SUMMER RESEARCH PROGRAMME
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The University of Liverpool was founded in 1881, and was one of the founding members of the Russell Group, an elite group of British research universities. Our unique Summer Research Programme allows students the opportunity to undertake a research project in their field alongside one of our world-leading academics.

Students will be enrolled in a 15-credit module that is entirely research-based. At the conclusion of the programme, students will participate in a mini-conference where they will present their research in a poster alongside their peers.

All of the available projects are listed in this brochure. Additional projects may be added until the end of December 2019, so please check back for updates. Keep in mind that you must select a specific project to apply for when applying to the programme.

THE DATES

Students may study for 4, 8, or 12 weeks, depending on the requirements of their specific project. All students must arrive in time for the official start of their session, as this is when the mandatory on-site orientation will take place. All projects are worth 15 credits no matter how long the student stays in Liverpool; the longer the stay, the more spread out the research will be.

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There will be three mini-conferences held during the summer; all students must present their research on one of these dates as a part of their assessment. Which of these dates can be agreed upon with the supervisor of the project. The mini-conference dates are as follows:

- Wednesday, June 24
- Wednesday, July 22
- Wednesday, August 19
ACCOMMODATION

Students will have the option of on-campus housing at Melville Grove, a University hall of residence, in single rooms during the Summer Research Programme. Students will be required to pay a £150 booking fee (non-refundable) to confirm their place in housing after being accepted to the programme. Students may also opt to arrange their own private accommodation.

Students attending the first session from June 1 who opt for university accommodation will be housed off campus until June 14 at the Sleep Eat Love hostel in a private, en-suite room. More information will be given after acceptance to the programme. All students will be able to move in on the Sunday before their start date during all sessions.

Housing prices for Summer 2020 are as follows:
- Session 1 (May 31-June 27, 2020): £696.92
- Session 2 (June 28-July 25, 2020): £553.84
- Session 3 (July 26-August 21, 2020): £553.84

CULTURAL ACTIVITIES

Studying abroad isn’t just about studying! We want you to spend your free time enjoying Liverpool and its surroundings to the fullest, which is why we’ve prepared some activities for you to get to know the Northwest of England! Students will have the opportunity to participate on day trips over the weekend to places like Snowdonia National Park, Chester, or York for a small extra fee. There will also be opportunities to explore Liverpool through various activities offered by the University for its students.

The University of Liverpool is located within 45 minutes to two major airports, providing links to most European destinations within a matter of hours! London is only about 2 hours away by train, and other major British cities like Manchester or Edinburgh are also easily accessible. While you’re completing your research with us, why not take the opportunity to explore other parts of Europe and the UK in your free time? Liverpool is perfectly located for such an opportunity.
HOW TO APPLY

Nominations and applications will open on January 15. Students who are applying from a partner university on an exchange basis should wait to receive an e-mail following the nomination from their home university. Students applying as a visiting, fee-paying student may apply directly online through our general application link.

The deadline to apply for projects is March 1.

When applying, students should note the specific project they are applying for, and should write their personal statement with that project and supervisor in mind. Students will apply through our online system, Mobility Online. When selecting their modules, they should note the module code as listed in this guide, as well as the project title. All projects are worth 15 credits at the University of Liverpool.

The application criteria are as follows:

• 3.0 Cumulative GPA or equivalent
• Must meet our English language requirements if not a native speaker
• Must fulfill any special requirements noted on the project detail pages

Students must submit:
• University transcript
• Proof of English language qualifications
• Personal statement detailing why you’re interested in the project, what experience you have related to the project, and how you fulfill any of the specific requirements noted in the project details

Students will be notified by the end of April if they’ve been successful in their application. Note that this is a competitive programme, and while we will endeavour to place students on their preferred project, admission is not guaranteed.

Questions? Contact us at erasmus@liverpool.ac.uk
Arts
GULF ARCHITECTURE PROJECT

SUPERVISOR DR GIAMILA QUATTRONE

Trained and registered as an architect in Italy, Dr Giamila Quattrone is Lecturer in Architecture at the University of Liverpool, where she has been recently appointed Faculty Lead of the Digital Heritage Sub-Theme. Previously she held numerous teaching and research positions in Italy at Università degli Studi Mediterranea di Reggio Calabria, in UK at Nottingham Trent University and Manchester Metropolitan University, and in Australia at The University of Newcastle and The University of New South Wales. In 2012 she established, with Prof Soumyen Bandyopadhyay and other colleagues, the ArCHIAM Centre (Study of Architecture and Cultural Heritage of India, Arabia and the Maghreb), which she has been since coordinating, working on heritage documentation, management and development in Oman and Morocco, through consultancy, research and design projects as well as capacity building and public engagement initiatives. Her research revolves around three main strands: settlement, architectural and construction patterns of traditional oasis settlements of Oman, Morocco and Tunisia, with a focus on their spatial and technological transformation as a result of socio-cultural and economic change; the work of Australian architect Glenn Murcutt; urban recycling and building adaptive reuse.

EMAIL: giamilaq@liverpool.ac.uk

SCHOOL: Arts

DEPARTMENT: Architecture

MODULE CODE: SOTA350

SUITEABLE FOR STUDENTS OF: Architecture

PLACES AVAILABLE: 2
GULF ARCHITECTURE PROJECT

PROJECT DESCRIPTION
The Gulf Architecture Project (GAP), a collaborative undertaking between the University of Liverpool and the Qatar National Library, seeks to provide an exciting and unique history of architectural identity and associated socio-cultural and economic commentary on Qatar and the Gulf region through the story of its architectural heritage, focusing on houses, their associated material culture, social customs, and history from the 1700s to 1960s.

The project aims to create a cohesive and comprehensive “digital knowledge platform” on the architectural heritage of Qatar and its region, hosted by the Qatar Digital Library (QDL). This is done by synthesising the existing bodies of literature, audio/video recordings and visual material (photographs, maps, drawings, historical imagery, etc.) of vernacular buildings towards creating a central digital archive in order to establish the “big picture” of Gulf Arab housing and material culture.

ADDITIONAL REQUIREMENTS

EXPERIENCE
- Literature review and use of reference manager software (eg., Mendeley).
- Use of desktop publishing and graphic design software, i.e, Photoshop, InDesign, Illustrator.
- Use of CAD software, i.e, AutoCAD, 3D Studio Max, Rhinoceros, Revit.

SKILLS, GENERAL AND SPECIAL KNOWLEDGE
- Good interpersonal skills and excellent communication both verbally and in written format.
- Good time management and organizational skills.
- Ability to plan and undertake activities, prioritising work independently and as part of a team, in order to deliver individual and team objectives.
- Ability to co-ordinate own work with that of others to avoid conflict or duplication of effort.
- Proactive and self-motivated.
- Flexible and enthusiastic attitude to work.
- Able to absorb new information and apply new knowledge quickly.
- Able to use initiative, creativity and judgement to tackle issues.
- Excellent attention to detail and accuracy.

PROJECT DATES

START DATE(S): Session 1 (June 1, 2020)

END DATE(S): July 24, 2020

LENGTH: 8 or 12 weeks
Electrical Engineering, Electronics, and Computer Science
I/O-EFFICIENT ALGORITHMS FOR EXPLORING BIG GRAPHS

SUPERVISOR DR KONSTANTINOS TSAKALIDIS

Dr Konstantinos Tsakalidis is a Lecturer in the Department of Computer Science at the School of Electrical Engineering, Electronics and Computer Science of the University of Liverpool. His research interests are in algorithms & data structures, graph algorithms, computational geometry and Big Data engineering.

EMAIL: K.Tsakalidis@liverpool.ac.uk

SCHOOL: Electrical Engineering, Electronics, and Computer Science

DEPARTMENT: Computer Science

MODULE CODE: COMP298

SUITABLE FOR STUDENTS OF: Algorithms & Data Structures

PLACES AVAILABLE: 2
I/O-EFFICIENT ALGORITHMS FOR EXPLORING BIG GRAPHS

PROJECT DESCRIPTION

Implement one of the following algorithms for exploring a graph stored on disk: breadth-first search, depth-first search, single source shortest paths, A* heuristic.

The project’s objectives are (i) to evaluate the I/O-performance of different implementations of basic priority queue data structures, and (ii) to apply the most efficient priority queue in the chosen exploration algorithm.

ADDITIONAL REQUIREMENTS

The student should have good to excellent knowledge about Linux, bash scripting and C++. The student should have interest for software engineering, graph algorithms, big data analytics.

PROJECT DATES

START DATE(S): Session 1 (June 1, 2020)
Session 2 (June 29, 2020)

END DATE(S): July 24, 2020
August 21, 2020

LENGTH: 8 or 12 weeks
MODULARITY IN PLANAR NETWORKS

SUPERVISOR DR MICHELE ZITO

Dr. Michele Zito is a lecturer in the Department of Computer Science of the University of Liverpool. He obtained a Ph.D. in Computer Science from the University of Warwick (UK), after completing his undergraduate studies in Italy, and an M.Sc. in Edinburgh. Author of more than 80 publications including articles on prestigious journals such as Theoretical Computer Science (Elsevier) and Algorithmica (Springer) and conferences including the ACM Symposium on Discrete Algorithms, his main research interests are the design and analysis of efficient algorithms, particularly related to Graph Theory, and the study of Random Structures. Over the past five years he became involved in a number of projects related to Complex Networks, and Domestic Renewable Energy Management.

EMAIL: michele@liverpool.ac.uk

SCHOOL: Electrical Engineering, Electronics, and Computer Science

DEPARTMENT: Computer Science

MODULE CODE: COMP298

SUITABLE FOR STUDENTS OF: Degree programmes including Algorithm Design and Analysis or the study of Networks

PLACES AVAILABLE: 1
MODULARITY IN PLANAR NETWORKS

PROJECT DESCRIPTION

The project is in the area of complex network analysis, an area of great importance in an age in which sensors and electronic devices make large amount of data easily accessible. The assortativity of a large network with respect to a given classification of the network nodes measures ¨the tendency for vertices in networks to be connected to other vertices that are like or unlike them according to the given classification.¨ Network modularity describes the maximum assortativity of a the given network. Planar networks (i.e. networks that can be drawn on a 2-dimensional surface without line crossing) tend to have high modularity, whereas networks generated by placing edges at random have low modularity. We plan to study computationally the modularity of so called Empire Networks, that somehow lay in between Planar and arbitrary random networks.

ADDITIONAL REQUIREMENTS

Knowledge of Python will be beneficial.

PROJECT DATES

START DATE(S): Session 1 (June 1, 2020)
Session 2 (June 29, 2020)

END DATE(S): July 24, 2020
August 21, 2020

LENGTH: 8 or 12 weeks
Dr Eduardo Coutinho is a Lecturer in Music Psychology at the Department of Music from the University of Liverpool and the Director of the APPLIED MUSIC Research Lab. He works in the interdisciplinary fields of Music Psychology and Affective Computing, where his expertise is in the study of emotional expression, perception and induction through music. He has contributed significantly to a broader understanding of the emotional impact of music on listeners, namely on the link between music structure and emotion, the types of emotions induced by music, and individual and contextual factors that mediate the relationships between music and listeners. Currently, his work focuses on the application of music in everyday life (and particularly Healthcare settings).

**EMAIL:** E.Coutinho@liverpool.ac.uk

**SCHOOL:** Arts

**DEPARTMENT:** Music

**MODULE CODE:** SOTA350

**SUITABLE FOR STUDENTS OF:**
- Computer Sciences
- Healthcare Informatics
- Music Psychology
- Affective Sciences

**PLACES AVAILABLE:** 2
PROJECT DESCRIPTION

Listening to music whilst exercising (e.g., running) can be a motivational booster as well as an performance enhancer. In this project, we aim at developing a software (website/mobile app) that helps people making the right music selections for specific types of exercise.

ADDITIONAL REQUIREMENTS

Students are expected to be experienced software developers (ideally with experience in mobile app development) and willing to engage with Music Psychology research.

PROJECT DATES

START DATE(S): Session 1 (June 1, 2020)

END DATE(S): June 26, 2020 (4 weeks)
July 24, 2020 (8 weeks)

LENGTH: 4 or 8 weeks
MUSIC SELECTIONS FOR REDUCING BLOOD PRESSURE

SUPERVISOR

Dr EDUARDO COUTINHO

Dr Eduardo Coutinho is a Lecturer in Music Psychology at the Department of Music from the University of Liverpool and the Director of the APPLIED MUSIC Research Lab. He works in the interdisciplinary fields of Music Psychology and Affective Computing, where his expertise is in the study of emotional expression, perception and induction through music. He has contributed significantly to a broader understanding of the emotional impact of music on listeners, namely on the link between music structure and emotion, the types of emotions induced by music, and individual and contextual factors that mediate the relationships between music and listeners. Currently, his work focuses on the application of music in everyday life (and particularly Healthcare settings).

EMAIL: E.Coutinho@liverpool.ac.uk

SCHOOL: Arts

DEPARTMENT: Music

MODULE CODE: SOTA350

SUITABLE FOR STUDENTS OF: Computer Sciences, Healthcare Informatics, Music Psychology, Affective Sciences

PLACES AVAILABLE: 2
PROJECT DESCRIPTION

Listening to certain types of music can lower blood pressure, but those effects depend on the characteristics of music that is listened to. In this project, we aim at developing a software (webpage or mobile app) that can generate music selections with the potential of lowering blood pressure. The ultimate aim is to apply this tool to help suffering from diseases such as hypertension and heart failure, which can have major implications in their quality of life.

ADDITIONAL REQUIREMENTS

Students are expected to be experienced software developers (ideally with experience in mobile app development) and willing to engage with Music Psychology research.

PROJECT DATES

START DATE(S): Session 1 (June 1, 2020)

END DATE(S): June 26, 2020 (4 weeks)

LENGTH: 4 or 8 weeks
Dr. Michele Zito is a lecturer in the Department of Computer Science of the University of Liverpool. He obtained a Ph.D. in Computer Science from the University of Warwick (UK), after completing his undergraduate studies in Italy, and an M.Sc. in Edinburgh. Author of more than 80 publications including articles on prestigious journals such as Theoretical Computer Science (Elsevier) and Algorithmica (Springer) and conferences including the ACM Symposium on Discrete Algorithms, his main research interests are the design and analysis of efficient algorithms, particularly related to Graph Theory, and the study of Random Structures. Over the past five years he became involved in a number of projects related to Complex Networks, and Domestic Renewable Energy Management.

**EMAIL:** michele@liverpool.ac.uk

**SCHOOL:** Electrical Engineering, Electronics, and Computer Science

**DEPARTMENT:** Computer Science

**MODULE CODE:** COMP298

**SUITABLE FOR STUDENTS OF:** Degree programmes including Algorithm Design and Analysis or the study of Networks

**PLACES AVAILABLE:** 2
NETWORK TOMOGRAPHY

PROJECT DESCRIPTION

A central issue in communication networks is to ensure that the given structure works reliably. Network Tomography is a family of distributed failure detection algorithms based on the spreading of end-to-end measurements rather than directly measuring individual network components. Typically a network is given as a graph along with a collection of paths in it and the goal is to take measurements along such paths to infer properties of the given network. Quoting Duffield (2003) "A key advantage of tomographic methods is that they require no participation from network elements other than the usual forwarding of packets. This distinguishes them from well-known tools such as traceroute or ping, that require ICMP responses to function. [...] Another feature of tomography is that probing and the recovery of probe data may be embedded within transport protocols, thus co-opting suitably enabled hosts to form impromptu measurement infrastructures". In early work we have studied tomographical algorithms on various network topologies, including, grids, randomnetworks, and hypercubes. The aim of this project is to runexperiments to test the effectiveness of such algorithms in detectingnode failure, as well as different traffic loads.

ADDITIONAL REQUIREMENTS

Knowledge of Combinatorics and Graph theory would help, but also interest in programming (Python) would be beneficial.

PROJECT DATES

START DATE(S):  
Session 1 (June 1, 2020)  
Session 2 (June 29, 2020)

END DATE(S):  
July 24, 2020  
August 21, 2020

LENGTH:  
8 or 12 weeks
I am co-Editor in Chief of Argument and Computation. I am a lecturer in the Department of Computer Science, at the University of Liverpool, UK, where I am a member of the Agent ART research group. I am Deputy Director of the on-line MSc programmes in Computing, fully delivered over the Internet. Other admin tasks include departmental European Liaison Officer, coordinating exchange student programmes, and departmental e-Learning specialist.
SELF TRACKING USING PERSUASIVE TECHNOLOGY

PROJECT DESCRIPTION

Persuasive technology is a relatively recent area which studies the impact that digital interventions can have on people's behaviour or beliefs.

A widely used set of guidelines to identify what persuades are the "6 Cialdini’s Principles" (you can find a quick animated video introduction here: http://www.youtube.com/watch?v=cFdCzN7RYbw

You are invited to think of self tracking/self monitoring behaviour (e.g. walk more, cut on sugar/vape etc., control your use of socials, turn off your phone, etc.) and create an app based on one or more of the Cialdini’s principles.

PROJECT DATES

START DATE(S):
- Session 1 (June 1, 2020)
- Session 2 (June 29, 2020)
- Session 3 (July 27, 2020)

END DATE(S):
- June 26, 2020
- July 24, 2020
- August 21, 2020

LENGTH: 4, 8, or 12 weeks
STYLOMETRIC ANALYSIS OF TWEETS

SUPERVISOR: DR FLORIANA GRASSO

I am co-Editor in Chief of Argument and Computation. I am a lecturer in the Department of Computer Science, at the University of Liverpool, UK, where I am a member of the Agent ART research group. I am Deputy Director of the on-line MSc programmes in Computing, fully delivered over the Internet. Other admin tasks include departmental European Liaison Officer, coordinating exchange student programmes, and departmental e-Learning specialist.

EMAIL: floriana@liverpool.ac.uk
SCHOOL: Electrical Engineering, Electronics, and Computer Science
DEPARTMENT: Computer Science
MODULE CODE: COMP298
SUITABLE FOR: Computer Science, AI
STUDENTS OF: Persuasive Technology
PLACES AVAILABLE: 1
STYLOMETRIC ANALYSIS OF TWEETS

PROJECT DESCRIPTION

"Stylometry" is the study of features related to literary style through computational methods, based on the assumption that authors write in a consistent way. A quick intro is here:


The project will look at devising appropriate stylometry techniques to analyse a data set of social media content (such as the ICWSM Spinn3r dataset).

ADDITIONAL REQUIREMENTS

Some knowledge of machine learning techniques would be preferred, but not essential.

PROJECT DATES

START DATE(S):  
Session 1 (June 1, 2020)  
Session 2 (June 29, 2020)  
Session 3 (July 27, 2020)

END DATE(S):  
June 26, 2020  
July 24, 2020  
August 21, 2020

LENGTH:  
4, 8, or 12 weeks
VISUALISING BIG DATASETS OF 3-DIMENSIONAL CRYSTALS

SUPERVISOR DR VITALIY KURLIN

Dr Vitaliy Kurlin is a mathematician by training, now teaching in Computer Science and collaborating with Chemists in the new Materials Innovation Factory: liverpool.ac.uk/materials-innovation-factory. Details of the research group and publications are at http://kurlin.org.

EMAIL:  vkurlin@liv.ac.uk

SCHOOL:  Electrical Engineering, Electronics, and Computer Science

DEPARTMENT:  Computer Science

MODULE CODE:  COMP298

SUITEABLE FOR STUDENTS OF:  Geometric and Topological Data Analysis with applications to Crystallography and Materials Science

PLACES AVAILABLE:  3
VISUALISING BIG DATASETS OF 3-DIMENSIONAL CRYSTALS

PROJECT DESCRIPTION

Solid crystalline materials (briefly, crystals) underpin many modern and future technologies from high-temperature superconductors to solar cells and gas capture to tackle the climate emergency.

An ideal crystal is defined by a collection of atoms or molecules in a non-rectangular box that is periodically translated in 3 independent directions. The key challenge in crystal discovery is to quantify a similarity between crystals in a new continuous way to explore "hot spots" and "black gaps" in the space of all theoretically possible crystals.

We aim to map the continuous space of crystals by using geometric invariants (distances, angles) that remain stable under atomic vibrations and should uniquely identify any crystal. Your implemented code can substantially contribute to speeding-up a discovery of new materials. More specific example projects are at http://kurlin.org/student-projects.php#potential

The first steps in the project will be to install and start using the Computational Geometry Algorithms Library (CGAL, https://www.cgal.org). The other potentially useful software are Eigen (http://eigen.tuxfamily.org) for linear algebra and Mercury (https://ccdc.cam.ac.uk/Community/csd-community/FreeMercury/) for visualising individual crystals given by CIFs, see https://en.wikipedia.org/wiki/Crystallographic_Information_File.

ADDITIONAL REQUIREMENTS

Programming skills in C++ or Python, excellent communication skills, ability to work in a team and learn new topics.

PROJECT DATES

START DATE(S): Session 1 (June 1, 2020)

END DATE(S):

LENGTH: 8 or 12 weeks
GAS SENSING WITH ZNO THIN FILM TRANSISTORS

SUPERVISOR  DR IAN SANDALL

I obtained my PhD in Physics from Cardiff University in 2007 and have since worked for Philips Research in Eindhoven, The University of Sheffield and I am now a Lecturer in Electrical Engineering and Electronics at The University of Liverpool. My research concerns the development and application of semiconductor photonic devices. These are devices that convert electrical signals into light (or vice-versa) and include things such as LEDs, Lasers, and CCD Cameras (as used in mobile phones). My current research is concerned with utilizing these devices to develop sensors for a variety of applications, including medical, defence and astronomical observation.

EMAIL:  isandall@liverpool.ac.uk

SCHOOL: Electrical Engineering, Electronics, and Computer Science

DEPARTMENT: Electrical Engineering and Electronics

MODULE CODE: ELEC298

SUITABLE FOR STUDENTS OF:  Electrical Engineering

PLACES AVAILABLE:  4
GAS SENSING WITH ZNO THIN FILM TRANSISTORS

PROJECT DESCRIPTION

Over the last few decades, with the rapid development of industrialization and urbanization, the severe air pollution primarily attributed to automobile exhaust and factory emission has become a great threat to human survival and development. Meanwhile, a leakage of flammable and explosive gases may result in loss of life and property damage. So, real-time and effective detection of those harmful gases via using gas sensors is in pressing need at present. Off all the numerous semiconductor gas sensors, semiconducting metal oxide based gas sensors have received wide research around the globe by virtue of their high gas response, excellent selectivity, good portability, and low fabrication cost.

Thin film and nano particle ZnO based transistors are highly sensitive to their surrounding environment. Chemical compounds in the atmosphere are able to bind and modify the surface potential of the ZnO resulting in measurable changes in the transistors electrical performance (i.e. causing a shift in the turn on voltage). As such these devices make promising candidates for low cost and portable gas sensing devices.

As well as environmental and industrial based gases as described above, the ability to monitor gases also has applications in medical diagnosis and treatments. One gas of particular interest is ketone (acetone), this is produced in people with diabetes and as such the reliable and accurate monitoring of ketone in breath samples offers a potential route to develop non-invasive diagnosis for diabetes, eliminating the need for repeated blood finger prick based tests, and long term creating the possibility of utilizing a mobile phone sensor and app to monitor glucose levels.

In this project the student will fabricate ZnO thin film Transistors, via thin film deposition techniques and characterize their electrical properties both under ambient conditions and when exposed to gases such as acetone. The selectivity and sensitivity of the devices will be evaluated, with an aim to determine the optimum device design.

PROJECT DATES

START DATE(S):
- Session 1 (June 1, 2020)
- Session 2 (June 29, 2020)
- Session 3 (July 27, 2020)

END DATE(S):
- June 26, 2020
- July 24, 2020
- August 21, 2020

LENGTH: 4, 8, or 12 weeks
GRAPH NEURAL NETWORKS FOR COMBINATORIAL PROBLEMS

SUPERVISOR  DR XINPING YI

Xinping Yi (S’12-M’15) has been a Lecturer (Assistant Professor) at the Department of Electrical Engineering and Electronics of the University of Liverpool since July 2017. He received his Ph.D. degree in Electronics and Communications (2015) from Telecom ParisTech, Paris, France. Prior to Liverpool, he was a research associate at Technische Universitat Berlin, Berlin, Germany (2014-2017), a research assistant at EURECOM, Sophia Antipolis, France (2011-2014), and a research engineer at Huawei Technologies, Shenzhen, China (2009-2011). His main research interests include information theory, graph theory, optimisation and machine learning, as well as their applications in wireless communications and artificial intelligence.

EMAIL:  xinping.yi@liverpool.ac.uk

SCHOOL: Electrical Engineering, Electronics, and Computer Science

DEPARTMENT: Electrical Engineering and Electronics

MODULE CODE:  ELEC298

SUITABLE FOR STUDENTS OF:  Deep Learning

PLACES AVAILABLE:  2
GRAPH NEURAL NETWORKS FOR COMBINATORIAL PROBLEMS

PROJECT DESCRIPTION

Many real-world problems, such as ride-sharing scheduling for online Taxi services (e.g., Uber, Didi), can be cast into combinatorial optimisation. Such problems are usually challenging to solve, especially when the size of the problem (e.g., the number of taxis) is considerably large. Graph Neural Networks (GNN) have been increasingly applied to solve such combinatorial problems and produce novel and efficient algorithms. This project aims to develop novel GNN architectures and algorithms to solve combinatorial problems such as dynamic task assignment and apply them to real-world applications of ride-sharing Taxi scheduling.

ADDITIONAL REQUIREMENTS

1. Basic knowledge of deep learning.

PROJECT DATES

START DATE(S): Session 1 (June 1, 2020)  Session 2 (June 29, 2020)

END DATE(S): July 24, 2020  August 21, 2020

LENGTH: 8 or 12 weeks
Engineering
The School of Engineering is open to hosting students on summer research projects in any of the research areas within the school, led by our 70 academic staff members.

Students with an interest in a particular area of Engineering can see the activities of the University’s 3 research centres on these web pages:

- Centre for Engineering Dynamics
- Centre for Engineering Sustainability
- Centre for Materials and Structures

Students should pick 3 possible research areas of interest or staff members they would like to work with and list them on Mobility Online (the online application) with the area of interest or staff member as the module title. Students should also expand upon their interest in their personal statement.

Previous projects have been available in the following areas:

- Engineering Sustainability
- Materials and Structure
- Engineering Dynamics
- Renewable Energy
- Risk and Uncertainty
- Virtual Engineering
- Aerospace Engineering & Avionics
- Nuclear Engineering
- Mechanical & Manufacturing Engineering
- Industrial Design
- Civil Engineering
- Architectural Engineering
- Biomedical Engineering
- Flight Science
- Additive Manufacturing

EMAIL: murphym@liverpool.ac.uk

SCHOOL: Engineering

MODULE CODE: ENG290

DATES: Available for 4-12 weeks during all sessions depending on project and supervisor. Students should indicate which dates they would want to attend in their personal statement.
IMPACT OF SOFT CONTACT LENS PERIPHERAL ZONE DESIGN ON OPTICAL POWER

SUPERVISOR DR AHMED ABASS

Dr Ahmed Abass is a lecturer at the school of Engineering, University of Liverpool. Dr Abass’s research is focused on the ocular biomechanics of the human eye. He works in the area of medical devices simulation and manufacturing.

EMAIL: a.abass@liverpool.ac.uk

SCHOOL: Engineering

DEPARTMENT: Engineering

MODULE CODE: ENG290

SUITEABLE FOR: Biomedical Engineering

STUDENTS OF:

PLACES AVAILABLE: 4
IMPACT OF SOFT CONTACT LENS PERIPHERAL ZONE DESIGN ON OPTICAL POWER

PROJECT DESCRIPTION

This project will involve an investigation component and design component ultimately focused on the impact of soft contact lens “peripheral zone” design on the optical power of the lens.

While there is available research regarding “optic zone” design for soft contact lenses, there has been comparatively little work performed on designing the soft lens “peripheral zone”. “Peripheral zone” design primarily affects the positioning of the lens on the eye and has a significant effect on the lens fit for the patient. Improving peripheral zone design practices may lead to soft lens designs that increase patient comfort, particularly for patients with astigmatism that rely on a fixed orientation of the lens for clear vision.

In this project, soft contact lenses of varying peripheral zone designs will be generated as finite element models using MATLAB and simulated on a model of the human eye in FEA software such as FEBio. The simulation results will be analysed by a MATLAB light ray-tracing code to identify the impact of each peripheral zone design on the power of the optic zone of the lens while on the eye. The results will be assessed to identify factors in peripheral zone lens design that minimize the variation in optical power across the optic zone. The results may further be used to generate a contact lens design with a peripheral zone optimal for minimising power variance across the optic zone.

ADDITIONAL REQUIREMENTS

Candidates are expected to use the available resources in the school of engineering, mainly computer labs and the MATLAB software package, in addition to the free finite element software package FE-BIO.

PROJECT DATES

START DATE(S):
- Session 1 (June 1, 2020)
- Session 2 (June 29, 2020)
- Session 3 (July 27, 2020)

END DATE(S):
- June 26, 2020
- July 24, 2020
- August 21, 2020

LENGTH: 4, 8, or 12 weeks
Determinations of Human Eye’s Optic Axes by Corneal Topography

Supervisor: Dr Ahmed Abass

Dr Ahmed Abass is a lecturer at the school of Engineering, University of Liverpool. Dr Abass’s research is focused on the ocular biomechanics of the human eye. He works in the area of medical devices simulation and manufacturing.

Email: a.abass@liverpool.ac.uk

School: Engineering

Department: Engineering

Module Code: ENG290

Suitable for: Biomedical Engineering

Places Available: 4
PROJECT DESCRIPTION

In this project, an innovative algorithm of finding the eye’s optical axis from topography data will be explored. The optical axis represents the path of a light-ray that enters and leaves the optical system of the eye along the same line.

While the eye’s optical axis may be a theoretical construct, the axis remains an important reference line for the measurement and the analysis of the ocular shape. Its applications include being a geometrical axis for spectacles and other corrective lenses that are manufactured in processes that require a unique axial centreline like a lathe centred on its spindles or an injection moulding machine where centring the two halves of the mould around a geometrical axis is an essential process.

As a line, the optical axis can be identified by two points. Accordingly, the student is expected to find the optimal optical axis of human eyes using the geometrical data of the anterior and posterior corneal surfaces as measured by topography machines. MATLAB Optimisation Toolbox (MathWorks, Natick, USA) will be used for finding the optimal intersection points of the optical axis with the corneal front and back surfaces. Then, a MATLAB code will be used to validate the optimal position of the eye’s optical axis that does not refract light rays through a light ray-tracing algorithm. All analysed will be carried out via custom-built MATLAB codes.

ADDITIONAL REQUIREMENTS

Candidates are expected to use the available resources in the school of engineering, mainly computer labs and the MATLAB software package.

PROJECT DATES

START DATE(S): Session 1 (June 1, 2020)
Session 2 (June 29, 2020)
Session 3 (July 27, 2020)

END DATE(S): June 26, 2020
July 24, 2020
August 21, 2020

LENGTH: 4, 8, or 12 weeks
Environmental Sciences
RECONSTRUCTING FOOD WEBS USING STABLE ISOTOPIES

SUPERVISOR  DR RACHEL JEFFREYS

I am a benthic ecologist/biogeochemist. I am particularly interested in deep-sea habitats (>200 m water depth). My primary research focus is food web ecology and organic matter biogeochemistry. My main research emphasis is on how organic matter quality and quantity structures benthic communities/food webs and in turn how these communities process and alter organic matter.

EMAIL:  rachel.jeffreys@liverpool.ac.uk

SCHOOL:  Environmental Sciences

DEPARTMENT:  Earth, Ocean, and Ecological Sciences

MODULE CODE:  TBA

SUITSABLE FOR STUDENTS OF:  Marine Biology
                                     Oceanography
                                     Environmental Science
                                     Biological Science
                                     Ecology

PLACES AVAILABLE:  2
PROJECT DESCRIPTION

In this project you will use the stable isotopes of carbon and nitrogen as a tool to investigate food web properties in the deep ocean. You will generate your own data by preparing samples for stable isotope analysis in the LIFER (Liverpool Isotopes for Environmental Research) lab.

ADDITIONAL REQUIREMENTS

Marine Biology, Oceanography or Environmental Science, Biological Science, Ecology, degree programme, or biochemistry/chemistry qualification at A-level

PROJECT LENGTH

START DATE(S): Session 1 (June 1, 2020)

END DATE(S): June 26, 2020
                July 24, 2020

LENGTH: 4 or 8 weeks
UNDERSTANDING THE CARBON SEQUESTRATION POTENTIAL OF FORESTS

SUPERVISOR DR ANDREW HACKET PAIN

I am a climate change ecologist with a particular interest in forests. My research investigates the relationships between climate and forest functioning, including tree growth (and carbon storage), tree reproduction and forest recovery from disturbance.

EMAIL: Andrew.Hacket-Pain@liverpool.ac.uk

SCHOOL: Environmental Sciences

DEPARTMENT: Geography and Planning

MODULE CODE: TBA

SUITABLE FOR STUDENTS OF: Environmental Science Ecology Physical Geography

PLACES AVAILABLE: 2
UNDERSTANDING THE CARBON SEQUESTRATION POTENTIAL OF FORESTS

PROJECT DESCRIPTION

This project will use tree ring samples collected from mountain forests in Europe to calculate annual aboveground carbon sequestration, and quantify the sensitivity to climate variation. You will build your own datasets through the preparation and measurement of existing tree-ring samples, incorporating full training in the measurement and cross-dating of tree-ring chronologies. You will convert tree ring measurements to carbon increment using allometric methods, and then analyse the year-to-year and long-term variations in carbon storage, and how they relate to climate and other factors.

ADDITIONAL REQUIREMENTS

Laboratory experience would be helpful, but not essential. Some knowledge of tree biology and/or forest ecology will help you in the interpretation of your data.

PROJECT LENGTH

START DATE(S):  
Session 1 (June 1, 2020)  
Session 2 (June 29, 2020)  
Session 3 (July 27, 2020)

END DATE(S):  
June 26, 2020  
July 24, 2020  
August 21, 2020

LENGTH:  
4, 8, or 12 weeks
History, Languages, and Cultures
CHILEAN EXILES AND THEIR POLITICAL ACTIVISM IN THE UK, 1973-1989

SUPERVISOR DR MARIEKE RIETHOF

Marieke Riethof has a PhD in Political Science and International Relations from the University of Amsterdam and is Senior Lecturer in Latin American Politics at the University of Liverpool. Her latest research examines the role of transnational solidarity movements and exile in the opposition to military dictatorship in Chile.

EMAIL: mriethof@liverpool.ac.uk

SCHOOL: History, Languages, and Cultures

DEPARTMENT: Modern Languages and Cultures

MODULE CODE: TBA

SUITEABLE FOR Latin American Politics
STUDENTS OF: Modern History

PLACES AVAILABLE: 2
CHILEAN EXILES AND THEIR POLITICAL ACTIVISM IN THE UK, 1973-1989

PROJECT DESCRIPTION

The research intern(s) will help organise and digitise an archive belonging to a Chilean political activist who went into exile in the UK in the 1970s and 1980s. The archive contains documents about Chilean political activism and human rights campaigning in the UK as well as collaboration with other solidarity groups (particularly Central America). The documents are unique because most available archival material focuses on the experiences of British, rather than Latin American, activists in the solidarity movement. This project provides interns with an opportunity to learn how academics use, organise and interpret archival material as part of an ongoing research project.

ADDITIONAL REQUIREMENTS

Approximately half of the archive is in English and the other half in Spanish. An ability to read Spanish is desirable, but not essential.

PROJECT LENGTH

START DATE(S): Session 1 (June 1, 2020)

END DATE(S): June 26, 2020

LENGTH: 4 weeks
Law and Social Justice
CAN THE EUROPEAN COURT OF HUMAN RIGHTS SHAPE EUROPEAN PUBLIC ORDER?

SUPERVISOR DR KANSTANTSOIN DZEHTSIAROU

Dr Kanstantsin Dzehtsiarou read for his undergraduate law degree in Belarus. Then he took a MA in European Studies from the University of Sussex. In 2007 Kanstantsin began working on his PhD project ‘European Consensus in the Case Law of the European Court of Human Rights’ (UCD Dublin, Ireland) which he successfully defended in 2011. Kanstantsin moved to the University of Liverpool in 2015 from the University of Surrey where he has been a lecturer and then a senior lecturer in law since January 2012. He is also a visiting professor at the European Humanities University (Lithuania), he cooperates with international inter-governmental and non-governmental organisations as an expert in international and European human rights law. His research interests spread between interpretation of the European Convention of Human Rights, reform of the European Court of Human Rights, administration of international justice, comparative and constitutional law.

EMAIL: dzeh@liverpool.ac.uk

SCHOOL: Law and Social Justice

DEPARTMENT: Law

MODULE CODE: TBA

SUITEABLE FOR: Law, Pre-Law, Human Rights, Political Science

PLACES AVAILABLE: 2
The European Court of Human Rights (ECtHR or Court) has referred to the term ‘European Public Order’ in over 100 judgments. This number suggests that its deployment is not a coincidence and the Court takes European Public Order seriously. Moreover, the Grand Chamber of the ECtHR is referring to European Public Order more and more often now. At the same time, in none of these judgments has the Court explained what European Public Order actually means and how it can be conceptualised. The Court’s references to European Public Order are often inconsistent and highlight various aspects of its meaning. If the ECtHR has an ambition to shape and regulate European Public Order it needs to clarify its understanding of this complex abstract notion.

Students will be involved in selecting relevant case law, analysing legal sources and reviewing publications on the topic. It will also involve some editorial work.

Native English speakers or level close to native; experience in editing and legal research will be preferable.

START DATE(S): Session 1 (June 1, 2020)

END DATE(S): June 26, 2020
                July 24, 2020

LENGTH: 4 or 8 weeks
THE EFFECTS OF PERSISTENT OBJECTION IN INTERNATIONAL CUSTOMARY LAW

SUPERVISOR  DR VASSILIS TZEVELEKOS

Vassilis joined the University of Liverpool School of Law and Social Justice in 2016 as a Senior Lecturer in Law. He holds a PhD on Public International Law from the European University Institute, where he also did a Master on Legal Research. Before the European University Institute he studied European Politics at the College of Europe (MA in European Politics) and Public International Law at Paris 1 Panthéon-Sorbonne (DEA). Vassilis did his main studies in Law (undergraduate) at the University of Athens and is qualified with the Athens’ Bar. In the past, he has been a visiting scholar at Columbia Law School and a Grotius Fellow for one academic year at the University of Michigan Law School. Vassilis is a general international law lawyer with a special interest in human rights protection. He has published in various areas, including theory of general international law, European human rights law and the interaction between the two -with emphasis on the system of the European Convention on Human Rights.

EMAIL:  v.tzevelekos@liverpool.ac.uk

SCHOOL: Law and Social Justice

DEPARTMENT: Law

MODULE CODE: TBA

SUITABLE FOR STUDENTS OF: Law, Pre-Law

PLACES AVAILABLE: 1
THE EFFECTS OF PERSISTENT OBJECTION IN INTERNATIONAL CUSTOMARY LAW

PROJECT DESCRIPTION

One of the two main methods (i.e. sources) in international law for the creation of rules is international customary law. This corresponds to a process leading to the establishment of unwritten rules that owe their legal force to the practice of members of the society (i.e. states) and to their belief (opinio juris) that their practice has been transformed into a legal duty (i.e. a customary rule) which is breached when society members diverge from it. Persistent objection is a doctrine holding that states that persistently object an emerging customary rule (i.e. a rule in the process of formation) may opt out from it, i.e. the rule is not opposable to persistent objectors.

The student working on this project/area will be asked to examine how international law textbooks (both current and old ones) have treated persistent objection and trace the evolution of this doctrine in these textbooks. Particular attention should be given to: a) which textbooks favour this doctrine, and b) which textbooks discuss the effects persistent objection may generate in the case of peremptory rules of international law (i.e. jus cogens rules).

ADDITIONAL REQUIREMENTS

Some knowledge of public international law is required.

PROJECT LENGTH

START DATE(S): Session 1 (June 1, 2020)
Session 2 (June 29, 2020)

END DATE(S): June 26, 2020
July 24, 2020

LENGTH: 4 or 8 weeks

ADDITIONAL NOTES

The student working on this project will work with Dr Tzevelekos remotely. Students will have in-person communication and support from other administrators and supervisors in the School of Law and Social Justice, as well as the Study Abroad Team, throughout their time in Liverpool.
SUPERVISOR DR VASSILIS TZEVELEKOS

Vassilis joined the University of Liverpool School of Law and Social Justice in 2016 as a Senior Lecturer in Law. He holds a PhD on Public International Law from the European University Institute, where he also did a Master on Legal Research. Before the European University Institute he studied European Politics at the College of Europe (MA in European Politics) and Public International Law at Paris 1 Panthéon-Sorbonne (DEA). Vassilis did his main studies in Law (undergraduate) at the University of Athens and is qualified with the Athens' Bar. In the past, he has been a visiting scholar at Columbia Law School and a Grotius Fellow for one academic year at the University of Michigan Law School. Vassilis is a general international law lawyer with a special interest in human rights protection. He has published in various areas, including theory of general international law, European human rights law and the interaction between the two -with emphasis on the system of the European Convention on Human Rights.

EMAIL: v.tzevelekos@liverpool.ac.uk

SCHOOL: Law and Social Justice

DEPARTMENT: Law

MODULE CODE: TBA

SUITABLE FOR STUDENTS OF: Law, Pre-Law

PLACES AVAILABLE: 2
The text of the European Convention on Human Rights (ECHR) is in most parts general and abstract. It acquires a specific meaning when it is interpreted in the light of the particular circumstances of a case. One of the methods of interpretation employed by the European Court of Human Rights (ECtHR) is the so-called European consensus method of interpretation. The exact meaning of this term and the function of this method of interpretation are debated in scholarship. It is commonly accepted however that, by means of this method, said Court proceeds with comparative analysis of extraneous sources (including state practice), i.e. of sources that are foreign to the text of the ECHR. The aim of the Court is to identify consensus/trends that allow it to establish particular human rights standards.

The student(s) working on this project will be given a number of ECtHR judgments and they will be asked to: a) identify all references made by all involved actors (such as the parties to the dispute, the Court itself, concurring/dissenting judges etc.) to extraneous sources, and b) assess these references with a view to conclude whether they amount to an application of the European consensus method of interpretation.

Additional Requirements

Knowledge of ECHR law

Project Length

Start Date(s):

Session 1 (June 1, 2020)
Session 2 (June 29, 2020)

End Date(s):

June 26, 2020
July 24, 2020

Length:

4 or 8 weeks

Additional Notes

The student working on this project will work with Dr Tzevelekos remotely. Students will have in-person communication and support from other administrators and supervisors in the School of Law and Social Justice, as well as the Study Abroad Team, throughout their time in Liverpool.
Life Sciences
I am programme director for anatomy at the University of Liverpool. My research is centred on understanding the development and evolution of the vertebrate brain. In particular, we work on the control of neurogenesis in cerebellar granule progenitors, the largest progenitor population in the brain, using focal genetic manipulation in the developing chick embryo. Deep in the annals of evolutionary history, I read Cell Biology at the University of Durham and subsequently received my PhD from the University of Oxford in the evolution of homeobox genes in animals. Following this, I moved to King’s College, London where my interest in the nervous system was honed, and before Liverpool was a lecturer in neurobiology on the Nanchang Joint Programme at Queen Mary, University of London.

EMAIL: tbutts@liverpool.ac.uk
SCHOOL: Life Sciences
DEPARTMENT: Cellular and Molecular Physiology
MODULE CODE: LIFE398
SUITABLE FOR STUDENTS OF: Developmental Neurobiology
PLACES AVAILABLE: 2
EXPLORING THE DEVELOPMENT OF THE EMBRYONIC CEREBELLUM

PROJECT DESCRIPTION

Our lab studies how the brain develops, particularly the process of neurogenesis in the cerebellum and how this evolves, using sophisticated genetic manipulations of the developing chick embryo. We study the cerebellum as it has the largest neuronal progenitor cell population in the brain, has significantly contributed to the evolutionary history of the brain, and also is a prominent place of origin for the most common paediatric brain tumour, medulloblastoma.

ADDITIONAL REQUIREMENTS

Be interested in embryonic development and prepared to work with chick embryos.

PROJECT LENGTH

START DATE(S):

- Session 1 (June 1, 2020)
- Session 2 (June 29, 2020)

END DATE(S):

- June 26, 2020
- July 24, 2020
- August 21, 2020

LENGTH:

4 or 8 weeks
SCREENING FOR CELLULAR STRESS CAUSED BY ABNORMAL COLLAGEN

SUPERVISOR DR ELIZABETH LAIRD

Dr Liz Canty-Laird is a Reader (Associate Professor) in the Department of Musculoskeletal Biology at the University of Liverpool, UK. Her research focusses on the role of abnormal type I collagen in inherited and age-related disease and encompasses tissue engineering and stem/progenitor cell studies. Liz carried out post-doctoral research in the Wellcome Trust Centre for Cell-Matrix Research at the University of Manchester, where she also studied for a PhD funded by Versus Arthritis. She holds a BSc in Biochemistry and Biological Chemistry from the University of Nottingham.

EMAIL: eglaird@liverpool.ac.uk

SCHOOL: Life Sciences

DEPARTMENT: Musculoskeletal Biology

MODULE CODE: LIFE398

SUITS FOR STUDENTS OF: Life Sciences, Biological Sciences, Biomedical Sciences, Veterinary Science, Medicine, Pre-Med

PLACES AVAILABLE: 1
SCREENING FOR CELLULAR STRESS CAUSED BY ABNORMAL COLLAGEN

PROJECT DESCRIPTION

The project aims to determine how abnormal type I collagen can cause bone fragility using laboratory techniques such as Western blotting and/or PCR. Collagen is the major structural component of vertebrate tissues. Collagen mutations result in brittle bones and/or loose connective tissues by detrimentally either affecting collagen tissue structure or the cells that make collagen. Comparing two different models can distinguish between effects of abnormal collagen on the tissue itself or on the cells. Results from this work are important to inform rational treatments for brittle bone disease.

ADDITIONAL REQUIREMENTS

Laboratory skills training e.g. pipette handling and understanding of safe laboratory working (good practice and following risk assessments). Prior knowledge of basic genetics, transcription, translation, protein folding and trafficking would be useful.

PROJECT LENGTH

**START DATE(S):** Session 1 (June 1, 2020)
Session 2 (June 29, 2020)

**END DATE(S):** July 24, 2020
August 21, 2020

**LENGTH:** 8 or 12 weeks
Psychology
A DESCRIPTIVE ANALYSIS OF INDIVIDUALS WITH CHRONIC PAIN

SUPERVISOR  DR CHRISTOPHER BROWN

Dr Christopher Brown is a neuroscientist and lecturer at the University of Liverpool. His research investigates how brain states influence pain perception and behaviour, with an aim to develop new treatments for chronic pain. He has studied brain processes related to the effects of expectancy, placebo and mindfulness on acute and chronic pain, involving the use of psychophysics, neuroimaging (EEG and fMRI) and statistical modelling.

EMAIL:  cab79@liverpool.ac.uk

SCHOOL:  Psychology

DEPARTMENT:  Psychology

MODULE CODE:  PSYC001

SUITABLE FOR STUDENTS OF:  Psychology, Neuroscience

PLACES AVAILABLE:  2
A DESCRIPTIVE ANALYSIS OF INDIVIDUALS WITH CHRONIC PAIN

PROJECT DESCRIPTION

We are currently undergoing data collection data for a large study (target n=165) that aims to understand how the brain’s structure and function contribute to pain perception in patients with chronic pain. We are recruiting participants with two types of chronic pain: fibromyalgia and rheumatoid arthritis. During the study visits, participants fill in multiple questionnaires exploring individual characteristics such as demographics, mental health, pain catastrophising and the impact of pain on daily life.

The student will manage the questionnaire database and do some basic statistical analysis exploring our samples demographics, clinical pain diagnosis, mental health and/or pain perception. There will be some flexibility on the research question to allow the student to research current pain literature and tailor the question to their interests. The student will also have the opportunity to observe EEG visits where patients do tasks whilst we measure the electrical activity of their brain, and MRI visits where we take ‘pictures’ of the brains structure and function whilst completing tasks.

ADDITIONAL REQUIREMENTS

Knowledge and a keen interest in statistical analysis, including experience analysing data on programs such as SPSS, R or Excel.

PROJECT LENGTH

**START DATE(S):**  
Session 1 (June 1, 2020)  
Session 2 (June 29, 2020)

**END DATE(S):**  
July 24, 2020  
August 21, 2020

**LENGTH:**  
8 or 12 weeks