellent workshop! Definitely the most useful/interesting one I've attended in all of my academic career." Based on the post workshop survey results, students were significantly more interested in academic-industry collaborations and were more likely to consider a career outside of academia. Students also recognized the important contribution of our sponsors, NSERC, PIMS and AARMS, noting that "If the workshop was not funded, I would not have been able to attend." As well, MITACS provided a $1,500 voucher towards an Accelerate Fellowship that was awarded to the EhEye team.

Along with the workshop, AARMS held its first Math/Stats Networking Event called "Formulating Success" in collaboration with Springboard Atlantic and NSERC. At the event, 6 companies and 7 researchers gave presentations on their research and experience with industry-academic collaborations; ACENET described how its resources can support research; and Acadia's Office of Industry & Community Engagement outlined the many funding programs that support industry-academic research. Over 60 people attended and enjoyed wide-ranging discussions while networking after the presentations.

Overall, the first AARMS IPSW was a busy, productive and successful week. So successful, that planning has already begun for the next one to be held at the University of New Brunswick (Fredericton) in May 2019! The workshop will be a full five days, with more time for student training and solution formulation. Keep an eye on the AARMS webpage for more details.

- Richard Karsten

Best Paper

Dr. Connie Stewart, a Statistician UNB Saint John, was recently awarded the Journal of Applied Statistics Best Paper Prize 2017 for her paper: "An approach to measure distance between compositional diet estimates containing essential zeros". See: http://explore.tandfonline.com/page/est/journal-of-applied-statistics-best-paper-prize From the link: " Since its publication, the paper has been viewed as a good reference for analysing dietary data from episodically consumed foods in a few nutritional studies conducted at the National Institutes of Health. The paper's potential practical influence is predicted to be high and the paper demonstrated how a good application of statistical methodology can concretely contribute to the society at large."

ECCC 2018

The 13th East Coast Combinatorics Conference (ECCC) was held May 7-9, 2018 at Dalhousie University, Halifax. This annual conference series was designed to bring together regional mathematicians and computer scientists (primarily but not exclusively from the Atlantic region) interested in all aspects of combinatorics and graph theory. The scope of the conference covers most aspects of modern combinatorics, including but not limited to graph theory, extremal combinatorics, combinatorial optimization, probabilistic combinatorics, combinatorial number theory, design and coding theory, finite geometries, and applications.

The conference included plenary and public talks, given by Gary Gordon and Elizabeth McMahon of Lafayette College, Easton, Pennsylvania USA, respectively. Dr. Gordon's plenary talk was entitled Trees and Subtrees, involving both combinatorics and probability theory, and featured joint work with several undergraduate students. Dr. McMahon's engaging public lecture, The Joy of SET: Combinatorics and Geometry, spanned both recreational mathematics and pure mathematics. Both talks were extremely well attended (approximately 40 and 50 attendees, respectively). The conference also featured 16 contributed talks by faculty, graduate students, and post-docs. The conference this year offered, for the first time, two afternoon Problem Sessions where the conference participants broke into small groups to work on open problems. Open problems were solicited in advance and disseminated at the start of the conference. To round out the event, there was a conference dinner held on Monday May 7, 2018 and a Student Gala on the evening of Tuesday, May 8, 2018.

"All SySTEMs Go": an AARMS -Girl Guides STEM camp

On May 12-13, 2018, AARMS hosted a camp for over 500 Girl Guides from New Brunswick and Prince Edward Island at the University of New Brunswick's Fredericton campus. The goal of the camp was to expose girls aged 9-17 to the Mathematical Sciences research undertaken at Atlantic Canadian universities such as UNB, as well as to inspire them to consider pursuing careers in STEM (Science-Technology-Engineering-Mathematics).

In addition to the the 500 Guides, Rangers and Pathfinders, around 150 adult volunteers from the Girl Guides of Canada participated. The core of the camp was the 46 unique mini-workshop sessions organizes by 64 University faculty, postdocs and students that covered virtually all of the STEM sub-disciplines. Sessions included "Amateur Radio", "Calendar mathematics and the date of Easter", "Coding with Drones", "Landslides", "Sprucebud worms", and many more.

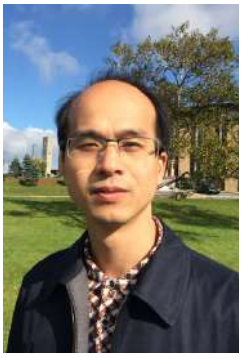
One of the highlights of the camp was the evening panel discussion, which featured a diverse group of women working in STEM. The panelists included academics of all career stages (undergraduates to professors) as well as women working as industrial scientists in aquaculture and education. The girls provided an endless supply of questions and were truly inspired and engaged by the answers from the experts.

Feedback from the event was very positive, with comments such as "this was the best Guiding event I've ever attended", "[we] can't wait to do this again", and "the instructors were very passionate about their field of study and were able to relate it to the girls that attended the sessions; they made learning fun!".

The camp was featured in the Daily Gleaner and Telegraph-Journal newspapers, in the Journal-Pioneer, and on Rogers TV. The sponsors and partners of the event included the Cyberlaunch Academy, Engineers and Geoscientists of New Brunswick, Let's Talk Science, NSERC, the Osco Construction Group, the Quartermain Earth Science Centre, UNB, and Worlds UNBound. Next spring, the camp will move to Dalhousie University.

Much more information about the event (including pictures and videos) can be found on aarms.math.ca/guides/ or on twitter (@AARMS_math). *- Sanjeev Seahra*

AARMS Postdoctoral Fellow: Shuaibing Luo



My name is Shuaibing Luo and I am an AARMS Postdoctoral Fellow at Memorial University of Newfoundland, working with Jie Xiao. My research interests are mainly in Complex Analysis and OperatorTheory.

In operator theory, people are interested in specific operators, forexample, multiplication operator, Toeplitz operator, composition operator etc. These operators can be represented by symbol functions and have rich connections to classical function theory, ordinary differential equations and other areas of mathematics. When studying these operators in the complex analysis setting, especially the holomorphic function spaces, we see there is a close interplay between operator-theoretic properties of these operators and function-theoretic properties of the inducing symbols.

Over the past year, we investigated the Toeplitz operator on the Dirichlet space and the multiplication operator on the Dirichlet-type spaces. The Toeplitz operator on the Dirichlet space is closely related to its symbol and displays many similar properties with the Toeplitz operator on the classical Hardy space. We obtained that for general symbols, the compactness of the product of Toeplitz operators forces the product of the symbols to be zero on the unit circle. For “smooth” symbols, the compactness of the product of Toeplitz operators is equivalent to the product of the symbols being zero on the unit circle. We also investigated the connectedness of the spectrum for the Toeplitz operator. We found that the spectrum is connected if the symbol is “smooth”. We think that this is true for the general symbol, and we are finding ways to attack it.

Dirichlet-type spaces were introduced by Stefan Richter when he was investigating cyclic analytic two-isometries in 1991. These spaces then were generalized by Alexandru Aleman to measures supported on the closed unit disk and studied extensively. In my PhD study (2009-2014) at the University of Tennessee, Knoxville, I was supervised by Stefan Richter and got to know these spaces. There are many unsolved problems in these spaces and I was intrigued by the corona problem. The famous corona theorem goes back to Lennart Carleson who demonstrated in 1962 that the unit disk is dense in the maximal ideal space of the multiplier algebra of the Hardy space. Later, people investigated the corona problem for many different spaces and got similar results. I studied the corona problem for the Dirichlet-type spaces in my doctoral thesis and obtained some partial result. During the one year postdoctoral position at Memorial University, we solved the corona problem for the Dirichlet-type spaces by showing that the unit disk is dense in the maximal ideal space of the multiplier algebra. This is an exciting result for us. In solving the corona problem, we used the Cauchy duality which also turns out to be a useful tool to study the multipliers of many other spaces.

At Memorial University, I also attended many memorable activities. I got together with the whole department at the Christmas party, presented some projects in the analysis seminar organized by Jie Xiao, and taught calculus courses. I would like to thank AARMS for giving me this wonderful opportunity to work at Memorial University.

News in Brief from Dalhousie

Jason Brown made the news recently, because of his work on attributing a Beatles song. Authorship of "In My Life", a song from the Rubber Soul Album has been claimed by both John Lennon and Paul McCartney. Together with Harvard statistician Mark Glickman, Jason has demonstrated that the math favours John Lennon's claim.

Chris Field was named a Fellow of the Institute of Mathematical Statistics for fundamental contributions to robust statistical methodology, saddlepoint approximation and bootstrap methods; for extensive and important efforts to bring robust statistical methods to scientific work in the life sciences, and for leadership in the field.

Dorette Pronk coached the first Canadian team to participate in the European Girls Math Olympiad, and they won Silver and Bronze. Canada's EGMO 2018 Team consisted of: Elnaz Hessami Pilehrood - Silver Medalist - Marc Garneau C. I., North York, ON; Anna Krokhine - Bronze Medalist - University of Toronto Schools, Toronto, ON; Jingzhi Liang - Bronze Medalist - Marc Garneau C. I., North York, ON; Karen Situ - Honourable Mention - University Hill Secondary School, Vancouver, BC; Sarah Sun - Deputy Leader - TD Bank, Toronto, ON; Dorette Pronk - Leader - Dalhousie University, Halifax, NS

Keith Taylor is this year's winner of the Graham Wright award of the CMS. Praised by his colleagues as being an ‘excellent role model for a well-rounded mathematician’, Dr. Taylor’s career, spanning more than four decades, has truly exemplified what this award represents, not just because of his excellent record of research and mentorship, but also through his academic work as Associate Dean, Dean and Associate Vice President at two Universities and through years of fundamental service to the CMS, including a term as President (2012-2014). Indeed, just to list his CMS committee work and appointments takes a full page on his vitae!

Emma Carline, grad student of Keith Taylor, won the AXIOMS award (2nd prize) at the Harmonic Analysis and Applications conference in June 4-8, Strobl, Austria, for her poster presentation on Projections in the l1 algebra of a crystal group: an example.

Canada's EGMO 2018 Team

QPL 2018

This summer, the 15th International Conference on Quantum Physics and Logic (QPL 2018) and the 34th Conference on the Mathematical Foundations of Programming Semantics (MFPS 2018) took place in Halifax. The conferences were co-located at Dalhousie University, with QPL running from June 3-7 and MFPS running from June 6-9. Jointly, the conferences brought together around 120 researchers from around the world.

QPL is an annual conference dedicated to the mathematical foundations of quantum physics, quantum computing, and related areas, with a focus on structural perspectives and the use of logical tools, ordered algebraic and category-theoretic structures, formal languages, semantical methods, and other computer science techniques applied to the study of physical behaviour in general. MFPS conferences are dedicated to the areas of mathematics, logic, and computer science that are related to models of computation in general, and to semantics of programming languages in particular. Both conferences belong to vibrant research communities.

The conferences had a joint session on quantum programming languages. Quantum programming is currently an active research area thanks to the recent experimental progress towards the development of quantum computers. The joint session between QPL and MFPS was an opportunity to foster interactions between two distinct research communities. The session featured five talks with speakers from both academia and industry.

QPL had four invited speakers and two invited tutorials for a total of 55 talks, as well as a poster reception. The QPL best student paper award went to Matthew Amy from the University of Waterloo for his submission titled "Towards large-scale functional verification of universal quantum circuits".

MFPS had four special sessions as well as contributed papers for a total of 32 talks. The special session topics were quantum programming languages, session types, differentiable programming, and gradual typing.

Both conferences received support from AARMS, Dalhousie University, the Pacific Institute for the Mathematical Sciences (PIMS), and the U.S. Office of Naval Research (ONR). Further support for QPL was provided by the Institute for Quantum Computing at the University of Waterloo (IQC), the Perimeter Institute for Theoretical Physics, and Xanadu.

1st Calculus Symposium

On May 29th and 30th, Acadia University hosted the first annual Calculus Instruction in Atlantic Canada symposium. This brought together 21 instructors from 8 universities in the Atlantic region to discuss the design and implementation of introductory calculus using evidence-based pedagogy. Our two plenary speakers, Dr. Costanza Piccolo (UBC) and Dr. David Bressoud (Macalester College, USA), provided information on best practices in calculus instruction from research at the Carl Wieman Science Education Initiative at UBC and the series of national studies of calculus instruction from the Mathematical Association of America. This informed the small-group discussion periods in the afternoon which looked at the similarities and differences in calculus instruction at Atlantic universities, evidence-based resources for improving our courses, and infrastructure to promote ongoing discussion of ideas, and resource sharing. AARMS was a major sponsor for this event, with additional funding provided by Acadia University, Science Atlantic, and Nelson Publishing.

Given the interest from participants and questions that came from our discussion groups, we are planning a second symposium, Bridging the Gap: High School and University Mathematics, at MSVU on May 24th and 25th of 2019. This will give participants the opportunity to hear from experts and engage in discussions on this topic.

- Caroline Cochran

Common ground: "South Asian Women in Mathematics"

The following article is about the AARMS-supported conference Symposium for South Asian Women in Mathematics. It was written by Sara Faridi (Dalhousie University) and is re-printed with permission from CMS Notes (Volume 50, No. 2, March-April 2018)

What unites us as mathematicians is our love of mathematics. It goes beyond our personal, national or cultural identities. Some of us are attracted to the grand open problems, some to the glorious past, some to the intriguing puzzles, and some to the art of sharing it with enthusiastic students. In a way, mathematics is a culture of its own within which we mathematicians live. Unlike so many others, we are paid to inhabit a world we love.

A typical mathematical event is multicultural, but one can easily be blind to that because the math culture takes over, and people are often focused on a narrow field. The excitement of sharing our interests shrouds our differences.

This can slightly change if you visit a math department in a different country and immerse yourself in that department's culture. Each department does things a bit differently. Perhaps they have different lunch routines. However, there are many similarities: there are seminars, colloquia, students, exams and defenses, poster boards announcing upcoming conferences and interesting problems to think about. No matter how exotic the new land, the math department is an island offering the comforts of home. Just like Starbucks, you can trust it to be the same the world over!

At a recent meeting of Women in Mathematics in Nepal, I had a completely different experience. I had already been to a conference at Thribhuvan University in Kathmandu the previous year, and had enjoyed the conference, the people, and the country immensely. During that meeting, the local female mathematicians approached the female conference participants for help in professional development. The prospects for female Nepalese mathematicians, they said, were limited at best.

It seemed natural to want to help, so some colleagues and I decided to organize a conference in Kathmandu inviting women mathematicians from Southeast Asian countries (who are culturally similar to the Nepalese) to share their own experiences of mathematical life: obstacles they have had to overcome, motivation of students and outreach, where to look for opportunities, roads to success, and so on.

We spent the next year planning, fundraising and writing to people. Most places we applied to were happy to support the event financially, and we managed to reach out to a large body of women: many from Nepal and neighbouring countries, and several more from Europe, the US, Japan, Korea and Canada.

The event was a success, we met our goal. We even made it to National TV!

We talked about mathematics and being mathematicians, and once again, after much effort to get everyone together, we were in the familiar setting of a mathematics conference.

But this time things were different: the dominant culture was not that of mathematics, but that of the region, dictated by geography and by cultural norms. The women from the region shared their stories of what it took them to do mathematics. While for me, mathematics was a choice of many fields I made in high school, for them it was a change of destiny and a breaking of all sorts of cultural barriers. Many successful female mathematicians from this area were wives, daughters-in-law, and mothers first, and mathematicians in their very limited spare time. Some picked their life-partners with a view of who would most be able and willing to support their mathematical career. Many women typically completed each degree after completing a family phase (children going to school, children getting married). There were women well into their forties who were contemplating their next academic degree.

The experience was humbling, and the obstacles faced by our colleagues seemed insurmountable.

As we planned the banquet dinner, we thought we should share some motivational stories with these women, about the journeys of female mathematicians in the previous century and their hardships, to smoothen their rocky road.

The Nepalese women disagreed. What we perceived as a rocky road was normal life for them, and the fact that we were there looking for ways to make things better warranted a celebration. It was a party after all, and there ought to be a talent contest! So we put all things in perspective, and spent the evening singing and dancing and celebrating our common love of mathematics in their way, and according to the cultures of the region.

Announcements

Congratulations to Michael Newton who, as of July 1, has been appointed as the Interim Chair of the Department of Biostatistics and Medical at Madison.

Sageev Oore gave an invited lecture on "Deep Learning and Music" at the Deep Learning & Reinforcement Learning Summer School last week, held at U of T's Rotman School, hosted by CIFAR and the Vector Institute.

The 18th ACM Symposium on Document Engineering (DocEng 2018) opens in Halifax on August 28; local organizer is Evangelos Milios.

AARMS will be accepting proposals for workshops and conferences through our online system. Deadline: September 15. The system is closed for updates but should be open on Sept 1.

It is never too late to join the circus.

Recent and Upcoming Events

20th International Conference on Descriptional Complexity of Formal Systems (DCFS)
July 25, 2018 - July 28, 2018

DCFS, the International Workshop on Descriptional Complexity of Formal Systems is an annual academic conference in the field of theoretical computer science. Beginning with the 2011 edition, the proceedings of the workshop appear in the series Lecture Notes in Computer Science. Already since the very beginning, extended versions of selected papers are published as special issues of the International Journal of Foundations of Computer Science, the Journal of Automata, Languages and Combinatorics, Theoretical Computer Science, and Information and Computation.

This year's DCFS was the 20th in the series. Topics of interest included: automata, grammars, succinctness of description of objects, circuit complexity, Kolmogorov complexity, frontiers between decidability and undecidability, nature-motivated (bio-inspired) architectures and unconventional models of computing.

Organizer: Stavros Konstantinidis (s.konstantinidis@smu.ca)

Diversity in Mathematics
August 7, 2018 - August 17, 2018

This event is part a multi-year, multi-level approach to promoting diversity and inclusivity in STEM. The annual two-week program includes a summer school for top undergraduate women from across Canada and the northwest United States, currently specializing in mathematics or a closely related STEM field, such as computer science, physics and statistics. The program shows them the many possibilities of math and science as a career, and encourages them to consider graduate studies, an arena where women are seriously under-represented. The program exposes them to the many facets of mathematical sciences as a career in an intense two week immersion. Career opportunities in academia and industry are given equal emphasis. We hope to encourage these gifted young women to continue on to graduate school, an arena where women are seriously under-represented.

Organizer: Malabika Pramanik (malabika@math.ubc.ca)

AAC minicourse by Professor Matej Bresar
September 9, 2018 - September 15, 2018

The Atlantic Algebra Centre presents a mini course "Functional Identities and Zero Product Determined Algebras" given by Prof. Matej Bresar. Functional identities are an important combinatorial tool applicable to problems in noncommutative and nonassociative algebra, linear algebra, and operator theory. They have been used in an essential way for the solution of the well-known Herstein's Lie map conjectures, which remained open for three decades. Matej Brešar was one of the authors of the solution. Dr Brešar is Professor of Mathematics at the University of Ljubljana and the University of Maribor. He has given plenary talks at a number of conferences and workshops, including some organized by Atlantic Algebra Centre. He has published over 150 research papers, is a co-author of the books "Functional Identities" (Birkhäuser, 2007) and "Introduction to Noncommutative Algebra" (Springer, 2014). Member of Slovenian Academy of Sciences and Arts.

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"Thus, in a sense, mathematics has been most advanced by those who distinguished themselves by intuition rather than by rigorous proofs.." -- *Felix Klein*