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# AI, ENGINEERING BIOLOGY & BEYOND

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## WORKSHOP PROGRAMME

TURING WORKSHOP | 13-14 MARCH 2023 | UNIVERSITY OF EDINBURGH

## Welcome

### Dear colleagues

It is our great pleasure to welcome you to this workshop on the exciting and rapidly evolving intersection of Artificial Intelligence (AI) and Engineering Biology. Both fields have seen tremendous growth in recent years, with AI being increasingly adopted across every stage of the Engineering Biology design cycle and for a growing number of biological design tasks.

The intersection of these two fields offers immense potential for innovation and discovery. AI can be used to analyse and understand complex biological data, accelerate system design, and ultimately bring Engineering Biology one step closer to real-world applications. At the same time, the various modalities of biological data offer unique challenges for their analysis, which can spur the development of new AI methodologies tailored for biology.

Beyond the hype, we have designed a programme that showcases concrete, real-world, exemplars of what AI can do for Engineering Biology, and highlight domain-specific challenges that will hopefully pique your ingenuity about the future synergy between these two technologies.

We would like to take this opportunity to thank our attendees and speakers, your contributions are key to the success of this meeting, as well as our local organizing team who have worked tirelessly to make this event possible.

Once again, welcome to our workshop. Let us all make the most of this opportunity to learn, connect, and explore the frontiers **AI, Engineering Biology & Beyond**.



Informatics Forum  
University of Edinburgh

Diego, Tom and Chris



**Diego Oyarzún**

University of Edinburgh



**Thomas Gorochowski**

University of Bristol



**Christopher Barnes**

University College London

## Turing Workshop on AI, Engineering Biology & Beyond

Lecture Theatre G07, Informatics Forum  
10 Crichton St, EH8 9AB, Edinburgh

**Monday 13 March**

<b>08:45</b>	<b>Arrival and Registration</b>
<b>09:15</b>	<b>Welcome</b> , Diego Oyarzún, University of Edinburgh, UK
<b>09:30</b>	<b>Jean Loup Faulon</b> , INRAE, France <i>In vitro and in vivo neural computations with metabolism.</i>
<b>10:30</b>	<b>Natalio Krasnogor</b> , Newcastle University, UK <i>Computational approaches for DNA/RNA nanobiotechnology</i> Chair: Christopher Barnes, University College London, UK
<b>11:30</b>	<b>Networking lunch</b>
<b>12:30</b>	<b>Early Career Session 1</b>  <b>Leonardo Castorina</b> (University of Edinburgh, UK) <i>TIMED: Accessible Machine Learning for Protein Sequence Design</i> <b>Charlotte Merzbacher</b> (University of Edinburgh, UK) Machine learning for optimization of multiscale biological circuits <b>Michiel Stock</b> (Ghent University, Belgium) Open-endedness, novelty and creativity in synthetic biology <b>Mariana Monteiro</b> (Imperial College London, UK) Soft Sensors for Control of Bioprocesses <b>Behzad Karkaria</b> (Bacto.bio) Design of Experiments and machine Learning for metabolite discovery <b>Adele De Hoffer</b> (Scuola Superiore Meridionale, Italy) Development and implementation of a Reinforcement Learning approach to control an inducible gene expression system in mammalian cells Chair: Diego Oyarzún, University of Edinburgh, UK
<b>14:00</b>	<b>UKRI Engineering Biology and AI</b> , Jamie Parker (BBSRC) & Karen Davies (EPSRC)
<b>14:30</b>	<b>Break</b>
<b>15:00</b>	<b>Lucia Marucci</b> , U Bristol, UK <i>Designing cellular phenotypes using mathematical models and AI</i>
<b>16:00</b>	<b>David Ross</b> , National Institute of Standards and Technology, USA <i>Precision Engineering of Biological Function with Large-Scale Measurements and Machine Learning</i> Chair: Susan Rosser, University of Edinburgh, UK
<b>17:00</b>	<b>Finish</b>

## Tuesday 14 March

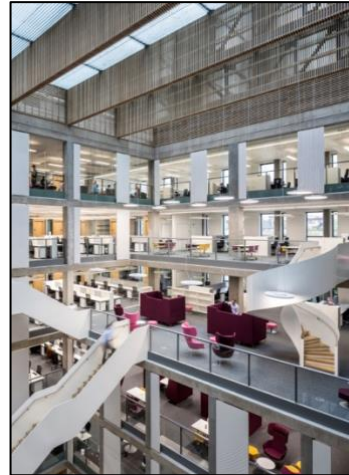
<b>09:00</b>	<b>Arrival &amp; morning coffee</b>
<b>09:30</b>	<b>Alexander Pritzel</b> , DeepMind, UK <i>The impact of AlphaFold on structural biology</i>
<b>10:30</b>	<b>Cleo Kontoravdi</b> , Imperial College London, UK <i>Hybrid modelling of bioprocessing: from understanding cell biology to controlling industrial systems.</i>  Chair: Christopher Wood, University of Edinburgh, UK
<b>11:30</b>	<b>Networking lunch</b>
<b>12:45</b>	<b>Early Career Session 2</b>  <b>Ricardo Valencia Albornoz</b> (University of Edinburgh, UK) Bayesian optimisation of surfactin production via high-throughput metabolomics  <b>Luxi Yu</b> (Imperial College London, UK) Ensemble Kalman Filter for estimation of intracellular nucleotide sugars from extracellular metabolites in monoclonal antibodies  <b>Pierre-Aurélien Gilliot</b> (University of Bristol, UK) Transfer-learning for accelerating design of genetic parts  <b>Sara Brancato</b> (University of Naples Federico II, Italy) Learning-based control of multiple cellular populations in a single chemostat  <b>Evangelos-Marios Nikolados</b> (University of Edinburgh, UK) <i>Deep learning models of protein expression</i>  Chair: Giovanni Stracquadanio, University of Edinburgh, UK
<b>14:00</b>	<b>High-throughput Engineering Biology at Edinburgh</b> , Giovanni Stracquadanio, University of Edinburgh, UK
<b>14:30</b>	<b>Break</b>
<b>15:00</b>	<b>Open discussion</b> – opportunities & challenges. Chair: Christopher Barnes, University College London, UK
<b>16:00</b>	<b>Hector García Martín</b> , Berkeley National Laboratory, USA <i>Leveraging Machine Learning &amp; Automation to Systematically Guide Synthetic Biology</i>  Chair: Diego Oyarzún, U Edinburgh, UK
<b>17:00</b>	<b>Concluding remarks</b> , Diego Oyarzún, University of Edinburgh, UK

## Our funder - The Alan Turing Institute

The workshop is funded by the Alan Turing Institute, the UK's national institute for Data Science and Artificial Intelligence, with headquarters at the British Library, London. Founded in 2015, the Institute is named in honour of Alan Turing, whose pioneering work in theoretical and applied mathematics, engineering and computing are considered to be the key disciplines comprising the fields of data science and artificial intelligence. The institute was originally comprised of five founding universities – Cambridge, Edinburgh, Oxford, UCL and Warwick – with eight new universities joining later in 2018 – Leeds, Manchester, Newcastle, Queen Mary University of London, Birmingham, Exeter, Bristol, and Southampton.

The Institute's ambitious goals are to advance world-class research and apply it to real-world problems, train the leaders of the future, and lead the public conversation by driving innovative ideas which have a significant influence on industry, government, regulation, or societal views, or which have an impact on how data science and artificial intelligence research is undertaken.

At Edinburgh, the Institute resides at the Bayes Centre, the University of Edinburgh's Innovation Hub for Artificial Intelligence and Data Science (<https://www.ed.ac.uk/bayes>).



Bayes Centre  
University of Edinburgh

## Turing Interest Group on data-centric biological design and engineering

<https://www.turing.ac.uk/research/interest-groups/data-centric-biological-design-and-engineering>

## Our venue – Informatics Forum, School of Informatics

The School of Informatics is a world-leader in computing science research and one of the birthplaces of Artificial Intelligence. It is the largest Informatics academic community in the UK and one of the largest in Europe. The School has 150+ faculty members, 200+ postdocs and 400+ doctoral students. It is based in the purpose-built Informatics Forum in Edinburgh city centre and adjacent to the new build Bayes Centre for Data Science and Artificial Intelligence. This year marks our 60<sup>th</sup> anniversary (<https://www.ed.ac.uk/c/60-years-computer-science-ai>).



Informatics Forum  
10 Crichton St

The Forum is not just labs and offices – there are also a number of artworks in and around the building. A number of Paolozzi pieces and artefacts are located in the Forum, Turing prints in the Turing Room on level 5, and a number of chrome and bronze sculptures, one of which is located in the café area on the ground floor of the Forum. William Darrell's Rhino Head is on the Charles Street Lane side of the building and Davy Forsyth's Byte on the Haynes Nano Stage next to the main entrance.

**Getting here:** <https://www.ed.ac.uk/informatics/about/location>

## Edinburgh Centre for Engineering Biology

The University of Edinburgh Centre for Engineering Biology launched in November 2022. It brings together a multidisciplinary community of more than 50 research groups and 200 researchers across the University from the former Centre for Synthetic and Systems Biology (SynthSys), and the UK Centre for Mammalian Synthetic Biology.

The Centre's research addresses diverse scientific questions with wide ranging impacts for society, industry, the economy and our planet. It builds on the University of Edinburgh's recognised strength in synthetic biology research, and will continue to develop and widen its remit in the future. This includes the engineering of biology for 'green', or sustainable, chemistry, which leads to more environmentally friendly ways of producing food, fuel, alternative materials and chemicals and the engineering of mammalian systems for a range of medical technologies, including cell therapies and tissue engineering.

It is underpinned by specialist research facilities including Edinburgh Genome Foundry, the world's largest automated DNA assembly platform, and EdinOmics, for mass spectrometry, metabolomics and proteomics analysis.



High-throughput DNA assembly system at the Edinburgh Genome Foundry

<https://www.ed.ac.uk/biology/centre-engineering-biology>

## Our people - key contacts

### Workshop chairs

Diego Oyarzún

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Christopher Barnes

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### Local organization

Julie Fyffe

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