Sheffield Hallam University

Computing

The Communication & Computing Research Centre (CCRC) and Cultural, Communication & Computing Research Institute (C3RI) welcome applications for full time, fully funded and part-time (fees only) PhD studentships, to start October 2017.

CCRC has a strong cross-disciplinary focus and extensive links with industrial and other external agencies. Research activity in Computing takes place in areas such as Human Computer Interaction (including applications in Heritage and Cultural Industries), Semantic Technologies, Data Analytics & Information Management, Computer Networks, Deep Learning techniques in AI and Games Software Development (including games based learning). CCRC is home to CENTRIC which specialises in terrorism, security and organised crime research.

In the REF 2014, 65% of research submitted by CCRC was rated as world-leading or internationally excellent and the social and economic impact of our research was judged as 90% world leading. The featured PhD research areas listed below offer a variety of rich opportunities to conduct research in applied computing, in the context of a wider funded research project or in collaboration with an external partner.

More information can be found on the C3RI website.

How to apply

Applicants should email their completed postgraduate application form (including a 1500 word proposal) to C3RI@shu.ac.uk by 12 noon on Friday 24 February 2017.

When completing the application form, you have the option of submitting a proposal for your own research idea OR you can develop a proposal in response to one of the featured PhD research opportunities listed below. In either case, please also summarise:

a) why you are interested in doing PhD research on this topic

b) how your skills and experience to date (including your undergraduate and/or masters dissertation, if relevant) prepare you to embark on the project and

c) any challenges that you foresee in conducting the research and how you might approach or solve them

We strongly recommend that you contact the project lead or other prospective supervisor to discuss and develop your research proposal before submitting your application form.

Please indicate clearly in the body of your email whether you would like to be considered for:

- Graduate Teaching Assistant (GTA) Scholarship offered by the Faculty of Arts, Computing, Engineering and Sciences (ACES) only
- University PhD scholarship only
- Both scholarship schemes
- Part-time study (fees only) - GTA scholarship excluded

International applicants are eligible to apply for full-time University PhD scholarships only. Where English is not your first language, you must show evidence of English language ability to the following minimum level of proficiency: an overall IELTS score of 7.0 or above, with at least 6.5 in each component or an

accepted equivalent. Please note that your test score must be current, i.e. within the last two years and that relevant certificates must be submitted at the point of application.

For all queries about the application process please email C3RI@shu.ac.uk

Selection process

Interviews will be held between April 3 and April 7 2017.

Shortlisted applicants will be required to give a 10 minute presentation (see below) followed by an interview. Interview panel members include the head of postgraduate research, a prospective director of studies and (for GTA applicants) a representative from the relevant teaching department. Where travel to Sheffield is not possible, interviews are conducted by Skype or conference call.

The presentation should outline your PhD research proposal or a research project you have already undertaken, as targeted to a non-expert audience, as we want to see how clearly you can articulate your ideas and key concepts. You may use PowerPoint if you wish or other visual aids as appropriate, but this isn't compulsory.

Research areas

1. A Taxonomy-based Tool for Visualising Gene Expression in Mouse Embryo Tissues in collaboration with the Edinburgh Mouse Atlas Project.

Project Lead: Simon Andrews (s.andrews@shu.ac.uk) with Albert Berger (Heriot Watt University)

This PhD project is to develop software to visualise gene expression in mouse embryo tissues. The Edinburgh Mouse Atlas Project is a major research project to discover where genes are expressed in the developing mouse embryo through biological assays - mapping over 4000 genes to over 6000 tissues in the embryo, over 26 stages of embryonic development. Although the project is creating a comprehensive database of the results, a tool is needed to visualise the gene expression. At the moment, biologists are restricted to querying the database for particular results but they are lacking an overall picture of the gene expression. The tool will make use of the 26 taxonomies that have been developed to describe the stages of the embryo to create an interactive, unfolding, map of embryonic tissues displaying the genes expressed in each tissue at each stage of embryonic development.

A clustering approach called Formal Concept Analysis will be used to automatically generate these annotated taxonomies from the experimental data in the EMAP database. As further experiments are completed, the tool will automatically maintain an updated picture of gene expression. In consultation with the needs of the biologists, the tool will be enhanced with visual analytics that provide answers to their questions of interest.

EMAP has a strong public engagement aspect, promoting the positive medical impact of research on the understanding of the development of embryos. It is expected that new visualisations of the research provided by the tool will play an important part in that engagement.

The PhD project will involve collaboration with Professor Albert Berger's team, in the Mouse Atlas Group at the MRC Human Genetics Unit, which is part of the Institute of Genetics and Molecular Medicine (IGMM) at Edinburgh University. Professor Burger will provide close support as a PhD second supervisor, access to the experimental data and training in the use of the EMAP database. Access will also be provided to the teams of EMAP biologists, to provide end-user requirements for the software tool. Visits to the research facilities and face to face research meetings will also be facilitated.

This research opportunity would appeal to students with an interest in computer science, data analysis or biology and with a background in programming.

2. The Discovery of an Interoperable Semantic Technology for Supporting Urban Planning Projects in collaboration with Spawforths planning consultancy and Enterprise Architecture Solutions (The Essential Project).

Project Lead: Simon Polovina (s.polovina@shu.ac.uk) with Elizabeth Uruchurtu and Barry Goodchild

This PhD research focuses on the implementation of Semantic technologies to support urban planning. It has been argued that the productivity of computers becomes less and less useful as we move from operational data processing to tactical and strategic decision-making. However, this highest, social-world level gives purpose to the data and why it is of interest in the first place. To address this gap, semantic technologies allow for the inclusion of both data and meanings within the same encoded framework. They thus bring data, information and knowledge into the same conceptual plane.

Housing and Urban Planning practice presents a real, social-world challenge where practitioners and governments are repeatedly looking to make the planning system both more efficient and more democratically accountable to the communities they serve. In doing so, they commonly turn to digital technologies. This domain thus serves as a rich case study for semantic technologies. The project will focus on the housing land availability and housing development in the region.

While the Semantic Web has become the predominant semantic technology, questions remain about its appropriateness for meta-modelling which, as in the case of the TOGAF content meta-model for enterprise architecture, extend the entity-relationships that describe data into tactical and strategic models for decision-making. It is likely that the Semantic Web, currently popularised by Open Linked Data and its connectivity with the Internet of Things will interoperate with other semantic technologies such as Frames and Common Logic.

You will have the benefit of an interdisciplinary supervisory team comprising researchers from the faculty of Arts, Computing, Engineering and Sciences (ACES) and also the faculty of Development &Society (D&S), with the support of external parties in the field of Urban Planning and Enterprise Architecture; such as Spawforths planning consultancy, East Ardsley, Leeds, and Enterprise Architecture Solutions (The Essential Project). You will have the opportunity to:

- practice enhanced skills in the application of IT to a complex, diverse and important policy field
- contribute to national and international research looking at the application of IT and, more specifically, Semantic Technologies to urban planning and urban management
- understand more about debates on the planning system and urban regeneration at both the local, city region and national levels
- become familiar with the procedures and techniques involved in planning and land development

The prospective candidate should have a Masters degree in Computer Science, Informatics, or a related subject; with strong software development skills. An interest in Semantic Web and related technologies is essential.

3. Designing a cyber-campus for challenging settings in collaboration with Learning Light Ltd
Project Lead: Chris Roast (c.r.roast@shu.ac.uk) with Louis Nisiotis and Elizabeth Uruchurtu

The aim of this proposed research is to investigate the application and/or development of 3D virtual worlds in the form of a cyber-campus to support teaching in difficult to manage learning environments.

Cyber campuses are meeting points in which learners can gather, share information, communicate and collaborate in 3D shared spaces. Using their virtual embodiments (avatars), learners navigate and interact with their tutors, peers and the environment, developing the feeling of 'being there'. Such environments can be considered as effective tools to support online learning, and can play a role in enabling access and participation in education when these are challenged or even impossible.

Unlike the majority of technology enhanced learning concepts, we are interested in educational settings where managing, engaging and supporting learners is intrinsically problematic or where learners may be poorly motivated. The work is motivated by an awareness of some of the difficult circumstances faced by e.g. offender tutors and trainers working in prisons. The existing research in the area of cyber campuses for learning support rarely considers or examines such situations.

We have support from Learning Light Ltd. who are willing to provide expert advice on specific learning contexts.

We're keen to receive applications from potential research students with a thorough knowledge of computer science concepts and programming languages, along with the ability to gather and assimilate new knowledge via interviews and focus groups.

Essential Skills: Knowledge and experience in contemporary programming languages and databases, including client - server architectures and/or social research methods in education and training. Good writing and communication skills.

Desirable Skills: Familiar with Multi User Virtual Environments (Opensim, Second Life or other), 3D design, Unity.

4. A deep learning approach to survival prediction in adult critical care admissions in collaboration with North Middlesex University Hospital.

Project Lead: Alex Shenfield (a.shenfield@shu.ac.uk) with Marcos Rodrigues and Jeronimo Moreno-Cuesta (North Middlesex University Hospital)

This research project aims to build upon the current state-of-the-art in machine learning to develop advanced decision support systems for medical practitioners to assist in the process of evaluating intensive care unit admissions. This will involve the development of novel methods for integrating the knowledge of the medical practitioners into the machine learning algorithms and will involve working closely with the research team at North Middlesex University Hospital in evaluating the effectiveness of the system.

For more than half a century, computer scientists have attempted to create a computational model of intelligence capable of representing the world and making accurate predictions. However, we are still a long way from this – especially in domains such as image interpretation which require both pattern recognition and processing of semantic concepts. Deep-learning architectures offer a way forward by more accurately mimicking the structure of the human brain - although it is only recently that advances in training algorithms have made such approaches feasible.

The Geometric Modelling and Pattern Recognition group at Sheffield Hallam University has many years of experience in applied pattern recognition and has recently acquired a state-of-the-art Deep Learning system (an NVIDIA DIGITS DevBox) comprising 4 TITAN X GPUs, latest generation Intel processor and 64GB RAM which will be available for use on this project. Training in machine learning (and in deep-learning strategies in particular) will be provided, as will training on interpretation of medical data and statistical evaluation techniques.

The proposed programme of research builds on the current, long-running, collaboration between the GMPR research group and North Middlesex University Hospital in several areas of machine learning and

image interpretation research. Recent work (Shenfield, Rodrigues, Valentine, Liu and Moreno-Cuesta, 2015) has shown the effectiveness of machine learning techniques in predicting patient mortality in an intensive care environment, and an outline proposal for a system to predict how well patients would respond to ICU admission was presented at the UK Critical Care Research Forum in 2016. This work builds upon both that proposal and the ongoing VIEWS project (which is looking at developing automatic image processing techniques capable of detecting patient deterioration based around action units from the Facial Action Coding System (FACS)).

This project offers you the opportunity to work as part of a truly multi-disciplinary team on cutting edge applied research and to develop a range of transferable skills in both machine learning and medical statistics.

Essential requirements are a good honours degree in Computer Science, Mathematics or Electrical / Electronic Engineering (or equivalent), excellent written and verbal communication skills, and willingness to work in a multi-disciplinary team.

5. VIEWS – Visual Early Warning System in collaboration with North Middlesex University Hospital.

Project Lead: Marcos Rodrigues (m.rodrigues@shu.ac.uk) with Alex Shenfield, Jeronimo Moreno-Cuesta (North Middlesex University Hospital) and Maribel Madrigal Garcia (North Middlesex University Hospital)

Artificial Intelligence (AI) has been heralded as the next step in computing evolution. The computer scientist, inventor and futurist Ray Kurzweil (from Kurzweil Accelerated Intelligence) stated that computers will be as smart as humans by 2029, and can become billions of times smarter by 2045. It sounds implausible, but prominent researchers agree and genius physicist Stephen Hawking has stated that "The danger is real that they [super-computers] could develop intelligence and take over the world." The concept of intelligence is elusive and refers in the broadest sense, to the ability of perceive and understand the world around us. Recent advances in Deep Learning (DL), a state-of-the-art machine learning technique, continue to advance into all areas of industry and human activity. DL methods are applied to multi-modal problems with complex data structure such as robotics, data mining, cybersecurity, and knowledge discovery. The project aims to develop computer vision-based DL techniques for a multidisciplinary application in the medical domain. We (the research team at Middlesex Hospital and GMPR at Sheffield Hallam University) have demonstrated for the first time that patients at risk of deterioration and patients that are terminally-ill have similar patterns of muscular action units in the lower and upper parts of the face. The research question is whether or not an artificially intelligent system can infer physiological states from facial expressions in a critical care environment.

A state-of-the-art Deep Learning system (an NVIDIA DIGITS DevBox) comprising 4 TITAN X GPUs, latest generation Intel processor and 64GB of RAM is available for use on this project.

Training will be provided on DL techniques, computer vision, and the specific medical application.

You will have the benefit of working with a multidisciplinary team and working on Deep Learning methods to both detect and recognise facial action units. The outcomes will be linked to a related project on prediction of survival rates upon admission to the critical care unit (a deep learning approach to survival prediction in adult critical care admissions).

You will benefit from truly inter-disciplinary research and cross-institution research within a computer science unit and a medical unit. The developed skills in AI Deep Learning will be invaluable to you for your future career, in any area of social or economic activity.

Required: Honours degree in computer science, mathematics or equivalent. Willingness to work in a highly demanding, multi-disciplinary project environment. Excellent communication skills (including the ability to communicate technical concepts to non-technical users).

Desirable: knowledge of computer vision, Matlab, OpenCV, programming skills.

6. Playstation VR Technology & Innovative Educational Applications in context of REVEAL in collaboration with Sony Interactive Entertainment Europe (SIEE) as part of the PlayStation First scheme.

Project Lead: Jacob Habgood (j.habgood@shu.ac.uk) with Daniela Petrelli and Tim Jay

REVEAL is a €1M EU-funded Horizon 2020 project pioneering the use of mainstream PlayStation VR technologies for innovative educational applications which engage audiences in the Europe's rich historical and scientific heritage. The first year of REVEAL will generate an Educational Environmental Narrative (EEN) application which tells the story of smallpox and the discovery of vaccination set within the Georgian estate of Dr. Edward Jenner. This application will provide an exciting platform upon which to base a programme of PhD research in game-based learning running alongside REVEAL. The EU project benefits from support from the R&D team at Sony Interactive Entertainment Europe (SIEE) and will generate new published applications for the PlayStation Store.

REVEAL's EEN applications will provide a basis for exploring a range of research questions related to game-based learning including, but not limited to; the educational affordances of immersive VR, learning analytics in VR environments, and the design and use of VR environments for museums. It could also potentially support VR-related research topics not directly linked to learning such as effective VR navigation techniques, or novel graphical visualisation techniques for VR. Set within the Steel Minions game studio, research students will have access to commercial PlayStation development equipment within a commercial studio environment. As such, a candidate with strong game development skills would be best placed to make the most of this opportunity. The Steel Minions is part of the Applied Gaming Technologies Research Group: an active community of researchers building and evaluating a range of innovative gaming applications.

We have a long-established partnership with Sony Interactive Entertainment Europe (SIEE) as part of the PlayStation First scheme. SIEE are formally named external partners on the REVEAL project.

There is plenty of scope here for interdisciplinary research, building on the foundation of either a previous degree in Game Development, Software Engineering or Computer Science, including a good working knowledge of C++ and real-time rendering systems. This PhD opportunity might also suit a professional game programmer looking for a career change.