

ANU COLLEGE OF SCIENCE

DEPARTMENT OF MATHEMATICS

ONE-DAY PROFESSIONAL DEVELOPMENT COURSE

INTERNET SECURITY, NUMBER THEORY & RSA CRYPTOGRAPHY

For Mathematics and IT Teachers, ACT Secondary Colleges & High Schools

When: CHANGE OF DATE to Friday June 2, 9.30am – 4.00pm

Where: Arndt Lecture Theatre 1, Arndt Building, ANU campus end of Kingsley Street, off Barry Drive

Cost: Free. Morning tea, lunch and afternoon tea provided

Organised by the Department of Mathematics, ANU

RSA cryptography is the basis of all internet banking, and all Amazon and Ebay transactions. It has the amazing property that you (or your computer) can tell everyone in the world how to code a secret message to you. Anyone may publish their coded secret message to you for everyone else to see, but only you hold the keys to decipher the coded message. Not even the CIA, Mossad, or the KGB could crack your code in a thousand years.

The method, discovered in 1977 by 3 mathematicians, relies on the difficulty of factoring large numbers and on a little number theory.

In this course we will discuss the algorithm for RSA cryptography and the mathematics behind it. You can even implement it in our computer labs. Extensive notes will be provided.

ANU secondary college: RSA cryptography is a major topic in the first of the four half units in the new maths minor course for selected years 11 and 12 students. The text is *The Heart of Mathematics* by Burger and Starbird, supplemented by the notes *An Introduction to Contemporary Mathematics* (latest version at www.maths.anu.edu.au/~john/secondarycollege)

The teachers involved will discuss their experiences with the course. There will also be time for discussion of pedagogy.

We are planning 3 more courses: A Hierarchy of Infinities, 2006; Geometry & Topology, 2007; Chaos & Fractals, 2007.



Mona Lisa with Keys, Fernand Leger, 1930

MORE INFORMATION

Registration, Administrative Information, Parking Vouchers: Katie.Lau@maths.anu.edu.au
(Please register early; we would like an early estimate and may need to restrict numbers)

Course Information: John.Hutchinson@anu.edu.au

DEPARTMENT OF MATHEMATICS

ONE-DAY PROFESSIONAL DEVELOPMENT COURSE

INFINITY: HISTORY, PHILOSOPHY, MATHEMATICS

For Mathematics and Other Teachers, ACT Secondary Colleges and High Schools

When: Friday 3 November, 9.30am – 4.00pm

Where: Arndt Lecture Theatre 1, Arndt Building,
ANU campus end of Kingsley Street, off Barry Drive

Cost: \$25 (morning tea, lunch and afternoon tea provided).

Organised by the Department of Mathematics, ANU

INFINITY – the infinitely large and the infinitesimally small, the potentially infinite and the actually infinite – has been a source of philosophical speculation since the Ancient Greeks.

With mathematics one can make sense of this. There is a hierarchy of infinities, indeed an infinite hierarchy. Following Cantor in the late 19th century, Gödel and Cohen in the 20th century, we will enter the 'transfinite paradise'.

We will discuss the history of infinity, and the role of infinity in mathematical models. We will look at the game of dodge ball and use it to show that the infinity of the irrational numbers is larger than the infinity of the rational numbers.

We will discuss the foundations of the real number system, talk about infinitesimals as used by Leibniz and Newton in their development of calculus, show how Cauchy made these ideas rigorous. We will discuss how in the 1960s a new approach to calculus was invented by Abraham Robinson in which there are 'hyperreals', both infinitely small and infinitely large, and how dy/dx can be seen as a ratio of two infinitely small hyperreals.

Preliminary Reading: See 'Professional Development Workshops for Teachers' at www.maths.anu.edu.au/DoM/secondary/ closer to the date of the workshop.

ANU SECONDARY COLLEGE: Infinity is a major topic in the second of the four half units in the new maths minor course for selected Years 11 and 12 students. The texts are *The Heart of Mathematics* by Burger and Starbird and the notes *An Introduction to Contemporary Mathematics* (latest version via the above website).

The teachers involved will discuss their experiences with the course. There will also be time for discussion of pedagogy.

We are planning two more such courses in 2007: Geometry and Topology; Chaos and Fractals.

Reaching for Infinity



The Ancient of Days, William Blake, 1794

MORE INFORMATION

Registration, Administrative information, parking vouchers, E: Katie.Lau@maths.anu.edu.au
(Please register early; we would like an early estimate and may need to restrict numbers)

Course Information, E: John.Hutchinson@anu.edu.au

ONE DAY PROFESSIONAL DEVELOPMENT WORKSHOP

CHAOS AND FRACTALS

For Mathematics and Other Teachers, ACT Secondary Colleges & High Schools

When: Friday May 18, 9.30am--4.00pm

Where: ANU campus

Morning: Lecture Theatre Floor 1, Sir Roland Wilson Building, McCoy Circuit.

Afternoon: Dept of Mathematics, John Dedman Building, end of Kingsley Street, off Barry Drive.

Cost: \$25, Morning tea, lunch and afternoon tea provided

Organised by the Mathematical Sciences Institute, ANU.

Chaos and Fractals: these are now almost household words. Chaotic processes behave in an erratic and essentially non-predictable manner. Fractals exhibit self similarity across a range of scales. These ideas are applied extensively in biology, chemistry, physics, geology, computer science, engineering and financial analysis.



Sierpinski Garden (1997)
Khaldoun Khashanah

We will examine the underlying concepts, look at some applications and do some computer experiments. Topics to be discussed include chaos in biology, the game of life, the Sierpinski triangle, self similarity, iterated function systems, chaos game, image compression, Julia sets, Mandelbrot set, and non integer dimensions.

Preliminary Reading: See “Professional Development Workshops for Teachers” at www.maths.anu.edu.au/DoM/secondary/ , *An Introduction to Contemporary Mathematics*.

ANU secondary college: Chaos and Fractals is the third of the four half units in the new maths minor course for selected years 11 and 12 students. The texts are *The Heart of Mathematics* by Burger and Starbird and the notes *An Introduction to Contemporary Mathematics* (see the above website).

The teachers involved will discuss their experiences with the course. There will be time for discussion of pedagogy.

We are planning one another such course in 2007 on Geometry & Topology. In 2008 and 2009 we hope to offer two courses a year on current developments and applications for topics taught in college/high school mathematics.

MORE INFORMATION

Registration and Payment, Administrative Information, Parking Vouchers: Katie.Lau@maths.anu.edu.au
(Please register early, we may need to restrict numbers and we would appreciate an early estimate anyway)

Course Information: John.Hutchinson@anu.edu.au

ONE DAY PROFESSIONAL DEVELOPMENT WORKSHOP

GEOMETRY AND TOPOLOGY

For Mathematics and Other Teachers in Secondary Colleges & High Schools

When: Friday Nov 9, 9.30 am -- 4.00 pm

Where: ANU campus

Arndt Lecture Theatre 1, Arndt Building,
end of Kingsley Street, off Barry Drive

Cost: \$25, Morning tea, lunch and afternoon tea provided
Organised by the Mathematical Sciences Institute, ANU



Interior of the Fourth Dimension (1913) Max Weber

Geometry originated from the study of shape and size and involves notions such as distance and curvature.

Topology is the study of geometric objects where (somewhat loosely) two objects are considered equivalent if one can be continuously deformed into the other.

It is natural to study not just the geometry and topology of objects in three dimensional space, but also to study higher dimensional objects and higher dimensional spaces. These ideas are fundamental in contemporary models of our universe, and in areas as diverse as robotics and mechanics.

We will examine aspects of classical Euclidean geometry including the Platonic solids, consider curved geometries, see how to visualise the fourth dimension, classify and describe all surfaces up to topological equivalence (including those which most naturally sit in 4D space), briefly discuss what the journal *Science* described as the most significant scientific achievement of 2006 --- the solution of the Poincaré conjecture, and more.

Preliminary Reading: See "Professional Development Workshops for Teachers", *An Introduction to Contemporary Mathematics* (Chap 5) www.maths.anu.edu.au/DoM/secondary/.

ANU secondary college: Geometry and Topology is the fourth and final half unit in the new maths minor course for selected years 11 and 12 students. The texts are *The Heart of Mathematics* by Burger and Starbird and the notes *An Introduction to Contemporary Mathematics* (see the above website). The teachers involved will discuss their experiences with the course.

In 2008 and 2009 we intend to offer two PD workshops each year on current developments and applications for topics taught in college/high school mathematics.

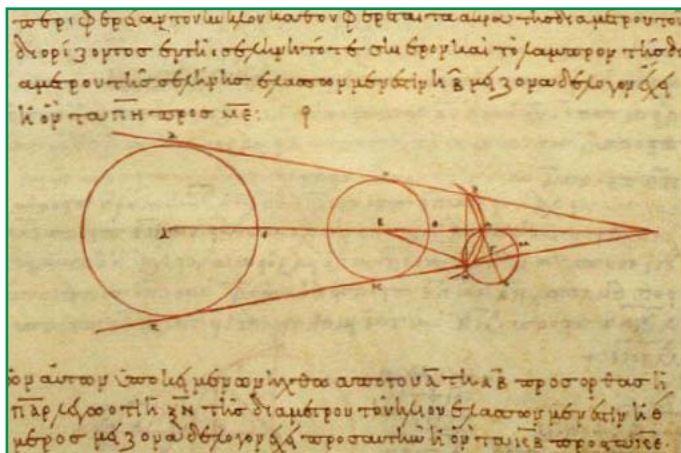
MORE INFORMATION

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Katie.Lau@maths.anu.edu.au

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Course Information: John.Hutchinson@anu.edu.au

ONE DAY PROFESSIONAL DEVELOPMENT WORKSHOP



MATHEMATICS AND THE UNIVERSE

For Mathematics and Other Teachers in Secondary Colleges & High Schools

One of a series of independent workshops on current developments and applications for topics taught in college/high school mathematics.

For information on previous and future workshops see www.maths.anu.edu.au/DoM/secondary/

We will see how mathematics has been used to model and study the universe, from antiquity to current day research. From trigonometry used by Antistarchus in 400BC to compute the distance to the moon and the sun, to 11 dimensional geometries now used to model the universe.

The material should be suitable to all mathematics teachers who want to increase their understanding of this important use of mathematics.

Background: Trigonometry should be enough!

Aristarchus (310–230 BC) on the distances to the Moon and Sun.

WHEN Wednesday June 25, 9.30 am – 4.00 pm

WHERE ANU campus. Arndt Lecture Theatre 1, Arndt Building, end of Kingsley Street, off Barry Drive

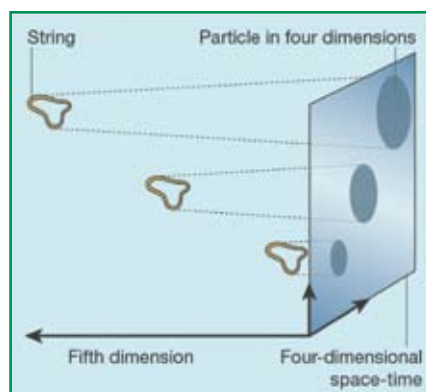
COST \$25, Morning tea, lunch and afternoon tea provided. Organised by the Mathematical Sciences Institute, ANU.

Right:

From "Into the fifth dimension"
Nature 2003, Juan Maldacena

Far Right

"Trance 2" 1997
Slawek Wojtowicz



MORE INFORMATION

Registration and Payment, Administrative Information, Parking Vouchers

E: Katie.Lau@maths.anu.edu.au

(Please register early, we may need to restrict numbers and we would appreciate an early estimate anyway)

Course Information

E: John.Hutchinson@anu.edu.au

ONE DAY PROFESSIONAL DEVELOPMENT WORKSHOP

MATHEMATICS AND THE ENVIRONMENT

For Mathematics and Other Teachers in Secondary Colleges & High Schools

When: Friday November 7, 9.30 am -- 4.00 pm

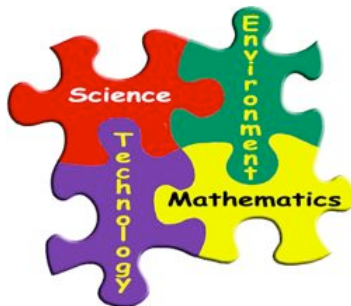
Where: ANU campus

Arndt Lecture Theatre 1, Arndt Building,
end of Kingsley Street, off Barry Drive

Cost: \$25, Morning tea, lunch and afternoon tea provided
Organised by the Mathematical Sciences Institute, ANU.



World Heritage Stromatolite, Hamelin Pool, W.A. --- about 30 cm tall



One of a series of independent workshops on current developments and applications for topics taught in college/high school mathematics. The goal is to give a top level view of some contemporary mathematics and applications.

For more information see
www.maths.anu.edu.au/DoM/secondary/

DETAILS

Registration and Payment, Administrative Information, Parking Vouchers:

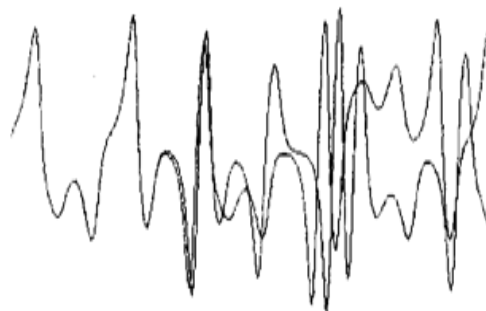
Katie.Lau@maths.anu.edu.au

(Please register early, we may need to restrict numbers and we would appreciate an early estimate anyway)

Course: John.Hutchinson@anu.edu.au

We will see how mathematics has been used to model the environment and how environmental problems have led to the development of new mathematics.

In the workshop we will discuss matters such as the connections between meteorology, biology and chaos; how stromatolites, the earliest evidence of life, are studied using differential equations and fractals; and some of the topics from a third year ANU course on environmental mathematics.



Lorenz's experiment: the difference between the start of these curves is .000127; between ends is about 1.0