Mostly Complex by Dave Kelly

You don’t need to study at the Bristol Centre for Complexity Science long to realise that a lot of things are thought to be ‘complex’ but pinning down exactly what is complex and just how complex something is can be tricky. A quick annual of the BBC’s website will enlighten you as to the general idea. A complex system is (roughly) one which contains many interacting parts, with the behaviour of the system ‘emerging’ from these interactions and so it cannot be understood using reductionist, bottom-up methods (i.e. looking at each component in isolation). There are many very important unsolved problems which fall under this description such as higher brain function emerging from interactions between neurons and the boom and bust of markets from interacting traders. The vision is therefore to use holistic top-down methods, using tools from many disciplines... Somewhat like holistic detective Dirk Gently, the creation of novelist Douglas Adams, who, to quote from Wikipedia, "makes use of ‘the fundamental interconnectedness of all things’ to solve the whole crime, and find the whole person. This involves running up large expense accounts and then claiming that every item (such as needing to go to a tropical beach in the Bahamas for three weeks) was, due to this ‘interconnectedness’.”

The similarity to BBCs students is uncanny.

...But getting back to the problem at hand, there have been many attempts at defining complexity quantitatively in order to bring some mathematical rigour to the loose criteria that are commonly used to identify complex systems. My work has focussed on one interconnected network: the central idea is that the behaviour of complex systems is difficult to predict. This builds on the idea of Kolmogorov complexity. The Kolmogorov complexity of a string is the length of the shortest computer programme (in some language) which will generate that string. This distinguishes between random strings and strings which contain some structure which may be utilised to obtain a shorter description. Random strings are assigned a high complexity, and strings with increasing regularity are less and less complex. What happens if we change this slightly to require a programme which gives half of a string will make a (slightly) a prediction of the rest of the string as is possible? Now we also assign a low complexity to purely random strings since the best we can do in this case is to guess at what character comes next. Our new measure of complexity, statistical complexity, is maximised for data which contains both structure and randomness, data which requires a lot of effort to model. The analogy here is drawn to a scientist attempting to model some phenomenon, encapsulated in a data set. The programme is the model, a scientist constructs to explain and predict the data, represented by the string. Computational mechanics provides a way to turn a property of the description into a property of the data. In fact the resulting complex behaviour will be ‘interconnectedness of all things’ and just how complex something is can be tricky. The multidisciplinary nature of our research avenues we chose to follow will add to our progress of science. We have experience in applying their theory supervisors, who already are leaders in their application areas. This, coupled with the way the research directions we chose to follow for three years. It’s interesting to reflect how one’s aspirations can change over the course of a project. Many of us have found ourselves taking an interest in an area of science we would never have even considered before the taught modules. The three months that I get for giving time to form relationships with colleagues and to get an idea whether this is the direction in which you would like to follow for three years. Whatever we decide to do we have the assurance that Bristol University and the Centre for Complexity Science will be there to support us. The centre has both a continually growing network of academics who are leaders in their application area and an arena of great theory supervisors, who already have experience in applying their expertise to a range of application areas. The centre is structured with continual communication, which gives us access to a comprehensive network of peer support. When we embark on our thesis the research avenues we chose not to follow will add to our increasingly wide range of skills. The multidisciplinary nature of our backgrounds and the centre may enable us to consider problems from unique perspectives that may seem radical to a specialist in an application and allow the divergence of thought that so often furthers the progress of science.
The Fifth International Meeting on Synthetic Biology will be held in Stanford, California. The conference is organised by the BioBricks Foundation, and will include three days of plenary and workshop sessions. Such meetings of cross-disciplinary fields considering the emerging field of Synthetic Biology aim to cement ideas into concrete applications. The developments in biotechnology are utilised to engineer synthetic biological systems for useful purposes, and in the process increase our understanding of these interactions with the natural world.

The Twentieth Annual Computational Neuroscience Meeting will be held at the Royal Institute of Technology. This year’s conference theme is “Neuronal function and dysfunction”. Attendees will attend and present their own research in the areas of neuroscience, computer science, geography and linguistics.

As the taught component of our MRes degree draws to a close it is time for us first years to choose two three-month projects. These past seven months have given us many useful resources and experiences which will inform our choices. Our journey began in October programming a climate change simulation using CME software on Bristol’s award winning supercomputer Blue Crystal. Help was at hand for those of us who were not familiar with C, R and remote access to a Linux operating system which were essential to complete the task. By the end of the first three weeks each of us was able to change parameters and produce a model of a particular climate change scenario. After a lecture series in Neuroscience we tried our hand at physiological modeling. We used XPP and Matlab to build a Morris-Lecar model of a neuron and analyse its behaviour using dynamical systems theory. Once the model was operational we explored and presented the different classes of neural behavior modeled over different ranges of parameter values. In between lecture courses we tried our hand at physiological modelling. We used XPP and Matlab to build a Morris-Lecar model of a neuron and analyse its behaviour using dynamical systems theory. Once the model was operational we explored and presented the different classes of neural behavior modeled over different ranges of parameter values.