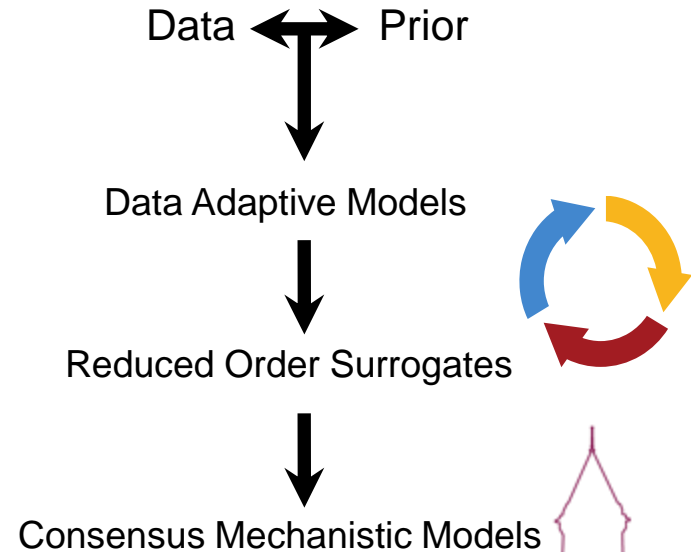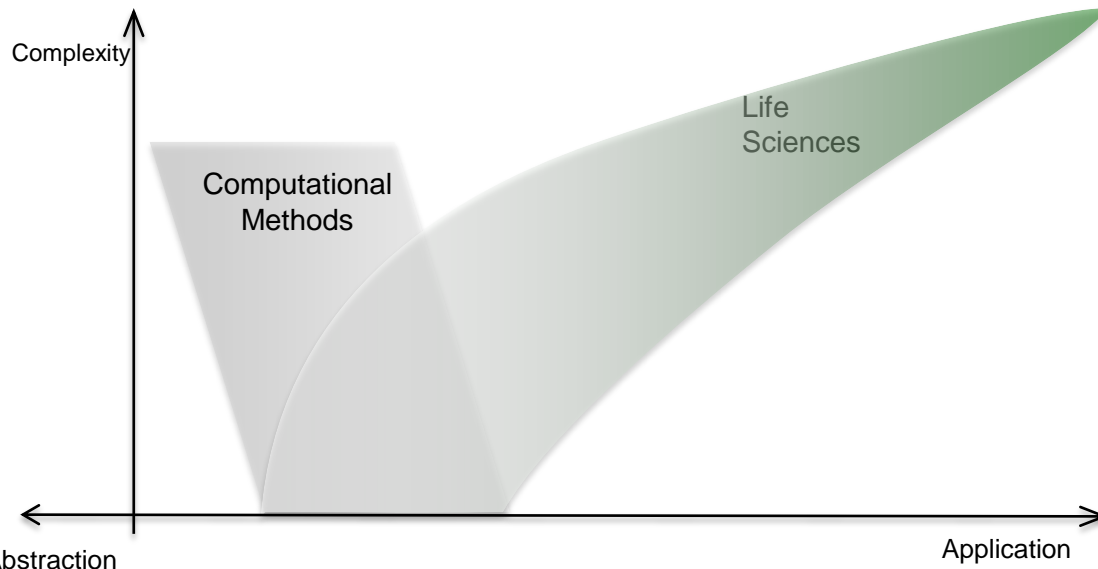# Proposed Themes to ATI

1. **Data Intensive Life Sciences**
   *Jean-Baptiste Cazier*

2. **Data Analytics and Computer Vision for Image Datasets on Many Scales**
   *Ales Leonardis*

Data ⟷ Prior

Data Adaptive Models

Reduced Order Surrogates

Consensus Mechanistic Models

Complexity

Life Sciences

Computational Methods

Abstraction

Application

# 1. Data Intensive Life Sciences

□ Life is Complex
 – by Nature

□ Data is Complex
 – Heterogeneous,
   □ Genomics, Clinical records, biomedical imaging, Scale …
 – Unstructured
   □ Clinical records, Socio-economics, …
 – Incomplete
   □ Clinical Records, Outcome, Toxicology report…
 – Unreliable
   □ Measurement, self report, …
 – Contradictory
   □ Knowledge base, …
 – …

# Challenges in Life Sciences

☐ Complexity of Data
 – Representations (scalable, hierarchical, compositional, interpretable)

☐ Complexity of Model
 – Learning (supervised, unsupervised, reinforcement, online, lifelong, from small data)

☐ Application of trained models to real-world problems
 – Inference (of parameters – as well as model structures, efficient, with feedback)

☐ Use of diverse, incomplete, and often contradictory expert knowledge
 – Incorporation of prior knowledge (unstructured, structured, expert and combination of experts)
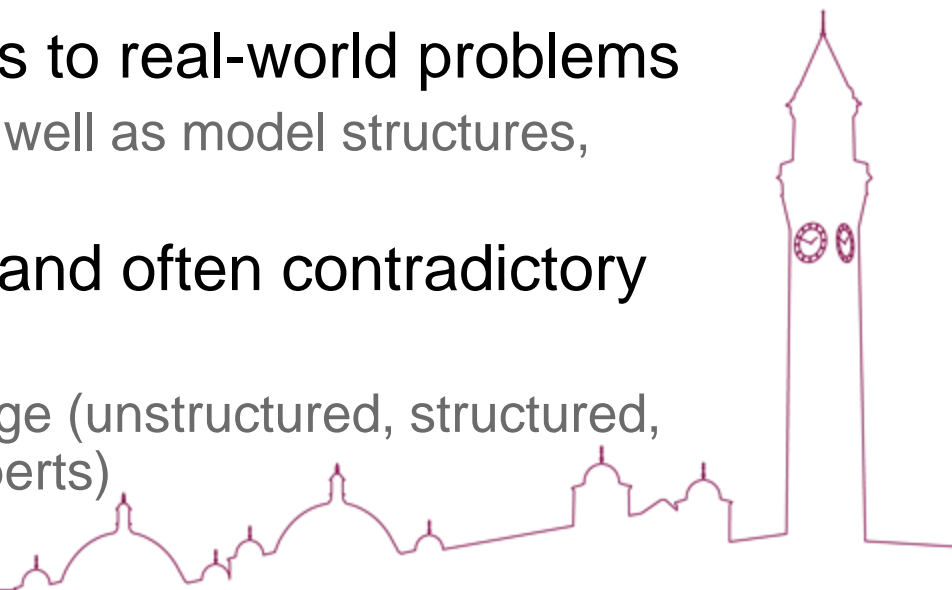
# Data Intensive Life Sciences

*<< Build on our portfolio of **high quality applied data science work in the life sciences field**, spanning **Geography** and **Environmental sciences**, as well as **Human Health**, particularly leveraging and enhancing ATI strengths in **Urban Analytics**, **Health** and **Government**.*

*We will deliver a programme across four key themes that bring together expertise, methodological innovation and novel tools across a series of levels of focus, and already include major funded infrastructure, and industrial collaborations and partnerships that embrace the collaborative ATI ethos. >>*

- ☐ **Environmental Analysis**
- ☐ **Monitoring health & disease**
- ☐ **Representation and integration of healthcare data**
- ☐ **Populations & Planning**
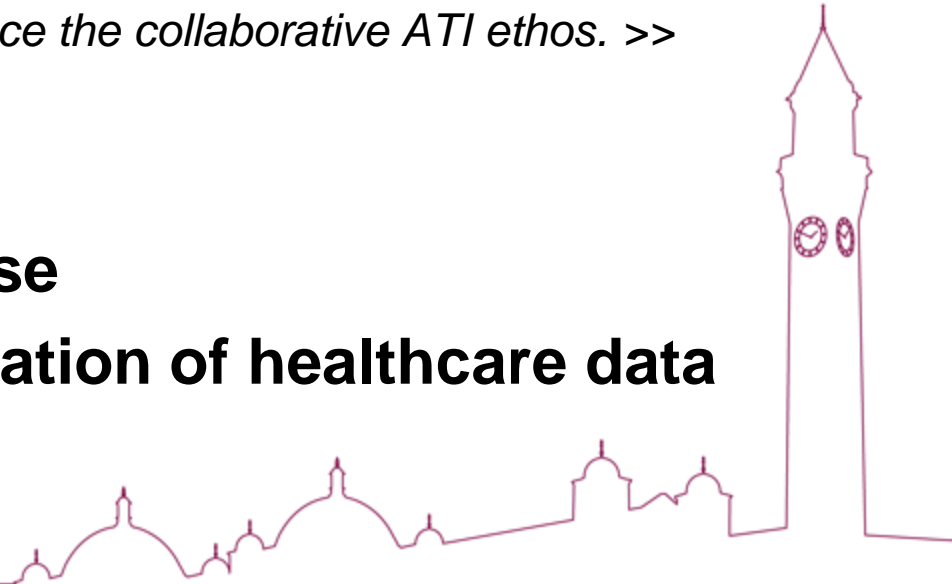
# Environmental Analysis

Developing improved understanding of the environmental context of health can help us understand not only the individual responses of a variety of species to pollution – and the consequences of this for human health – but also inform novel approaches for monitoring and prediction that utilise innovative genomic and metabolomic methodologies. This includes engineering new instruments and sensors to better measure chemicals in complex environments.
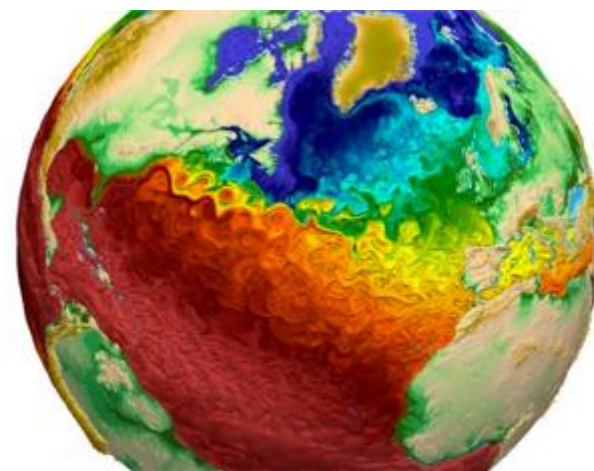
Key UoB researchers: *Ben Brown, Mark Viant, John Colbourne,…*

**Add you Name Here**

# Monitoring Health & Disease

The ability to phenotype, monitor and track both human health as well as the micro-organisms that can directly impinge on this is increasingly critical for modern medicine. We bring together world-leading expertise and industrial collaborations in cutting- edge genomics and metagenomics approaches to the diagnosis, treatment and surveillance of infectious disease; novel genetic/genomic modelling tools; and mass spectrometry and metabolomics technology innovation for clinical and research use. We already lead the international deployment of novel genomics technologies in response to viral outbreaks such as Zika and Ebola, as well as the population genomics arm of the national 100,000 Genomes Project. Cognitive neuroscientists are discovering brain biomarkers to predict neurodegenerative diseases such as Alzheimer's disease and determine which patients experiencing persistent vegetative states will regain consciousness.

<u>Key UoB researchers</u>: *Jean-Baptiste Cazier, Helen Cooper, Damian Cruse, Warwick Dunn, Davinia Fernandez-Espejo, Simon Hanslmayr, Nick Loman, Ali Mazaheri, Kim Shapiro, Justina Zurauskiene, …*

**Add you Name Here**
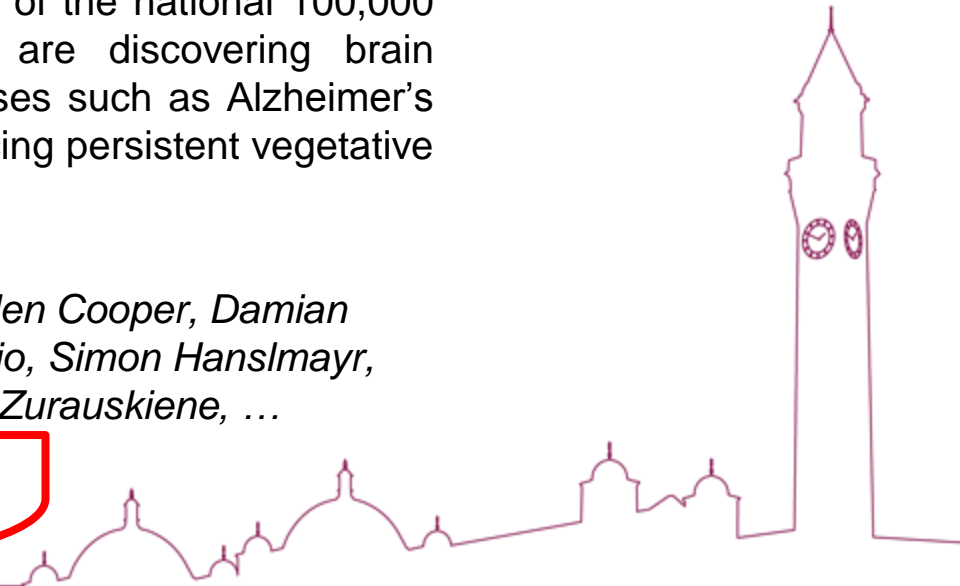
# Representation and integration of Healthcare data

We will look to align our relevant strengths – including those of our wider NHS allies in Birmingham Health Partners – to opportunities presented through the ATI, e.g. HDR UK. We will develop new research and innovation in computable representation and integrated analysis of the patient pathway in secondary healthcare, including Artificial Intelligence, Natural Language Processing, Semantic Technologies, as well as the issues of security and confidentiality around the use of patient data. Our access to one of the most sophisticated Electronic Healthcare Records in the world – uniquely developed in-house and incorporating user-led patient portal design – allows us to incorporate and deploy innovation in real-world applications.

<u>Key UoB researchers</u>: *Simon Ball, George Gkoutos, Melanie Calvert, Chris Yau (Turing Fellow), …*

**Add you Name Here**

# Populations & Planning

Uniting expertise in urban planning, digital geographies and big data analytics, we will use a range of data to undertake new research on networks of communities, individuals and firms, analysis and planning, urbanisation and governance, and how this connects to resilience, health, environmental and economic change. This includes for example the use of big data of high spatio-temporal resolution (e.g. mobile phone data and large internet archives) in urban and regional analysis, or assessing urban temporalities and rhythms in assessing how to activate new spaces.

<u>Key UoB researchers</u>: *Emmanouil Tranos, Lauren Andres, Eric Chu, …*

**Add you Name
Here**

# Since the application...

- Engaged in Conversations across Campus
- Received 35 Turing Fellow Applications
  - ➢ 13 from MDS/LES
  - ➢ 23 related to Data Intensive Life Sciences
  - ➢ Goes beyond the two themes
- ➢ Extend and Refine the remit
  - ➢ Responsible AI
  - ➢ …

Complexity

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Life
Sciences

Abstraction

Application
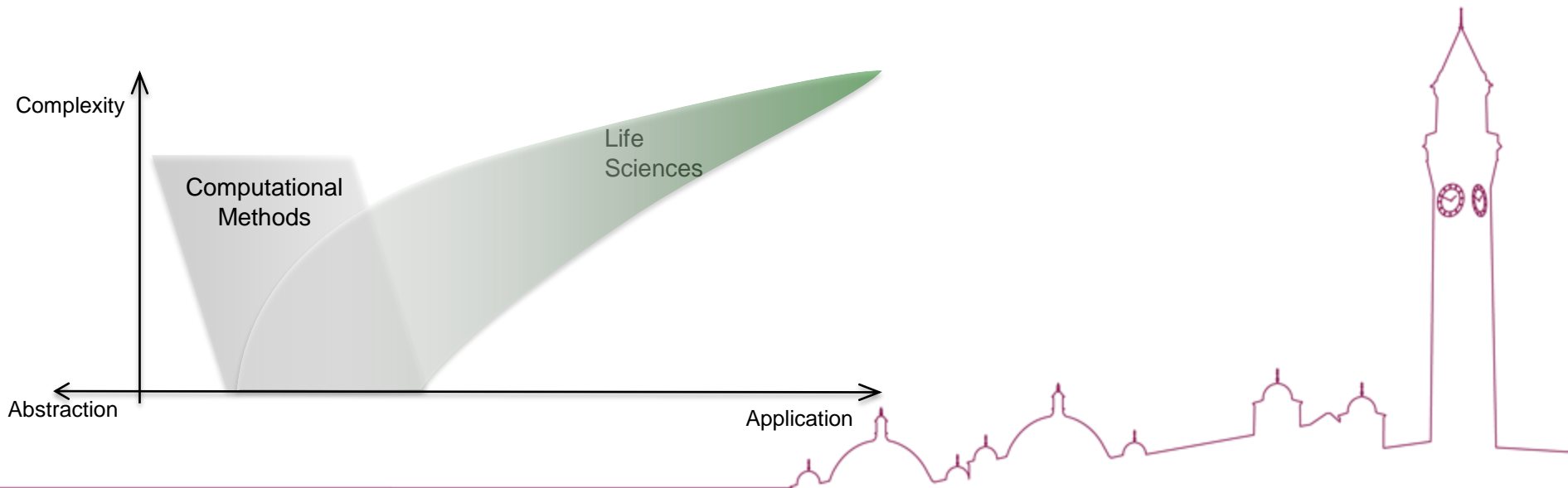
# ATI's perspective

## Theme areas for new university partners

| University | Data science for science | Data-centric engineering | Defence and security | Digital humanities | Environment and sustainability | Ethics | Financial services | Government | Health | Life sciences | Robotics | Urban analytics |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Birmingham | ■ | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Bristol | | | ■ | | | | | | ■ | ■ | | |
| Exeter | | | | ■ | ■ | | | | ■ | | | |
| Leeds | | | | ■ | ■ | ■ | ■ | ■ | ■ | | ■ | ■ |
| Manchester | | ■ | | ■ | ■ | | ■ | | ■ | ■ | | ■ |
| Newcastle | | ■ | ■ | ■ | | | | ■ | ■ | | | ■ |
| Queen Mary's | | ■ | | | | | | | ■ | | | |
| Southampton | ■ | | | ■ | ■ | ■ | | | | | | |

- 🟥 Data Intensive Life Sciences
- 🟦 Imaging at scale
- 🟪 Both

# What next ?

☐ Engage in the conversation

☐ Join an existing Project

☐ Put forward a Project
  – In line with **ATI Programmes**/SIG/Themes/Projects
  – Exciting for the **ATI Researchers**
  – Where **ATI Expertise** can be beneficial
  – Make use of **ATI Resources**

**Contact us !** J.Cazier@bham.ac.uk