

Descriptif de module 64-41

Domaine : Economie & Services
Filière : Informatique de gestion

1. Intitulé de module **Math for machine learning** **2022-2023**

Code :
64-41

Niveau :

- Module de base
 Module d'approfondissement
 Module avancé
 Module spécialisé
 Autres :

Type :

- Module principal
 Module lié au module principal
 Module facultatif ou complémentaire
 Autres :

Type de formation :

- Bachelor Master MAS DAS CAS Autres :

Caractéristique :

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

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 Italien
 Allemand Anglais
 Autres :

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 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.
- Handle the above points in a programming setting.
- Understand the basics of vectors, matrices, the operations that can be performed on them and their meaning.
- Understand what linear systems are and how to solve them.

5. Objectifs détaillés des enseignements

- Handle the notions of discrete and continuous probabilities and solve relevant problems.
- Handle probability distributions
- 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 learn machine learning models.
- Functions and their graphs, domains, and range of functions, graphs of equations and graphs of 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 operations
 - inner products, norms, and distances
 - Basis, linear independence,
 - Orthonormal vectors, Gram-Schmidt algorithm
- Matrices
 - Matrix operations
 - Matrix-vector multiplication
 - Matrix examples
 - Linear equations and systems of linear equations
 - Matrix multiplication, QR factorization
 - Matrix inverses
 - Left and right inverse
 - Inverse
 - Solving linear equations
 - Pseudo inverse
- Least squares

Probability and Statistics

- Summarizing data: frequencies, measures of location (mean, median) 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
- Mathematical expectation
- 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 Calculus, Linear Algebra, and Probabilities and Statistics. Each

course is given for 15 weeks and two periods per week. The course are a mixture of theory and practice. The practical exercises are done in groups.

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 :

Practical Exercises (Travaux Pratique) : 40% A number of practical exercises will be given within each of the three courses.	Final Exam : 60% A final written exam that will cover all the material given in the course.
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