Welcome to the Department of Mathematics

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UNIVERSITY OF SURREY

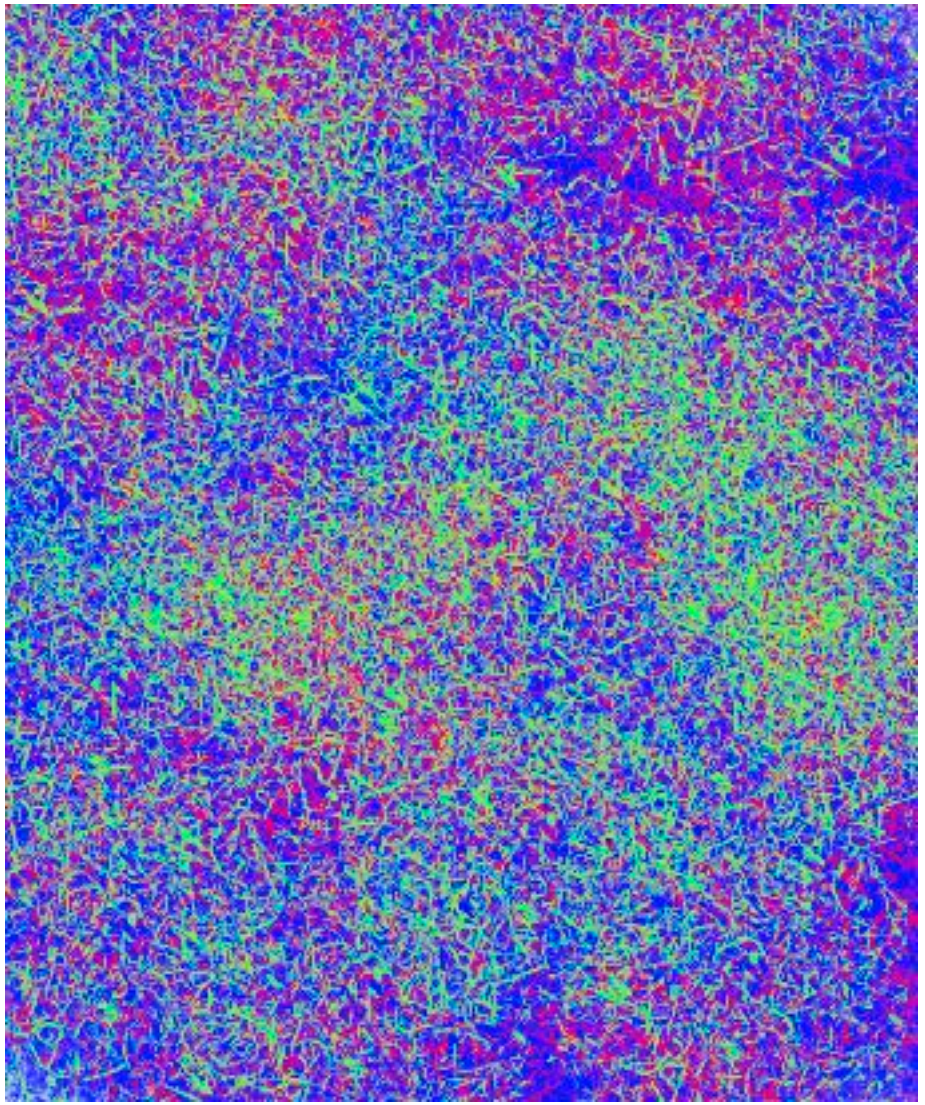
A Mathematical Interlude

Theorem

Consider the plane $\mathbb{R}^2$. Suppose that every point in $\mathbb{R}^2$ is assigned one of three colours (e.g. Red, Green or Blue).

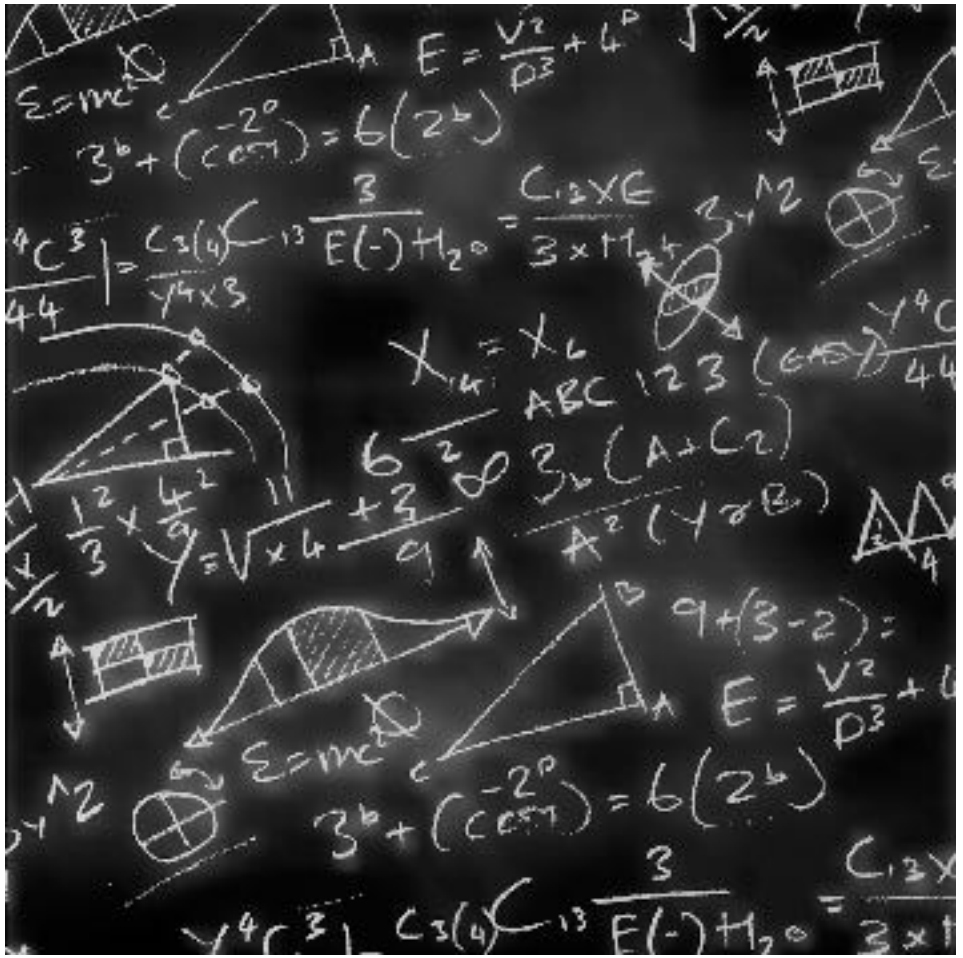
Then there exist at least two points on the plane, at distance 1 apart, which have the same colour.

[Note: the colour assignment is completely arbitrary]



Details from this presentation are available online:

https://www.surrey.ac.uk/department-mathematics/study/undergraduate



Think Ahead: Your Goals and Ambitions

- A good degree (especially in mathematics!) opens doors.
- Is a good degree sufficient to secure the career of your choice?
- At Surrey we offer not only the support required to help students achieve a good degree, we also offer many opportunities to enhance your CV.
- The combination of an excellent choice of modules, together with professional training, internships, project work, and language courses – all of which are optional – help to place our graduates at the front of the job market.

Opportunities at Surrey

Motivation + Support = Success

How do we study mathematics

- Lectures
  - *Large groups (120+)*
  - *Note-taking*
  - *50 minutes long*
  - *About 12 hours per week*

- Tutorials/seminars
  - *Smaller groups (about 15)*
  - *More discussion based*
  - *2-3 hours per week*

- Private study
  - *At least 20 hours per week*
  - *Biggest difference moving to university.*

Mathematics Degree Programmes

MMath Degree Programmes (4 or 5* Years)

- MMath Mathematics (4 or 5* years; G104/103/G100*)
- MMath Mathematics with Statistics (4 or 5* years; G104/103/G100*)

BSc Degree Programmes (3 or 4* Years)

- BSc Mathematics (G101/G102*)
- BSc Mathematics with Statistics (G1G3/G1GH*)
- BSc Financial Mathematics (N300/N301*)
- BSc Mathematics with Music (G1W3/G1WH*)

* Includes Professional Training Year

Combined Degree Programmes

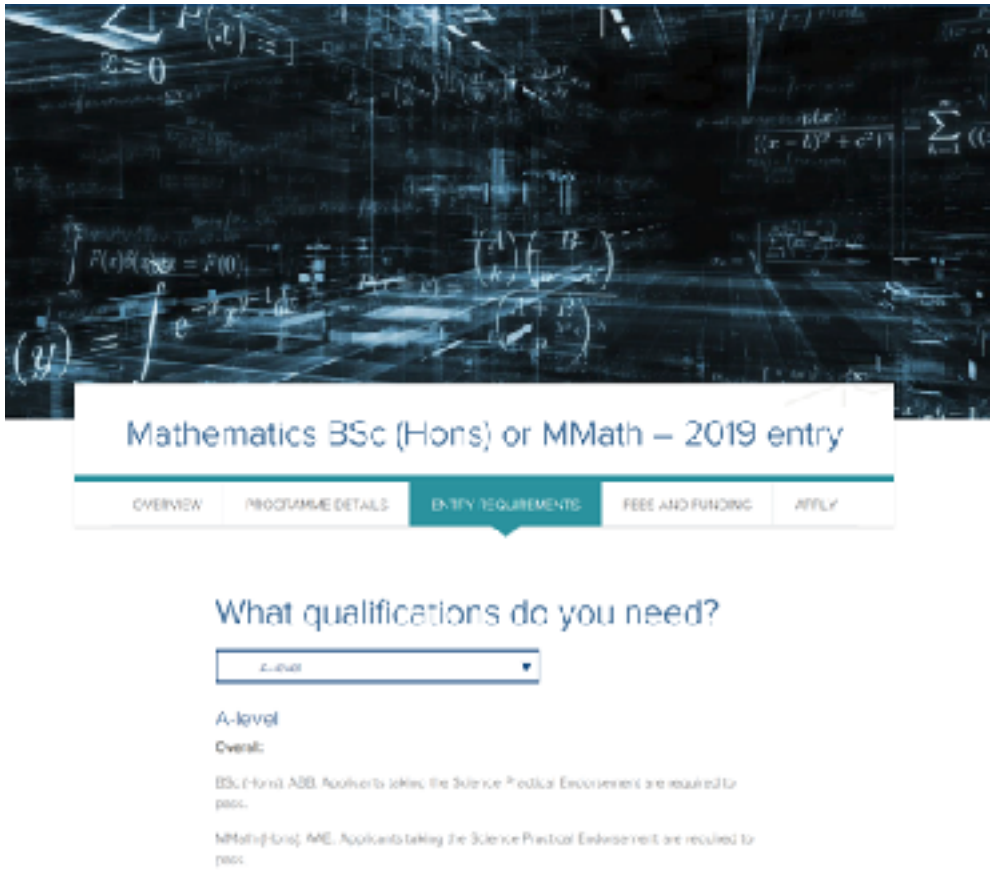
» BSc, MMath & MPhys in: Mathematics and Physics

- *50% Mathematics, 50% Physics*
- *All three also available with professional training*

» BSc in: Economics and Mathematics

- *50% Mathematics, 50% Economics*
- *also available with professional training*

Entry requirements



» Example grade offers:

Mathematics BSc : AAB-ABB (Mathematics Grade A)

MMath Mathematics : AAA-AAB (Mathematics Grade A)

» **Headline**: We are looking for the best mathematicians who will profit from our degree.

» **Please consult the University website** for full entry requirements for all Maths programmes

https://www.surrey.ac.uk/subjects/mathematics

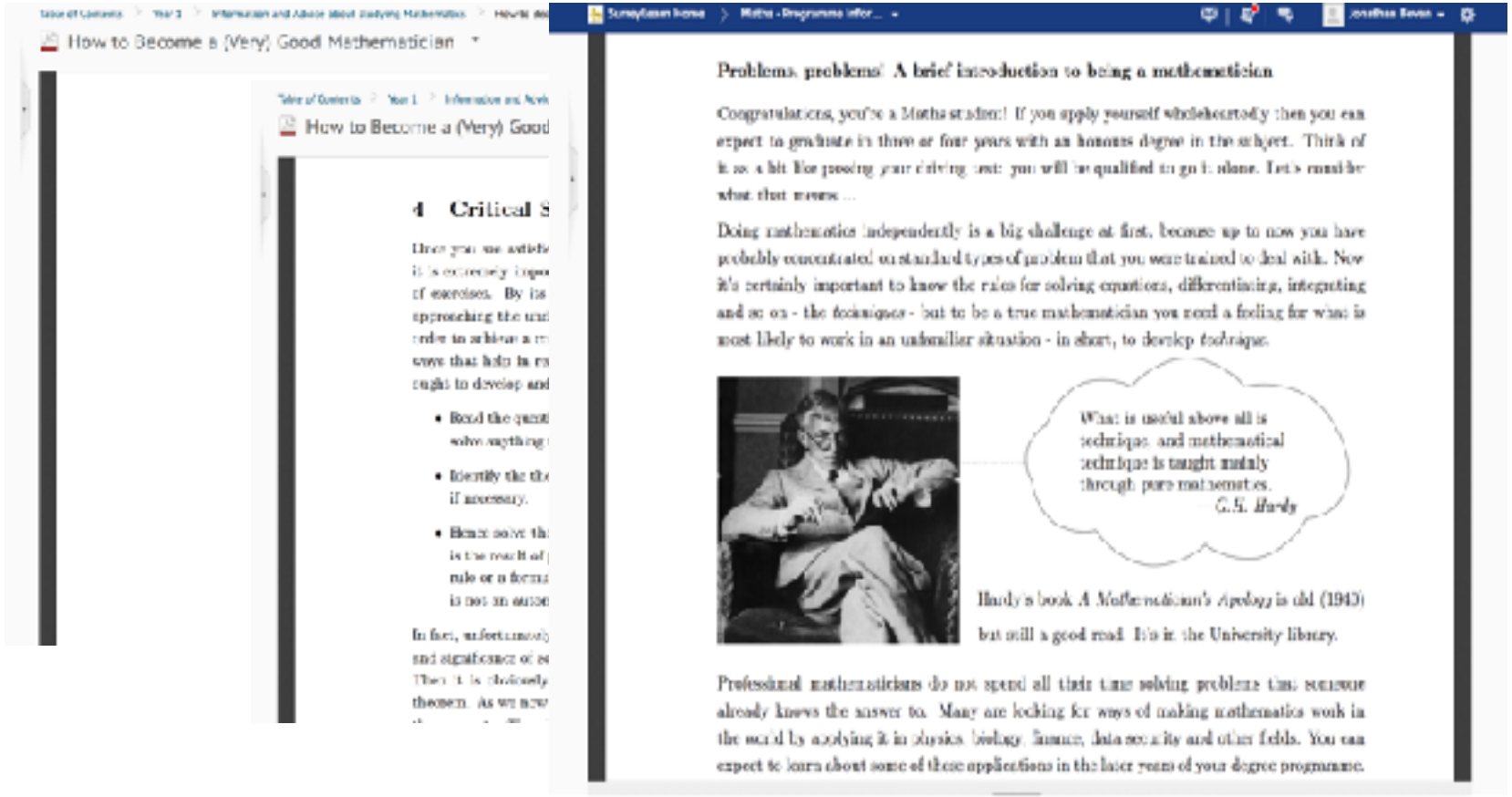
The Foundation Year

» For students without an A in Mathematics A-level

- Entry grades CCD (with a minimum of C in A-level Mathematics).
- Students take 8 modules — 4 in Mathematics, 1 Computing, 2 Economics, and 1 Physics module.
- Integrated academic skills help equip students to study effectively and successfully in university.
- During the Foundation Year, students are fully integrated with the university community and environment.
- Accommodation is guaranteed for all students in the Foundation Year.

Stepping up to University Mathematics

» Supporting the transition from School/College to University is important, so the department has created some resources to help. These include:



Year 1

- Provides a **broad base** covering:
  - **Algebra** (Prime numbers, Complex numbers, Introduction to Groups).
  - **Linear Algebra** (Solution of Linear Equations, Vectors and Vector Spaces, Matrices).
  - **Calculus** (Functions, Curve sketching, techniques of differentiation and integration, First Order Ordinary Differential Equations).
  - **Real Analysis** (Axioms of real numbers, Sets and sequences, Quantifiers, Convergence, Boundedness).
  - **Mechanics** (Newton's Laws, Energy, Conservation laws).
  - **Probability & Statistics** (Bayes' Theorem, Standard discrete distributions, Expectation and moments, Probability generating functions, Central limit theorem, Hypothesis testing).
  - **Developing transferable skills** (Computing/Programming, Research skills, Communication skills)
  - **Degree course specific modules**
    - *Introductory Economics*
    - *Oscillations and Waves*
    - *Instruments and Orchestration*

Year 1: Overview

» Unassessed coursework

- Designed to help you gain a deeper understanding of the lecture notes.
- Feedback given.
- Helps you prepare for…..

» Assessments

- Class tests (typically 25% of overall mark).
- Exams at the end of each semester (typically 75% of overall mark).

…..and this pattern of assessment continues in subsequent years.

Examples of coursework and seminar exercises include...

3. Find the following integrals:

(a) $\int x^2 \ln x \, dx, \quad x > 0;$

(b) $\int \frac{x^3+1}{x^2+1} \, dx;$

(c) $\int_0^{\frac{\pi}{2}} \frac{1}{\sin x + 1} \, dx;$

(d) $\int_{\frac{\pi}{6}}^{\frac{\pi}{2}} \sin x \cos x \ln(\sin x) \, dx.$

SEMINAR SHEET 2: REAL ANALYSIS I (MAT1032), 2017.

Question 1:

a) Prove by contradiction that any non-empty subset $A \subset \mathbb{N}$ has a minimal element

b) Prove that for any $A \subset \mathbb{N}$ and any $n \in \mathbb{N}$, the set $A \cap [1, n]$ is finite.

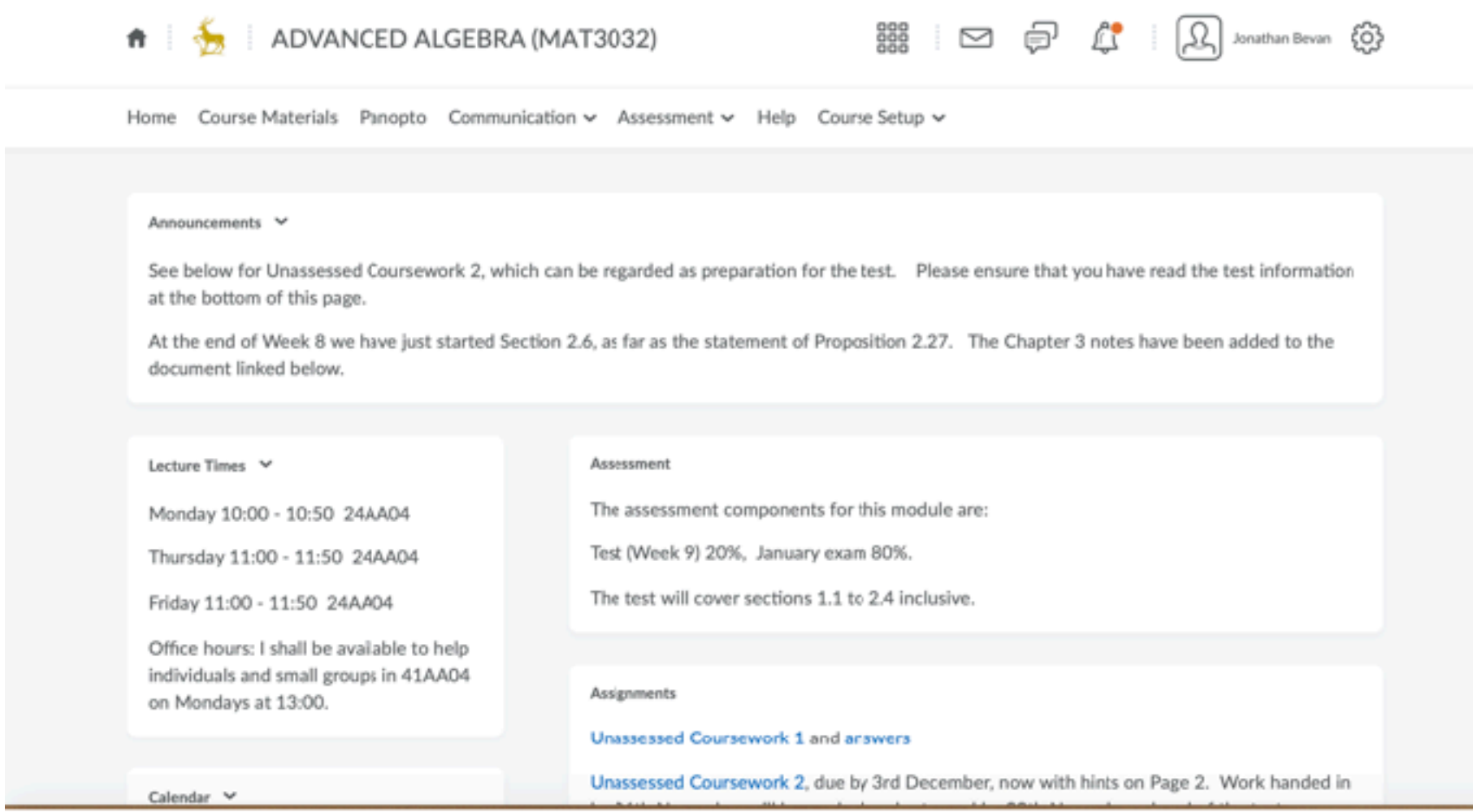
c)* Using a) and b) verify that any infinite subset of a countable set is countable.

Seminar Problems 2

1. (a) Use the Euclidean algorithm to find the greatest common divisor of 27 and 22. Hence find integers m and n such that $gcd(27, 22) = 27m + 22n$. Use this result to find an integer $x \in \{0, 1, \ldots, 26\}$ such that $22x \equiv 1 \pmod{27}$.

   (b) The diagram shows a 13-hour clock. If the hour hand is initially pointing to 13 as shown, where will it be pointing 10^{14} hours later? (Assume the clock never stops.)

SurreyLearn – the University's VLE: a screenshot



Year 2: Overview

» Wide range of **compulsory** and optional modules building on foundation of Year 1 material

- **Ordinary Differential Equations**
- **Groups and Rings**
- Curves and Surfaces
- **Real Analysis** (M/MM, not FM)
- Numerical & Computational Methods (Not FM)

- General Linear Models
- Mathematical Statistics
- Stochastic Processes
- Inviscid Fluid Dynamics
- **Linear Partial Differential Equations**

together with course specific modules:
(Microeconomics, Musical Performance and so on.)

Years 3 and M

» Wide range of modules specific to degree course, e.g.:

- Advanced Algebra
- Data Science
- Game Theory
- Quantum Mechanics
- Graphs and Networks
- Ecology & Epidemiology
- Special Relativity & Electrodynamics
- Statistical Methods with Financial Applications
- Mathematics Education
- Experimental Design
- Lagrangian Fluid Dynamics
- Theory of Derivatives Pricing

Final year projects and Literature Reviews

- Optimising financial portfolios
- Simulation in the social sciences
- Analysis of bio-medical statistics
- Pharmaceutical drug modelling

Department of Mathematics

- ~ 30 Academic and Research Staff
- ~ 20 Postgraduate Students
- ~ 350 Undergraduate Students




- Undergraduate Teaching
- PhD Training
- Research:
  - *Mathematics of Life and Social Sciences*
  - *Dynamical systems and PDEs*
  - *Fields, Strings and Geometry*
  - *Fluid Mechanics and Meteorology*

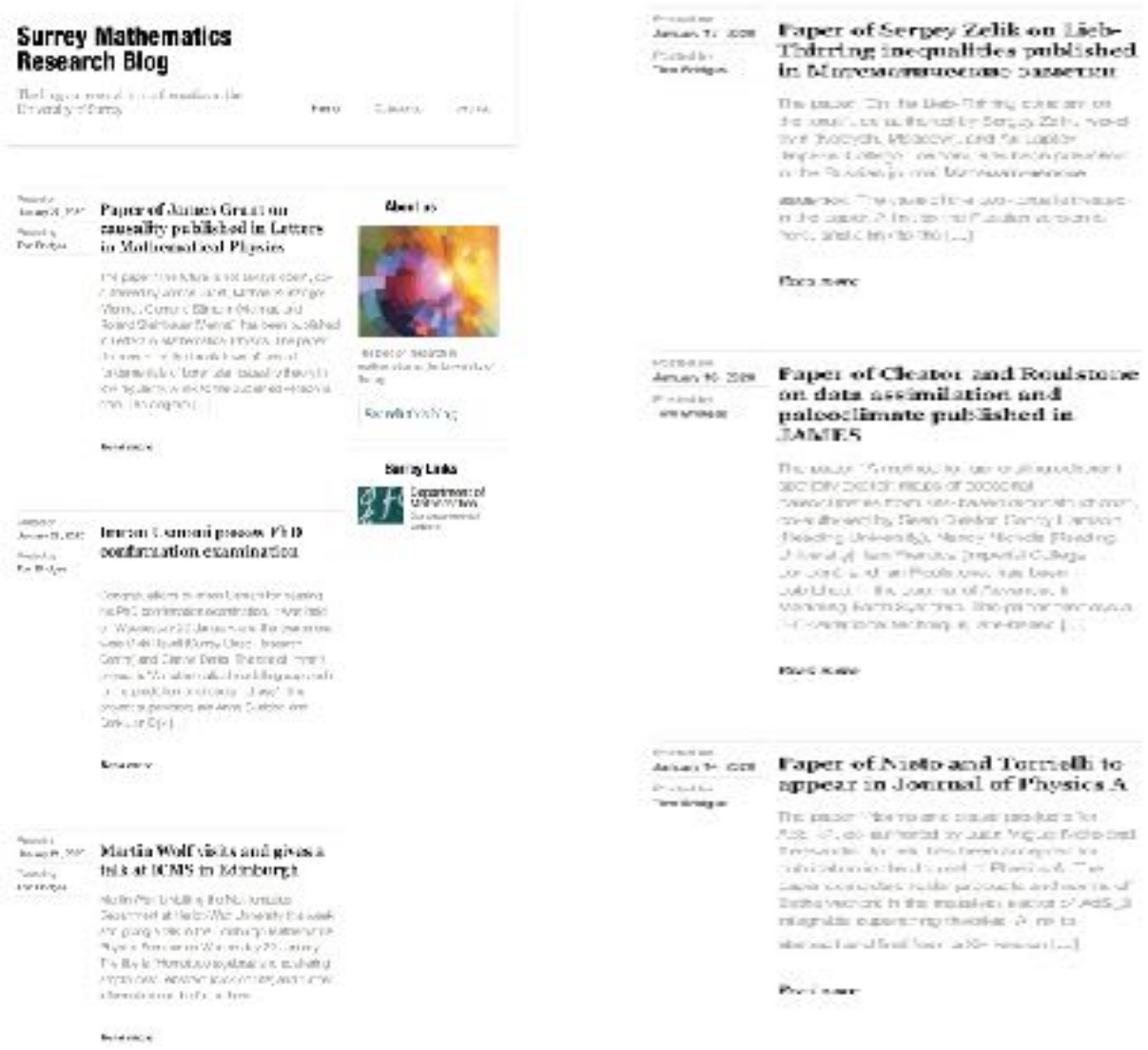






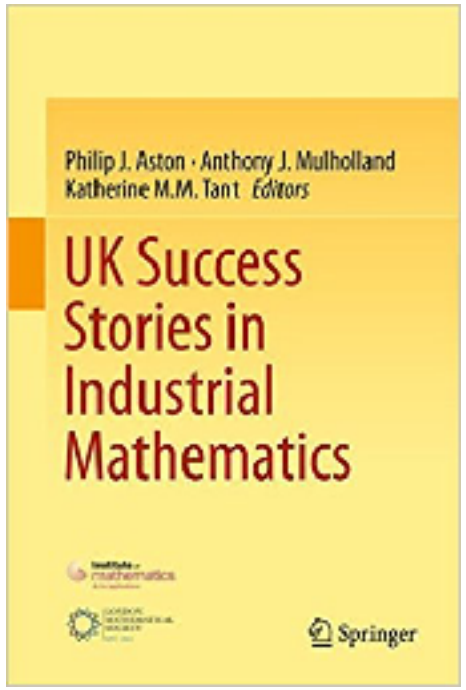


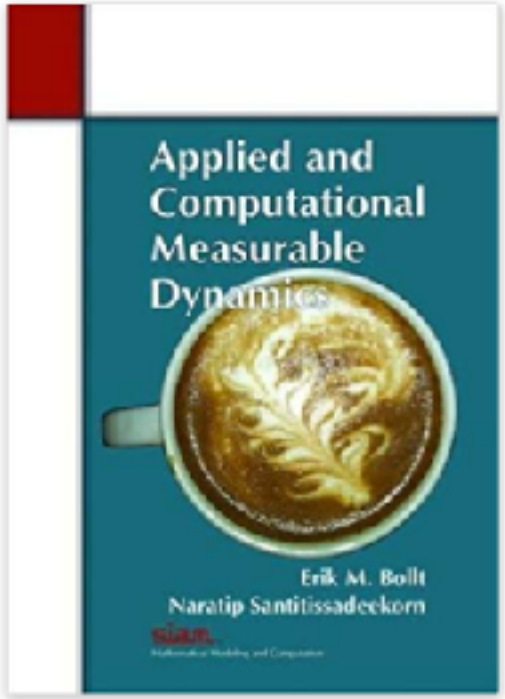

Research

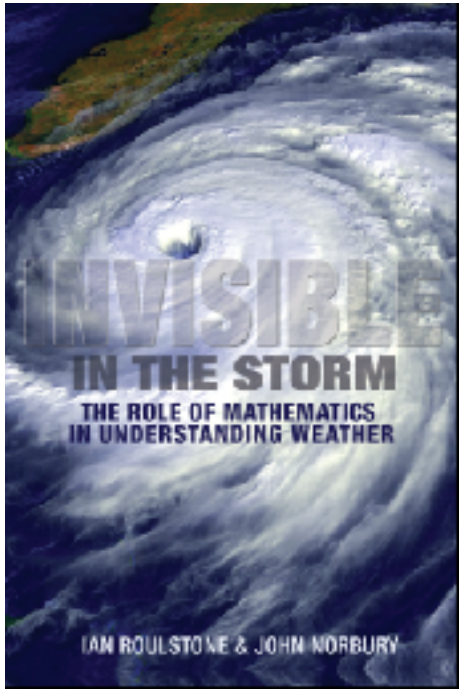


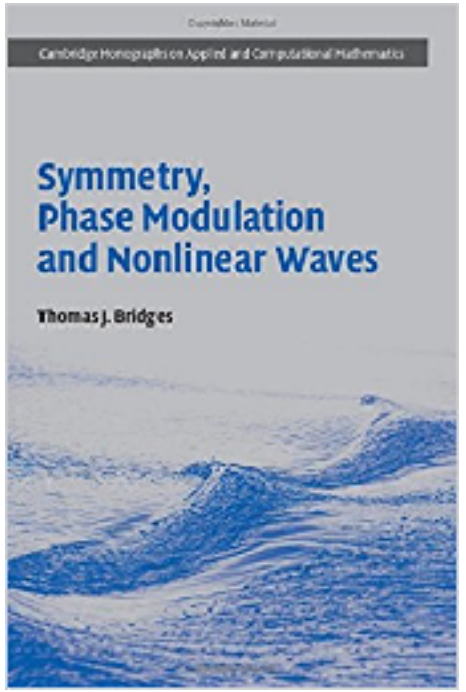
- *We are an active research community and our research informs our teaching!*
- *See our blog blogs.surrey.ac.uk/mathsresearch/*

Books & Scientific Journals





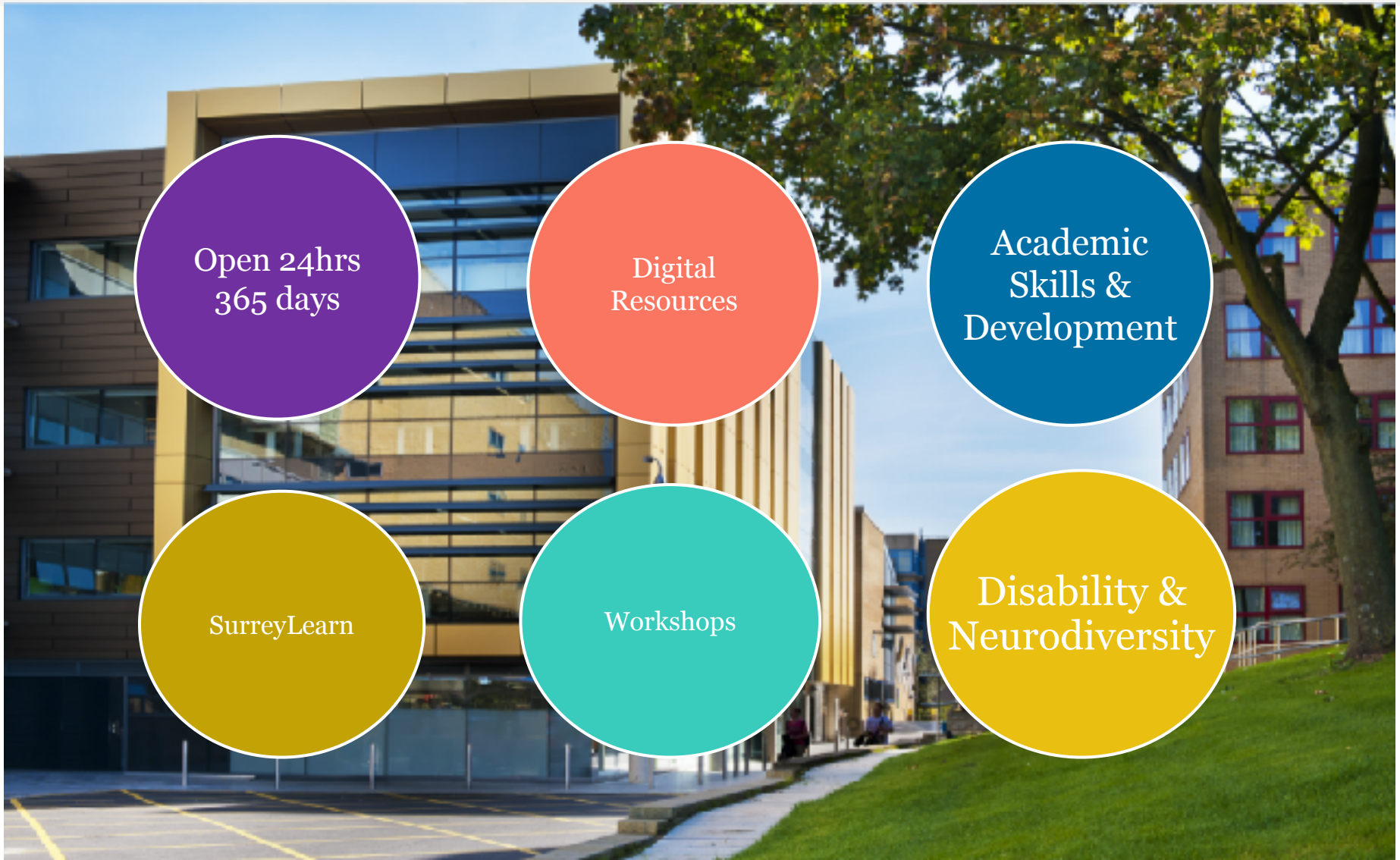




Department of Mathematics

British Applied Maths Colloquium hosted here in 2017

Award winning facilities



Accommodation at Surrey

- More details can be found at https://www.surrey.ac.uk/accommodation
- Descriptions of the different types of rooms can be found at

  https://www.surrey.ac.uk/accommodation/our-accommodation

Optional Opportunities

- Global Graduate Award in Languages
- Global Graduate Award in Sustainability
- Study Abroad
- Summer Research Experience
- Professional Training

All excellent additions to your CV!

Global Graduate Award in Languages

- To promote student mobility.
- Arabic, Chinese, French, German, Italian, Japanese, Portuguese, Russian, Spanish.
- Modules are assessed and results appear on transcript, but don’t provide credit towards degree.

Study Abroad - internationality

- An option for Year 2 of study:
- *One semester or a year at an 'approved' overseas university.*
- *Modules taken provide credit towards final degree.*
- *Currently agreements in place for universities in Canada, USA, Singapore and Australia.*

Professional Training

- Optional, but many students take advantage of the opportunity.
- One year between years 2 and 3.
- Placements arranged from the end of the 1st year and throughout the 2nd year.
- Professional Training Coordinators assist in finding placements.
- Placements may be overseas.

Professional Training

- A salary is paid by the employer.
- Regular visits are made during the year by academic staff (the University charges about 15% of the normal tuition fee during the placement).
- Written report and presentation at the end of the placement.
- Students frequently offered employment after degree.

Some Recent Placements

- **Pharmaceutical:** GSK, Pfizer, Quintiles, Roche
- **Finance:** Bank of England, Lloyds TSB, HSBC, Goldman Sachs
- **Actuarial:** Royal Sun Alliance, AXA, Mercer
- **Computing:** Microsoft, IBM, Intel
- **Education:** AQA, HEFCE
- **Government:** Civil Service, HM Customs, DTI, ONS, NATS
- **Car Industry:** Rolls-Royce, Bentley, Peugeot, Citroen
- **Marketing:** Marks and Spencer, Reuters, Nestle

MMath: Placement Options

- 4 Year Variant:

  Placement is 8 months at end of year 3, start of year 4.

  Placement consists of half of the assessment for the final year.

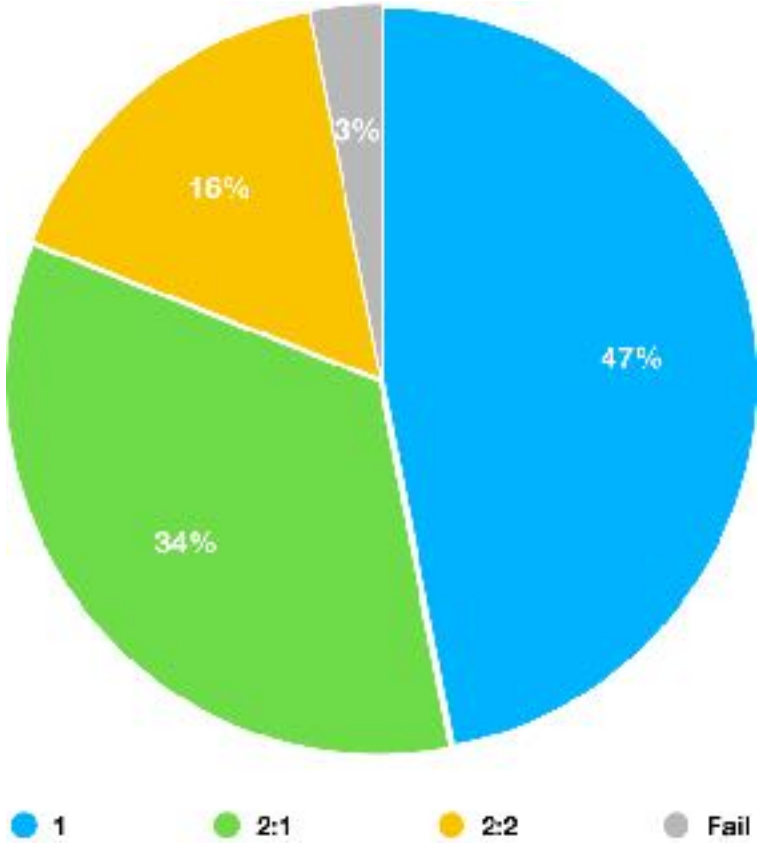
- 5 Year Variant has professional training year between years 2 and 3.

- Recent placements in actuarial, finance and pharmaceutical companies.

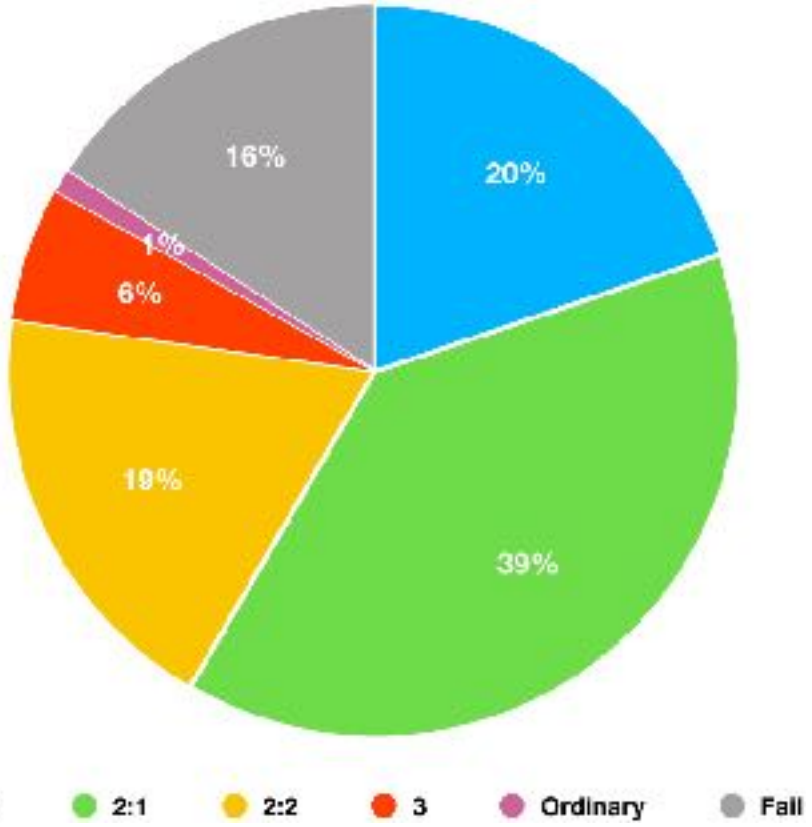
Professional Training Year Results

» Placement year vs. non-placement-year degree classes 2017

Placement student degree class percentages



Non-placement student degree class percentages



Some Recent Graduate Destinations

- New Business Analyst (Barclays Bank, Canary Wharf)
- Pensions Administrator (Aon, Woking)
- Associate Software Engineer (Accenture, London)
- Statistical Programmer (Quintiles, Bracknell)
- Trainee Accountant (Crane, Ipswich)
- Analyst (HSBC, London)
- Graduate Implementation Consultant (Fidessa, London)
- PhD Mathematics
- MSc Mathematics, Medical Statistics, Astrophysics, Financial Maths
- Graduate Teacher Trainee
- PGCE Mathematics

Summary

- Courses designed for flexibility with wide range of options.
- MMath prepares for study at higher level.
- Professional Training enhances CV and future job prospects.
- Overall: excellent preparation for successful entry to job market or post-graduate training.

Mathematics at Surrey

For more information on our courses and modules, and application details, visit our website at:

https://www.surrey.ac.uk/subjects/mathematics/

This presentation can be downloaded from the link provided by the Surrey admissions team.

The Solution to the 3-Colouring Problem

PROOF

» *Suppose [for a contradiction] that every pair of points distance 1 apart have different colours.*

» Choose an arbitrary point on the plane P. P must be red, green, or blue. Suppose that P is red.

» Construct the circle C_1 of radius 1, centre P. All points on this circle must be either green or blue.

» Choose an arbitrary point Q on the circle C_1 — Q must be either green or blue. Suppose Q is blue.

» Construct the circle C_2 of radius 1, centre Q. As Q is blue, all points on this circle must be red or green.

The Solution to the 3-Colouring Problem

- Let R be a point at which the circles C_1 and C_2 intersect. There are two such points — for the purposes of this proof, either will do.
- As R is at a distance 1 from P, R cannot be red. As R is at a distance 1 from Q, R cannot be blue.
- So R must be green.
- Construct the circle C_3 of centre R, radius 1. Consider the intersection of the circles C_2 and C_3
- There are two points at which C_2 and C_3 intersect. One of these is P. Let the other point be S.
- S is distance 1 from Q, so S cannot be blue. S is distance 1 from R so S cannot be green. So S is red.

The Solution to the 3-Colouring Problem

- Let C be the circle of radius $\sqrt{3}$ with centre P. This circle passes through the point S.
- As the position of Q on the circle C_1 is arbitrary, the whole of C must be red.
- This means that there are two points on C, of distance 1 apart, which are both red, which contradicts the initial assumption.
- Hence, the initial assumption must be false.
- Hence, there must exist at least two points, distance 1 apart, with the same colour. ■

The Solution to the 3-Colouring Problem

» Illustration of Proof

Points T and U are both red.