Course motivation and organisation

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ELEN062-1
Introduction to Machine Learning
September 18, 2024

1. Problems addressed
2. Background and prerequisites
3. Teaching methodology, material, exams, contacts

Problems addressed in this course

How can we design and/or make use of algorithms in order to extract from (possibly very large) datasets good decision strategies, predictive models, explanations and interpretations ?

- $\Rightarrow$ Batch-mode supervised learning (The main building block)
- $\Rightarrow$ Classical algorithms (Decision trees, nearest-neighbor, neural nets etc.)
- $\Rightarrow$ Theory (Sampling, likelihood, bias/variance, statistical learning theory)
- $\Rightarrow$ Advanced algorithms (Ensemble methods, kernel-based methods)
- $\Rightarrow$ Diverse learning protocols (SSL, RL, ActL, USL, on-line learning etc.)

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NB.
- Many practical problems are concerned
- Most are related to complex and uncertain environments
- Scalability considerations are important

Background and prerequisites

- Way of thinking:
  - probability theory, information theory, logic
- Mathematical analysis tools:
  - linear algebra, calculus, optimization theory, statistics
- Problem solving attitude:
  - algorithmics, complexity theory, intuition

Teaching methodology, material, exams

- Lectures: mandatory every Wednesday AM
  - 9:0-12:00
- Personal work:
  - 3 mandatory projects by groups of two or three students with written report
- Material: slides of lectures and selected chapters of reference textbooks
- Evaluation: projects (40%); oral exam (60%) (January)
- Contacts persons:
  - P.Geurts@uliege.be, L.Wehenkel@uliege.be: any question related to the course
  - sacha.lewin@uliege.be, y.claes@uliege.be: any question related to the projects

Lecture topics

- Introduction to machine learning — Today
- Supervised learning
  - Decision trees
  - Linear models
  - Nearest-neighbor methods
  - Neural networks
  - Sampling, bias and variance, model assessment and selection
  - Ensemble methods and feature selection
  - Support vector machines and kernel-based methods
- Unsupervised learning
  - Clustering
  - Dimensionality reduction
- Plus a few special lectures related to the projects: introduction to scikit-learn, project explanations and corrections.