1. KentVision Code and title of the module

COMP6362 – Machine Learning Algorithms

## Division and School/Department or partner institution which will be responsible for management of the module

Division of Computing, Engineering and Mathematical Sciences

School of Computing

## The level of the module (Level 4, Level 5, Level 6 or Level 7)

Level 6

## The number of credits and the ECTS value which the module represents

15 credits (7.5 ECTS)

## Which term(s) the module is to be taught in (or other teaching pattern)

Autumn or Spring

## Prerequisite and co-requisite modules and/or any module restrictions

Pre-requisite (Physics courses):

PHYS37000: Laboratory and Computing Skills for Physicists

Pre-requisite (Computing courses):

COMP3220: Foundations of Computing I and COMP3250 Foundations of Computing II and either

COMP3200: Introduction to Object-Oriented Programming

or COMP3590: Programming for Artificial Intelligence

## The course(s) of study to which the module contributes

Compulsory to the following courses:

BSc Artificial Intelligence with and without Year in Industry

Optional to the following courses:

BSc Computer Science with and without Year in Industry

BSc Computer Science (Networks) with and without Year in Industry

BSc Computer Science (Cyber Security) with and without Year in Industry

BSc Computer Science for Health with and without Year in Industry

BSc Computing with and without Year in Industry

BSc Data Sciences

BSc Software Engineering with and without Year in Industry

BSc Physics with and without Year Abroad

BSc Physics with Astrophysics

MPhys Physics with and without Year Abroad

MPhys Physics with Astrophysics

## The intended subject specific learning outcomes. On successfully completing the module students will be able to:

1. Describe what is meant by machine learning, list a number of types of machine learning algorithms (e.g. neural networks) and give a brief description of each together with some examples of their (actual or potential) applications.
2. Select the appropriate machine learning paradigm for a particular problem and be able to justify this choice based on knowledge of the properties and potential of this paradigm. To be able to compare the general capabilities of a number of such paradigms and give an overview of their comparative strengths and weaknesses.
3. Explain the mathematical equations that underlie selected machine learning algorithms, both the equations/ algorithms that define predictions or decisions, and those that define learning (e.g. the backpropagation algorithm for neural networks).
4. Analyse learning phenomena from the point of view of their being computational systems. To be able to take these phenomena and identify the features which are important for computational problem solving by learning from data or from simulation.
5. Build machine learning models (e.g. neural networks) using state-of-the-art simulation technology and apply them to the solution of problems. In particular, to select from the canon of learning algorithms which is appropriate for a particular problem domain.
6. Discuss examples of challenges related to learning from data. To be able to analyse related systems not directly studied in the course in a similar fashion.
7. Discuss examples of machine learning models as applied to various tasks.

## The intended generic learning outcomes. On successfully completing the module students will be able to:

1. Utilize the library, exploit online resources and internet sites to support investigations into these areas.
2. Improve their analytical skills in respect of subsymbolic systems.
3. Enhance their time management and organisation skills.
4. Learn effectively for the purpose of continuing professional development.

## A synopsis of the curriculum

In this module you learn what is meant by machine learning and how to explain the key algorithms (especially the backpropagation algorithm for learning deep neural networks) and mathematical equations that underlie them. You also familiarise yourself with a range of machine learning algorithms and their inner mechanisms. Using state-of-the-art software technology apply these algorithms to the solution of problems. You will study the existing machine learning implementations of selected algorithms, and you will also engage in implementation of algorithms and procedures relevant to machine learning.

## Reading list

## The University is committed to ensuring that core reading materials are in accessible electronic format in line with the Kent Inclusive Practices.

## The most up to date reading list for each module can be found on the university's [reading list pages](https://kent.rl.talis.com/index.html).

Christopher M Bishop. Pattern recognition and machine learning. Springer, 2006.

Francois Chollet. Deep learning with Python. Simon and Schuster, 2021.

Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong. Mathematics for machine learning. Cambridge University Press, 2020. url: https://mml-book.github.io/book/mml-book.pdf.

Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani. An introduction to statistical learning with applications in R. Vol. 112. Springer, 2013.

Tom M. Mitchell. Machine Learning. McGraw-Hill, 1997.

Kevin P Murphy. Machine learning: a probabilistic perspective. Cambridge, MA, 2012.

Randall C O’Reilly and Yuko Munakata. Computational explorations in cognitive neuroscience: Understanding the mind by simulating the brain. MIT press, 2000.

Simon J.D. Prince. Understanding Deep Learning. MIT Press, 2023.

Stuart J. Russell and Peter Norvig. Artificial Intelligence: A Modern Approach (4th Edition).

Pearson, 2021.

Haykin, S. (1999) Neural Networks, A Comprehensive Foundation. Prentice Hall International Edition.

Bengio, Yoshua, Ian Goodfellow, and Aaron Courville. Deep learning. MIT press, 2017.

Sejnowski, Terrence J. The deep learning revolution. MIT press, 2018.

Ian H. Witten, Eibe Frank, Mark A. Hall, and Christopher J. Pal. Data Mining, Fourth Edition: Practical Machine Learning Tools and Techniques. 4th. San Francisco, CA, USA: Morgan Kaufmann Publishers Inc., 2016.

## Contact Hours

Private Study: 111

Contact Hours: 39

Total: 150

## Assessment methods

* 1. Main assessment methods

Two simulation assessments (individual; 12 hours; 20% total)

Examination (2 hours; 80%)

13.2 Reassessment methods

Like for like

## Map of module learning outcomes (sections 8 & 9) to learning and teaching methods (section 12) and methods of assessment (section 13)

**Module learning outcomes against learning and teaching methods:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Module learning outcome** | 8.1 | 8.2 | 8.3 | 8.4 | 8.5 | 8.6 | 8.7 |  | 9.1 | 9.2 | 9.3 | 9.4 |
| Private study | x | x | x | x | x | x | x |  | x | x | x | x |
| Lectures and seminars | x | x |  | x |  | x | x |  |  | x |  |  |
| Practical |  | x | x |  | x |  |  |  | x | x | x |  |

**Module learning outcomes against assessment methods:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Module learning outcome** | 8.1 | 8.2 | 8.3 | 8.4 | 8.5 | 8.6 | 8.7 |  | 9.1 | 9.2 | 9.3 | 9.4 |
| Simulation assessment 1 |  | x | x |  | x | x |  |  | x | x |  |  |
| Simulation assessment 2 |  | x | x |  | x | x |  |  | x | x |  |  |
| Examination | x | x | x | x | x | x | x |  | x | x | x | x |

## Inclusive module design

The Division recognises and has embedded the expectations of current equality legislation, by ensuring that the module is as accessible as possible by design. Additional alternative arrangements for students with Inclusive Learning Plans (ILPs)/declared disabilities will be made on an individual basis, in consultation with the relevant policies and support services.

The inclusive practices in the guidance (see Annex B Appendix A) have been considered in order to support all students in the following areas:

a) Accessible resources and curriculum

b) Learning, teaching and assessment methods

## Campus(es) or centre(s) where module will be delivered

Canterbury

## Internationalisation

The topics addressed by this module relate to a field which is of international importance, given the global role of computers in today's technological innovation. The topics covered by this module are international in nature, being identical worldwide and independent of traditional spoken language.

**DIVISIONAL USE ONLY**

**Module record – all revisions must be recorded in the grid and full details of the change retained in the appropriate committee records.**

| Date approved | New/Major/minor revision | Start date of delivery of (revised) version | Section revised  (if applicable) | Impacts PLOs (Q6&7 cover sheet) |
| --- | --- | --- | --- | --- |
| 30/11/2021 | Major | Sept 2022 | 6,9,10,11,12,13,14 | No |
| 11/04/2022 | Minor | September 2022 | 8, 12, 13 | No |
| 10/01/2023 | Minor | September 2023 | 6,7,13,14 | No |
| 23/11/2023 | Major | September 2024 | 1, 8, 9, 10, 11 | Yes |