

## 1- Project Title: Personalized medicine, Machine learning, Genomics & Skin Disorders

This topic proposes a few projects that involve bioinformatics analysis and potentially applications of machine learning algorithms to High-Throughput DNA sequencing datasets generated in collaboration with biomedical and clinical researchers. Topics include personalized medicine, predicts response to treatment in patients with skin condition using genomics/proteomics profiles and clinical parameters data, development of prototype of web-based platform for biomedical big data analysis, development of scalable and reproducible bioinformatics workflows

These projects will benefit of collaborations with a multidisciplinary team of academic staff, post-doctoral researchers and PhD students from Centre for Skin Science Bradford Institute for Health Research, and possibly with clinical researchers from NIHR Leeds Biomedical Research Centre

These projects will give opportunities to learn and research and co-author research publications.

### Activities Involved:

- Review of current Literature and methodology.
- Meetings with the PhD and academic staff
- Weekly reports.
- Design and implementation of a prototype
- Documentation writing.
- Project management using version control system

### Deliverables:

- Prototype using Galaxy, Nextflow, Python, R, and other relevant software for processing biomedical data
- Weekly progress reports. Report on the literature review; User Documentation; Final Report.

### Prerequisites:

- Programming/ software development experience
- Familiarity or interest in bioinformatics, Unix, R, Python, Galaxy, Nextflow, will be a plus but opportunities to learn will be provided

**Places available:** 4

## 2- Project Title: The laterality and refractive associations of amblyopia (lazy eye)

In association with the Myopia Research Group at the Wolfson Institute and the School of Optometry and Vision Science.

### Context of Project:

The project will investigate the significance of laterality in children with amblyopia (more commonly known as lazy eye). Amblyopia affects ~2% of the population and is the most common cause of visual loss in childhood. The condition is almost always unilateral; 90%+ of cases affect one eye only. However, contrary to the 50:50 split expected on statistical grounds, 60% of individuals who develop amblyopia do so in their left eye. This project will explore this left-sided laterality in amblyopia the associations and origins of this asymmetry. This project will involve looking at a large dataset of 2,000+ children with optical data to identify trends and associations concerning the laterality of amblyopia. These data have been gathered in a series of amblyopia treatment studies conducted by the “Paediatric Eye Disease Investigator Group” (PEDIG). We will be able to examine whether for example left- versus right-eye amblyopia is associated with deeper levels of amblyopia (i.e. poorer visual ability), or with particular aetiologies for this condition (e.g. anisometropic versus strabismic).

### Activities Involved:

- To review the literature on amblyopia development.
- To statistically analyse the PEDIG datasets, and identify trends and correlations of demographic and optical traits amongst those with amblyopia.
- To document the literature review and findings into a manuscript for potential submission and authorship.
- Work in the newly developed Wolfson Research Centre, a multi-disciplinary site that focuses on health research and hosts over 50 students and academics from the University of Bradford and University of Leeds.

### Deliverables:

- Weekly progress reports and meetings.
- Statistical analysis scripts.
- A project report, including literature review, description of methods, written in a potential manuscript format.

### Prerequisites:

Suitable for any student who is enthusiastic about research and who is comfortable working with a large dataset, or willing to learn about working with a large dataset. Experience using statistical software such as R/Stata/SPSS is highly desirable. The student could be an optometrist or researcher in the vision sciences, but no prior knowledge of optometry or optical background is needed. Hence this project could appeal to students with a wide range of undergraduate or postgraduate training.

**Places available:** 2

### **3- Project Title: The genetic and environmental factors associated with amblyopia development**

In association with the Myopia Research Group at the Wolfson Institute and the School of Optometry and Vision Science.

#### **Context of Project:**

This project will employ statistical software to investigate the prediction of individuals likely to develop amblyopia ('lazy eye'). The project will involve using polygenic risk scores for refractive error (i.e. optical prescription) alongside parental factors (e.g. maternal smoking during pregnancy) previously associated with increased amblyopia risk in other cohort studies. We will apply this prediction model approach to the Born in Bradford database, a large cohort of >10,000 children. It is hoped that should the combined predictive model demonstrate good accuracy, it could be used to identify babies who are at higher risk of developing a lazy eye. Therefore, this study will explore the application of genetic and environmental data to amblyopia development.

#### **Activities Involved:**

- To review the literature on amblyopia, refractive error.
- To create and apply a polygenic risk score to the Born in Bradford dataset.
- To investigate the predictive ability of parental factors in identifying those at increased risk of developing amblyopia in the Born in Bradford dataset.
- To run statistical analyses to identify whether the predictive model can distinguish between the children who did and did not develop amblyopia.
- Work in the newly developed Wolfson Research Centre, a multi-disciplinary site that focuses on health research and hosts over 50 students and academics from the University of Bradford and University of Leeds.

#### **Deliverables:**

- Weekly progress reports and meetings.
- Statistical analysis & coded scripts.
- A project report, including literature review, description of methods and results found, into a manuscript for potential publication.

#### **Prerequisites:**

Suitable for any student who is enthusiastic about research and who wants to experience working in bioinformatics and genetic prediction of a complex trait. Experience using statistical software such as R along with python script writing is highly desirable. The student could be an optometrist, but no prior knowledge of genetics, vision science, or optometry is needed. Hence the project may appeal to students with a wide range of undergraduate or postgraduate backgrounds and training.

**Places available: 2**

#### 4- Project Title: Analysis of the glucose response in skin and hair cells

##### Context of Project:

Diabetes Mellitus (DM) can result in chronic non-healing wounds ultimately leading to lower limb amputations. Studies have shown haired punch grafts can accelerate wound closure when compared with non-haired grafts, however the contribution of different populations of fibroblasts from skin to wound healing under elevated glucose levels and the effects of high glucose concentrations (as seen in DM) on these cells are unclear.

Based in the Centre for Skin Science (CSS) labs, this project will aim to characterise the human glucose receptor (SLCA1-4) in different fibroblast subpopulations isolated from skin and hair cells and how levels change in response to high glucose levels similar to those seen in DM. Expression of other targets downstream in the glucose response pathway will also be analysed.

##### Activities involved

- Current literature review will be used to assess relevant targets
- qPCR analysis to analyse gene expression
- Western blot analysis and quantification to analyse protein expression and post translational modifications.
- Statistical analysis of results
- Fluorescent microscopy and primary cell culture.

##### Deliverables

- Documentation of results and final report.
- Weekly progress reports to CSS Academic staff and Senior Scientist
- Participation in day-to-day laboratory running and organisation.
- Opportunities to learn and research and co-author research publications.

##### Prerequisites

- Basic lab skills (i.e. pipetting) and experience would be an advantage (prior knowledge of techniques listed above would be desirable)
- Familiarity with general laboratory safety, COSHH, risk assessments etc.
- Knowledge of basic statistical data analysis
- Person must be organised and able to work independently under instructions to a specific protocol.
- Good communication and documentation skills.

**Places available:** 2

## 5- Project Title: Assessment of thermomechanical behaviour of polymeric patches for buccal drug delivery system

### Context of Project:

Buccal drug delivery systems enjoy better bioavailability and faster onset of action than other traditional oral dosage forms. However, there are many challenges to developing a successful system including enzymatic degradation, limited site of absorption and poor adhesion. The latter could be mitigated using polymers with enhanced mucoadhesive properties

This project will be assessing the behaviour of polymeric formulation based on their mucoadhesive and mechanical properties under the temperature, shear forces and humidity of the buccal environment. Thermomechanical and rheological properties of incorporating various additives will be evaluated. Furthermore, *in vitro* release studies will be carried out to assess the effect of these additives on drug release profile.

### Activities involved

- Preparation of mucoadhesive formulations with various levels of copolymers and additives.
- Thermomechanical evaluation of the performance of the formulation in the dry and hydrated states.
- *In vitro* drug release studies

### Deliverables

- Documentation of results and final report.
- Weekly meetings with the research group.
- Presentation of the work in the pharmaceuticals group meeting.
- Opportunities to learn and practice thermomechanical and imaging techniques such as DSC, DMA and SEM and to co-author research publications.

### Prerequisites

- Basic knowledge of formulation science, polymers and pharmacokinetics is expected. Students with experience in polymeric formulations and drug delivery will be able to take advantage of the advanced characterisation techniques in our lab such as SAXS, WAXS and Raman mapping.

**Places available: 2**

## Internship Opportunities: 2019-2020

### Computing Enterprise Centre Artificial Intelligence Research (AIRe) Group and Advanced Automotive Analytics Research Institute

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#### *Academic Contact:*

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***Project Title:***

***UoB1. Automotive Engineering Big Data Analytics and Machine Learning Applications***

with [Advanced Automotive Analytics \(AAA\) Research Institute](#)

***Context of Project:***

This topic proposes a number of projects that involve statistical analysis, visualisation, processing, transformation of automotive engineering data and applications of machine learning and image processing algorithms for data modelling. Topics include warranty and fault prediction, Engine Control Unit and driver data (made available from the automotive industry and NASA) for vehicles (such as cars, trucks, buses) augmented with data about their use and faults. The projects will be developed as part of the AAA team, and will involve coordination with PhD students and academic staff.

***Activities Involved:***

Review the relevant work in the literature for interfaces to complex databases.

Design of prototype that aims to browse contents of a database in a multimedia manner

Implement the design using an appropriate high level language (Python, R, Java) and/or tool (Tableau, Weka, KNIME)

Testing the prototype: there are possibilities to work with a research team on real data sources and case studies from automotive industry

Document the literature review, own models and code.

Opportunities to learn and research and co-author research publications.

***Deliverables:***

Weekly progress reports. Literature review

Scrum meetings with the PhD, RA and academic staff; weekly reports.

A prototype system, dashboard or collection of scripts

Report and other relevant user, maintenance and deployment documentation

***Prerequisites:***

Good software development and statistical analysis knowledge and skills are expected.

Familiarity/expertise and opportunities to learn s/w tools such as Python, R, Tableau, Weka, Knime, Java, Matlab.

***Project Title:***

***UoB2. Big Data 3D Visualisation using Virtual Reality and Data Augmentation***

with [Artificial Intelligence Research \(AIRe\) Group](#) in collaboration with [Advanced Automotive Analytics \(AAA\) Research Institute](#)

***Context of Project:***

Gamification and Virtual Reality are currently increasingly applied to serious applications such as Engineering and Business Analytics and Data Mining.

The project aims to create a virtual reality environment prototype to visualise various data and machine learning models and their performance (for example benchmark data sets from UCI ML and Kaggle repositories, and also proprietary sources such as Engine Control Unit and driver data (made available from the automotive industry) for vehicles (cars, trucks, buses or e-bike systems) augmented with data about their use and faults, in an interactive way.

Part of the Advanced Automotive Analytics Institute, these projects will benefit of collaborations with a multidisciplinary team of academic staff, post-doctoral researchers and PhD students from Computer Science and Engineering schools and possibly with automotive industry representatives.

***Activities Involved:***

Current Literature and s/w solutions Review.

Scrum meetings with the PhD, RA and academic staff; weekly reports.

Design and implementation of a prototype on benchmark data.

Documentation writing.

***Deliverables:***

Prototype using Oculus Rift, Oculus Rift-ready desktops in Computing Enterprise Centre and AAA, Unity3D, R, Python, TensorFlow, Tableau and other relevant software for processing

Weekly progress reports. Report on the literature review; User Documentation; Final Report.

***Prerequisites:***

Prerequisites skills: programming and problem solving, enthusiasm; previous experience in game programming, user interfaces and/or machine learning & data mining may be a bonus though are not compulsory.

Familiarity or interest in R, Python, Tableau, Java will constitute a plus.

***Project Title:***

*UoB3. Responsible Artificial Intelligence: ethics, efficiency, explainability metrics for AI tools*

with [Artificial Intelligence Research \(AIRe\) Group](#) and [Division of Psychology](#).

***Context of Project:***

The project will research and test computation measurements for AI tools (mainly chatbots) and also use of social media data mining to understand and leverage advanced statistical and qualitative metrics and social aspects to AI tools and algorithms. These include ethics and efficiency of chatbots, efficiency and explainability of Machine Learning algorithms involved in decision support.

***Activities Involved:***

To review and analyse the current AI market and identify the providers of AI measuring tools for the responsible AI dimensions such as efficiency, explainability, ethics etc.

To develop chatbot prototypes for a specified problem and run qualitative and quantitative evaluations of the AI tools.

To test the system against case studies.

To document the literature review, chatbot construction, metrics, experiments and case studies.

***Deliverables:***

1. weekly progress reports. 2. s/w prototype or scripts. 3. the project report, including introduction on current approaches, review on methods to be used, description of the problem to be studied, and deployment, user and maintenance documentation.

***Prerequisites:***

Suitable for any student who has studied Software Development, Programming, AI and Machine Learning. Interest or expertise in Python, R, Tableau and Java are a plus.

***Project Title:***

*UoB4. Mind Power: EPOC+ driven mobile applications*

with [Computing Enterprise Centre](#)

***Context of Project:***

Innovative applications of Emotiv EPOC+: mind-controlled mobile applications, sentiment, mood or EEG hands-free HCI. See for details and examples: <https://www.emotiv.com/epoc/> and <https://www.brad.ac.uk/ei/computer-science/student-projects/>

The topics can be research for game or mobile application interfacing, supporting users with disabilities, hands-free interfaces or sentiment analysis in a number of applications, including engineering, driving, smart city, digital health and gamification. Applications currently of interest involve displaying emoticons on a mobile device, and control of Arduino Zumo devices or a drone.

***Activities Involved:***

Literature and s/w Review Report;

Scrum meetings with the PhD, RA and academic staff.

Weekly progress reports. User Documentation; Final Report.

Prototype using Emotiv EPOC+ and mobile devices or simulators in Computing Enterprise Centre.

***Deliverables:***

Prototype and user documentation of the various software applications.

***Prerequisites:***

Java or C# programming experience and problem solving enthusiasm; mobile application development is a bonus but is not compulsory. Devices and libraries are made available. May involve contacting and communicating with the technical support team of Emotiv EPOC+ and working in team (should the period allow) with local students working on similar projects.

***Project Title:***

*UoB5. AAA Transport/Aviation Logistics Using Mobile and Big Data Applications*

with [Advanced Automotive Analytics \(AAA\) Research Institute](#) and [Computing Enterprise Centre](#)

***Context of Project:***

System for supporting transport and logistics companies to implement their own ideas for vehicle routing in automotive or aviation projects. The project will provide mobile device interfaces and database solutions that will include third party software, devices, and interaction with company representatives.

***Activities Involved:***

Literature and s/w Review Report;

Scrum meetings with the RA, academic and industry staff, as applicable.

Weekly progress reports. User Documentation; Final Report.

Prototype mobile devices or simulators in Computing Enterprise Centre.

***Deliverables:***

Usable prototype for mobile devices.

User documentation.

Report.

***Prerequisites:***

Enthusiasm, problem solving, programming.

Java or Swift software development, APIs, web and/or mobile (Android, iOS) technologies are a plus.

***Project Title:***

*UoB6. Smart City mobile device applications*

with [Computing Enterprise Centre](#) and [Internet of Things Lab](#)

***Context of Project:***

The Computing Enterprise Centre works with the ERDF funded project SCORE on smart cities applications. The projects range from using Raspberry Pi, smart sensors and mobile device programming for dashboards, management information systems and data mining, and demonstration purposes, IoT and app development at Bradford City Council.

***Activities Involved:***

To review literature on IoT use for smart cities and particularly flooding/ flood monitoring.

***Deliverables:***

1. weekly progress reports. 2. a working prototype. 3. the project report, including introduction on current approaches, review on methods to be used, description of the problem to be studied, and application of design methodologies to develop the prototype.

***Prerequisites:***

Suitable for any student who has studied Software Development and Programming.

Mobile Application Developing, IoT knowledge, while not compulsory, are an advantage.

***Project Title:***

***UoB7. Intelligent Network Services***

with [Computing Enterprise Centre](#) and Department of Computer Science

***Context of Project:***

The Computing Enterprise Centre works with the ERDF funded project Xalient on smart capacities additions for intelligent network services.

The project requires to design and build a cloud hosted, web-based system prototype integrating various services such as monitoring systems, device orchestration toolsets, AI components and an IT Service Management platforms.

The prototype platform will utilise a number of isolated existing platforms with data visualisation component extracting significant data from the monitored systems and exploiting advanced data analytics techniques.

***Activities Involved:***

To review literature and industry projects on intelligent networks, data mining, machine learning and their use in IT Service Management solutions.

To design, run and test scripts to gather, analyse and visualise relevant data.

To provide documentation and deployment of solutions.

***Deliverables:***

1. weekly progress reports. 2. a working prototype. 3. the project report, including introduction on current approaches, review on methods to be used, description of the problem to be studied, and application of design methodologies to develop the prototype.

***Prerequisites:***

Suitable for any student who has studied Software Development and Programming, Computer Networks, Cloud services.