SUSTAIN

Sustainable Understandable agri-food Systems Transformed by Artificial INtelligence

Overview

- Collaboration between 4 universities: Lincoln, Aberdeen, Queen's Belfast and Strathclyde.

- 104 months, 1st April 2024-30th September 2032.

- Budget: £10,942,566.

- 60 Phd students.

- 5 cohorts of 12, equally split between universities.
  - 3 per university per year

- Each cohort funded for 4 years.

- First cohort starts October 1st 2024.

Vision

- The agri-food sector effects every person in the UK every day, by providing the food we eat to sustain our wellbeing.

- The Food & Drink sector is the largest manufacturing sector in the UK.

- The sector faces vast challenges, including environmental factors, labour shortages, eco-political conflicts and global health issues.

- To meet these challenges, the agri-food sector needs revolutionary change in the way that it operates.

- We believe that AI---when applied judiciously, appropriately and safely---can create this revolutionary change if we have a generation of leaders with deep knowledge of both AI and the agrifood domain.

- SUSTAIN was co-created to train this generation of leaders.

UNIVERSITY OF LINCOLN   1495 UNIVERSITY OF ABERDEEN   QUEEN'S UNIVERSITY BELFAST   IGFS THE INSTITUTE FOR GLOBAL FOOD SECURITY   University of Strathclyde Glasgow

Team

Simon Parsons

Elizabeth Sklar

UNIVERSITY OF LINCOLN

Louise Manning

Kate Smith

QUEEN'S UNIVERSITY BELFAST

Ilias Kyriazakis

Chris Creavy

University of Strathclyde Glasgow

Christos Tachtatzis

Craig Michie

Georgios Leontidis

Pete Smith

1495 UNIVERSITY OF ABERDEEN

UNIVERSITY OF LINCOLN

1495 UNIVERSITY OF ABERDEEN

QUEEN'S UNIVERSITY BELFAST | IGFS THE INSTITUTE FOR GLOBAL FOOD SECURITY

University of Strathclyde Glasgow

University of Lincoln

Expertise in:

- Machine Learning, Deep Learning
- Computer Vision
- AgriRobotics
- Modelling and simulation
- AI Planning
- Explainable decision making
- Supply chain

- Agricultural economics
- Land management
- Agricultural innovation & social inclusion

- Soil Science
- Plant Science
- High throughput phenotyping
- Environmental monitoring

Example Facilities:

- 200 hectare working farm
  - Both arable and animal
- Robot-enabled soft fruit farm
- Agroforestry site
- IoT-equipped refrigeration unit
- Private 5G-SA network
- Mobile phenotyping platform
- Engineering workshops
- Robotics labs
- Flux tower

Collaboration between School of Computer Science and Lincoln Institute for Agrifood Technology, others welcome!

University of Aberdeen

Cross-School Collaboration

Expertise in:

- Machine/Deep Learning and Computer Vision
- Multimodal and Representation Learning
- Neurosymbolic and Classical AI
- Natural Language Processing and Generation
- Privacy, Security and Trust
- Foundation models
- Knowledge Graphs and Ontologies

- Agri-Food Systems
- Land Use Management
- Food Security
- Nutrition, Diets, Food Inequalities
- Aquaculture & Marine Ecosystems
- Soil Science (soil carbon, microbial diversity, etc.)
- Plant Science

Example Facilities:

- In-house HPC facilities (>1300 CPU cores and >13 A100-80GB GPUs)
- Greenhouse facilities
- New Science Teaching hub with flexible laboratory spaces
- Aquarium facilities (fresh and salt water)
- Environmental Analytical Suite
- Human Nutrition Unit
- Rowett Institute Analytical Facilities
- Nano Scale Electron Microscopy
- Doubly-Labelled Water Laboratory
- X-Ray CT for Soil Sciences
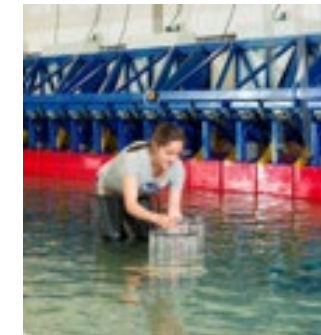- Scottish Fish Immunology Research Centre

Queen's University Belfast

- At Queen's the CDT is a collaboration between two Schools:
  - School of Biological Sciences (SBS)
  - School of Electrical, Electronic Engineering and Computer Science (EEECS)
- **PI and Co-Is**
  - Ilias Kyriazakis (SBS)
  - Niall McLaughlin (EEECS)
  - Chris Creevey (SBS)
  - Anna Jurek – Loughrey (EEECS)

- Participation of colleagues from **other Schools** (e.g. Maths and Physics) would be particularly welcome!

Queen's University Belfast

- The CDT aims to train PhD students on multidisciplinary projects that realize the potential of digital technologies within the agri-food sector

- The CDT aligns closely with the aims of the **Momentum One Zero Institute**
  - A cross-disciplinary digital innovation hub for ICT, Health and Life Sciences and Agri-Food

- Collaboration between digital technologies and agri-food research is not new for Queen's, e.g.:
  - The automated detection of vice in livestock
  - Automated welfare monitoring of broiler chicken flocks (FlockFocus)
  - Detection of lameness in cattle (KTP - CattleEye)
  - Using AI for bioscience discovery
  - From spectroscopy to data analytics

# University of Strathclyde
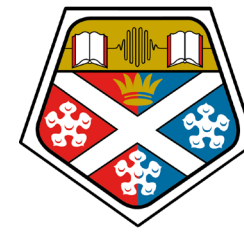
Facilities

- At Strathclyde the CDT is a collaboration between two Faculties:
  - Faculty of Engineering
  - Faculty of Science

- **Participating Departments**
  - Electronic and Electrical Engineering
  - Computer and Information Sciences
  - Management Science and Entrepreneurship
  - Mathematics and Statistics

- Participation of colleagues from **other Faculties and Departments** would be welcome!

National Manufacturing Institute Scotland

Digital Dairy Chain
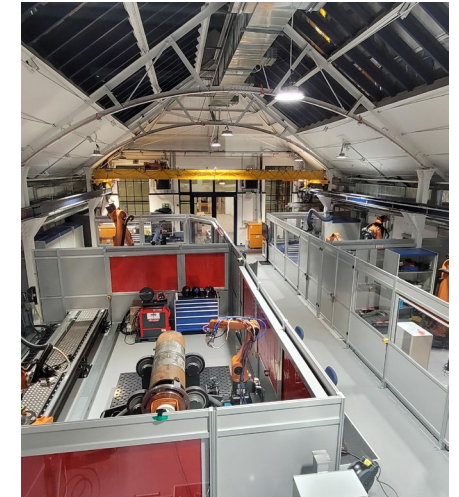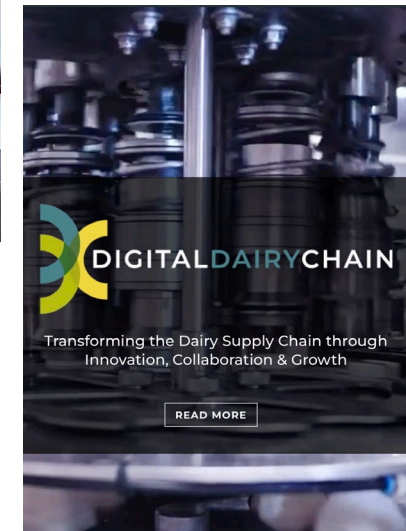
Sensor Enabled Automation Robotics & Control Hub

ARCHIE-WeSt is a regional supercomputer in the West of Scotland

Expertise

- Artificial Intelligence
- Machine Learning and Deep Learning
- Neuromorphic
- Explainable AI
- Trustworthy and Ethics in AI
- Generative AI
- Computer Vision
- Natural Language Processing
- Remote Sensing and Earth Observation
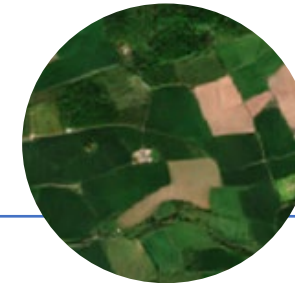- Foundational Models
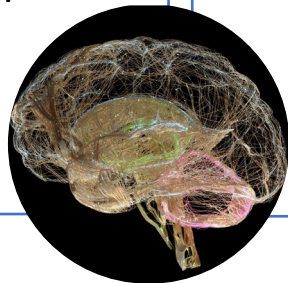
Applications

Livestock:

- Animal Health Monitoring
- Positive Welfare
- Production Efficiency and Quality Monitoring
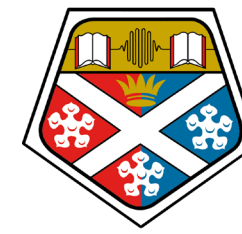- Green House Gas Monitoring
- Sustainable Production

Arable:

- Earth Observation & Remote Sensing
- Crop recognition & Yield prediction
- Fertiliser application & Disease detection
- Soil
- Carbon Sequestration
- Robotics

Smart Factory

- Automation and Robotics
- Digital Twins
- Supply Chain
- Inline processing
- Human Machine Interaction

Application areas

- Advancing our ability to measure and analyze key sustainability factors across the agri-food system (e.g. GHG emissions, resource use, crop yield, supply chain, human interactions);

- Reducing the environmental impact of agri-food practices (e.g. lowering NOX emissions from nitrogen input and GHG from animal systems, increasing sustainable productivity and biodiversity, enhancing carbon sequestration); and

- Informing human decision-making across the agri-food system, from researchers and producers to consumers (e.g. trade-offs with energy consumption of AI technologies like deep learning, use of in-field agri-robotics, food choices to maintain sustainable diets).

Key areas of AI

- Machine Learning
    - deep/reinforcement/evolutionary learning with real-world data challenges, e.g. sparse data, heterogeneous data, integration of domain knowledge, federated learning;
- Explainable AI
    - neuro-symbolic/cognitive modelling, reasoning under uncertainty, computational argumentation/dialogue, natural language generation, human-machine interaction; and
- Trustworthy and Ethical AI
    - responding to bias in data sets and digital twins, system verification/validation, reproducability at scale, data sharing, consideration of fairness/disruption/impact
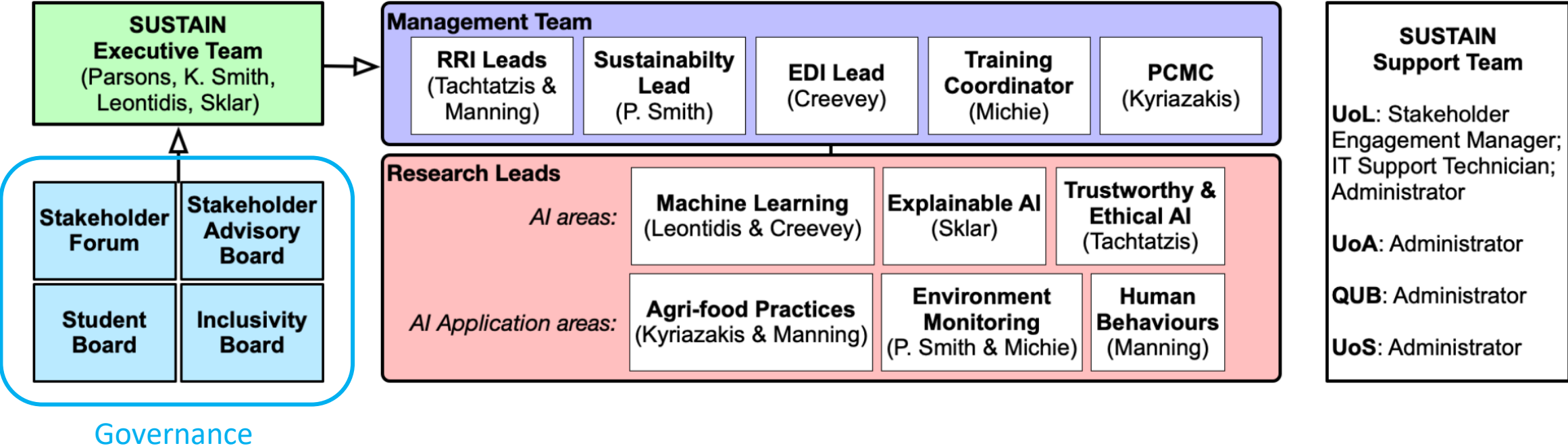
Training

Training
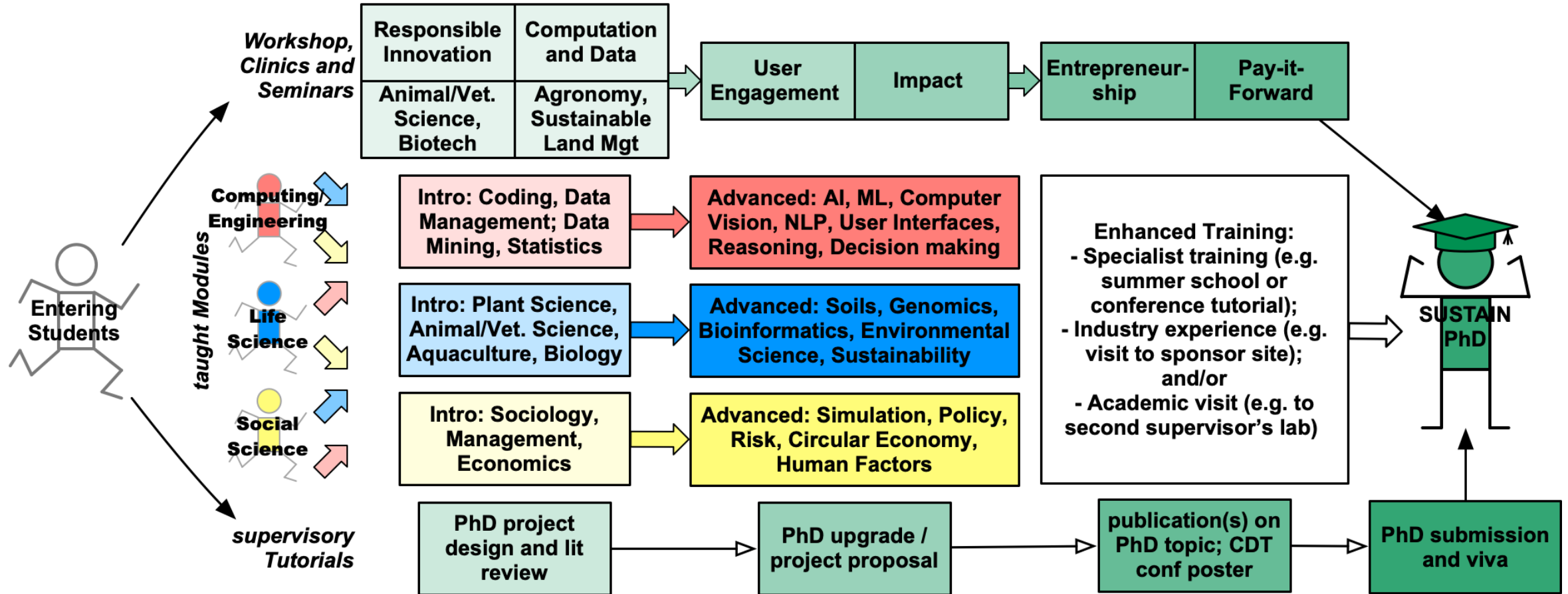
- Students from CS/Engineering, Life Sciences, Social Sciences.

- Research starts on Day 1.

- Compulsory SUSTAIN Workshops.
  - Responsible Innovation, Computation, Animal Science, Agronomy etc.

- Optional clinics.

- Taught modules as needed.
  - Across all four universities
  - Breadth requirements

Management/governance structure

Project topics/supervision

- Projects sit at the intersection of:
  - Application areas
    - Measuring/analyzing key sustainability factors
    - Reducing the environmental impact of agri-food practices
    - Informing human decision-making across the agri-food system
  - Key areas of AI
    - Machine Learning
    - Explainable AI
    - Trustworthy and Ethical AI
- E.g. ML for precision spraying, Neuro-symbolic models for land management.

Project topics/supervision (p2)

- Projects should ideally have:
  - Supervisors from 2 different institutions.
  - Supervisors from 2 different disciplines.
  - Industry partner.
  - Industry-relevant topic.
- We realise that for this year, it will be extremely challenging to meet all of these requirements.

The SUSTAIN Team can help with identifying topics, supervisors and industry partners.

Project funding

- Industry relevance is a design choice
  - Deliver projects that are clearly relevant to the agrifood sector
- Also a financial need (UKRI requires leverage)
  - Looking to cover one third of the total cost of the 60 studentships through sponsorship.
- Every project needs an industrial sponsor.
- Can be a single company, or a "thematic pool" (up to 3 entities).
- SUSTAIN team can help with matching projects and sponsors.

Benefits of participation

- SUSTAIN students can support your business by analysing key data sets.

- SUSTAIN research could result in joint IP, and to inform solutions to challenging problems in sustainable agriculture.

- Industry-led student training and site visits will raise the profile of your business, within a unique and relevant community, feeding into your business marketing strategy.

- Projects will be co-designed with industry partners, enabling research to be pushed rapidly towards real-world applications.

- A co-designed project will aim to solve a particular technology challenge, thereby securing sector advancement for your business.

- The research will be heavily supplemented by UKRI funding, significantly amplifying your return on investment.

- A PhD studentship could be used as the first stage of a long-term employment / R&D engagement.

- Projects will have supervisors from across the consortium providing high levels of expertise tailored to the project.

- Your organisation will be invited to SUSTAIN events, providing the opportunity to network/collaborate with leading stakeholders from across industry, academia and Government.

- You will be an acknowledged sponsor and will be given the opportunity to promote your company at conferences, events and via other resources.

- Research Studentship funding qualifies for R&D Tax credits when undertaken via a Contract with a University (Sub-contractor costs).

Recruitment timeline

- 21 Jan 2024, Submission of project proposals (first round)
- 29 Jan 2024, Launch student recruitment
- 25 Feb 2024, Deadline for student applications
- 04 Mar 2024, Interviews start
- 15 Mar 2024, Interviews end
- 22 Mar 2024, Students notified
- 01 Oct 2024, First cohort starts

Further rounds if necessary

How to apply (supervisors)

- Submit an expression of interest:
  - https://forms.office.com/e/iZQEB8MLj8
  - Right now
- Complete the project proposal form on the SUSTAIN website:
  - http://www.sustain-cdt.ai
  - By the submission deadline

Contact details

✉ sustain@lincoln.ac.uk

🌐 http://www.sustain-cdt.ai

in sustain-cdt

𝕏 sustain_cdt

Uniting industry and research for a more sustainable future