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Haute école de gestion
Genève

Descriptif de module 64-41

Domaine : Economie & Services
Filière : Informatique de gestion

1. Intitulé de module — Math for machine learning — 2025-2026

Code :
64-41

Type de formation :
☒ Bachelor ☐ Master ☐ MAS ☐ DAS ☐ CAS ☐ Autres :

Niveau :
☒ Module de base
☐ Module d'approfondissement
☐ Module avancé
☐ Module spécialisé
☐ Autres :

Caractéristique :
☒ Module dont l'échec peut entrainer l'exclusion définitive de la filière selon l'art.15, al.1 des directives cadres "statut des étudiants-e-s"

Type :
☒ Module principal
☐ Module lié au module principal
☐ Module facultatif ou complémentaire
☐ Autres :

Organisation temporelle :
☒ Module sur 1 semestre
☐ Module sur 2 semestres
☐ Semestre d'automne
☒ Semestre de printemps
☐ Autres :

2. Organisation

Crédits ECTS
5

Langue principale d'enseignement :
☐ Français
☐ Allemand
☐ Autres :
☐ Italien
☒ Anglais

3. Prérequis

☐ Avoir validé le module
☐ Avoir suivi le module
☒ Pas de prérequis
☐ Autres :

4. Compétences visées / Objectifs généraux d'apprentissage

At the end of the semester the students should:

- Be able to work with univariate, and multivariate functions.
- Understand the characteristics of commonly used basic functions such as linear, polynomial, logarithms and exponential functions.
- Understand the concept of derivatives and be able to work with the gradient.
- Be able to handle the notions of discrete and continuous probabilities and solve relevant problems.
- Be able to make decisions based on the use of probabilistic models.
- Be able to describe data with relevant measures.
- Understand the concept of vectors
- Be able to visualize vectors and data (instances) as vectors
- Understand the spaces and the dimensionality of the spaces in which the vectors exist
- Understand, and be able to perform, basic vector operators, such as additions, subtractions, scalar-vector multiplications
- Understand the vector inner product and its intuition
- Understand, and be able to compute, vector distances and norms and how they can be used for prediction.
- Understand the linear combinations of vectors and how they relate to predictive algorithms such as linear regression.
- Understand basic concepts of vectors spaces: vector span, linear dependence and independence of vectors, basis of vectors

5. Objectifs détaillés des enseignements

- Handle the notions of discrete and continuous probabilities and solve relevant problems.
- Handle the concepts of conditional, marginal and joint probabilities.
- Use conditional probabilities and Bayes Theorem to update beliefs and make decisions.
- Describe data with measures of location and variation and with frequency distributions.
- Be able to formulate simple application problems in terms of functions.
- Be able to work with various functions, visualize the functions
- Be able to work with derivatives.
- Be able to formulate simple real-world problems using functions and find solutions.
- Handle vector and matrices, understand and visualize the results of operations that involve them.
- Define and solve linear systems.

6. Plan et chapitres des cours

The module is divided in three large sub-modules: Calculus, Linear Algebra and Probability and Statistics.

Calculus

- Introduction to calculus, linking the real-world problems with basic concepts such as functions, derivatives of functions and how those concepts help us to train, use and understand machine learning models.
- Functions and their plots, domains, and range of functions, visualizing functions
- Min, max of a function, saddle points
- Univariate functions: Linear and polynomial functions
- Logarithms and exponential functions
- Inverse functions
- Limits, one-sided limits, two-side limits, continuous functions, limits of functions at the infinity
- Derivatives
- Rules for differentiation
- Multivariate functions
- Partial derivatives
- Gradients

Linear Algebra

- Vectors
    - Vector visualizations, vector spaces
    - Vector operations (additions, subtractions, scalar multiplications)
    - Vector inner products and angles
    - Vector norms and distances
    - predictive classification using distances (k-NN)
    - linear combinations of vectors and their relation to linear regression
    - Linear equations and systems of linear equations
- Vector spaces (if time allows)
    - The span of a vector set
    - Basis of a space
    - linear independence and dependence of vectors,
- Matrices (if time allows)
    - Matrix operations
    - Matrix-vector multiplication
    - Matrix examples

Probability and Statistics

- Summarizing data: frequencies, measures of location (mean, median, etc.) and measures of variation (variance, standard deviation)
- Counting and visualizing data
- Events, event space, sets, subsets
- The notion of discrete probability
- Axioms of probability
- Contingency table
- Conditional and marginal probability
- Multiplication rules and Bayes Theorem
- The notion of continuous probability
- Probability Mass Function (PMS), Probability Density Function (PDF), Cumulative Distribution Function (CDF)
- The Normal Distribution

- Data likelihood

7. Forme du cours et méthodes pédagogiques

The module is organized in three courses corresponding to (i) Calculus, (ii) Linear Algebra, and (iii) Probabilities and Statistics. Each course is given for 15 weeks and two periods per week. The courses are a mixture of theory and practice. There will be a midterm exam (CC) during the semester, which will contribute to the final grade with 30%.

8. Modalités d'évaluation et de validation

Acquis : A-E
Remédiation : Fx
Répétition : F

L'évaluation du module se fera en principe de la manière suivante :

Contrôle Continu (CC) : 30% A midterm exam (CC) during the semester, that will cover all the material given in the module so far.	**Final Exam : 70%** A final written exam that will cover all the material given in the module. The duration of the final exam will be 3 hours.