Course Unit File

NOVA IMS Information Management School

Machine Learning in Marketing

Level:	**Second cycle**	**Semester:**	**Spring**
Curricular Unit Code:	**200203**	**Duration:**	**S2**
Year:	**1**	**Academic year:**	**2022-23**

Total of hours

Total of Hours Spent	Contact Hours	Nr. of hours per week	ECTS
210	; 30 TP	2	7.5

T - Theoretical; TP - Theoretical and practical ; PL - Practical and Laboratorial; TC - Field Work; S - Seminar; E - Internship; OT - Tutorial Orietation; O - Other

Responsible teaching staff

Nuno Miguel da Conceição António

Other teaching staff

Ana Isabel Neves Edmundo, Diogo de Bernardes Henriques e Almeida Diogo, Nuno Miguel da Conceição António, Vasco Miguel Lourenço Guerreiro Jesus

Office hours

Tuesdays and Wednesdays, 18h30-20h00 (subject to scheduling)

General objectives

Machine learning is a discipline within the field of Artificial Intelligence, which, through algorithms and statistics, provides computers with the ability to identify patterns in data and make predictions. This curricular unit will familiarize students with the most common machine learning algorithms and their applications in marketing.

Enrolment Requirements

It is recommended that students have basic knowledge of statistics, Python, and data science (explore and clean data).

Learning outcomes of the curricular unit (LO)

Upon completion of this course, students should be able to:

- **LO1** . Understand Machine Learning fundamentals
- **LO2** . Recognize and identify Machine Learning tools and applications in marketing.
- **LO3** . Understand the Machine Learning project lifecycle.
- **LO4** . Identify and know how the main families of algorithms work.
- **LO5** . Identify and know the key performance measures used in Machine Learning models.
- **LO6** . Know how to apply the key different algorithms in marketing cases using Python.

Syllabus

LU1 . Introduction to Machine Learning
LU2. Machine Learning applications in marketing.
LU3 . Introduction to CRoss-Industry Standard Process for Data Mining (CRISP-DM) Methodology.
LU4. Data understanding.
LU5 . Data preparation.
LU6 . Modeling: Model validation, generalization, and overfitting.
LU7 . Modeling: Supervised learning - regression: performance measures.
LU8 . Modeling: Main families of algorithms: linear regression, decision trees, neural networks, Support Vector Machines (SVM), K-Nearest Neighbors (KNN).
LU9 . Modeling: Supervised learning - classification: performance measures.
LU10 . Modeling: Main families of algorithms: logistic regression, decision trees, neural networks, Naive Bayes, SVM, and KNN.
LU11 . Modeling: Ensembles of methods.
LU12 . Modeling: Models? interpretability.
LU13 . Unsupervised learning - clustering.
LU14 . Implementing Machine Learning projects.

Curricular unit Planning

Class	Type	Activities	Due
1	T	• Course overview • Introduction to Machine Learning (LU1) • Machine Learning tools and applications in marketing (LU2) • Introduction to CRoss-Industry Standard Process for Data Mining (CRISP-DM) Methodology (LU3)	
2	T	• Data understanding (LU4) • Data preparation (LU5) • Project 1: Regression (LU14) • Modeling: Model validation, generalization, and overfitting (LU6)	
3	T	• Modeling: Supervised learning - regression (LU7 and LU8)	

4	P	• Data understanding (LU4) and Data preparation (LU5) • Modeling: Supervised learning - regression (LU7 and LU8) • Project 1 Q&A	
5	P	• Modeling: Supervised learning - regression (LU7 and LU8) • Project 1 Q&A	
6	T	• Project 2 - Classification (LU14) • Modeling: Supervised learning - classification (LU9 and LU10)	Project 1
7	T	• Modeling: Supervised learning - classification (LU9 and LU10)	
8	P	• Modeling: Supervised learning - classification (LU9 and LU10) • Project 2 Q&A	
9	T	• Modeling: Ensembles of methods (LU11) • Modeling: Models? interpretability (LU12)	
10	T	• Project 3 - Clustering (LU14) • Unsupervised learning - clustering (LU13) • Evaluation and Deployment (LU3)	
11	P	• Modeling: Supervised learning - classification (LU9 and LU10) • Project 2 Q&A	
12	P	• Unsupervised learning - clustering (LU13) • Evaluation and Deployment (LU3) • Project 3 Q&A	Project 2
13	P	• Unsupervised learning - clustering (LU13) • Evaluation and Deployment (LU3) • Project 3 Q&A	
14	P	• Projects discussion	Project 3

Type:
- T: Theoretical
- P: Practical

Demonstration of the syllabus coherence with the curricular unit's learning objectives

The learning units (LU) cover the learning outcomes (LO) as presented in the following table:

	LO1	LO2	LO3	LO4	LO5	LO6
LU1	X					
LU2	X	X				
LU3			X			X
LU4			X			X
LU5			X			X
LU6			X			X
LU7			X		X	X
LU8			X	X		X
LU9			X		X	X
LU10			X	X		X
LU11			X	X		X
LU12			X		X	X
LU13			X	X	X	X
LU14						X

Teaching methodologies

The curricular unit is based on theoretical-practical classes. The sessions include the presentation of concepts and methodologies and the practical application of different concepts using different languages and computer applications. Several teaching strategies are applied, including slide presentations and step-by-step instructions on approaching practical examples, questions, and answers. The practical component is oriented towards exploring tools introduced to students, including the discussion of the best approach in different scenarios.
Applications used: Python, Jupyter notebook, Microsoft visual code

Evaluation

Due to the application-based design of the course, evaluation is continuous and applies to both the theory and practical components. There is no ?one only exam? with a single weight of 100%.
All evaluation grades are on a scale of 0-20. The final course grade is calculated based on the following weights:

- Three group projects:
  - Members: 3 to 4
  - Delivery for each project: Python notebook (commented)
  - Weight on final grade: 20% per project
- Exam:
  - Individual
  - With consultation of materials
  - Minimum grade: 8.0:
  - Weight on final grade: 40%

All submissions should be made via Moodle. Submissions after the deadline will be rejected.

Demonstration of the coherence between the teaching methodologies and the learning outcomes

The theoretical presentation of concepts and methodologies, followed by application exercises, provides students with the knowledge, skills, and competences listed as learning objectives at the beginning of classes. Problem-solving and the application of step-by-step instructions are stimulating for the understanding of the topics covered and allow to increase knowledge in areas of particular interest to students.
Projects and works require the intensive use of computation.

Bibliography

[A] Ng, Andrew (2017). Machine Learning Yearning. Retrieved from https://www.deeplearning.ai/machine-learning-yearning/
[B] Abbott, D. (2014). Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst. Indianapolis, IN: Wiley: Available at the Nova IMS VPN: http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=752690
[C] Kelleher, J. D., Namee, Brian, M., D?Arcy, A. (2015). Fundamentals of machine learning for predictive data analytics: Algorithms, Worked Examples, and Case Studies. Cambridge, MA: The MIT Press
[D] Miller, T. W. (2015). Marketing Data Science: Modeling Techniques in Predictive Analytics with R and Python. USA: Pearson Education Ltd.
[E] Artun, O., and Levin, D. (2015). Predictive Marketing: Easy ways every marketeer can use customer analytics and big data. Hoboken, NJ: Wiley
[F] Hastie, T., Tibshirani, R., Friedman, J. (2001). *The Elements of Statistical Learning* . New York, NY, USA: Springer New York Inc..
[G] Materials and references URLs provided in class by the instructor