

Mathematics Enrichment Camp 2010

Date: Saturday, 14 August 2010

Time: 9.00am to 6.00pm

Venue: Lecture Theatre 25
Faculty of Science, National University of Singapore



Department of Mathematics

Programme

Time	Activity
9.00am	Registration
9.30am	Welcome Address By Professor Shen Zuwei Deputy Head, Department of Mathematics
9.40am	Brief Introduction to the Exciting World of Mathematics By Associate Professor Leung Ka Hin
10.00am	Mathematics, Computation and Science By Professor Tay Yong Chiang
11.00am	Tea Break
11.30am	Mathematics of Google™ PageRank™ By Dr Andy Yip
12.30pm	Lunch Break
1.30pm	Cantor's Paradise By Associate Professor Yang Yue
2.30pm	An Introduction to Optimization By Professor Toh Kim Chuan
3.30pm	Tea Break
4.00pm	Lecture on "The Mathematics of Sudoku" By Associate Professor Helmer Aslaksen
5.00pm	Sudoku Competition By Associate Professor Helmer Aslaksen
6.00pm	End of Programme

Abstracts

Mathematics, Computation and Science

By Professor Tay Yong Chiang

Computers play an increasing role in mathematical applications (logistics optimization, statistical analysis, etc.), and even help prove theorems (e.g. Four Colour Theorem). Conversely, mathematics is crucial to many computer applications: aircraft modelling, movie animation, web search, etc. However, this interplay between mathematics and computation is tangential to Computer Science. This talk will explain why the relationship between Mathematics and Computation goes deeper, touching on the fundamental nature of Science itself.

About the Speaker

Tay Yong Chiang received his BSc from the University of Singapore and PhD from Harvard University. He is professor in the Departments of Mathematics and Computer Science. He has spent sabbaticals at Princeton University, Massachusetts Institute of Technology, Cambridge University, Microsoft Corporation and Intel Research.

Mathematics of Google™ PageRank™

By Dr Andy Yip

How many times do you Google a day? You may realize that Google is such a successful web search engine. Besides its success in business strategies, the search engine itself outperforms many of its competitors. Have you ever wondered how it works? Okay, there are many unknowns to the public. However, according to Google's own admission in <http://www.google.com/corporate/tech.html>, "we developed our serving infrastructure and breakthrough PageRank™ technology that changed the way searches are conducted", the so-called PageRank algorithm has played an important role in the overall search engine. The algorithm is a computational procedure which gives each webpage a popularity score. Back in the late 90's, most web search engines could merely find webpages that are relevant to the keywords the user entered, many of which are uninteresting to most surfers. But Google went beyond it by employing the PageRank algorithm which ranks the webpages based on their popularity scores inferred from the hyperlink structure of the World Wide Web. On the surface, the algorithm involves nothing more than solving a system of linear equations (more precisely, finding an eigenvector of a given eigenvalue). But Google faces a practical challenge: the system of

linear equations is the world's largest consisting of an estimated 13 billions of unknowns (as of April 2010) and is ever changing. Therefore, computational speed, storage and robustness to changes are critical issues that need to be addressed to make the algorithm useful in reality. In this talk, I will highlight some of the mathematics used by Sergey Brin and Larry Page, founders of Google, to resolve these issues in their proposal of the PageRank algorithm written when they were graduate students in 1998. Two branches of mathematics, linear algebra and numerical analysis, are involved.

About the Speaker

Andy Yip received the Ph.D. in mathematics from the University of California, Los Angeles in 2005. He joined the Department of Mathematics at National University of Singapore in July 2005 as an Assistant Professor. His research interests include variational and PDE methods in image processing and related computational mathematics aspects.

Cantor's Paradise

By Associate Professor Yang Yue

Set theory was created by Georg Cantor in 1870's. Since then the study of "infinity" has been part of modern mathematics. The world of infinities has become, to quote David Hilbert, "the Paradise that Cantor has created". The talk follows the historical order of set theory. We begin with some of Cantor's famous results. Next we discuss the issue of paradoxes and the reactions of mathematicians. Finally we will mention Cantor's Continuum Hypothesis and its importance to foundations of mathematics.

About the Speaker

Yang Yue has been with the department of mathematics, NUS since 1992. He graduated from Peking University and received his PhD from Cornell University. He works in the field of mathematical logic.

An Introduction to Optimization

By Professor Toh Kim Chuan

Optimization is a major branch of applied mathematics focusing on modeling and finding the optimal solutions, or the best course of actions, for decision problems (typically from economics, management, science and engineering) that are constrained by limited resources. The goal is often to maximize objectives such as profit, production output, and bandwidth, or to minimize objectives such as cost, error, and risk. Optimization is used extensively in social and economic activities ranging from optimal time management and resource allocation to optimal design of manufacturing processes and instruments. In this

talk, we will see various essential applications of optimization in diverse areas such as machine learning, computational chemistry, finance, and engineering.

About the Speaker

Toh Kim Chuan received his B.Sc. in Mathematics from NUS and PhD in Applied Mathematics from Cornell University. His research interest is in the design, analysis and implementation of algorithms for large scale conic optimization problems; as well as their applications in science and engineering. He is recognized for his work on SDPT3, a software package for semidefinite programming. He has been invited to speak at various international meetings. He is an Associate Editor of SIAM J. Optimization, and an Area Editor of Mathematical Programming Computation. He won the NUS Outstanding Researcher Award in 2003.

The Mathematics of Sudoku

By Associate Professor Helmer Aslaksen

Sudoku is a logic puzzle where you are given a 9×9 grid made up of nine 3×3 blocks. The goal is to place the numbers 1 through 9 into the cells in such a way that each row, column and box contains each number exactly once. Some of the cells are given, and this is done in such a way that there is a unique way to fill in the remaining cells. The puzzles can be of varying levels of difficulty. They can be easy enough to appeal to anybody, while a mathematician will immediately be fascinated by the more fiendish puzzles and start thinking about algorithms. I will describe some of the techniques for solving this puzzle and we will solve some puzzles together.



About the Speaker

Helmer Aslaksen was born in Oslo, Norway, and did his undergraduate at the University of Oslo. After receiving his Ph.D. at the University of California, Berkeley, he joined the Department of Mathematics at the National University of Singapore in 1989.

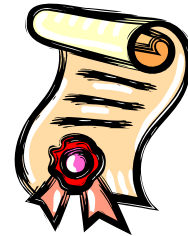
His interests include geometry, Lie groups, and the relationship between mathematics and astronomy and art. He has been academic advisor for the exhibition Art Figures: Mathematics in Art at the Singapore Art Museum and The Dating Game: Calendars and Time in Asia at the Asian Civilization Museum and for the TV series Ancient Chinese Inventions on the Discovery Channel. He was also on the Program Committee and a judge for National Science Challenge, a TV science quiz for secondary school students. In 2001 he won the fourth prize in the Boeing Writing Contest. He was on the organizing committee of a topic study group at the International Congress on Mathematical Education in 2004. He has been invited to be a plenary speaker for the Mathematical Association of America.

He has an extensive web site, including a highly ranked page on The Mathematics of the Chinese Calendar.

At the NUS he has introduced two General Education Modules, Heavenly Mathematics: Cultural Astronomy and Mathematics in Art and Architecture.

In 2004 he was awarded the University's Outstanding Educator Award.

Sudoku Competition!



Rules of competition

- The competition will last up to 45 minutes.
- The first 10 people who manage to finish the puzzle will receive prizes.
- If at the end of 45 minutes there are less than 10 people who have finished the puzzle, we will grade incomplete puzzles, giving one point for each correct entry.

Getting to the Camp

1. Take the MRT and alight at Buona Vista MRT Station.
2. Transfer to SBS Bus Service 95 at the bus-stop opposite the station (across the North Buona Vista Road, in front of the Ministry of Education building).
3. Alight at the bus-stop in front of the Lim Seng Tjoe Lecture Theatre 27 in NUS.
4. Follow the map and walk to Lecture Theatre 25.
5. For an interactive map of NUS, please visit <http://www.nus.edu.sg/campusmap/>



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Registration Instructions

1. The Registration Fee per person is **S\$30 (GST inclusive)** and this includes 2 tea breaks and lunch.
2. Payment is by **cheque only**. Please make cheque payable to **National University of Singapore**.
3. Cancellations are **not refundable** although participants can be substituted.
4. Please send the completed registration form together with the cheque **by Friday 23 July 2010 to:**

Ms Chan Lai Chee
Department of Mathematics
Blk S17 (SOC1) Level 7
National University of Singapore
10 Lower Kent Ridge Road
Singapore 119076

5. For further information, please contact Ms Lynette Wong (6516 8322, matwongl@nus.edu.sg), or Ms Chan Lai Chee (6516 2762, matclc@nus.edu.sg)

Mathematics Enrichment Camp 2010

Registration Form

Individual Registration

Name: _____

Institution: _____

Email: _____

Phone: _____

Bank & cheque number: _____

Block Registration - Please also complete BLOCK REGISTRATION LIST on page 9

Institution: _____

No. of students: _____

Name of teacher-in-charge: _____

Email: _____

Phone: _____

Bank & cheque number: _____

Mathematics Enrichment Camp 2010

Block Registration List

Complete and return this page together with the registration form (page 8) and payment.
Enter the particulars on a new page if necessary.

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