Use of AI in the sciences: where are we headed?
An interactive workshop at The University of Edinburgh

Date: 9th April, 2021

Organisers: Somya Iqbal & Samuel Gibbon (EASTBIO DTP, UofE)

Location: Zoom link to be shared with the participants.

Order of events

10:00 – Overview - **Professor Manuel Trucco**

10:45 – Padlet – Participant interaction

11:00 – Live demonstration by **Samuel Gibbon**

11:30 – Speaker 2 – **Dr Emma Pead**

12:15 – Screen break

12:30 – Speaker 3 – **Professor Giovanna Tinetti**

13:15 – Lunch break

14:00 – Speaker 4 – **Dr Paul De Sousa**

14:45 – Panel discussion with: **Professor Guido Sanguinetti, Dr Oisin Mac Aodha** & **Dr Marta Vallejo** chaired by **Somya Iqbal**

15:30– End

Programme in depth:

Speaker abstracts

Professor Emanuele Trucco

Title: a crash course introduction to deep learning

Purpose, building blocks, examples of life sciences/medicine problems that have been solved successfully, how to get started for people with no computer science background.

Affiliations: University of Dundee
https://www.dundee.ac.uk/people/emanuele-trucco
https://vampire.computing.dundee.ac.uk/

Dr Emma Pead

Title: What's in your eye?
The meteoric rise in retinal imaging technologies and digital analytic techniques, such as AI, have the potential to transform eye care across community and hospital services by providing new insights into ocular, systemic and neurodegenerative diseases. For ocular diseases this includes the development of automatic early detection techniques to aide in patient stratification and progression monitoring. For systemic and neurodegenerative diseases this includes the application of AI systems for risk

prediction and biomarker discovery. We will explore the application of AI to a challenging task in ophthalmology, lessons learned and how AI is helping to unlock the potential of the retina as a window to body and brain health.

Affiliations: University of Edinburgh
https://www.research.ed.ac.uk/en/persons/emma-pead
https://www.ed.ac.uk/clinical-sciences/ophthalmology/scone/about-us

Professor Giovanna Tinetti

Professor Giovanna Tinetti is a Professor of Physics and Astronomy at the University College of London (UCL), and part of the Exoplanets research group. The term "exoplanet" is used to describe planets orbiting stars other than our own.

Professor Tinetti works on galactic planetary science, trying to understand the chemical composition of planets in our galaxy, how they form and evolve and why they are so diverse. Understanding the formation of planets elsewhere in our galaxy allows us to understand more about our own planet and solar system, as well as the history of the galaxy. Her work uses AI to understand exoplanet and she will be sharing her work in this area.

Affiliations: University College London
https://www.ucl.ac.uk/astrophysics/
http://giotin.org/pages/research.html

Dr Paul De Sousa

Title: Artificial Intelligence in Biomedical Discovery Supporting Innovations in Personal and Societal Health and Welfare

Artificial Intelligence and its application to Big Data and the Internet of Things promises new opportunities to gain insight, prediction and control of discovery, production and delivery of innovation. Over the last decade this has progressed from machine learning and detection of features not apparent or readily accessible to unassisted human assessment to the development of dynamic and interpretable models based on the fusion of multi-parametric data across all domains of life and industry. In my presentation I will focus on the evolution of its application in biomedical discovery of animal development pertinent to future innovations in the diagnosis, tracking and treatment of disease. Stepping back from early prophetic ambitions for AI to find answers for the "meaning of life, the universe and everything", there have been tangible successes understanding animal and human development and preservation of health to inform the scope of the challenge and clarify the routes to making impactful changes in how to improve individual and societal health and welfare.

Affiliations: The University of Edinburgh/ Massive Analytic
https://www.ed.ac.uk/profile/dr-paul-de-sousa
https://www.massiveanalytic.com/

Professor Guido Sanguinetti

Professor in the Institute for Adaptive and Neural Computation at the School of Informatics, University of Edinburgh. My interests focus on probabilistic modelling of biological systems, with particular emphasis on inference in dynamical systems.

More information: https://sites.google.com/site/gsanguinettilab/

Dr Oisin Mac Aodha

Dr Mac Aodha is a Lecturer (Assistant Professor) in Machine Learning in the School of Informatics at the University of Edinburgh. His current research interests are in the areas of computer vision and machine learning, with a specific emphasis on human-in-the-loop methods such as machine teaching.

More information: https://homepages.inf.ed.ac.uk/omacaod/

Dr Marta Vallejo

Dr Marta Vallejo is a Tenure Track Research Fellow in Biomedical Signal and Image Processing in the Institute for Sensor Signals and Systems at Heriot-Watt University. She is also part of the ICT-Robotic for Independent Living Testbed, a 'Living-Lab". Her current research activities focus on the application of machine learning techniques, including deep learning and evolutionary algorithms, to neurodegenerative diseases. She is particularly interested in the processing of biomedical signals and images and the creation of biomedical classifiers.

More information: https://researchportal.hw.ac.uk/en/persons/marta-vallejo

https://www.edinburgh-robotics.org/academics/marta-vallejo

Live demonstration by Samuel Gibbon

We will fine-tune a pre-trained state-of-the-art convolutional neural network to classify images. We will ask you to think of something to classify, e.g. facial expressions, breeds of a certain animal, cells, leaves. We will download the images (150 of each category) using Microsoft Azure, and train in Python using fastai, which is built on top of PyTorch. Next, we will use the model to predict the category of a brand-new image. If there's time, we'll put the trained network into production, e.g. build a mini-website. Everything presented is taken directly from the **fastai** course, as taught by **Jeremy Howard** and his colleagues, which I highly recommend.

Organisers:

Somya Iqbal – I am an EASTBIO PhD candidate and my project is titled: **Artificial Intelligence Mediated Discovery and Bio-validation of novel regulators of nervous system stability**

Age related decline and neurodegeneration are growing issues around the world and some of the characteristic markers of this decline are centred around neuronal vulnerability and dysfunction in specific brain regions. This vulnerability impacts the nervous system and disrupts its stability, therefore understanding which factors contribute to the regulation of the nervous system is of paramount interest. Whilst previous work in the field identified neuronal cell death as the cause of

cognitive decline, it is now understood that specific compartments of the neuron can be differentially vulnerable and affected in both healthy age related decline and in neurodegenerative diseases namely the synapse, axon, and the cell soma. The synapse in particular has been implicated in a wide range of conditions since vulnerability in this compartment shows early signs of disruption in pre symptomatic conditions, making it a prime pathological target. Therefore, it is important to investigative synaptic health in pre symptomatic as well as symptomatic conditions to create better maps of the mechanisms involved in this vulnerability and target disease at an early stage. Thus, my project will work with data collected from the synaptic proteome and investigate which molecular targets are involved in synaptic health within normal healthy ageing and disease contexts. The project will build on this by refining the methodological approach of identifying relevant proteomic targets by using an AI tool provided by Massive Analytic: https://www.massiveanalytic.com/

Samuel Gibbon

EASTBIO PhD student. Based in the Centre for Clinical Brain Sciences, I am working with retinal and MR images to help explain cognitive and health outcomes in the Lothian Birth Cohort, a group of elderly participants living in Scotland. Our aim is to help characterise the biological correlates of healthy and pathological ageing in the retina and brain.