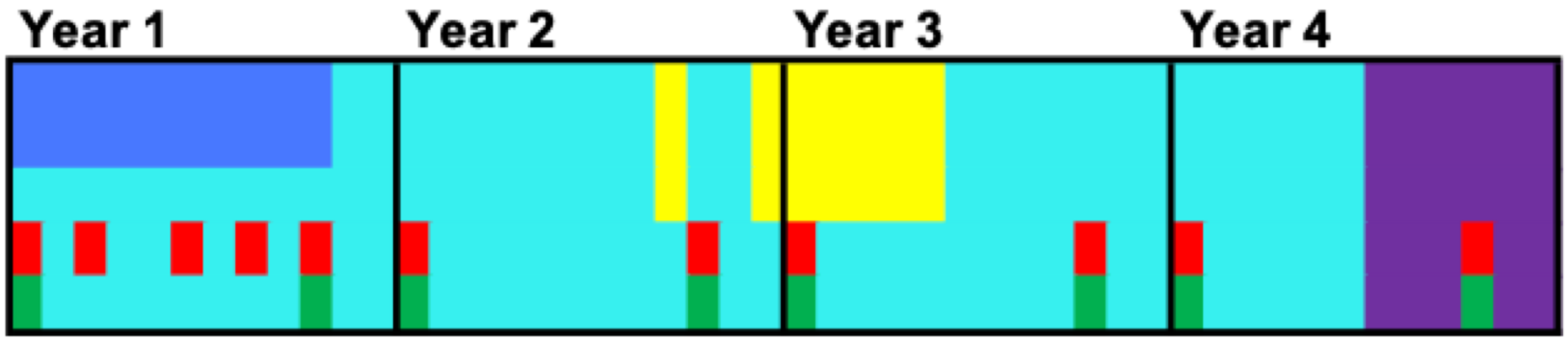
Year 1 Activities

Teaching and Learning

Timeline



Research project
External placement
Thesis writing
Taught modules
Cohort training events (computational skills)
Autumn and spring meeting, transferrable skills training and external partner engagement

6 month placement can take place anytime during years 2 and or 3.

Taught modules: main principles

- Modules delivered at the 5 partner universities
- Register once you have obtained your university email addresses
- Accessible via recorded lectures, online material
- Meet the lecturer in person via zoom meeting (to be scheduled)

- No exams at the end (you are no longer undergrads!)
- Assessment via coursework and participation
- Monitored by lecturer and CDT management team
- Part of probation, progression after 6/12 months

Year 1: Modules

- Semester 1
  - Machine Learning - Bristol
  - Data Analysis - Cardiff
- Semester 1+2
  - Information Visualisation - Bangor
  - Reading and Writing Development Group - Aberystwyth
- Semester 2
  - Machine Learning - Swansea

- Research-theme specific modules, in the students' home university

Module: Machine Learning (semester 1)

- https://www.bris.ac.uk/unit-programme-catalogue/UnitDetails.jsa?ayrCode=20%2F21&unitCode=COMS30035
- Dr Rui Ponte Costa (Bristol University)
- Assessment: Coursework

Module: Machine Learning (semester 1)

Machine Learning is the science of how we can build abstractions of the world from data and use them to solve problems in a data-driven way. This unit introduces the field of Machine Learning, and teaches how to create and use software that improves with experience.

After successfully completing this unit, you will be able to understand the fundamental principles of machine learning and how to build models of data.

Peter Flach, ***Machine Learning: The Art and Science of Algorithms that Make Sense of Data*** (Cambridge University Press, 2012) ISBN: 978-1107096394

Module: Data Analysis (semester 1)

- https://data.cardiff.ac.uk/legacy/grails/module/PXT125.html
- Prof Haley Gomez (Cardiff University)
- Assessment: Coursework

Module: Data Analysis (semester 1)

- To introduce students to the mathematical and statistical techniques used to analyse (physics) data. Similar techniques are also employed in a non-physics environment such as financial modelling, industry or other sciences
- To develop research skills, computing skills and the ability to work independently
- To translate raw data into a robust measurement and to interpret data given a hypothesis
- To be familiar with approaches and methods in interpreting data, particularly with large data sets
- To be familiar with using statistical techniques and methods of quantitative analysis of data

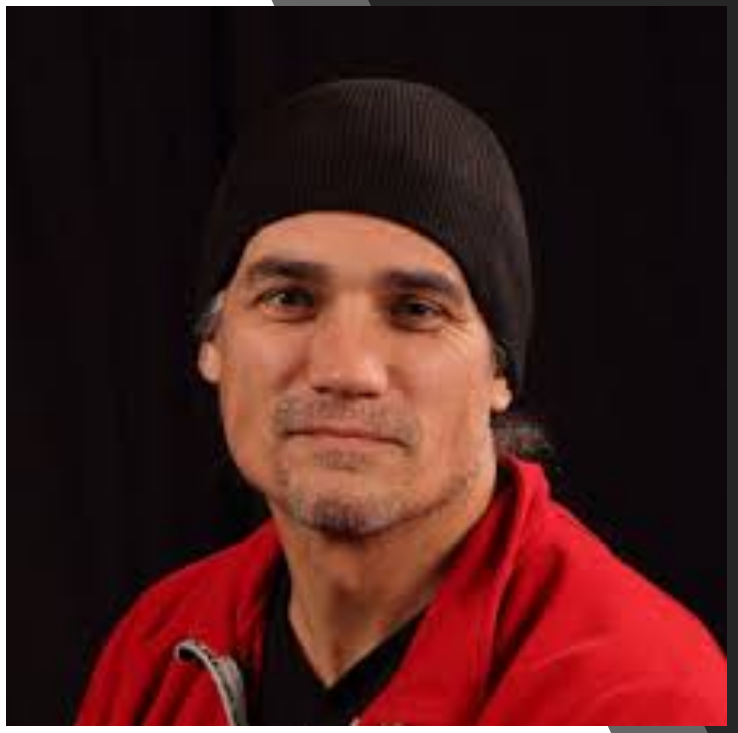
Module: Information Visualization (sem 1+2)

- https://www.bangor.ac.uk/computer-science-and-electronic-engineering/postgraduate-modules/ICE-4121
- Prof Jonathan Roberts (Bangor University)
- Assignments in 2nd semester
- Poster presentation on research project

Module: Information Visualization (sem 1+2)

- The history and future of Information Visualization; the challenges of Information Visualization; tasks; user, perception, data types.
- Looking at data. Data capture and problems of capturing data. Selection/abstraction of data (aggregation, sampling; binning; cropping); Big data challenges.
- Understand current visualisation techniques, including traditional plots (bar, line, scatter etc.), parallel coordinate plots, treemaps, re-orderable matrix; scatter plot matrix.
- Perception and interpretation; understanding how humans perceive information. Encoding of value; Encoding of relation; Models: Bertin, Mackinlay (Quantitative, Ordinal, and Categorical), Semiotics.
- Design of visualisations, dashboards, and considering alternative solutions and critical analysis of these visualisations.
- Interaction and exploration, looking at focus + context and distortion technique; multiple views and composite interaction; brushing; animation.

Module: Reading and Writing Development (sem 1+2)



- https://www.aber.ac.uk/en/modules/deptfuture/PGM2610/AB0/
- Prof Reyer Zwiggelaar (Aberystwyth University)
- Delivered via slack and zoom
- Assessment: draft literature review, reflective essay

Module: Reading & Writing Development (sem 1+2)

Aim is to develop the research skills of the students, with an emphasis on the critical analysis of the literature

- Identify and discuss subject specific literature
- Communicate with non-experts
- Defend points from the literature, which they might not support
- Reflect on aspects in the literature
- Critically evaluate the literature
- To write up literature review aspects

Module: Machine Learning (semester 2)

- https://intranet.swan.ac.uk/catalogue/default.asp?type=moddetail&dept=any&mod=MA-M08&ayr=20%2f21&psl=TB2&detailOnly=false
- Dr Farzad Fathizadeh (Swansea University)
- Assessment: Coursework

Module: Machine Learning (semester 2)

The module introduces basic concepts of machine learning and some of its popular methods in a practical manner from a mathematical perspective.

- Concept of learning, linear perceptron
- Types of learning: supervised learning, reinforcement learning and unsupervised learning
- Use of probability in learning and noisy data
- VC dimension, generalization, complexity, bias-variance tradeoff
- Linear classification, linear regression, logistic regression, gradient descent and stochastic gradient descent
- Overfitting, regularization, cross validation
- Support vector machines, kernel methods
- Decision trees, random forests
- K-means clustering and mixture models
- Neural networks

Research-specific modules

In addition, you should take research–specific modules at your university, relevant for your research topic, e.g.

- Machine Learning for Intelligent Systems (Aberystwyth)
- Virtual Environments & Human Perception (Bangor)
- Statistics for Particle Physicists (Bristol)
- Gravitational Waves (Cardiff)
- Machine Learning in Healthcare (Swansea)

This is arranged in discussion with your supervisor and the local PGR coordinator

Taught modules

Recap:

- No exams, but coursework and assessments
- Registration with other universities overseen by CDT management, once you have your university email addresses
- Take advantage of what is on offer!

Any questions?

Transferable Skills Training

Delivered throughout the programme, via inter/intra cohort meetings

- Communication, critical thinking, unconscious-bias, EDI, impact
- Leadership, grant writing, public engagement
- Management and financial planning skills
- Thesis writing, employability, careers

- Training/workshops led by industrial partners

Delivery via (virtual) events

- Two-day zoom meetings to meet up, receive training, get to know your peers, work on open problems, exchange experiences
- Research Software Engineer (RSE) led sessions
- Cohort-building activities/transferable skills
- Mentoring by experienced CDT students

Schedule to be communicated in October, with your input

Face-to-face residential meetings will resume, once it is permitted!

Annual meetings

Two meetings per year for all students, external partners, supervisors

- All cohorts and external partners invited, networking and feedback
- Autumn meeting:
  - welcome to new cohort
  - Pairing of students with external partners
  - Mentoring, feedback, transferable skills, …
- Spring meeting: annual conference
  - Science! oral and poster presentations
  - EDI, RI, industrial research presentations by external speakers
  - Mentoring, feedback, transferable skills, …
- External Stakeholder board meetings

Responsible Research & Innovation (RRI)

Best practice and pro-active actions

Responsible Innovation – Induction Event

- Responsible research in the global context – societal responsibilities, plagiarism, falsification, collaboration
- Issues of integrity – individual and institutional responsibilities
- Data management – sharing data, open access, medical data
- Research ethics – human participants, animals, health
- AI and ML specific aspects – bias, transparency
- Case studies

Responsible Innovation – Subsequently

- Reflect on which RI issues may arise
- Two-page report
  - Written in the spring
  - Part of the end-of-year progression
- Explicit example of RI in the context of AI
  - At spring meeting
- Peer learning/reflection in later years

Input from external partners on RI in non-academic environments welcome, for example via presentations at annual meetings

Industrial and external placements

Industrial Placements

Indicative 6 month placement in industry, public sector or commerce around the end of the 2nd or during the 3rd year

- Work on an AI/ML/AC project, e.g.,
  - Novel ML models applied to industrial data
  - Applications of multi-agent systems for decision making
  - data analysis and large-scale calculations
- Relevant to the company and not necessarily part of the Ph.D. project
- Benefit to the student: applying gained knowledge in industrial contexts
- Benefit to the company: availability of unique skills to solve a problem relevant to them

Shorter placements in 2nd year (2 weeks) to get to know the partner

How is the CDT related to industrial applications?

Research areas of the CDT:

- Machine learning applications to advanced fundamental science contexts: relevant for industrial applications in which speed, volume, variability etc. are challenging
- Medical applications: immediate relevance in related industrial contexts
- Novel algorithms and methods: give the possibility to transform and disrupt ways of operating with data

Details of the placements

- The students will remain enrolled at the University during the placement
  - They will be paid by the host university
  - They will not be members of staff at the partner organisations
  - CDT and academic supervisors will validate the suitability of the industrial project in the context of the CDT training
- An agreement will be signed between the student and partner detailing IP expectations
- If possible, and appropriate, students will be encouraged to publish the results obtained during the placement

Expectations for students

- Students will be offered choice of placement project
- Students will attend a placement briefing session prior to the placement
- Students will attend required induction at partners
- Students will be responsible for the work they do on the placement
- The work is not expected to form part of the PhD, but should make use of the skills the students have learned
- Students will give a presentation about their placement work at the next CDT meeting

Expectations for supervisors

- Assist in selection of the project
- Preparation prior to start of project
- Remain involved in student supervision with regular check-ins
  - Initial supervisory visit
  - at least monthly meeting
  - Possibility of student visits to university

Expectations for hosts

- Students are hosted by partner organisation
  - Provide an appropriate working environment
  - Provide necessary induction and training
  - Primary supervision is provided by partners
- Partner organisations are expected to provide a challenging project that builds on the ML/AI/AC skills acquired by the students
- Mentoring/supervision from partners

Questions?