Descriptif de module 64-41

Domaine : Economie & Services
Filière : Informatique de gestion

1. Intitulé de module
Math for machine learning 2021-2022

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 entraîner 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
☑ Italien
☐ Allemand
☐ Anglais
☐ Autres :

3. Préréquis
☐ Avoir validé le module
☐ Avoir suivi le module
☑ Pas de préréquis
☐ 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 are linear systems 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 modules 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 fo equations and graphs of functions
- Min, max of a functions, 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
7. Forme du cours et méthodes pédagogiques

The module is organised 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 exercised 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 :

<table>
<thead>
<tr>
<th>Practical Exercises (Travaux Pratique)</th>
<th>Final Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
<td>80%</td>
</tr>
<tr>
<td>A number of practical exercise will be given within each of the three courses.</td>
<td>A final written exam that will cover all the material given in the course.</td>
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