Warwick Centre for Complexity Science

Newsletter Issue 8, Summer 2017

go.warwick.ac.uk/complexity

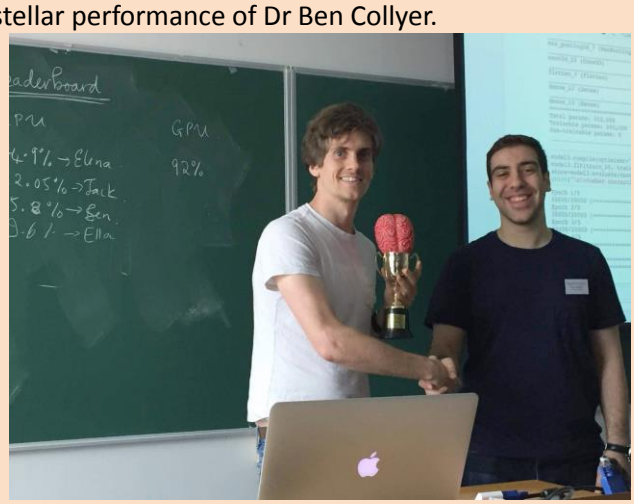
The Machines Take Over the Complexity Centre

By Ayman Boustati, 1st year PhD student

Earlier this summer, the MathSys CDT ran the Introduction to Machine Learning Summer School to an enthusiastic audience of 80 participants. The event ran for three days, from the 21st of June until the 23rd of June, and included presentations from external speakers as well as three tutorial sessions organised by staff and students of the CDT.

The seven presentations spanned a range of topics in Machine Learning. Participants were given an excellent introduction to the history of the field by Dr David Barber from University College London and were exposed to applications of machine learning in healthcare and natural-language processing by Dr Christopher Yau from Birmingham University and Dr Maria Liakata from Warwick University. In addition, the presentations covered advanced topics in machine learning, such as *Environment Simulators for Agent Planning* by Dr Silvia Chiappa from Google Deepmind, *Lipschitz Continuity for Inference and Decision Making* by Dr Jan Peters from the University of Oxford and *PDEs and variational approaches in inverse imaging and their adaption via learning* by Dr Carola-Bibiane Schönlieb from the University of Cambridge. The potential impact of continuing advances in machine learning and artificial intelligence on the economy and society was also addressed by a talk from Matthew Lawrence of the Institute of Public Policy Research. Sami, one of the participants, says: "I found the more theoretical aspects of the summer school particularly interesting. It gave me a better intuition as to exactly what was going on. I also found the applications to image analysis exciting."

Attendees of the summer school also participated in a series of tutorials designed by Dr Magnus Richardson, MathSys CDT Director, as well as MathSys students Nada Jankovicova, Jevgenij Gamper, Michael Pearce, Iliana Peneva, Ayman Boustati and Jeremy Reizenstein. The tutorials introduced participants to the basics of artificial neural networks and deep learning and were very well attended, culminating in a mini-hackathon won by the stellar performance of Dr Ben Collyer.



I'M A SCIENTIST!

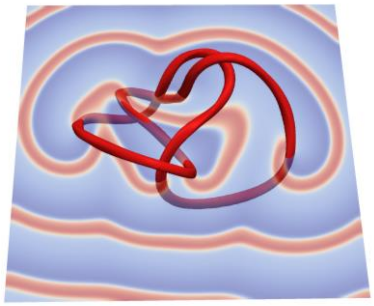
By Nada Jankovicova, MSc student

In June, Elizabeth Buckingham-Jeffery participated in "I'm a scientist!", an online outreach event for schools all over the UK. It was an X Factor-style competition between scientists in which students got to ask them any questions about science, or their daily lives, and then voted for their favourite scientist. Liz won the competition in the 'epidemic zone' by being very accessible, friendly and comprehensible. As she recalls: "It was so much fun! As well as the questions you can see online, there were two live chats in a day, where students would be online firing questions at us. I really enjoyed answering the varied, sometimes bizarre, but sometimes very insightful questions from the young students. One of the most interesting challenges was letting the students know that jobs use skills from many subjects and that maths and biology are much more interconnected than they think at school. I also learned new things from other scientist's answers!" Liz is planning to use her prize of £500 for further public engagement activities.

Congratulations to Liz on her success!

Collaboration with Cambridge

By Nada Jankovicova, MSc student



Jack Binysh, 2nd year PhD student, has been awarded a David Crighton Fellowship, which supports young researchers in the field of applied mathematics working on problems in fluid mechanics, acoustics, waves and vibration. Jack will work with Professor Ray Goldstein in Cambridge on Knotted Vortex Dynamics in the FitzHugh-Nagumo model from September. He will study two related problems - the dynamics of the vortex filaments themselves, and the properties of the waves they generate, with the aim of understanding how they lead to preservation of knot topology. We wish him lots of success!

Complexity Annual Retreat

By Iliana Peneva, 2nd year PhD student

This year students and staff of the Centre went to YHA Ravenstor in the beautiful Peak District for the annual retreat. As usual, fantastic talks from PhD students filled the three days of the retreat. The best four talks, given by Michael Pearce, Gian Lorenzo Spisso, Tim Pollington and Jim Skinner, were awarded prizes. We also had the chance to get

useful advice on starting/writing as you begin/finish your PhD and to see some excellent presentations from external speakers. Tobias Galla from the University of Manchester offered a great perspective on being an interdisciplinary researcher, while Complexity alumni Marcus Ong and Dan Sprague from Spectra Analytics shared their experience as data scientists. This year saw the return of the Warwick Annual Research Projects (WARPs), which provided again a great opportunity for collaboration and work on interesting projects, such as using reinforcement learning to win a game of Spoof. In the free time, we managed to explore the area and to enjoy some Bakewell tart.

We look forward to the next retreat when we will celebrate ten years of the Centre for Complexity Science!

Biophysics in Bangalore

by Sami Al-Izzi, 1st year PhD student

Held in Bangalore, this year's Experimental and Theoretical Approaches to Cell Mechanics (EMBO) summer school brought together an impressive group of world leaders in cellular biophysics for a week of fascinating talks, great food and beautiful 36˚C weather. Bangalore, the capital of Karnataka state in southern India, has a rich history in Physics dating back to Nobel Laureate C.V. Raman. The lectures on Membrane Physics by Pierre Sens, and Active Gels by Jean-François Joanny were excellent, and the introduction to Active Matter given by Sriram Ramaswamy opened my eyes to a whole new approach to the subject. Frank Jülicher and Stephen Grill gave a series of brilliant lectures on the Biophysics of Tissues and Morphogenesis, showing how both discrete computer models and continuum mechanics could be used to build an understanding of something as complex as the wing formation in drosophila! It also provided a great opportunity to meet some theorists working in Madan Rao's group at National Centre for Biological Sciences, including a few alumni from Warwick. I visited Madan's group the week after the conference and gave a presentation on my research, which was a lot of fun.

Overall I had great time and would definitely recommend the EMBO summer schools to people interested in Biophysics.

Final Adieu to Warwick

by Sam Johnson, Warwick Zeeman Lecturer

Like with an optical illusion you can't unsee, I struggle to believe it has been nearly three years since I began working at Warwick. Whether this is because time flies when you're having fun, it has been a tremendous period, full of fun, discovery and interesting people. Although the prospect is undeniably exciting, it is with a certain bittersweetness that I leave for my new job at Birmingham. Most of my work at Warwick has revolved around the Complexity Centre. I was very fortunate to teach the MathSys module 'Computational Methods for Complex Systems', which allowed me to explore with some of the brightest students I have met a whole range of curious topics. I also organised the Complexity Forum seminars, from which several new collaborations have sprouted. As to my research, I have had the opportunity at Warwick to work closely with some very talented people, in particular, Janis Klaise and Guillem Mosquera from Complexity/MathSys, as well as Weisi Guo from the Engineering School.

As of August I will be taking up a permanent lectureship in applied mathematics at the University of Birmingham. My aim is to build a group focused on exploring the relationship between structure and function in complex, dynamical systems. I hope to work closely both with some of the combinatorics people, and with more applied researchers with biology expertise. But one of the many good points about working at Birmingham is its proximity to Warwick, so I look forward to still seeing you all around in the Complexity Centre.

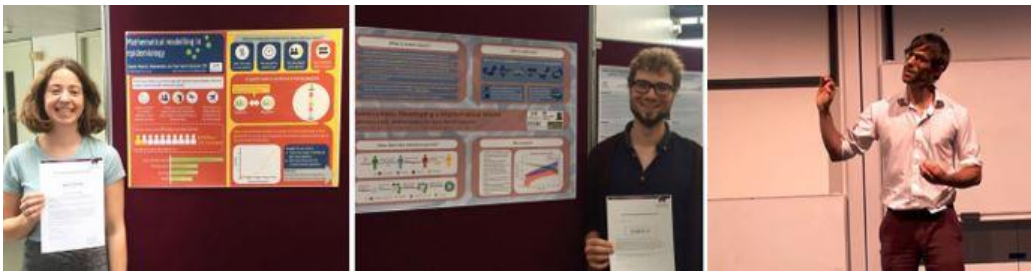
Recent publications from our students and staff:

- **Buckingham-Jeffery E**, Morbey R, Elliot AJ, Harcourt S, Smith GE. Correcting for day of the week and public holiday effects: improving a national daily syndromic surveillance service for detecting public health threats, BMC Public Heath 17:477 (2017)
- **Hill EM**, **Tildesley M**, House T. Evidence for history-dependence influenza pandemic emergence, Scientific Reports, 7:43623(2017)
- Whitfield CA, Adhyapak TC, Tiribocchi A, **Alexander GP**, Marenduzzo D, Ramaswamy S. Hydrodynamic instabilities in active cholesteric liquid crystals, EPJE 40: 50 (2017)

Postgraduate Research Showcase

Congratulations to Sophie Meakin, Cameron Lack and Tim Pollington! Every year the University of Warwick organises a Postgraduate Research Showcase to display the variety of postgraduate research across Warwick and to allow postgraduate researchers to engage with the University community. The Showcase event brings together two academic competitions: a research poster competition and Three Minute Thesis competition. Sophie won both the Faculty of Science and the Best Overall Poster prizes, with her poster "Mathematical modelling in epidemiology", and Cameron took home a runner up award. Tim took part in the 3MT competition with a talk on "How far do we need to spray households to control a neglected tropical disease". He recommends entering the competition as it is a great opportunity to practise public speaking to a large audience and to learn a lot in the preparation for it.

Congratulations to them from the Centre!



Viva Success

Congratulations to Yuri Lifanov, Bernd Taschler, Thomas Rafferty, Gwilym Enstone, Diana Khoromskaia and Edward Hill for the completion of their PhDs! Yuri's viva was on "Lattice Models on Nucleation from Solution", Bernd's was on "Spatial Point Process Models for MRI Lesion Data in Multiple Sclerosis", Tom's was on "Dynamic Properties of Condensing Particle Systems", Gwilym's was on "Abstract surface growth modelling with application to graphene", Diana's was on "Active Liquid Crystals in Thin Geometries", and Ed's was on "Modelling influenza at the human-animal interface"

We wish them the best in their careers!

Change in Editorial Team

Ayman Boustati and Iliana Peneva, who have been part of the editorial team for the past 2 years, are leaving the team. We thank them for the great work they have done and wish them all the best!

We welcome Jevegnij Gamper, an MSc student, on to the editorial team!

Events coming soon:

- 4th – 8th September, Warwick Mathematics Institute, European Study Group with Industry 130
- 11th – 15th September, Warwick Mathematics Institute, Introduction to geometry, dynamics and moduli in low dimensions
- 18th – 20th September, Zeeman Institute (SBIDER), Mathematical Challenges from the Life Sciences
- 18th – 22nd September, Warwick Mathematics Institute, Geometric topology in low dimensions
- 27th September, Complexity Centre, MathSys MSc Project Presentations
- 6th November, Warwick Mathematics Institute, MiR@W Day: Mathematics and Physics far from Equilibrium
- 6th December, MathSys Open Day
- 11th – 14th December, Warwick Mathematics Institute, DIMAP 10 year Anniversary Workshop
- 11th – 15th December, Warwick Mathematics Institute, Computation in Geometric Topology
- 18th December, Warwick Mathematics Institute, Variational Approaches to Problems in Solid Mechanics

Editors:
Gareth Alexander,
Ayman Boustati,
Jevgenij Gamper,
Nada Jankovicova,
Iliana Peneva,
Luke Whincop

Contact G.P.Alexander@warwick.ac.uk

EPSRC Engineering and Physical Sciences Research Council
THE UNIVERSITY OF WARWICK
centre for complexity science