Full Syllabus

Course Title

Advanced Topics in Machine Learning for Computational Biology

Lecturer

Dr. Jérôme Tubiana

Semester

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Course requirements

Introduction to Machine Learning (0368-3235)
OR Introduction to Statistical Learning (0365.3130)
OR another equivalent course.
No prior knowledge of biology is required.

Final grade components

Homeworks (Theoretical and Biological Data Analysis, 40%), Article Presentation (50%), Article Report (10%).

Course schedule

Class no. / Date	Subject and Requirements (assignments, reading materials, tasks, etc.)
Class 1	Linear models and extensions (GLM, GAM, LASSO) for Tabular Data.
Class 2	Decision trees and extensions (Decision rules; boosted trees) for Tabular Data.
Classes 3,4	Interpretable Machine Learning with Model agnostic-explanations. a) Partial Dependency and Accumulated Local Effects plots. b) Permutation Feature Importance. c) LIME and SHapley Additive exPlanations (SHAP).
Classes 5,6	Deep Learning Architectures for Unstructured Data a) Convolutional Neural Networks. b) Graph Neural Networks. c) Transformers. d) Saliency maps.
Classes 7,8	Data visualizations with low-dimensional embeddings (PCA, tSNE, UMAP).
Class 9	Meaningful feature extraction with Matrix Factorization Algorithms (K-means; Non-negative Matrix Factorization; Sparse PCA; Sparse Dictionary Learning).
Classes 10,11,12	Deep Generative Models a) Taxonomy of Generative models (Autoregressive, Latent variable, etc.) b) Variational Inference & Variational Autoencoders. c) Denoising Diffusion Generative Models
Class 13	Developing and Troubleshooting Deep Learning models

Required course reading

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Optional course reading

a) An Introduction to Statistical Learning by James, Witten, Hastie, Tibshirani & Taylor.
https://www.statlearning.com
b) Interpretable Machine Learning by Molnar. https://christophm.github.io/interpretable-ml-book/
c) Understanding Deep Learning by Prince.
https://udlbook.github.io/udlbook/

Comments

The course will be given in English