2018 YCCSA SUMMER SCHOLARSHIP PROJECT SUBMISSION

This form is for prospective project supervisors to submit their projects to be included in the YCCSA Summer Scholarships Programme for 2019.

It is the purpose of the YCCSA Summer School that any projects submitted are novel and interdisciplinary in nature.

Date	*5th January 2019*
Supervisors' Names and Departments / Affiliation and Contact Email	*Matt Dale (YCCSA, Computer Science)* *Simon O'Keefe (Computer Science)* *Andrew Pratt (Physics)* *Martin Trefzer (Electronic Engineering)*
Project Title	*Creating a Carbon Computer – Unconventional Computing with Novel Nanomaterials*
Project Description	*As we approach the miniaturisation limits of conventional electronics, alternatives to silicon transistors – the basic building block for conventional electronic devices – are being hotly pursued. One such alternative is to exploit the natural properties of complex substrates rather than highly constraining them to implement classical computing models, i.e. Turing machines, binary logic, etc. This emerging field is known as unconventional computing [1].* *To date, the field has several questions still unanswered; what's an appropriate computational model for substrate **x**? How can we program **x**? What tasks can **x** solve? What makes **x** compute? What is a "good" **x**? Recently, we developed the **CHA**racterisation of **R**eservoir **C**omputers framework [2] to help answer these questions for any substrate. However, at present, we still have limited physical substrates to test.* *In this project, you will primarily explore the material side, i.e. designing and fabricating substrate **x**. To guide you on the material side, we have a number of potential candidates for **x** in the physics department, e.g. graphene membranes [3] and iron nanoparticles [4]. These materials feature a great variety of (unconventional) properties with a range of novel applications (https://www.nature.com/articles/nmat5025, https://www.manchester.ac.uk/discover/news/graphene-smart-membranes-can-control-water/) and previous EiM work with graphene flakes and CNTs has shown promising results with regards to their computational capacity. To evaluate whether **x** is a good candidate for computing, you will use the CHARC framework.* *This cross-disciplinary project combines material science with computer science and electronic engineering. You will work in various laboratories across several departments, preparing and testing material samples. The nature of this project makes it very rewarding, gaining practical skills across many disciplines, building physical systems and working in a very "blue sky" area of research.*

Required Skills	*The project will suit a student with any science and/or engineering background. Basic knowledge of electronics and programming would be beneficial.*
Supervision and Collaboration Arrangements	*The student will be co-supervised by the whole team. Material samples will be created in Physics, measuring system in Electronic Engineering and computational models in Computer Science.*
Project Dates	*The summer school runs for 9 weeks, starting on Monday, 08 July 2019 and finishing on Friday, 06 September 2019.*
Other Information	*n/a*
References	*[1] Adamatzky, A. (Ed). Advances in Unconventional Computing: Volume 1: Theory. Vol. 22. Springer, 2016.* *[2] Dale, et al. A Substrate Independent Framework to Characterise Reservoir Computers. arXiv. 1810.07135. 2018.* *[3] Yang, Q., et al. Ultrathin graphene-based membrane with precise molecular sieving and ultrafast solvent permeation. Nature Materials 16.12. 2017: 1198.* *[4] Pratt, A., et al. Enhanced oxidation of nanoparticles through strain-mediated ionic transport, Nature Materials 13.1. 2014: 26.*

When complete, please email the form to sarah.christmas@york.ac.uk