ES9ZR-15 AI and Machine Learning for Diagnostics

23/24

Department
School of Engineering
Level
Taught Postgraduate Level
Module leader
Deepak Parashar
Credit value
15
Module duration
10 weeks
Assessment
100% coursework
Study location
University of Warwick main campus, Coventry

Description

Introductory description

This module introduces students to data-driven technologies in diagnostics, especially Machine Learning (ML) and other Artificial Intelligence (AI) approaches that are transforming the modern landscape of medicine by helping doctors diagnose patients more accurately, leading to better health predictions and effective treatments.

Module aims

The aims of the module are to introduce students to state-of-the-art ML and AI techniques used for implementing in a range of clinical and medical data such as screening, radiology, pathology, electronic health records, risk stratification, and personalised medicine, leading to efficient and precise diagnosis and prognosis of disease.

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.

Indicative data analytic topics:

1. Hypothesis testing and statistical decision-making
2. Statistical models of association, predictor and outcome of disease.
3. Data format/structure, pre-processing, feature extraction, dealing with missing data
4. ML methods: Regression, SVM, Random Forest, Gradient Boosting, PCA, Clustering, etc. plus relevant packages
5. AI: Convolution Neural Networks (Recurrent/2D/3D), Graph Convolution Network, etc. plus relevant packages
6. Assessing and quantifying model accuracy
7. Implementing in real-world diagnostic and prognostic datasets.
8. Synthetic datasets and its role in health data science
9. Medical use cases and inference.

Learning outcomes

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

- Understand the methods applied to different datasets for predictive diagnostics or classification
- Select and use appropriate tools/software packages to define and run ML and AI models.
- Evaluate performance and accuracy of models
- Understand the role of ML/AI in healthcare and make unbiased real-world inference.

Indicative reading list

1. Essential Medical Statistics, 2nd Edition, by B.R. Kirkwood and J.A. Sterne, Blackwell Publishing 2003.
2. Machine Learning Fundamentals: A Concise Introduction, by H. Jiang, CUP 2021.
3. Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2, 3rd Edition, by S. Raschka and V. Mirjalili, Packt Publishing 2019.
4. Applied Predictive Modelling, by M. Kuhn and K. Johnson, Springer 2018.
5. Artificial Intelligence: A Modern Approach, 4th Edition Edition, by S. Russell and P. Norvig, Pearson 2021.

Interdisciplinary

A split of clinical and engineering focussed data science methods. A mix of statistical, computational and mathematical approaches.

Subject specific skills

1. Gain knowledge of the current landscape of diagnostic data.
2. Be able to formulate research questions suitable for statistical analysis.
3. Learn programming packages in R and Python in order to implement a range of Statistical, ML, and AI models.

4. Interpret results fairly maintaining the integrity of the analysis.
5. Understand the scenarios where it would be beneficial to generate synthetic data.

Transferable skills

1. Apply ML and AI algorithms and techniques in a variety of healthcare data.
2. Appreciate similar and dissimilar technologies in related disciplines.
3. Adapt analytic methods for interdisciplinary research.

Study

Teaching split

Provider	Weighting
WMG	50%
Warwick Medical School	50%

Study time

Type	Required
Lectures	10 sessions of 2 hours (13%)
Seminars	10 sessions of 1 hour (7%)
Supervised practical classes	10 sessions of 2 hours (13%)
Private study	50 hours (33%)
Assessment	50 hours (33%)
Total	150 hours

Private study description

Students will undertake private study to ensure that they have basic programming skills in Python and R. Online courses will be provided for them to follow.
In addition, students will undertake preparatory tasks such as pre-reading before seminars and lectures and follow-up data analysis tasks from the lab sessions.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A

	Weighting	Study time	Eligible for self-certification
Assessment component			
Data analysis Report	75%	40 hours	Yes (extension)
Students will undertake a data analysis task and prepare a report			
Reassessment component is the same			
Assessment component			
Presentation	25%	10 hours	No
Students will present their findings on the data analysis task			
Reassessment component is the same			

Feedback on assessment

Presentation: Two assessors listening to the presentations and marking on fixed criteria. Presentation to other members of the group who will give informal feedback.

Report: Written feedback provided on report, based on assessment criteria. Feedback on programming style/practice/efficiency in addition to report.

Availability

Pre-requisites

Some knowledge of Python/R programming language

Courses

This module is Core for:

- TESA-H1CA Postgraduate Taught Diagnostics, Data and Digital Health
  - Year 1 of H1CA Diagnostics, Data and Digital Health
  - Year 1 of H1CB Diagnostics, Data and Digital Health (Medical Diagnostics)

- Year 1 of H1CC Diagnostics, Data and Digital Health (Medical Imaging)