Supervisor name	email address	subejct area	Research Project Title
Myfanwy Hill	senior.tutor@kings.cam.ac.uk	Senior Tutor	Beyond the break with Eton
Andela Sarkovic	as2572@cam.ac.uk	Mathematics	Expansion and random graphs
Andela Sarkovic	as2572@cam.ac.uk	Mathematics	Mixing times of random walks on dynamical configuration model
Iris Hardege	ih287@cam.ac.uk	Medicine	Exploring the complexity of dopamine signalling in the C. elegans nervous system
Sebastian Eves-van den Akker	se389@cam.ac.uk	Natural Sciences (Plant Pathogen Interactions	Effectors of plant immunity
Sam Moore	sam214@cam.ac.uk	Information Studies	Mapping the small press landscape at Cambridge’
Alice Hutchings	ah793@cam.ac.uk	Computer Science	10 years of the Cambridge Cybercrime Centre
Martin Hyland	M.Hyland@dpmms.cam.ac.uk	Mathematics	Deeper Elementary Mathematics
Martin Hyland	M.Hyland@dpmms.cam.ac.uk	Mathematics	Tensor products
Martin Hyland	M.Hyland@dpmms.cam.ac.uk	Mathematics	Logic of fixed points
Martin Hyland	M.Hyland@dpmms.cam.ac.uk	Mathematics	School mathematics: what is the shape of the subject?
Olaf Kranse & Tom Thirkell	ok297@cam.ac.uk; tjt35@cam.ac.uk	Biology & Biology	Advancing Research through Automation at Kings College Meadow
Bert Vaux	bv230@cam.ac.uk	Linguistics	Tagged Audio Corpus of Kazakhstani Uyghur
Tiffany Harte	th558@cam.ac.uk	Physics	Environment monitoring for a quantum sensing experiment
Tim Flack	tjf1000@cam.ac.uk	Engineering	Hardware Cyclometer emulator using Field-Programmable Gate Arrays (FPGA)
Tim Flack	tjf1000@cam.ac.uk	Engineering	Software emulator and visualisation of the Polish Bomba
Coco Newton	ccn30@cam.ac.uk	Neuroscience	Reviewing the ethics of using neurotechnologies in healthcare

Research Project Title: Beyond the break with Eton

Supervisor name and role at King's: Myfanwy Hill, Fellow

Supervisor email: senior.tutor@kings.cam.ac.uk

Research Project description:

A history of Access and Widening Participation at King's in the late twentieth and early twentieth century

Student learning outcomes:

Archival research building on two research projects done in 2024. This project should focus on the discourse within the College, University and wider HE sector in the late twentieth century and early twenty first century. To include oral histories to be collected from academics who instigated some of the initiates we now run in the College. This project will not focus on the history of women joining the college as that has already been extensively documented elsewhere, but will rather look at access to a King's education by students from underrepresented backgrounds (however that might have been seen at that point in the history of the College).

New skills the student will develop

Primary source analysis, archival research, report writing, oral history collection

Profile of a successful applicant, including any necessary skills or knowledge the student will need to have.

Any student with an interest in contributing to the understanding of the recent history of King's

Facilities available (e.g. supervision, membership of a research group, support, etc.)

weekly supervision, archive access

Duration of the project (All projects should be between 6 - 10 weeks long.)

6 weeks

Please indicate your preferred start date below, or if you don't have a preference:

30 June

How many students would the project be suitable for? (Please note that all submitted projects should be able to operate with one student only, even if multiple participants would be advantageous.)

1-2

Any other comments

Research Project Title: Expansion and random graphs

Supervisor name and role at King's: Andjela Sarkovic, Fellow

Supervisor email: as2572@cam.ac.uk

Research Project description:

The goal of the project would be to see if certain random graps are a small set expanders (which means that every set of vertices of small enough size has a number of neighbours outside of the set which is proportional to size of the set). One possibility would be to study a particular random graph model which has a community structure. Another direction is to study if small set expanders satisfy that under a small random perturbation (eg picking a random set of edges and deleting them and replacing them with random edges such that degrees stay the same) they are still small set expanders.

Profile of a successful applicant, including any necessary skills or knowledge the student will need to have.

Experience with basic probability and graph theory is useful

Facilities available (e.g. supervision, membership of a research group, support, etc.)

Duration of the project (All projects should be between 6 - 10 weeks long.)

8 to 10 weeks

Please indicate your preferred start date below, or if you don't have a preference:

no preference

How many students would the project be suitable for? (Please note that all submitted projects should be able to operate with one student only, even if multiple participants would be advantageous.)

up to 2 students

Any other comments

Research Project Title: Mixing times of random walks on dynamical configuration model

Supervisor name and role at King's: Andjela Sarkovic, Fellow

Supervisor email: as2572@cam.ac.uk

Research Project description

Mixing times are a way to quantify a rate of convergence of Markov chains to their invariant distribution. The goal of this project would be to study the mixing time of a simple random walk on a dynamical configuration model. This has been studied for a non-backtracting random walks in https://arxiv.org/pdf/2012.11012

Profile of a successful applicant, including any necessary skills or knowledge the student will need to have.

Basic knowledge of Markov chains is needed.

Facilities available (e.g. supervision, membership of a research group, support, etc.)

Duration of the project (All projects should be between 6 - 10 weeks long.)

8-10 weeks

Please indicate your preferred start date below, or if you don't have a preference:

no preference

How many students would the project be suitable for? (Please note that all submitted projects should be able to operate with one student only, even if multiple participants would be advantageous.)

up to 2 students

Any other comments

Research Project Title: Exploring the complexity of dopamine signalling in the C. elegans nervous system

Supervisor name and role at King's: Iris Hardege, Research Fellow

Supervisor email: ih287@cam.ac.uk

Research Project description

Animal behaviours are crucial for survival and reproductive success, exhibiting remarkable conservation across diverse organisms, regardless of their complexity. The driving force behind these behaviours lies in the flow of information through neural networks. This highly regulated process involves the release of neurotransmitters from presynaptic neurons and the subsequent activation of receptors in postsynaptic neurons, forming the foundation of signal transmission across all organisms. Fast neurotransmission is mediated by ion channel receptors. Typically, we think of neurotransmitters acting via these receptors as being exclusively excitatory or inhibitory. However, discoveries in Drosophila and C. elegans have challenged this binary view, revealing the existence of both excitatory and inhibitory ligand-gated ion channels (LGICs) gated by the same neurotransmitter. Interestingly, despite having just 302 neurons, C. elegans encodes excitatory and inhibitory ion channel receptors for all major neurotransmitters, some within the same neurons. This along with a fully mapped connectome make it an ideal model organism to study this phenomenon. We recently identified both excitatory and inhibitory dopamine-gated LGICs from C. elegans and found that they can be expressed within the same neurons. This raises several interesting questions about how a small nervous system utilises this complexity. In this project you will work to understand the molecular mechanisms and behavioural importance of these two classes of dopamine-gated ion channels. To do this you will generate a range of mutations in these receptors and study the impact of these receptors by expressing them in Xenopus oocytes and performing electrophysiological recordings, with the aim to generate altered versions of the channels that switch them from excitatory to inhibitory and vice versa. These mutations will then be generated in vivo in C. elegans animals using CRISPR/Cas9, with the ultimate aim of understanding how altering the valance of a given receptor affects behaviour and the flow of information through the network.

Student learning outcomes

This project will provide the student an opportunity to undertake hands on research in a laboratory setting. They will be able to perform independent research, troubleshooting and develop and test their hypothesises.

New skills the student will develop

The student will learn a range of technical laboratory skills including molecular biology (PCR, cloning, mutagenesis), electrophysiology (Two-Electrode Voltage Clamp) and C. elegans handling and behavioural analysis. The student will also develop skills in time management especially in the prioritisation of tasks as well as good record keeping and teamwork.

Profile of a successful applicant, including any necessary skills or knowledge the student will need to have.

You should have an interest in biology, in particular neuroscience or molecular biology. Ideally you will be taking natural sciences with a focus on biology modules. Some technical experience of molecular biology will be a plus, for example gained from undergraduate practicals. Mainly you will be motivated and interested in learning and keen to develop new skills.

Facilities available (e.g. supervision, membership of a research group, support, etc.)

You will be part of the research group based in the main Zoology building and will have access to lab facilities and office space. Supervision will be provided by various group members and overseen by the PI.

Duration of the project (All projects should be between 6 - 10 weeks long.)

10 weeks

Please indicate your preferred start date below, or if you don't have a preference:

no preference

How many students would the project be suitable for? (Please note that all submitted projects should be able to operate with one student only, even if multiple participants would be advantageous.)

1-2

Any other comments

Research Project Title: Effectors of plant immunity

Supervisor name and role at King's: Sebastian Eves-van den Akker, Fellow

Supervisor email: se389@cam.ac.uk

Research Project description

This research project focuses on the "effectors of plant immunity" encoded in pathogen genomes. Plant pathogens are a major threat, and in some cases a dominant threat, to global food security. The central tenet of this project is that understanding how pathogens cause disease in sufficient detail will lead to novel routes to control. Here, our focus is directed to pathogen "effectors": pathogen molecules delivered inside the host which facilitate disease. This project will develop tools to explore these effectors by allowing molecular characterisation of their function. The overarching goal will be to develop specific antibodies against selected pathogen effectors. This will involve identification and cloning of selected effectors. Cloned effectors will be tested in various heterologous protein production systems to identify those which allow the most effective expression. Antibodies can then be raised against the purified effector proteins and can be made available for the downstream applications. Producing antibodies will allow a deeper understanding of these effectors, by enabling various downstream experiments for functional characterisation such as determining localisation or identifying interacting molecules/proteins, allowing further analysis of how these effectors interact with the plant immune system and how these effectors fit in the context of the pathologies, and the food insecurity that result. Thinking more broadly, pathogens appear to be remarkable innovators on host biology. Unexpected findings, in some cases of substantive utility in unintuitive ways, have come from understanding pathologies (genome editing is a good example). This project will suit an individual fascinated by the products of evolution, the process of discovery, and the potential impact on global challenges.

Student learning outcomes

Principles of molecular cloning and core molecular biology approaches; First hand experience of plant pathologies; forming and testing hypotheses in a laboratory setting; develop critical thinking and data analytical/interpretation skills.

New skills the student will develop

Wet lab skills in molecular biology and biochemistry.

Profile of a successful applicant, including any necessary skills or knowledge the student will need to have.

This project is designed to build fundamental wet lab molecular biology and biochemical skills. No prior knowledge or experience is required, but a working knowledge of plant-pathologies will be an advantage.

Facilities available (e.g. supervision, membership of a research group, support, etc.)

The successful applicant will join the plant-parasite interactions group, lead by Sebastian Eves-van den Akker, at the Crop Science Centre, Department of Plant Sciences. They will work with experienced members of the lab to learn any and all requisite techniques.

Duration of the project (All projects should be between 6 - 10 weeks long.)

10

Please indicate your preferred start date below, or if you don't have a preference:

no preference

How many students would the project be suitable for? (Please note that all submitted projects should be able to operate with one student only, even if multiple participants would be advantageous.)

1

Any other comments

Research Project Title: Mapping the small press landscape at Cambridge'

Supervisor name and role at King's: Dr. Sam Moore, College Research Associate

Supervisor email: sam214@cam.ac.uk

Research Project description

There is a rich tradition of small press publishing at the University of Cambridge and its constituent colleges. These presses are typically organised by working academics and publish a wide range of material including poetry zines, research journals and experimental works, operating in a DIY fashion without involvement by professional publishing organisations. Though frequently based in arts and humanities disciplines, especially literary studies, there are no doubt presses across many other disciplines within the university. However, to date there has been no work to understand the past and present of small press publishing at Cambridge: how many presses exist at the University, in which fields, and what do they publish? Why do these academics do what they do and how do they support their work? This project seeks to build a fuller picture of the small press landscape at Cambridge. The student researcher will be encouraged to adopt their own approach, utilising word-of-mouth ('snowball' methodology), web searching and archival work, or a combination of all three. Students may also opt to interview the editors behind these presses in order to understand their publishing practices and motivations, or they may decide to present the work as a database or report. This work will contribute to the growing body of research on 'scholar-led' publishing cultures and may form the basis for a deeper, interview-based project or a project operating a larger scale across multiple universities.

Student learning outcomes

The student will acquire a rich understanding of DIY publishing cultures. They will also understand how to select and evaluate appropriate methodologies for landscape analyses and present their work in a suitable manner.

New skills the student will develop

The student will learn more about independent research and how to approach a research question to maximise the best possible result. This could also include semi-structured interviews, database design or structured report writing.

Profile of a successful applicant, including any necessary skills or knowledge the student will need to have.

No skills or knowledge are necessary, although this project may suit a student in English or a related humanities discipline, particularly one interested in publishing or creative writing. The student should be comfortable using their own initiative and working independently.

Facilities available (e.g. supervision, membership of a research group, support, etc.)

The student will meet weekly with Dr. Samuel Moore (Cambridge Digital Humanities and the University Library). Dr. Moore will guide the student and will help them to determine the best approach to the project that fits with their skills and experiences. They will also have the opportunity to present their work to the staff of Cambridge Digital Humanities, if desired.

Duration of the project (All projects should be between 6 - 10 weeks long.)

6

Please indicate your preferred start date below, or if you don't have a preference:

30 June

How many students would the project be suitable for? (Please note that all submitted projects should be able to operate with one student only, even if multiple participants would be advantageous.)

Multiple participants would be advantageous. I'm happy for up to 3 students to work on this but would be willing to consider more if needed/desired.

Any other comments

Research Project Title: 10 years of the Cambridge Cybercrime Centre

Supervisor name and role at King's: Alice Hutchings, Fellow

Supervisor email: ah793@cam.ac.uk

Research Project description

The Cambridge Cybercrime Centre was established in 2015. In the past 10 years, we have collected and shared datasets with over 400 academic researchers across multiple disciplines and countries. This project will collate and synthesise the research using these datasets. The aim is to provide an overview of the impact of the Centre, from the research that has been generated, the benefits to early career researchers (e.g. graduate students, postdoctoral researchers), capacity building, and knowledge dissemination. The project will involve identifying key metrics and collecting evidence from citations, case studies and the researchers who use our datasets. It will feed into a report assessing how the Centre has influenced research, enabled the generation of new insights, and informed policy decisions. The objective is to understand the Centre's influence in the research ecosystem and identify areas for growth.

Student learning outcomes

Learning outcomes include analytical skills, research and critical thinking, project management, and communication skills.

New skills the student will develop

Skill development includes data analysis and visualisation, literature and citation review, report writing and presentation skills, and practical experience in measuring impact.

Profile of a successful applicant, including any necessary skills or knowledge the student will need to have.

This project is open to students from any academic background. When applying, please outline what skills and experience you have that will be beneficial for the project.

Facilities available (e.g. supervision, membership of a research group, support, etc.)

The successful applicant will be a member of the Cambridge Cybercrime Centre. The research group includes eight postdoctoral researchers and graduate students. There will be day-to-day support, weekly team meetings and regular supervision meetings. The Centre will hold its annual conference on 23 June, and it would be beneficial for the successful applicant to attend.

Duration of the project (All projects should be between 6 - 10 weeks long.)

6 weeks

Please indicate your preferred start date below, or if you don't have a preference:

30 June (but student should be available to attend a meeting on 23 June)

Please confirm that your project won't be affected detrimentally if the student attends a number of mandatory sessions in College as part of the programme.

We have our regular team meeting at 11am on Mondays at West Cambridge, which it would be beneficial to attend.

How many students would the project be suitable for? (Please note that all submitted projects should be able to operate with one student only, even if multiple participants would be advantageous.)

2

Any other comments

Research Project Title: Deeper Elementary Mathematics

Supervisor name and role at King's: Martin Hyland, Fellow

Supervisor email: M.Hyland@dpmms.cam.ac.uk

Research Project description

Can we see in elementary mathematics ideas which go beyond standard proofs?

Student learning outcomes

Beyond the mathematics an appreciation of what lies beneath the surface.

New skills the student will develop

Habits of reflection; patience.

Profile of a successful applicant, including any necessary skills or knowledge the student will need to have.

School mathematics experience and an interest in the issues.N/

Facilities available (e.g. supervision, membership of a research group, support, etc.)

None

Duration of the project (All projects should be between 6 - 10 weeks long.)

Any length but 10 weeks gives a better chance to find something.

Please indicate your preferred start date below, or if you don't have a preference:

no preference

How many students would the project be suitable for? (Please note that all submitted projects should be able to operate with one student only, even if multiple participants would be advantageous.)

Up to 4. Group discussion may be helpful.

Any other comments

Research Project Title: Tensor products

Supervisor name and role at King's: Martin Hyland, Fellow

Supervisor email: M.Hyland@dpmms.cam.ac.uk

Research Project description

Search for examples not arising from multi algebra. Examples in higher dimensions.

Student learning outcomes

Acquaintance with some abstract aspects of algebra.

New skills the student will develop

Habits of abstract thought.

Profile of a successful applicant, including any necessary skills or knowledge the student will need to have.

Knowledge of basic courses in modern algebra

Facilities available (e.g. supervision, membership of a research group, support, etc.)

None

Duration of the project (All projects should be between 6 - 10 weeks long.)

10 weeks ideally. 8 weeks sensible minimum.

Please indicate your preferred start date below, or if you don't have a preference:

no preference

How many students would the project be suitable for? (Please note that all submitted projects should be able to operate with one student only, even if multiple participants would be advantageous.)

For breathing space at most two

Any other comments

Research Project Title: Logic of fixed points

Supervisor name and role at King's: Martin Hyland, Fellow

Supervisor email: M.Hyland@dpmms.cam.ac.uk

Research Project description

Issues arising from Solovay's theory of provability as a modal logic

Student learning outcomes

Different aspects of modern logic

New skills the student will develop

Handling an interplay of perspectives. Theory building.

Profile of a successful applicant, including any necessary skills or knowledge the student will need to have.

Preparedness to grapple with the topic

Facilities available (e.g. supervision, membership of a research group, support, etc.)

None

Duration of the project (All projects should be between 6 - 10 weeks long.)

Best say 10 weeks

Please indicate your preferred start date below, or if you don't have a preference:

no preference

How many students would the project be suitable for? (Please note that all submitted projects should be able to operate with one student only, even if multiple participants would be advantageous.)

Best to cap at two.

Any other comments

Research Project Title: School mathematics: what is the shape of the subject?

Supervisor name and role at King's: Martin Hyland, Fellow

Supervisor email: M.Hyland@dpmms.cam.ac.uk

Research Project description

School mathematics: what is the shape of the subject? How do things really (!) hang together.

Student learning outcomes

Deeper understanding of Maths

Profile of a successful applicant, including any necessary skills or knowledge the student will need to have.

Preparedness to grapple with the topic

Facilities available (e.g. supervision, membership of a research group, support, etc.)

None

Duration of the project (All projects should be between 6 - 10 weeks long.)

Best say 10 weeks

Please indicate your preferred start date below, or if you don't have a preference:

no preference

How many students would the project be suitable for? (Please note that all submitted projects should be able to operate with one student only, even if multiple participants would be advantageous.)

1 - 2

Any other comments

Research Project Title: Advancing Research through Automation at Kings College Meadow

Supervisor name and role at King's: Olaf Kranse & Tom Thirkell, College Research Associates

Supervisor email: ok297@cam.ac.uk; tjt35@cam.ac.uk

Research Project description

(Motivation) Automation is becoming an increasingly more desirable method for data-collection and analysis in research. To develop a system that fits their experimental need, a modern scientist is required to be familiar with available building tools (hardware and software). Exposure to electrical engineering through hands-on projects will provide a stepping stone for students into utilising this discipline. For engineers, exposure to research highlights real-world application of their expertise In short, involvement with other disciplines is important for a students development, regardless of their background. The inter-disciplinary setting of a college provides the ideal setting for a project where students can benefit from each other's education. (Project) We will develop a system of devices that automatically collects data on the meadow over time. The collected data will cover a wide-range of the dynamics in the meadow, e.g., first flower emergence, dominant plant species, meadow health, effect of meadow on surroundings, etc. With this data we will gain greater understanding of the positive ecological impacts of meadow establishment in an urban environment. In the first week, the students will be provided with an introductory course to data-collection using hardware and software. This will be held on the meadow to help familiarise them with the experimental grounds. A device has to be weather proofed to be placed in the meadow. We encourage students to design an enclosure for their electronics, using the 3D printers at the Crop Science Centre. As a fallback, we have commercially available enclosures in-house, ready for use. For this project, students will use 'sensor-modules', which contain the required circuitry build-in. This will allow the students to get familiar with sensors, without the need of a deeper understanding of the electronics. We will provide pre-defined research goals to automate: 1) Track the effects of the weather on the meadow (image capturing weather station), 2) Water retention of soil in meadow vs grass (water level sensors grid), and 3) Nitrogen, phosphorus, and potassium (NPK) monitoring (NPK-sensors grid).

Student learning outcomes

The students will gain: 1) Insight in cross-disciplinary collaborations, 2) Real-world use cases for their subject of study, and 3) Insight into real-world application of automation.

New skills the student will develop

The project will cover different disciplines, and therefore the skills developed are dependent on their background. The goal is to build hardware and software to automate the study of the meadow. This includes; electronic engineering (sensors and micro-controllers), software engineering (programming of micro-controllers), biology (study of the meadow). The new skills are either: How to apply automation to research, and/or; Where to apply automation to research.

Profile of a successful applicant, including any necessary skills or knowledge the student will need to have.

Any student is welcome regardless of subject of study. No prior skills required. A base understanding of Python, previous experience with Raspberry Pi and/or Arduino are useful, but not required.

Facilities available (e.g. supervision, membership of a research group, support, etc.)

Most of the design can be done remotely. Building of device is done at the Crop Science Centre (west Cambridge). Electronics will partially be tested in the lab and in the meadow. Sensors are made available through the lab.

Duration of the project (All projects should be between 6 - 10 weeks long.)

8-10 weeks

Please indicate your preferred start date below, or if you don't have a preference:

30 June

How many students would the project be suitable for? (Please note that all submitted projects should be able to operate with one student only, even if multiple participants would be advantageous.)

1-3

Any other comments

Research Project Title: Tagged Audio Corpus of Kazakhstani Uyghur

Supervisor name and role at King's: Bert Vaux, Fellow

Supervisor email: bv230@cam.ac.uk

Research Project description

Our research project aims to create a comprehensive, phonetically searchable corpus of Uyghur using an audio recording of the entire Bible spoken by a native speaker from the Ujgurskij Rajon in Kazakhstan. This initiative represents an important step in Uyghur linguistic research, as it will provide an extensive dataset of naturally spoken Uyghur, allowing for in-depth analysis of the language's phonetic and phonological properties. To achieve this, we will use Praat, a widely utilized phonetic analysis software package, to generate spectrograms for the entire corpus. These spectrograms will serve as the foundation for aligning both phonetic and phonemic transcriptions in the International Phonetic Alphabet (IPA) with the corresponding audio segments. By doing so, we will enable researchers to systematically analyze the phonetic and phonological characteristics of Uyghur speech, including segmental and suprasegmental features such as vowel harmony, stress patterns, and prosody. This work is particularly crucial because existing linguistic research on Uyghur has overwhelmingly relied on written data, which introduces significant limitations. Uyghur has been written in multiple scripts—including Arabic, Latin, and Cyrillic—each of which presents significant shortcomings in representing the full range of phonetic and phonological variation in the spoken language. Written texts fail to capture crucial aspects such as vowel reduction, assimilation, and other coarticulatory effects that shape natural speech. Our corpus will provide the first large-scale, systematically annotated dataset of spoken Uyghur, filling a major gap in linguistic resources. The corpus will be designed to be fully searchable, allowing researchers to investigate both general phonetic patterns and conditioned phonological processes. For example, scholars will be able to analyze how phonemes vary depending on their phonetic environment, how stress and intonation patterns function in connected speech, and how dialectal features manifest in natural spoken Uyghur. Ultimately, this project will provide a valuable resource for linguists, phoneticians, and computational researchers interested in Uyghur phonetics and phonology. By making this corpus publicly accessible, we hope to facilitate new discoveries about the sound system of Uyghur, contribute to broader studies in Turkic linguistics, and support efforts to document and preserve the language.

Student learning outcomes

Through this project, students will gain proficiency in the International Phonetic Alphabet (IPA), including the specialized symbols used for narrow transcription of an unfamiliar language. They will develop hands-on experience with Praat, learning to generate and analyze spectrograms, align phonetic transcriptions with spectral

components, and interpret acoustic data. Additionally, students will acquire a deeper understanding of Uyghur phonetics and phonology, including its segmental and suprasegmental features. By engaging with real linguistic data, they will build skills in phonetic analysis, acoustic interpretation, and corpus development, preparing them for further research in phonetics, field linguistics, and computational linguistics.

New skills the student will develop

phonetic transcription, ear training, use of phonetic analysis software

Profile of a successful applicant, including any necessary skills or knowledge the student will need to have.

The successful applicant should have some knowledge of linguistics, and especially phonetics and phonology. Some knowledge of coding and computational linguistics would also be helpful.

Facilities available (e.g. supervision, membership of a research group, support, etc.)

The student will be able to work on their own time and wherever is convenient for them, but I will be available to supervise them in person as much as is necessary.

Duration of the project (All projects should be between 6 - 10 weeks long.)

10 weeks

Please indicate your preferred start date below, or if you don't have a preference:

30 June

How many students would the project be suitable for? (Please note that all submitted projects should be able to operate with one student only, even if multiple participants would be advantageous.)

1

Any other comments

none

Research Project Title: Environment monitoring for a quantum sensing experiment

Supervisor name and role at King's: Tiffany Harte, Fellow

Supervisor email: th558@cam.ac.uk

Research Project description

Ultracold atoms are dilute gases of atoms cooled to nK above absolute zero, that offer the benefits of a quantum system while also being highly tuneable using laser light and magnetic fields. Ultracold atom platforms have applications across quantum science, including quantum computing, quantum simulation, and quantum sensing - where the atoms' exquisite sensitivity to small forces underpins sensing applications such as accelerometer, magnetometry and new efforts to study phenomena such as dark matter and gravitational waves. We are developing new quantum sensors based on two different technologies: atom interferometry (using the interference between two spatially-separated atom clouds to sense small forces that can affect their evolution) and the interactions between atoms trapped in an optical lattice created by the interference of laser light. The efficient and stable running of these experiments requires a high level of monitoring and stability of the lab environment and the lasers and magnetic fields that control the atoms. As we scale up our experiment functionality and settle into our new lab space in the Ray Dolby Centre we're looking for a student to help develop a more scalable and reliable experiment monitoring solution, based on Raspberry Pis and experiment monitoring hardware ranging from temperature and humidity sensors to photodiodes and custom magnetic field probes. Depending on progress and student interest, possible extensions to the project are possible in a variety of directions including vibrational analysis and minimisation for optical systems, characterisation and minimisation of thermal and other ambient effects in precision optics, and vibrational/seismic analysis of the lab environment.

Student learning outcomes

The student will learn about the physics behind ultracold quantum technologies, and the intersection of hardware and software required to reliably run and monitor a precision sensing experiment. They will learn about the impact of various noise sources on the stability of the experiment and interpretation of results.

New skills the student will develop

The student will gain experience working with experiment monitoring hardware, data acquisition, database handling, data visualisation, networking and general programming and computational skills (including a very good familiarity with linux). As the project evolves, they will gain familiarity with a number of experimental systems and requirements including lasers and optics, magnetic field control, and precision

timing. They will receive training in safe practice in laser labs, optics handling, and may work directly on optical systems.

Profile of a successful applicant, including any necessary skills or knowledge the student will need to have.

Physical sciences background with an interest in developing computational skills - programming and computational basics would be helpful but you'll be supported in learning the specific skills required. The student should have an interest in data collection and visualisation, and very good attention to detail. Most importantly they should be enthusiastic to learn more about experimental quantum science and the hardware that supports this work. This project is most suitable for a 1A or 1B student.

Facilities available (e.g. supervision, membership of a research group, support, etc.)

The student will be part of a large research team (a sub-group of 10 people, in a wider group of 20) and will have the opportunity to join any group activities that interest them. They would be encouraged to shadow other team members to learn about lab operations, both to aid the development of the project and to learn more about the underlying physics of the experiments. The team has weekly meetings and journal clubs. Due to a period of leave for the primary supervisor, supervision will be primarily by two designated PhD students with oversight from a senior academic.

Duration of the project (All projects should be between 6 - 10 weeks long.)

6 weeks

Please indicate your preferred start date below, or if you don't have a preference:

no preference

Please indicate what arrangements can be made for any longer periods of absence during the summer below.

Leave will cover the entire summer but two enthusiastic PhD students have offered to supervise the project - I will develop the project goals with them in some detail and they will have the oversight of a senior academic.

How many students would the project be suitable for? (Please note that all submitted projects should be able to operate with one student only, even if multiple participants would be advantageous.)

1

Any other comments

Research Project Title: Hardware Cyclometer emulator using Field-Programmable Gate Arrays (FPGA)

Supervisor name and role at King's: Tim Flack, Fellow

Supervisor email: tjf1000@cam.ac.uk

Research Project description

The Polish Cyclometer was the first electromechanical device invented to assist in the breaking of the Enigma code. In a world first, the Cyclometer was recreated in a collaboration between King's College and the Cambridge University Engineering Department, to match the original as closely as possible. However, this came at great cost both financial and in terms of the time taken. This project aims to recreate the Cyclometer using the Field-Programmable Gate Array (FPGA), which is a form of reconfigurable integrated circuit. Not only will this be useful as a means of showing the workings of the Cyclometer more clearly, the project could be used to inform a variety of STEM outreach projects using FPGAs to inspire the next generation of computer scientist and engineering students.

Student learning outcomes

Cryptanalysis methods that were originally used to break the Enigma. FPGA design and programming. Other hardware design.

New skills the student will develop

As above, none of the above-mentioned are likely to be covered in undergraduate courses.

Profile of a successful applicant, including any necessary skills or knowledge the student will need to have.

A knowledge of circuit construction and programming needed. Ideally some experience of FPGAs.

Facilities available (e.g. supervision, membership of a research group, support, etc.)

Regular supervision, use of facilities in the Engineering Department.

Duration of the project (All projects should be between 6 - 10 weeks long.)

10 weeks

Please indicate your preferred start date below, or if you don't have a preference:

30 June

How many students would the project be suitable for? (Please note that all submitted projects should be able to operate with one student only, even if multiple participants would be advantageous.)

2

Any other comments

This project will be best suited to engineering students or computer science students who have experience in circuit design and build.

Research Project Title: Software emulator and visualisation of the Polish Bomba

Supervisor name and role at King's: Tim Flack, Fellow

Supervisor email: tjf1000@cam.ac.uk

Research Project description

The Polish Bomba was the second electromechanical device used in the regular breaking of the Enigma in the lead up to the Second World War. Although the principles of the Bomba are well known, there are no surviving Bombas, and recreating them in their original form would be a formidable task. The aim of this project is to emulate the operation of the Bomba, and then develop graphical visualisation tools to show how it works. As well as aiding the understanding of this historically-important device, the project could be used in engineering or computer science outreach work.

Student learning outcomes

Cryptanalysis methods that were used to break the Enigma. Software design and programming. Graphical design and implementation.

New skills the student will develop

As above.

Profile of a successful applicant, including any necessary skills or knowledge the student will need to have.

Some experience of writing software would be useful, particular graphics programming. Knowledge of web design so that the outcome can be made public. Ability to understand advanced cryptanalysis methods.

Facilities available (e.g. supervision, membership of a research group, support, etc.)

Regular supervision.

Duration of the project (All projects should be between 6 - 10 weeks long.)

10 weeks

Please indicate your preferred start date below, or if you don't have a preference:

30 June

How many students would the project be suitable for? (Please note that all submitted projects should be able to operate with one student only, even if multiple participants would be advantageous.)

1

Any other comments

This project would suit engineering, computer science, mathematics or NST Physical students with an interest and aptitude in programming.

Research Project Title: Reviewing the ethics of using neurotechnologies in healthcare

Supervisor name and role at King's: Coco Newton, College Research Associate

Supervisor email: ccn30@cam.ac.uk

Research Project description

Neurological and neuropsychiatric disorders have enormous social and economic impacts. In the UK, one in six people – 16.5 million individuals – has at least one neurological condition, with a cost to the NHS of £4.4 billion per year. These disorders go far beyond issues with movement and motor skills; they include Alzheimer's, epilepsy, addiction, and depression. We're part of a new government research programme (ARIA; Advanced Research and Innovation Agency) which seeks to develop next-generation precision neurotechnologies capable of interfacing with the human brain at the circuit level to achieve more precise and effective treatments for brain disorders. While the opportunities arising from these neurotechnologies are vast, their risks are not just commensurately large but also largely unknown, falling into two major categories of either technological risk (the interventions themselves fail, cause harm, or do not deliver promised benefits) or implementation risk (they are not deployed in a manner that best meets the needs of the most people). The latter is particularly pertinent both in light of longstanding inequities in healthcare provision to ethnic minorities and other historically disadvantaged communities and in the very nature of neurotechnologies which may aggravate digital era two-tier societal segregation into "haves" and "have-nots". The future availability of precision neurotechnologies may give rise to additional unknown sources of risk that associate with the unique features of the brain, including wider issues of privacy, self-identity and cognitive enhancement. As part of our interdisciplinary team of researchers from Cambridge and UCL, you will lead on a review of the literature around these ethical issues of neurotechnologies, drawing from research studies to regulatory documents and reports from international bodies. With support from researchers from the Engineering Design Centre and the Kavli Centre for Ethics, Science and the Public, the outcome of your review will contribute to the development of our new framework to help neurotechnology innovators accelerate the implementation of their devices into healthcare settings – ensuring that they are risk managed, equitable and feasible.

Student learning outcomes

Gain knowledge about the current state and future potential of neurotechnologies, including their applications and limitations; Experience working in an interdisciplinary team, integrating perspectives from engineering, ethics, science, and public policy; Learn about the challenges and opportunities in translating innovative technologies into practical healthcare solutions.

New skills the student will develop

Formulate a clear research question, conduct comprehensive literature searches across relevant databases, critically appraise the quality of studies, extract relevant data, synthesize findings from diverse sources, assess potential biases, and interpret results in a structured and transparent manner

Profile of a successful applicant, including any necessary skills or knowledge the student will need to have.

Knowledge of either neuroscience, psychology, philosophy of the mind, or ethics (essential); Broad curiosity around the future potential of neurotechnologies (desirable); Experience reading and critiquing academic literature (desirable)

Facilities available (e.g. supervision, membership of a research group, support, etc.)

A desk space in the Engineering Design Centre on Trumpington Street; weekly supervision from neuroscience and ethics researchers; opportunity to attend weekly lab meetings at the Institute of Cognitive Neuroscience (UCL) and Health Systems Group (Cambridge)

Duration of the project (All projects should be between 6 - 10 weeks long.)

8-10 weeks

Please indicate your preferred start date below, or if you don't have a preference:

7 July

How many students would the project be suitable for? (Please note that all submitted projects should be able to operate with one student only, even if multiple participants would be advantageous.)

1-2

Any other comments