Mathematics Enrichment Camp 2005

Date: Tuesday 13 December 2005

Time: 8.00am to 5.00pm

Venue: National University of Singapore
Faculty of Science
Lecture Theatre 25 (map attached)

This Camp is specially tailored for SM2 students, and students from junior colleges and NUS High School.

Organised by
Department of Mathematics
National University of Singapore

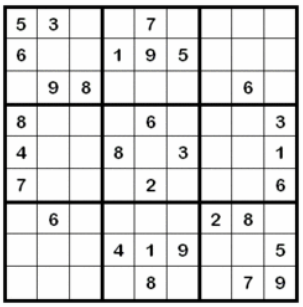
Programme

Time	Activity
8.00am	**Registration**
8.30am	**Welcome Address** *Professor Lee Seng Luan* *Head, Department of Mathematics*
8.40am	**Brief Introduction to the Department of Mathematics** *Associate Professor Goh Say Song*
9.00am	**Lecture on "The Mathematics of Sudoku"** *Associate Professor Helmer Aslaksen*
10.00am	Tea Break
10.30am	**Lecture on "The Shape of the Universe"** *Associate Professor Brett McInnes*
11.30am	**Lecture on "Famous Problems in Mathematics"** *Professor Zhu Chengbo*
12.30pm	Lunch Break
1.30pm	**Lecture on "Wavelets: Mathematics in Modern Technologies"** *Associate Professor Goh Say Song*
2.30pm	**Lecture on "Graph Colouring & Its Applications"** *Professor Koh Khee Meng*
3.30pm	Tea Break
4.00pm	**Sudoku Competition** *Associate Professor Helmer Aslaksen*
5.00pm	End of Programme

Abstracts

The Mathematics of Sudoku

Associate Professor Helmer Aslaksen



5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9

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 Civilisation 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.

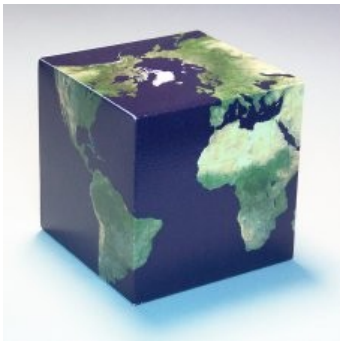
He has an extensive web site, including a highly ranked page on The Mathematics of the Chinese Calendar.

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.

The Shape of the Universe

Associate Professor Brett McInnes



One of the great questions in science is this: is the Universe finite or infinite? Astronomers have found no evidence either way, but they have recently discovered something that may be relevant: it seems that, on really huge scales, the three-dimensional space in which we live has the geometry of a flat space [rather than that of a sphere or something like that]. However, even a perfectly flat space can still be finite. In this talk I will explain how a flat space can be finite, and why there are theoretical reasons to believe that our Universe is finite, even if it is extremely large.

About the Speaker

Associate Professor Brett McInnes is interested in and does research on the uses of mathematics, especially geometry, in physics. He is the author of over 60 research papers on this subject; his work has appeared in top physics journals such as Nuclear Physics B. He has also won several teaching prizes at National University of Singapore. See his webpage http://www.math.nus.edu.sg/~matmcinn/

Famous Problems in Mathematics

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!!!???

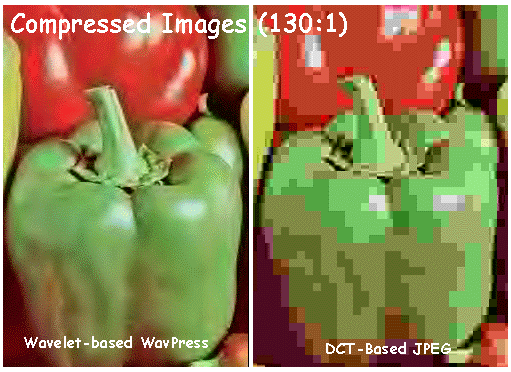
The speaker will also explain why these problems have inspired mathematicians throughout ages and update the audience on the status of their solutions (if any).

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.

Wavelets: Mathematics in Modern Technologies

Associate Professor Goh Say Song



In the digital age, mathematics plays a very important role in modern technologies. Wavelets are new mathematical functions that have numerous applications in science and engineering. Every day, large amount of data, which include digital images and videos, are generated, and they often need to be compressed to save computer storage space and to facilitate transmission through local networks and the Internet. Wavelets provide efficient representation of these data, which is the key to effective compression. In this talk, the concept of efficient data representation for compression and an idea of how the wavelet transform helps to achieve it will be presented. The construction of some elementary examples of wavelets will also be shown.

The talk will conclude with demonstrations of wavelet-based image and video compression technologies developed by the Centre for Wavelets, Approximation and Information Processing in the Department of Mathematics. These technologies perform better than existing software in the current market.

About the Speaker

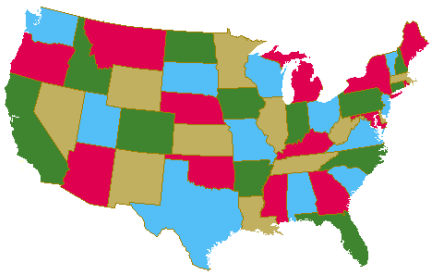
Associate Professor Goh Say Song received his B.A. (Hons) degree from the University of Oxford in 1988 and his M.Sc. and Ph.D. degrees from the University of Michigan, Ann Arbor, in 1990 and 1992 respectively. He has been teaching in the Department of Mathematics, National University of Singapore, since 1994. He was awarded by the University its Teaching Excellence Award in 1997, 1998, 1999, Excellent Teachers Award in 2002, 2003, 2004, and by the Faculty of Science its Outstanding Science Lecturer Award in 1997, Meritorious Teaching Award in 1998, 1999, 2000, Teaching Excellence Award in 2001, 2002, 2003, and placed on its Honour Roll in 2004.

A/P Goh's research interests are on the theory and applications of wavelets. He is currently the Assistant Head of the Department and also the Deputy Director of the Centre for Wavelets, Approximation and Information Processing. A/P Goh is highly supportive of activities in mathematics education, and he has given numerous enrichment talks to various secondary schools and junior colleges.

Graph Colouring & Its Applications

Professor Koh Khee Meng

Motivated by the Four Colour Map Problem, the concepts of a graph, its colouring and chromatic number are introduced. While the problem of evaluating the chromatic number of a graph is very difficult in general, an efficient algorithm for finding its upper bound is presented. Applications of colouring to the time-tabling problem and traffic phasing problem are finally mentioned.



About the Speaker

Koh Khee Meng is Professor in the Department of Mathematics at the National University of Singapore. He obtained his PhD from the University of Manitoba in Canada in 1971.

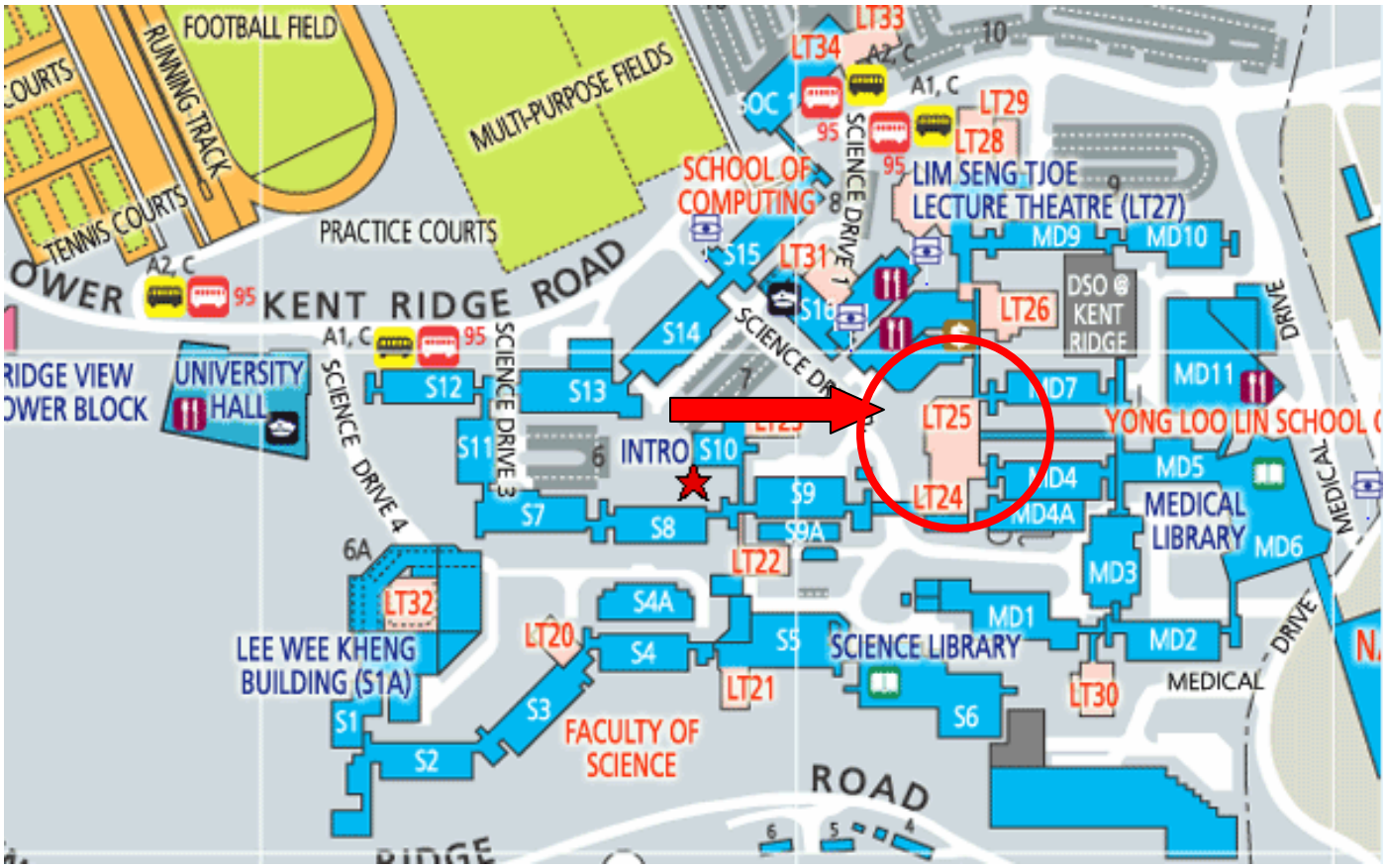
Among several other significant appointments, Prof Koh was the chairman of the Singapore International Mathematical Olympiad Committee (1991-93), a council member of the Institute of Combinatorics and Its Applications (International) (1995-97) and the president of the Singapore Mathematical Society (1996-98). He has also won numerous Teaching Awards from the Faculty of Science, NUS. Prof Koh specializes in Combinatorics and Graph Theory and has had many papers published in international scientific journals. He is co-author of the books: Principles and Techniques in Combinatorics , College Mathematics Volumes I & 2 , Counting , and Chromatic Polynomials and Chromatic Polynomials and Chromaticity of Graphs.

Sudoku Competition

The competition will last up to 45 minutes. If you manage to finish the first puzzle, you hand it in and you will be given a second puzzle. If 10 people manage to finish the second puzzle, we will end the competition and award prizes. If at the end of 45 minutes there are less than 10 people who have finished both puzzles, we will grade incomplete puzzles, giving one point for each correct entry.

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.

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



Mathematics Enrichment Camp 2005
Registration Form

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 <u>Wednesday 30 November 2005,</u> to:**
   Ms Lynette Wong
   Department of Mathematics
   National University of Singapore
   2 Science Drive 2
   Singapore 117543

5. For further information, please contact Lynette at 65168322 or email matwongl@nus.edu.sg

<u>Individual Registration</u>

Name: _____

Institution: _____

Email: _____

Phone: _____

Bank/Cheque number: _____

<u>Block Registration</u> - Please also complete Page 10.

Institution: _____

No. of students: _____

Name of teacher-in-charge: _____

Email: _____

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Mathematics Enrichment Camp 2005

For Block Registration, please complete and return this page together with the registration form and payment.
If the headcount exceeds 30, please enter the particulars on a new page.

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