# Alumni Math Sharing

Ananya Kumar, Cheng Herng Yi,
Li Xuanji, Lim Sung Hyun and Ryan Chan

19, 21 and 22 February 2013

**Abstract**

Math is fun, cool and interesting, and you can do it too! We hope these talks and sharings can give a glimpse of the fascinating beauty of math, as well as motivate and equip you for your own math explorations.

All talks will be held in **Seminar Room 2B** (Level 6), except for on Friday, 22 February, when **Seminar Room 2C** will also be used.

## 1 Tuesday, 19 February

### 2 pm – 3 pm: Origami Research

*Cheng Herng Yi*

Origami isn't just about folding little paper animals - insights from folding paper have been applied to satellite technology, surgical equipment and computer simulations. At heart is the mathematics behind the humble piece of paper, which gives rise to challenging unsolved problems and computer algorithms, including software that design complex origami *on-demand*. Worldwide, teams of researchers from many institutions including MIT and Oxford University are working on these exciting fronts of research. I will be presenting about the fascinating work that I've seen, with a focus on mathematical research.

**Prerequisites:** Basic familiarity with angles

### 3 pm – 4 pm: (Movie Screening) Between the Folds

*presented by Cheng Herng Yi*

Origami, the ancient art of paperfolding, is much more than making simple paper toys. Its explosive development over the past 50 years have led to technical masterpieces, expressive paper sculptures and even engineering applications. Origami is even revolutionising math education in Israel. Ten origami masters and their work are introduced, woven into a narrative of the connections between origami, art and science.

**Prerequisites:** None

### 4 pm – 6 pm: Beauty of Complex Analysis

*Lim Sung Hyun*

Differentiable functions on complex numbers behave quite differently from that of real numbers, and in fact give birth to a very beautiful, elegant geometric theory of complex analysis. For example, if a complex function is differentiable once, it is differentiable infinitely many times! Interesting properties and surprising connections to other fields of mathematics such as geometry, number theory and even fractals will be presented in a wide breadth.

**Prerequisites:** Familiarity with differentiation and integration

## 2 Thursday, 21 February

### 2 pm – 3 pm: Math Research in High School

*Ananya Kumar, Cheng Herng Yi & Lim Sung Hyun*

All of you will do a research project to graduate NUS High, but the nature of math research is unique among high school science research. Math research needs only the development of an idea, and requires barely any expensive equipment or facilities. We encourage you to do it by yourselves, and you can! We will discuss some skills, mindsets and tools that are useful for math research. Our high school math research experiences will also be shared - how our explorations led to fascinating discoveries and research that clinched awards at SMPF[1], SSEF[2] and ISEF[3].

**Prerequisites:** None

### 3 pm – 4 pm: Tools and Tips for Mathematics

*Ananya Kumar, Cheng Herng Yi & Lim Sung Hyun*

A joke goes that the only tools a Mathematician needs are a pencil, paper and a dustbin. However, some parts of research can borrow much assistance from computer tools. They could perform trial-and-error with great precision or help you find resources. Softwares like Mathematica can handle hardcore algebra in no time and quickly draw complicated function plots. Online communities of mathematicians can point you to resources and guide you when you get stuck. We will introduce a few such tools that we have used in our research, including the all-important LaTeX which was used to write this document!

**Prerequisites:** None

[1]Singapore Mathematics Project Festival
[2]Singapore Science and Engineering Fair
[3]Intel International Science and Engineering Fair

### 4 pm – 6 pm: Luck or Skill? – An Insight to Intellectual Games

*Ryan Chan*

Games have been an essential part of the entertainment industry for a very very long time. Sports, board games, card games, console games, party games, you name it. Most of us enjoy playing games because of the social aspect, but other common reasons include sweating it out, the unpredictability of chance, or indulgence in fantasy. However, intellectual games have been overlooked and neglected by many (including mass media), and the community for these games have been diminishing over the years. But the fact that some of these games originated decades or even centuries ago is proof that they continue to fascinate minds all over the world. What is the allure of these games? Luck, skill, or a combination of both?

**Prerequisites:** None

## 3 Friday, 22 February

There will be two *parallel* sessions.

### 2 pm – 3 pm: The Schläfli Symbol

*Cheng Herng Yi* at **Seminar Room 2B**

The *Schläfli Symbol* is a way to describe regular polyhedra (3D geometric shapes that are symmetric) using only a few whole numbers. For instance, a cube is represented by {4, 3}. A myriad of complicated and beautiful geometric shapes can be defined using this spartan notation. Some interesting properties of these numbers will be presented.

**Prerequisites:** None

### 2 pm – 4 pm: Lambda the Ultimate

*Li Xuanji* at **Seminar Room 2C**

The Lambda Calculus is an elegant notation for reasoning about functions. We will show how to use this seemingly impoverished system to construct almost all of mathematics and how this system naturally includes the concept of computation. The talk aims to let viewers appreciate the mathematical beauty of computer science instead of seeing it as a branch of engineering that uses computers.

**Prerequisites:** None