Dyson - draft #13

Main Personal Statement

I am particularly interested in the abstract parts of maths that aren't covered in the A Level curriculum. Topics like group theory, category theory, type theory, topology, linear algebra, etc. I especially love visualising these abstract concepts where applicable.

I completed the UKMT Senior Challenge in 2022 and got Gold and Best in School. I took the MAT and TMUA in 2022, and STEP in 2023, although I didn't get the STEP grades that I wanted. I practised STEP questions a lot, but my practice wasn't properly targeted. I have since learned the flaws in my system and I am now practising in much more effective ways.

I am currently in a gap year and looking for work while continuing to practice STEP questions and revise A Level maths content. I also have a few programming projects on the go, including one that involves creating simple 3D animations from scratch, and uses a lot of geometry.

My Computer Science coursework was focused on visualising 2D linear transformations. When I first learned them in school, I struggled to visualise them, so I wanted a tool that would show a given transformation and allow the user to interact with it. An interactive version of the 3blue1brown linear algebra series would be perfect,

but I couldn't find anything suitable. I mainly wanted to see matrix multiplication represented as transformation composition. Since I couldn't find a suitable app, I made one myself. During development, I faced many mathematical challenges such as converting between coordinate systems and drawing lines in the correct places on the canvas. It involved solving many interesting geometric problems, and researching various computational methods. The project proved useful for explaining matrices to my peers, and teachers have used it to teach the topic in lessons.

Certain questions in textbooks have prompted me to write my own LaTeX papers to explore the ideas they present. For example, a question which asked for polynomials which give pure powers of n when summed from 1 to n. While exploring the generalisation, I found an interesting pattern in the coefficients that looked like those of binomial expansions. Exploring this pattern, I found a formula. My proof was originally several pages long but then I asked a forum about my discovery and learned that it was simply a finite telescoping series. This made my proof far shorter, and I learned a valuable lesson about stepping back to see simpler solutions, and collaborating with other people.

When I listened to A Brief History of Mathematics on BBC Sounds, my favourite episode was about Galois. It detailed his life and inspired me to look further into Galois theory, although the prerequisite knowledge is quite advanced, so I can only just grasp the basics. It's incredibly interesting and I definitely want to learn more about it. Abstract algebras like Galois theory, group theory, and quaternions are the topics that interest me the most, since they don't have much obvious practical application, and I want to dive deep to understand them in more detail.

In Year 12, I joined an online course with MIT about using matrices to solve linear differential equations. I didn't know what differential equations were at the time, and I barely understood matrices, but I wanted to extend my knowledge. It started with linear transformations and matrices, and then introduced eigenvectors and eigenvalues. My main takeaways were row echelon form and Gauss-Jordan elimination, which allowed me to easily solve linear simultaneous equations by hand. I supplemented it with the 3blue1brown linear algebra series, but when the course started to use these techniques to solve differential equations, I had to stop because I knew nothing about the subject. I tried to learn about differential equations but I couldn't get very far at the time, so I had to step away and come back later, but it did teach me valuable lessons about mathematical modelling.

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