

AI for Medicine Artificial Intelligence for Medicine

By Genoa University- Italy

Proponents

Rosanna Turrisi, Annalisa Barla

Machine Learning Genoa Center (MaLGA) and

Department of Computer Science, Bioengineering, Robotics and Systems Engineering (DIBRIS)

Università di Genova

Format

5 classes, 4h each (2.5h theory + 1.5 practice)

Dates

Thursday, 7 July 2022, from 10 a.m. to 2 p.m. (CET)

Monday, 11 July 2022, from 2 p.m to 6 p.m. (CET)

Thursday, 14 July 2022, from 10 a.m. to 2 p.m. (CET)

Monday, 18 July 2022, from 2 p.m to 6 p.m. (CET)

Friday, 22 July 2022, from 10 a.m to 2 p.m. (CET)

Target

BSc, MSc and (possibly) PhD students in Computer Science/Computer Engineering/Bioengineering

Medical students, lecturers, instructors, and professionals

Recommended background knowledge

Linear algebra

Probability and basic statistics

Calculus

Objectives

This course aims at providing the basics of Artificial Intelligence for biomedical applications. Students will learn machine and deep learning methods and how to set up an experimental pipeline that guarantees reproducible results. All classes are divided into theory and practice.

Materials

- Slides used in class
- Jupyter notebooks in Python (Google Colaboratory platform)
[with standard libraries such as NumPy, SciPy, Scikit-learn, PyTorch/Keras]
- Bibliography

Syllabus

- 1) Introduction to Artificial Intelligence
Theory [2.5h]
 - a) Examples of AI in medicine and biology
 - b) Data driven methods: supervised /unsupervised

- c) Supervised: classification/regression
- d) Shallow learning: regularization methods
- e) Deep learning: artificial neural networks
- f) Experimental design (cross-validation, model selection, over-/underfitting, confusion matrix, performance metrics [F1-score, accuracy, precision/recall]; out-of-sample, BIC/Akaike, stability)

Practice [1.5h]

- bias/variance
- overfit

2) Machine learning methods for prediction

Theory [2.5h]

- a) Examples of predictive methods for diagnosis or prognosis
 - i) Early detection of disease
 - ii) Disease progression prediction
 - iii) Disease staging
- b) Shallow learning: regularization methods
 - i) RLS
 - ii) SVM
 - iii) RF

Practice [1.5h]

- Dataset on diabetes [<https://www.kaggle.com/datasets/mathchi/diabetes-dataset>]
- Experimental design for model selection
- Resampling strategies and methods comparison for classification

3) Deep learning methods for prediction

Theory [2.5h]

- a) Examples of predictive methods for diagnosis or prognosis
 - i) Early detection of disease
 - ii) Disease progression prediction
 - iii) Disease staging
- b) Deep learning
 - i) Multilayer perceptron
 - ii) FeedForward NN

Practice [1.5h]

- Dataset on diabetes [<https://www.kaggle.com/datasets/mathchi/diabetes-dataset>]
- Model dependency on learnable parameter and model stochasticity

4) Applications of AI in medicine

Medical image prediction [2h]

- Deep learning (CNN)
- Skin cancer prediction on ISIC dataset [<https://www.kaggle.com/datasets/nodoubttome/skin-cancer9-classesisic>]

5) Biomarker identification

Theory [2.5h]

- a) Examples of variable selection in medicine

b) Case study:
identification of pathogenic molecular variables

c) SVM-RFE

d) Lasso

Practice [1.5h]

- Variable selection for genomics