Informatics for Sustainability

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Application-driven Research
Overview

- Research for the Anthropocene
- Energy use in buildings
- Real macroeconomics
The Antropocene

- **Pliocene → Pleistocene → Anthropocene**
  - Earth system driven by humans
- Arctic sea ice
- Atmospheric composition
- Land use
Interacting Systems

- Geological
- Biological
- Chemical
- Social
- Cultural
- Political
- Economic
- ...

...
Predictive Modelling of Interacting Systems

- Lots of modelling paradigms
  - Statistical and probabilistic
  - System dynamics
  - Dynamical systems
  - Event driven
  - Coupled differential equations
  - …

- In many cases, data is key for predictive models
Energy as Prime Mover

- Many systems constrained by physical sciences
  - Strongly: geology, ocean, atmosphere, biosphere
  - Moderately: economy
  - Weakly: political, financial, cultural
- What makes things happen in physics?
  - Energy
Energy Use in Buildings

• Of UK energy demand
  – About 30% is from domestic buildings
  – About 18% is from non-domestic buildings

• Can we use computational methods to reduce these figures?
IDEAL: Intelligent Domestic Energy Advice Loop

Sensors in dwellings

Data cleaning
Behaviour inference

At scale: hundreds of households

Feedback generation
- Graphs and images
- Text and captions
- Drill-down
Inference challenges

- One model or many (how many)?
- Transfer learning?
- Validation in large scale?
Public Sector Non-Domestic Buildings

- University and City of Edinburgh
  - Offices, labs, community centres, libraries, …
  - Social and organisational systems are key
  - Sensor + BEMS data
    - For feedback to stakeholders
    - For automated control systems
Possible PhD areas

- Inferring behaviours from sensor + other data
- Data-driven automated control systems
- Learning from user interactions
- Privacy and security concerns
- … MSc project in the area is advised
Real Macroeconomics

- The economy as a sociophysical system for the production of goods and services
- Macroeconomic statistics (ONS) allow us to construct a system dynamics model important sectors.
- Key for prediction: projecting how particular macroeconomic statistics will develop over time
- If interested, discussion required to establish suitable MSc project
Other possible application areas

- Low-carbon energy generation
- Smart grids
- Inference from remote sensing data for e.g., climate models
- Uncertainty in environmental risk
- ...