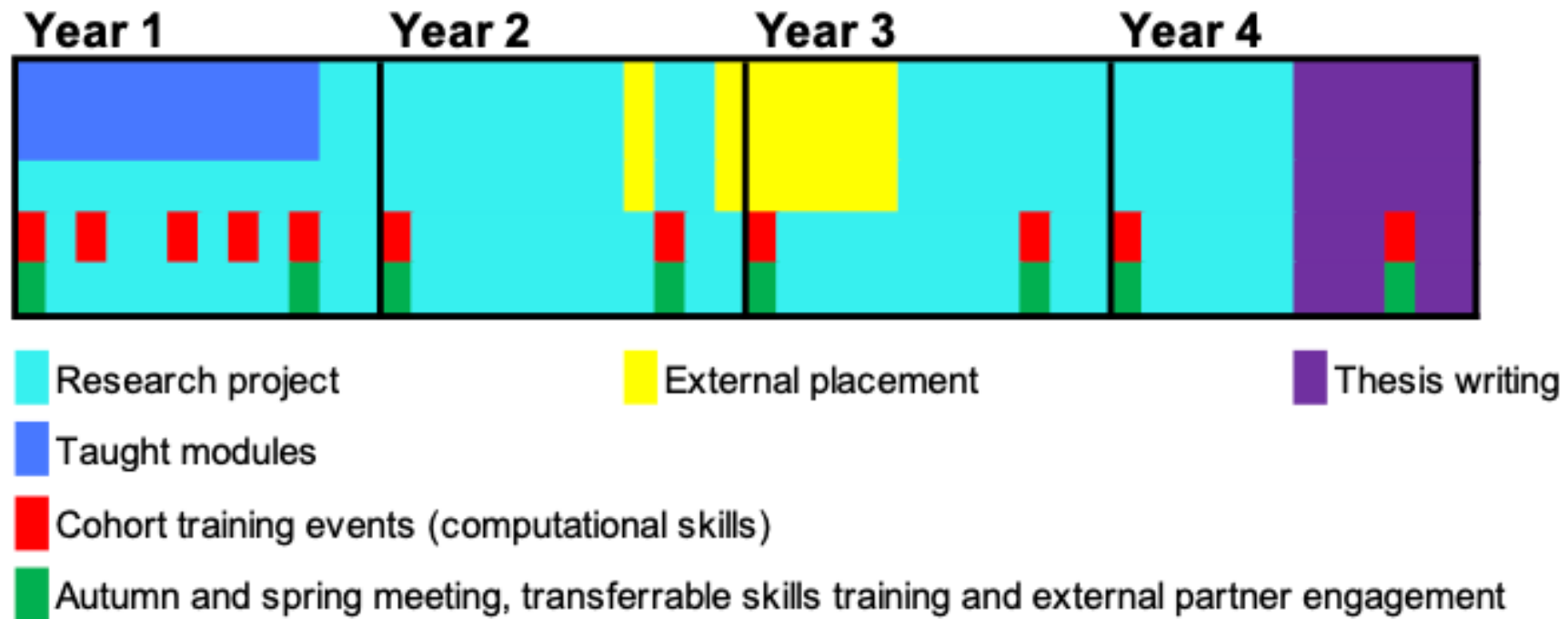


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Year 1 Activities

Teaching and Learning

# Timeline



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

# Taught modules: main principles

- Modules delivered at the 5 partner universities
- For Bristol and Cardiff: register after obtaining your university email address
- 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
  - Reading and Writing Development Group - Aberystwyth
- Semester 2
  - Information Visualisation - Bangor
  - Quantum computing - Swansea
- Research-theme specific modules, in the students' home university

# Module: Machine Learning (semester 1)



- Dr James Cussens (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.

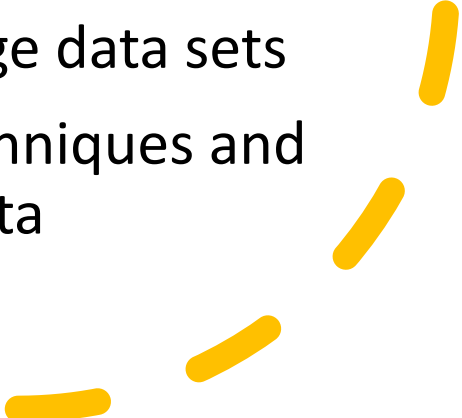
Peter Flach, ***Machine Learning: The Art and Science of Algorithms that Make Sense of Data*** (Cambridge University Press, 2012) ISBN: 978-1107096394

# Module: Data Analysis (semester 1)



- Prof Haley Gomez (Cardiff University)
- Assessment: Coursework
- See later today

# 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 2)



- Prof Jonathan Roberts (Bangor University)
- Assignments in 2<sup>nd</sup> 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)



- Prof Reyer Zwiggelaar (Aberystwyth University)
- Delivered via slack and Teams
- 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: Quantum computing (semester 2)



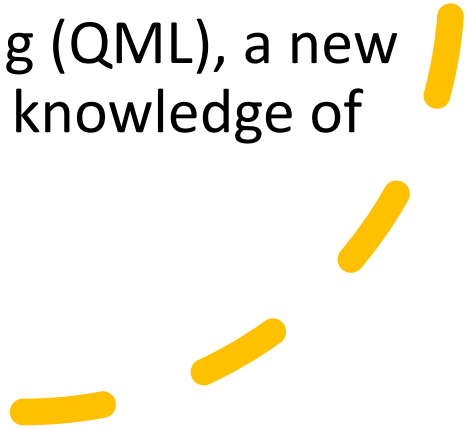
- Prof Gert Aarts (Swansea University)
- Delivered via zoom lectures + recordings
- Assessment: Coursework

# Module: Quantum Computing (semester 2)

Introduction to basic concepts of quantum mechanics, quantum algorithms and quantum computers.

Understanding of most relevant quantum algorithms, including Grover's search algorithm, Shor's algorithm for factoring, quantum teleportation, quantum cryptography protocols and quantum error correction.

The aim of this module is to provide a foundation to continue with quantum machine learning (QML), a new and more exploratory research area. No knowledge of physics is assumed.



# 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!
- If you have done the **specific module** already, no need to take it again.

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 shortly

Dates are fixed, please put them in your diaries

# 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

# Travel, accommodation, RTSG

Costs for training events (like the current one) are covered by the CDT

- Please contact Roz for questions
- Respond promptly to information requests (booking, travel, reimbursement, etc)

RTSG: research training support grant

- purchase a laptop, again via Roz
- conference, workshop, PhD school: discuss with your supervisor
- do not book independently, uni travel rules are non-trivial
- always first agree with your supervisor and Roz for bookings, claims etc

**please respond  
to Roz's emails  
promptly!**



# Responsible Research & Innovation (RRI)

Best practice and pro-  
active actions

# Responsible Innovation

- 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

- 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

Part of module  
delivered by Reyer  
Zwiggelaar (Aber)

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

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Questions?