Luke Collins

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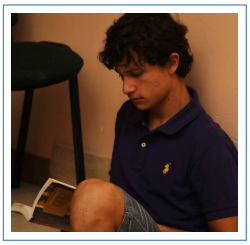


Publications

In peer-reviewed journals:

2020 **Luke Collins and Irene Sciriha**, *On the walks and Canonical Double Coverings of Graphs with the Same Main Eigenspace*, Discussiones Mathematicæ Graph Theory.
(preprint: https://arxiv.org/abs/1906.05790)

2018 **Irene Sciriha and Luke Collins**, *Two-Graphs and NSSDs: An Algebraic Approach*, Journal of Discrete Applied Mathematics.
(doi: https://doi.org/10.1016/j.dam.2018.05.003)

Education

2019 – 2020 **MASt in Mathematics**, University of Warwick, Coventry, UK.
Graduated with Distinction.

Modules I took: analytic number theory, algebraic number theory, ring theory (mainly involves non-commutative algebra), elliptic curves, graph theory, Galois theory, advanced real analysis.

2015 – 2019 **BSc (Hons) in Mathematics and Computer Science**, University of Malta, Msida, Malta.
Graduated first class with honours (*summa cum laude*).

For the maths part of my degree, I studied modules on graph theory (algebraic, topological, spectral), combinatorics (enumerative, probabilistic, extremal, topological), group theory, abstract algebra, linear algebra, real and complex analysis, vector analysis, geometry, functional analysis, general topology, set theory, and differential equations. For the computer science part, I studied formal languages, automata theory, computability theory, complexity theory, functional programming, principles of programming languages, data structures and algorithms, operating systems, systems programming (UN*X), databases, modelling and discrete event simulation, OOP, signals and systems, and machine learning.

2015 – **DipABRSM in Piano Performance**, ABRSM, London, UK.
Programme: Scarlatti Sonatas (K. 208 and K. 209), Beethoven's Pathétique Sonata (Op. 13), Schubert Impromptu in G♭, (Op. 90 No. 3).

2015 **TEFL Course**, Easy SL Language School, Valletta, Malta.
EFL course which qualifies for teaching English as a foreign language in Malta.

2013 – 2015 **A-Levels**, St. Aloysius' College, Birkirkara, Malta.
Obtained MATSEC A-level in Pure Mathematics, Computing and English, MATSEC Intermediate in Philosophy, Maltese, Physics and Systems of Knowledge, and AQA A-level in Mathematics & Further Mathematics.

Academic Projects

Master's Dissertation in Mathematics

Title *The Ternary Goldbach Conjecture*

Institute Mathematics Institute, Zeeman Building, University of Warwick

Supervisor Prof. Adam Harper

URL https://drmenguin.com/publication/maths-masters-project

Description We review Hardy–Littlewood's proof of the ternary Goldbach conjecture for sufficiently large odd numbers which assumes the Generalised Riemann Hypothesis, then discuss Vinogradov's improvement of the minor arcs bound to prove the result unconditionally for N sufficiently large (i.e., Vinogradov's theorem), and finally explore some ideas from Helfgott's 2014 proof which substantially improves the minor arc bounds, establishing the result analytically for $N \geqslant 10^{27}$, and checking the remaining cases by computer, proving the conjecture for all $N \geqslant 7$.

Undergraduate Dissertation in Mathematics

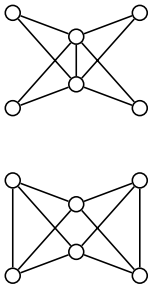
Title *On the walks and Canonical Double Coverings of Graphs with the Same Main Eigenspace*

Department Department of Mathematics, Faculty of Science, University of Malta

Supervisor Prof. Irene Sciriha

URL https://drmenguin.com/publication/maths-undergrad-project

Description The main eigenvalues of a graph G are the eigenvalues of its $(0,1)$-adjacency matrix having at least one corresponding eigenvector not orthogonal to the all-ones vector $\mathbf{1} = (1, \ldots, 1)$. In this dissertation, the relationship between the main eigenvalues of a graph and the number of walks is discussed. The number of walks N_k of length k in the graph G is expressed solely in terms of the main eigenvalues and main angles of G. The walk matrices of two comain non-isomorphic graphs with the same main eigenspace are shown to be of the same column space. Moreover, various properties of graphs relating the main eigenvalues, eigenspaces, eigenvectors and canonical double covers are catergorised in a hierarchical form.



Undergraduate Dissertation in Computer Science

Title *Synthesising Safety Runtime Enforcement Monitors for μHML*

Department Department of Computer Science, Faculty of ICT, University of Malta

Supervisor Prof. Adrian Francalanza

URL https://drmenguin.com/publication/cs-undergrad-project

Description In this project, we consider a subset sHML of formulæ in the Hennessy-Milner Logic with recursion (μHML) which are enforcable through suppressions. A synthesis function is introduced, which converts safety properties in sHML to suppression enforcers through a formula normalisation process. This synthesis function is implemented in the form of a Haskell program which parses formulæ in sHML and produces the required enforcement monitors.

Awards and Scholarships

2020 **Endeavour Scholarship**, *MASt in Mathematics, University of Warwick*.
Finished among the top 50 out of around 300 applicants for the Endeavour scholarship scheme, a funding programme organised by the Government of Malta for postgraduate study which funded my Master's degree at Warwick.

2019 **BehAPI Summer School**, *University of Leicester*.
Awarded a fully-funded position at the Behavioural API Summer School in Leicester. This summer school consisted of a week of lectures on various topics related to API development, including session types and runtime verification. Part of the EU Horizon 2020 Project. (URL: `https://bit.ly/2wpttxi`)

Teaching Experience

2020 **Teaching Assistant**, *Number Theory*.
Gave support classes and graded assessed assignments for the second year undergraduate introductory course on number theory (MA257) at the University of Warwick.

2020 **Substitute Lecturer**, *Programming for Scientists*.
Gave two lectures for an undergraduate course on programming (MA117). Mathematics Building, University of Warwick.

2019 **Introduction to LaTeX**, *A Workshop for PhD Students*.
Six hour workshop for all doctoral students at the University of Malta organised by the Doctoral School. Together with my friend Dr. Jean-Paul Ebejer, I taught the basics of LaTeX, figures, captions, lists, bibliographies, indices, beamer and TikZ. (Course notes: `https://drmenguin.com/teaching/latex-course`)

2014 – **Private Tuition**.
Tutoring mathematics and computing at intermediate and advanced level to students of all ages. Primarily one-to-one, preparing bespoke notes in LaTeX and making use of Wolfram *Mathematica* as a visual learning aid. Notes and *Mathematica* notebooks are made available to students via a Moodle VLE. (Website: `https://maths.com.mt`, Moodle: `https://vle.maths.com.mt`)

Professional Experience

2019 – **Copy Editor of Scientific Journal**, Xjenza Online, Malta Chamber of Scientists.
Reviewing and compiling articles in LaTeX for publication in the academic journal Xjenza. Also managing the website for Xjenza. URL: `https://www.xjenza.org/`

2017 – 2019 **Research Assitant**, University of Malta, Msida, Malta.
Conducting research in algebraic graph theory, with particular focus on spectral graph theory and group theoretic results for graphs. Also did work on combinatorial entities such as two-graphs and NSSDs.

2015 – 2016 **Language Instructor**, Berlitz Language School, Paceville, Malta.
Teaching English as a foreign language (TEFL) to students of various ages and nationalities.

2013 – 2015 **Web Developer**, Rynix Solutions, Imrieħel, Malta.
Created websites for individual clients and small organisations using HTML, CSS and Javascript.

Other Projects

2019 – **Malta Mathematical Society**.

Reinstated the Malta Mathematical Society together with Prof. Joseph Muscat at the Department of Mathematics, University of Malta. The Society organises lectures and activities for the general public to promote mathematics, as well as encouraging research both professionally and recreationally for its members. During the COVID-19 pandemic, we've organised various online talks and activities (facebook.com/MaltaMathSoc). Also designed the logo (the Bridges of Königsberg graph as a traditional Maltese *luzzu*) and the website for the society.

2018 – **LearnD Mobile App**, *Business startup*.

Cofounder and back-end developer of a cross-platform mobile application which serves as a tool to help struggling O- and A-level students, by allowing them to search for university students who are willing to help them in their studies. This is a mutually beneficial arrangement: the struggling student benefits from one-to-one assistance from someone who has recently undergone the same experience, and the university student is provided with a flexible means of income (https://learnd.com).

Explaining the app to Maltese President H.E. Marie-Louise Coleiro Preca

This project was awarded over €60,000 in combined funding from the University of Malta Business Incubator (https://bit.ly/2VExDIl) and other private investors, and has recently bought by Munnin Ltd, a subsidiary of of Konnekt (https://konnekt.com).

2015 – **Mathematics Notes and A-Level Textbook**.

Author of various sets of notes on topics in advanced level and undergraduate mathematics and computer science, typeset in LaTeX, made freely available at https://maths.com.mt/notes under a creative commons license. Also the author of an advanced level mathematics textbook (ongoing) for use in Maltese schools, aimed at students who wish to sit for pure mathematics A-level (MATSEC).

2016 – **Maths and Science Communication**.

Involvement with various efforts relating to public maths and science communication, such as writing articles for the Times of Malta (e.g. https://bit.ly/30ByYDx) or manning stands at the Science in the City yearly festival in Valletta, Malta.

2015 – **Various Programming Projects**.

Building and maintaining various programming projects on the community website GitHub (https://github.com/drmenguin), including a multiplayer console-based snakes game which illustrates TCP/IP networking principles in C, an interpreter for a small Turing complete programming language called MiniLang in C++, a website built using Jekyll and a maze game in Java which illustrates test-driven program design.

2013 – **Websites**.

Designed website for mathematics tuition, www.maths.com.mt, for LearnD, www.learnd.com, and personal website www.drmenguin.com.

Oral Skills and Presentations

Good communication skills gained through presenting mathematical research, teaching both group and individual classes, scouting activities, attending various camps, seminars and symposia, and additional team building activities.

2020 – **Maths YouTube Videos**.
Created various maths communication videos on YouTube and for the Malta Mathematical Society on our Facebook page.

Youtube Channel: `youtube.com/c/LukeCollins/`

MMS Videos: `facebook.com/MaltaMathSoc/videos`

2019 **S^3 Annual Science Conference**, Esplora, Kalkara, Malta.
Presented results obtained in my own research on walks, walk matrices, and bipartite double covers of graphs.

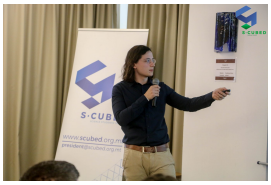
Booklet: `issuu.com/scubedpres/docs/booklet`

Slides: `https://drmenguin.com/talks/s3-2019`

2019 **Combinatorics and Graph Theory Day**, University of Malta.
Presented results obtained in my own research on two-graphs and conference graphs. Joint event between the University of Malta and the University of Pannoia, Hungary.

Slides: `https://drmenguin.com/talks/cgtd-2019`

2018 **S^3 Annual Science Conference**, St. Julian's, Malta.
Presented proof techniques and results obtained in my own research on two-graphs, Seidel switching, and non-singular graphs with a singular deck (NSSDs).



Article: `https://bit.ly/2qMhxj3`

Slides: `https://drmenguin.com/talks/s3-2018`

Voluntary Work

2018 – **Mathematics Exposition**, *Various Schools*, Malta.
Visiting secondary schools and sixth forms throughout Malta and Gozo, engaging children with mathematical and problem-solving activities such as the utilities problem and its variant on a mug (i.e., embedding the graph $K_{3,3}$ in the plane v.s. on a torus) and different proofs of Pythagoras' theorem. Encouraging them to pursue further studies in mathematics. Representing the Mathematics Department of the University of Malta.

2015 – 2016 **Working with Local and Migrant Communities**, *OFD*, Malta.
Voluntary work with OFD (The Organisation for Friendship in Diversity), a small youth-led NGO working with children and adults from local and migrant communities to foster a respect for diversity and promote social inclusion.

2011 – 2015 **Study Support**, *St Jeanne Antide Foundation*, Ħal Tarxien, Malta.
Helping children with learning difficulties to study and develop academically.

Languages

Programming Languages.
Strong in the following languages: Haskell, C, C++, C in the UN*X environment, Java, Python, Mathematica, TEX and LATEX.

Comfortable with: SQL, HTML, CSS, Javascript.

Have some experience with: Erlang, Go, VHDL.

Natural Languages.
English (C2) Maltese (C2) Italian (B2) Latin (A2)

Other Skills

Management and Leadership Skills.
Management and leadership skills gained from various activities, including participation in the Duke of Edinburgh Award and Scouting.

Programming Ability.
Thorough command of C-like languages and Python. Effective use of Wolfram Mathematica for mathematical research. Taking part in programming competitions such as Google Code Jam.

Working with UN*X Environments.
Making use of and designing a highly customised and minimalist Arch Linux distribution forked from LARBS. Experienced with systems programming (in C) on various Unices.

Scouting Skills.
I was a scout, venture and rover from age 13–20 at St Augustine's College Air Scouts.

Hobbies and Interests

Mathematics Stack Exchange.
Active member of the Math Stack Exchange website, I frequently answer people's questions there.

Profile: `math.stackexchange.com/users/301095/luke-collins`

Classical Music, Opera and Theatre.
Enjoying listening to and playing music ranging from the renaissance and baroque to the late romantics. Regularly attending concerts, recitals and operatic functions both locally and around Europe.

Brazilian Jiu-Jitsu.
I've been practising jiu-jitsu at Arete Malta for half a year, currently a 2 stripe white belt.

Logic Puzzles and Games.
Worked through various books by Raymond Smullyan, Martin Gardner and others. Particularly fond of chess, connect-4 and poker.

Reading.
Appreciation of classical literature, Maltese poetry, classical antiquity, WWII history, dystopian and post-modern novels (especially *dying earth* novels), political theory and philosophy, particularly philosophy of mathematics.