

# Mathematics Enrichment Camp 2006

8.00am to 5.00pm

Thursday, 14 December 2006

Lecture Theatre 23

Faculty of Science, National University of Singapore



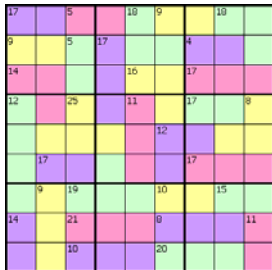
Department of Mathematics

# Programme

Time	Activity
8.00am	Registration
8.30am	Welcome Address Professor Chong Chi Tat, Head of Department
8.40am	Brief Introduction to the World 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 "Graph Colouring & Its Applications" Professor Koh Khee Meng
11.30am	Lecture on "Topology and Poincaré Conjecture" Associate Professor Wu Jie
12.30pm	Lunch Break
1.30pm	Lecture on "Modeling Games with Mathematical Programming" Assistant Professor Karthik Balakrishnan Natarajan
2.30pm	Lecture on "A Short Look at Quantitative Finance" Associate Professor Tan Hwee Huat
3.30pm	Tea Break
4.00pm	Sudoku Competition! Associate Professor Helmer Aslaksen
5.00pm	End of Day

**UPDATED!**

# Abstracts



## The Mathematics of Sudoku 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.

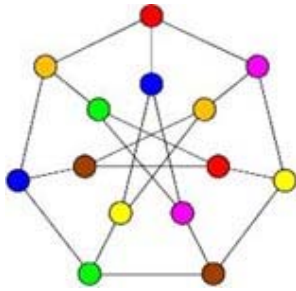
His interests include geometry, Lie groups, and the relationship between mathematics and astronomy and art. He has been academic advisor for the exhibition *Art Figures: Mathematics in Art* at the Singapore Art Museum and *The Dating Game: Calendars and Time in Asia* at the Asian Civilization Museum 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.

# Abstracts



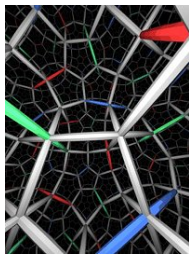
## Graph Colouring & Its Applications Professor Koh Khee Meng

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 1 & 2, Counting, and Chromatic Polynomials and Chromaticity of Graphs.



## Topology and Poincaré Conjecture Associate Professor Wu Jie

Topology is a branch of mathematics studying qualitative questions about the fine and global structures of geometrical objects. In topology, we do not ask: how big is it? But rather: does it have any holes in it? Is it all connected together, or can it be separated into parts?

Recently the famous Poincaré Conjecture in Topology has been successfully solved.

This lecture introduces what is topology, and discusses some famous and exciting problems such as Poincaré conjecture and homotopy groups.

### About the speaker

Associate Professor Wu Jie received his Ph.D. from University of Rochester in 1995. His research interests are on algebraic topology and group representations. His research on homotopy groups and homotopy theory of loop spaces has been highly recognized by topology community in the world; his work has appeared in top mathematics journals such as Journal of American Mathematical Society.

# Abstracts

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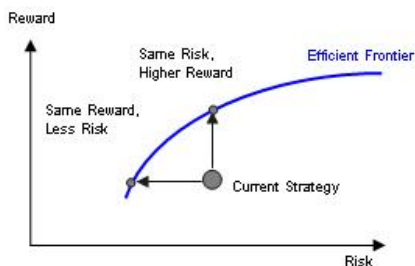
## Modeling Games with Mathematical Programming Assistant Professor Karthik Balkrishnan Natarajan



Modeling decision problems in a mathematical framework is one of the key skills that every Operations Research practitioner should possess. In mathematical programming, the problems are generally modeled as linear, nonlinear or integer programs. In this talk, we use games to highlight this key modeling aspect.

### About the speaker

Assistant Professor Karthik Natarajan's research interests are in the area of operations research, particularly in decision making under uncertainty. He received his Phd under the Singapore-MIT Alliance in 2004 and has been in the department of Mathematics since then. He was awarded the Excellent Young Teacher Award in 2005 and Faculty Teaching Excellence Award in 2006



## A Short Look at Quantitative Finance Associate Professor Tan Hwee Huat

The area of Mathematics where topics in Finance are given a quantitative treatment is called Quantitative Finance. In the first part of the talk I will introduce some financial instruments such as bonds, annuities and options, and reveal how Mathematics is used to obtain valuation formulae for the fair prices of these

financial instruments. In the second part, I will show examples of how basic financial instruments can be combined to yield more complex financial instruments, and how they can be priced.

### About the Speaker

Tan Hwee Huat obtained his PhD in Applied Mathematics from The University of Adelaide, Australia in 1988 and has been lecturing at National University of Singapore where he is now an Associate Professor. He has a special interest in teaching various mathematical modules involving the use of computers for problem solving. These modules include various undergraduate modules at various levels in numerical analysis and operations research, and quantitative finance. He is also involved in teaching in the Masters of Financial Engineering Programme at the Risk Management Institute. His current research interests include topics in financial mathematics and quantitative finance, especially in pricing high dimensional American-style derivatives.

# Sudoku Competition!



1. The competition will last up to 45 minutes.
2. If you manage to finish the first puzzle, you hand it in and you will be given a second puzzle.
3. If 10 people manage to finish the second puzzle, we will end the competition and award prizes.
4. 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.

# 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/>



## ***Mathematics Enrichment Camp 2006***

### 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 **Thursday 30 November 2006**, to:

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

5. For further information, please contact Angeline (65162738 or [matyeea@nus.edu.sg](mailto:matyeea@nus.edu.sg)) or Stella (65164403 or [matpcy@nus.edu.sg](mailto:matpcy@nus.edu.sg))

## ***Mathematics Enrichment Camp 2006***

### Registration Form

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#### **Individual Registration**

Name:

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Institution:

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Email:

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Phone:

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Bank & cheque number:

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#### **Block Registration** - Please also complete BLOCK REGISTRATION LIST on page 8

Institution:

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No. of students:

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Name of teacher-in-charge:

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Phone:

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## ***Mathematics Enrichment Camp 2006***

### Block Registration List

Complete and return this page together with the registration form (page 7) and payment.  
Enter the particulars on a new page if necessary.

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