Mathematics Enrichment Camp 2008

Date: Tuesday, 9 December 2008

Time: 9.00am to 6.00pm

Venue: Lecture Theatre 23

            Faculty of Science, National University of Singapore

ORGANIZED BY

NUS
National University
of Singapore

DEPARTMENT OF MATHEMATICS

Registration OPEN!

Programme

Time	Activity
9.00am	**Registration**
9.30am	**Welcome Address** By Professor Zhu Chengbo Deputy Head, Department of Mathematics
9.40am	**Brief Introduction to the Exciting World of Mathematics** By Associate Professor Goh Say Song
10.00am	**Mathematics, Computation and Science** By Professor Y.C. Tay
11.00am	Tea Break
11.30am	**Famous Problems in Mathematics** By Professor Zhu Chengbo
12.30pm	Lunch Break
1.30pm	**Mathematics at the Frontier of Science and Technology** By Professor Shen Zuowei
2.30pm	**Applied Mathematics from the Perspective of 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 Y.C. Tay

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

Y.C. Tay 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. His main research interest is performance modeling. He has multiple teaching awards.

Famous Problems in Mathematics

By Professor Zhu Chengbo

This lecture introduces, and discusses some of the most famous and exciting problems in the history of mathematics, such as

- Continuum Hypothesis (Cantor 1878): is there a set which is "bigger" than the set of natural numbers but "smaller" than the set of real numbers?

- Fermat's Last Theorem (claimed in 1637): on the integer solutions of the equation $x^n + y^n = z^n$ $(n>2)$.

- Poincare conjecture (1904): on the type of bounded 3-d space possible that contains no holes.

- The Riemann Hypothesis (1869): on the distribution of prime numbers, as reflected in some "strange fact" about zeroes of the Riemann zeta function $\zeta(s)$.

$$\zeta(s) = 1 + \frac{1}{2^s} + \frac{1}{3^s} + \frac{1}{4^s} + \frac{1}{5^s} + \ldots = \sum_{n=1}^{\infty} \frac{1}{n^s}$$

RH: all non-obvious zeroes of $\zeta(s)$ lie on one straight line.
10 trillion zeroes of $\zeta(s)$ cannot be wrong!!!???

The speaker will also explain why these problems have inspired mathematicians throughout ages and update the audience on the status of their solutions (if any).

About the Speaker

Zhu Chengbo is a professor of mathematics at the National University of Singapore. He was educated as an undergraduate in Zhejiang University, China from 1980-1984 and received his PhD from Yale University in 1990. Professor Zhu's research interest is in representation theory of Lie groups, which is about continuous symmetries and their applications. He was a winner of Young Scientist Award (1998) by the Singapore National Academy of Science and Young Researcher Award (2001) by the National University of Singapore.

Mathematics at the Frontier of Science and Technology

By Professor Shen Zuowei

At the 2007 Oscars, two of the three movies nominated for the special effects Academy Award --- *Poseidon* and *Pirates of the Caribbean: Dead Man's Chest* --- both made by Industrial Light & Magic (ILM), used intensive numerical simulation. In 2008, a professor from Stanford University who worked with scientists from ILM won the technical academy award for the year from the Academy of Motion Picture of Arts and Sciences.

While most people are impressed by the simulations of explosions, water drops and human facial textures, few realize the depth and extent of mathematics, computer graphics and computational physics that went into the design of the algorithms that led to the results seen in movies and computer games.

Advances in computer technology have made it possible to apply some of the most sophisticated developments in mathematics and science for the design and implementation of fast algorithms running on a large number of processors for the simulation of complex physical phenomena and biological objects with a level of realism that was not thought possible until recently.

This talk will give a sketch of the exciting of the applications of mathematics in sciences and technology, the technical knowledge and training in mathematics, science and computer science that is needed to do state-of-the art research and development in many areas of science and modern technology.

About the Speaker

Shen Zuowei is Professor of Mathematics at the National University where he has been on the faculty since 1993. He is best known for his fundamental work on wavelet frames and Gabor frames. More recently, his research has focused on the emerging field of mathematical imaging which aims to restore images by using wavelet and Gabor frames. He has been invited to speak at over fifty international conferences and workshops. He is an editor of nine journals in his fields. He won the University Research Award in 1997, the National Science Award in 1998 and the University Outstanding Researcher Award in 2008.

Applied Mathematics from the Perspective of 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

Associate Professor 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.


Rules of competition

1.   The competition will last up to 45 minutes.

2.   The first 10 people who manage to finish the puzzle will receive prizes.

3.   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 23.

5. For an interactive map of NUS, please visit
http://www.nus.edu.sg/campusmap/
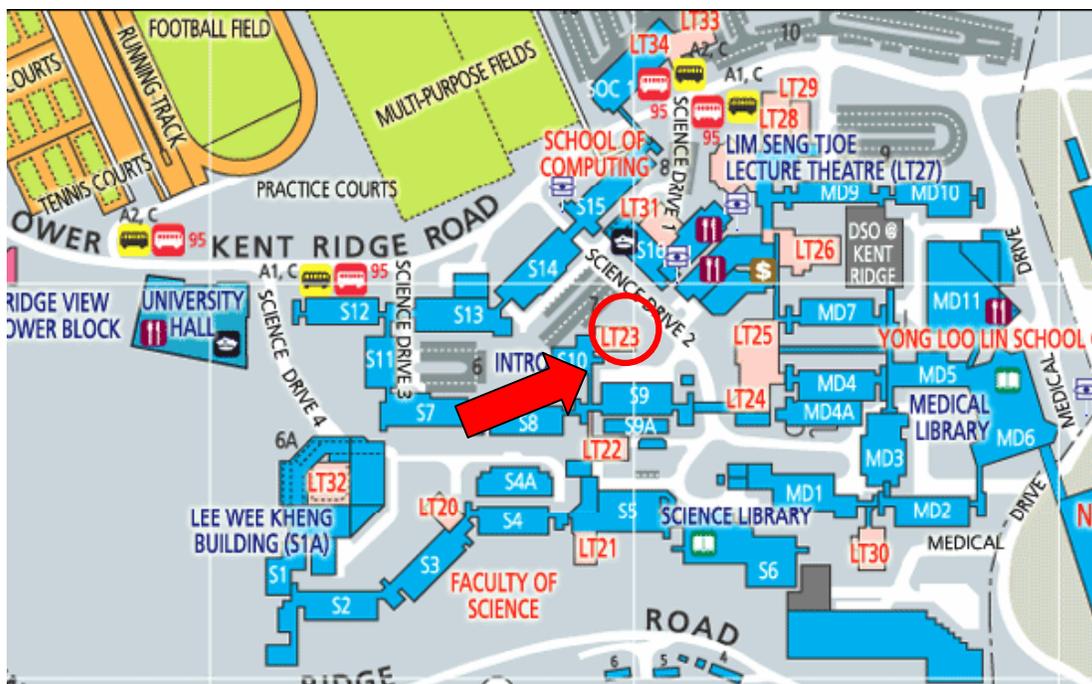
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REGISTRATION INSTRUCTIONS

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 your payment **by Saturday 1 November,** **to:**

> Ms Angeline Yee
> Department of Mathematics
> National University of Singapore
> 2 Science Drive 2
> Singapore 117543

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

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REGISTRATION FORM

Individual Registration

Name:

Institution:

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Bank & cheque number:

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

Institution:

No. of students:

Name of teacher-in-charge:

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Bank & cheque number:

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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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