CS429-15 Machine Learning Algorithms and Practice

26/27

Department
Computer Science
Level
Undergraduate Level 4
Module leader
Gabriele Pergola
Credit value
15
Module duration
10 weeks
Assessment
Multiple
Study location
University of Warwick main campus, Coventry

Description

Introductory description

Data Mining.

Module aims

Foundation in Machine Learning Concepts: To deepen the understanding of foundational concepts in machine learning, encompassing both traditional data mining algorithms and advanced machine learning methodologies.

Grasping the Role of Machine Learning in Real-World Applications: To provide a comprehensive understanding of how machine learning techniques can be leveraged to solve complex real-world problems.

Mastery of Machine Learning Algorithms: To gain a broad-scope and thorough knowledge of a variety of algorithms used in machine learning.

Practical Application of Machine Learning Tools: To enhance the ability to apply advanced machine learning tools and techniques to real-world data, offering a more practical and applied focus.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

Introduction to machine learning, basic concepts and motivation;
Data pre-processing and basic data transformations;
Regression models (linear regression, logistical regression);
Classification: linear discriminants, SVMs, other classifiers such as decision trees and forests;
Model evaluation, bias-variance trade-off;
Ensemble methods: boosting, bagging & random forests;
Dimensionality reduction: Principal Component Analysis (PCA), T-distributed Stochastic Neighbour Embedding (t-SNE/UMAP);
Introduction to deep learning, backpropagation, gradient descent;
Convolutional neural networks;
Word embeddings;
Sequence-to-sequence models, Residual Neural Networks;
Attention mechanisms and memory networks;
Language processing;
Unsupervised deep learning and generative models;
Learning Strategies such as Transfer learning, etc.

Learning outcomes

By the end of the module, students should be able to:

- Display a comprehensive understanding of different data mining tasks and the algorithms most appropriate for addressing them.
- Evaluate models/algorithms with respect to their accuracy.
- Demonstrate capacity to perform a self-directed piece of practical work that requires the application of data mining techniques.
- Critique the results of a data mining exercise.
- Develop hypotheses based on the analysis of the results obtained and test them.
- Conceptualise a data mining solution to a practical problem.

Indicative reading list

Reading lists can be found in Talis

Specific reading list for the module

Research element

The students shall be required to explore the literature about latest methods related to classification and deep learning.

Interdisciplinary

Applied machine learning lies at the intersection of statistics, data mining, computer science and mathematics.

Subject specific skills

Design of machine learning solutions
Learning to develop novel algorithms related to machine learning
Conducting proper experiment design in machine learning

Transferable skills

Experiment design
Critical Thinking
How to conduct literature reviews

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (20%)
Practical classes	10 sessions of 1 hour (7%)
Private study	110 hours (73%)
Total	150 hours

Private study description

Private study should focus on the following components:

a. Assigned reading
b. Coding exercises
c. Assignment solution
d. Review of the lab component
e. Revision of the lecture slides

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Students can register for this module without taking any assessment.

Assessment group C2

	Weighting	Study time	Eligible for self-certification
Assignment 2 Assignment 2.	25%		No
Assignment 1 Assignment 1.	25%		No
Centrally-timetabled examination (On-campus) CS429 MEng Examination.	50%		No

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- Answerbook Pink (12 page)
- Students may use a calculator

Assessment group R2

	Weighting	Study time	Eligible for self-certification
In-person Examination - Resit CS429 MEng resit examination	100%		No

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- Answerbook Pink (12 page)
- Students may use a calculator

Feedback on assessment

Formative feedback will be provided in lab sessions and also during lectures where answers are given in class to short exercises.

Summative feedback:

- Written feedback will be provided on the practical assignment and will be given electronically with explanation on the mark given.

Past exam papers for CS429

Availability

Pre-requisites

No Warwick module is required as pre-requisite. However familiarity with basic probability and statistics (for example: discrete and continuous random variables, densities and distributions, common distributions including Bernoulli, binomial, uniform and normal distribution, expectations) will be needed.

Courses

This module is Optional for:

- Year 5 of UCSA-G504 MEng Computer Science (with intercalated year)
- Year 1 of TMAA-G1P0 Postgraduate Taught Mathematics
- TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
    - Year 1 of G1PC Mathematics (Diploma plus MSc)
    - Year 2 of G1PC Mathematics (Diploma plus MSc)
- Year 4 of UCSA-G503 Undergraduate Computer Science MEng

This module is Option list B for:

- Year 4 of UCSA-G408 Undergraduate Computer Systems Engineering
- Year 5 of UCSA-G409 Undergraduate Computer Systems Engineering (with Intercalated Year)
- Year 4 of UCSA-G4G3 Undergraduate Discrete Mathematics
- Year 5 of UCSA-G4G4 Undergraduate Discrete Mathematics (with Intercalated Year)

This module is Option list C for:

- UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
    - Year 4 of G105 Mathematics (MMath) with Intercalated Year
    - Year 5 of G105 Mathematics (MMath) with Intercalated Year
- UMAA-G103 Undergraduate Mathematics (MMath)
    - Year 3 of G103 Mathematics (MMath)
    - Year 4 of G103 Mathematics (MMath)
- Year 4 of UMAA-G107 Undergraduate Mathematics (MMath) with Study Abroad