Issue 8 - May 2025

Maths Matters

Editor: Elleanore P 12F
Contributors: Dr Neman

FORTITUDINE CRESCAMUS

Welcome to the May issue of the Newstead monthly maths newsletter!

Each issue covers various maths matters: we will highlight some new or interesting maths **(Maths in the Moment)**, take you back in time for a snippet of historical maths fact **(Mathematical Time Machine)**, explain how maths is applied in the real world and how it links with other subjects **(Maths Meets the World),** show maths in unexpected places **(Maths in the Unexpected)** and give 5 recommendations **(Reasons to Love Maths).** The last section **Insights from the Newstead Maths Team** features the second part of the interview with Dr Neman.
All this to prove that Maths does Matter!
No doubt maths also matters to you so please get in touch and contribute to the next issue of this newsletter with your recommendations.
If you would like to contribute please contact **Elleanore P in 12F or Dr. Neman.**

MATHS Time Machine

Square Root Day

5 May 2025 (**5/5/25**) was the last **Square Root Day.** It is an unofficial holiday celebrated on days when both the day of the month and the month are the square root of the last two digits of the year. Ron Gordon, a high school teacher, created the **first Square Root Day** for Wednesday, September 9, 1981 (**9/9/81**).

This rare maths holiday **only happens 9 times in a century** on the following dates: 1/1/01, 2/2/04, 3/3/09, 4/4/16, 5/5/25, 6/6/36, 7/7/49, 8/8/64 and 9/9/81.

MATHS In The Moment

AI Discovers New Maths: Meet *AlphaEvolve*

Imagine a robot that can come up with clever new maths ideas—ideas even top scientists had not thought of. That's exactly what **AlphaEvolve**, a **new** artificial intelligence (AI) developed by **Google DeepMind**, is designed to do!
AlphaEvolve is like a **superpowered problem-solver**. It **creates new algorithms** (step-by-step instructions for solving problems) by trying out lots of different possibilities, learning which ones work best, and improving over time. It even **discovered a better way to multiply big numbers**—something mathematicians had not improved on in over 50 years!
The AI uses a **method similar to evolution in nature**. It starts with many possible solutions, tests them, keeps the best ones, and combines them to make even better ideas. Over time, this process creates smarter and more efficient algorithms.
These discoveries could **help speed up computers, make energy systems more efficient**, and even **support scientific breakthroughs**. While humans still play a key role, tools like **AlphaEvolve** show how AI can work with us to unlock new ways of thinking and explore the future of maths.

Read Google DeepMind blog post about **AlphaEvolve**.

"Like what you do, and then you will do your best."
Katherine Johnson

MATHS in the unexpected

Maths used in Simulating Hair in Pixar’s Brave

In Pixar’s Brave, Merida’s hair is famously wild and curly—but animating that realistically was a major **mathematical challenge**.

How math was used:

Pixar's engineers used **differential equations** and **mass-spring models** to simulate how each strand of her hair would bounce, twist, and interact with others. They modelled the hair as a series of particles connected by virtual springs—then applied **calculus and physics** to calculate the forces on each strand as she moved. This created hair that responded naturally to movement and gravity, making Merida feel more lifelike and believable on screen.

The maths involved:

- **Vector calculus** for motion
- **Linear algebra** for transformations (like rotation and scaling)
- **Numerical methods** to simulate physics frame-by-frame

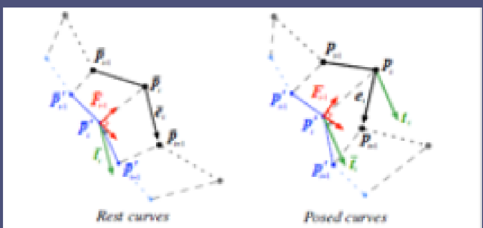
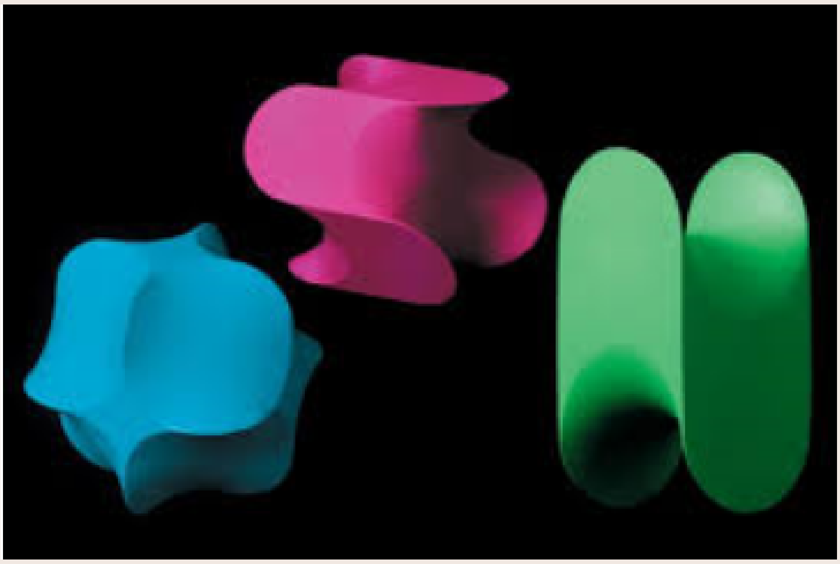


Figure 5: *We precompute the rest edge $\bar{e}_i$ (left) and store it in the local frame $\bar{F}_{i-1}$ (show at $\bar{p}_i$ for illustration) giving the reference vector $\bar{t}_i$. We use the current pose's local frame F_{i-1} (right) to compute t_i, our target bending direction, from $\bar{t}_i$. Note that bold black line represents the hair while the thin blue line represents the smoothed curve.*

An extract from a technical paper Pixar’s animation team.

MATHS Meets The World

'Soft Cells'—Nature's Hidden Geometry



Mathematicians discover new **universal class of shapes** to explain complex **biological forms**. The new class of shapes are called **soft cells** and are prevalent in nature. Unlike traditional geometric shapes with sharp corners, soft cells have curved edges and minimal or no corners, allowing them to tile spaces seamlessly.

In two dimensions, soft cells resemble teardrop shapes with two pointed cusps. These **patterns** are observed in **muscle tissues**, **zebra stripes**, and **river islands**. In three dimensions, soft cells become even more intriguing, forming structures without any corners. A notable example is the **chambers of a nautilus shell**, which, despite appearing angular in cross-section, are composed of **smooth, cornerless 3D soft cells**.

The mysterious world of soft cells - the secret geometry that defies traditional mathematical norms – is explored in this video.

FIVE REASONS THIS MONTH TO LOVE MATHS

1.Read **Google DeepMind** blog post about **AlphaEvolve**: A Gemini-powered coding agent for designing advanced algorithms.

2.Read **University of Oxford**’s news release on soft cells that are used to explain complex biological forms.

3.This video explores the mysterious world of **soft cells**, a new shape.

4.This paper describes the **mathematical techniques** used to **animate Merida's hair** in Pixar's Brave.

5.This video explains how **Pixar** by **using maths** made Marida’s amazing curly red hair – from 7m30sec in the video.

Insights from the Newstead Maths Team

In this edition of our Maths Matters, we bring you the second part of an **interview with Dr. Neman, Head of Maths**, who talks about her favourite mathematical paradox and discusses radians and degrees.
See the March issue for the first part of this interview.

Elleanore: **Dr Newman what is your favourite mathematical paradox, and what does it teach us about mathematics and logic?**

Dr. Neman: **Paradoxes** reveal the limits of our knowledge. They often highlight what we don't know or haven't fully understood yet. In ancient Greece, for example, people avoided discussing infinity because they couldn't accept the concept. That is why they focused only on solely positive numbers or what we call natural numbers today.
One famous paradox is the **Barber Paradox**, described by **Bertrand Russell**. It touches on foundations of **set theory** and was published during the time when mathematicians like Frege were trying to rebuild all of mathematics based on the idea of sets. Russell found a contradiction: if a barber shaves everyone who doesn't shave themselves, does he shave himself?
This paradox shows the problem with self-referential sets—sets that either do or do not contain themselves. It exposed flaws in Frege's work and forced a re-evaluation of mathematical foundations. Even today, we accept that any system, that can count integers, will include at least one unprovable axiom, thanks to Gödel's incompleteness theorems.

Elleanore: **Both degrees and radians are ways to measure angles, but radians are dominant in advanced mathematics and physics. Why are radians considered more natural, and when might degrees be more useful?**

Dr. Neman: **Radians** are essential in advanced mathematics because they relate directly to arc length and the unit circle, which makes them ideal for calculus, differential equations, and understanding motion. So, instead of randomly sectioning a circle into 360 pieces, or a right angle into 90, we discuss instead the length of the arc facing it.
When dealing with a particle moving in a circle, for instance, we measure angular displacement in radians because the velocity and acceleration equations rely on this continuous measure. Degrees do not provide that mathematical continuity.
That said, **degrees** are still useful for everyday or visual tasks—like navigation, geometry learnt in school, or interpreting angles quickly. They are intuitive and accessible, even if they are less precise in mathematical terms.