

AI: MACHINE LEARNING FOUNDATIONS

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Consultant Director of numerous projects of strategic planning and business development, market studies and quality improvement, revenue growth and cost optimization, business processes reengineering, information systems design and implementation, for companies in virtually all industries, in both public and private sectors, with a systemic approach based on the identification of innovative competitive strategies, efficient organizational and process transformation and a firm leverage on the impulse of new technologies

Education

He is a Civil Engineer graduated with honors, special End Of Career Award, Bachelor of Economics and Business Administration, PhD student (unfinished) in Applied Quantitative Economics, and holds a CISA Title from the EDPAA (now ISACA) and a Master in Corporate Finance IESE, University of Navarra.

Professional Background

He became International Partner in Arthur Andersen in 1997, led the area of Innovation and Business Transformation, responsible for comprehensive quality management services, shared services centers, process reengineering and technological integration and the eBusiness area for strategic planning and development of interactive business and electronic commerce nationwide.

International Director of the World Excellence Center for Business Process Reengineering, member of the eBusiness leadership team in EMEIA and coordinator of this practice in the Mediterranean region.

He was a Managing Director in KPMG Consulting/BearingPoint, responsible for the Technology industry within the Telecommunications, Media and Content Sector and leader of the area of Process Innovation Solutions and Advanced Technology

He has served as Member of Board of Directors, Advisory boards or Management Consultant in matters of strategy and business development for several Spanish companies and Advisor of Venture Capital Companies and M&A Firms.

Arbitrator of the Madrid Arbitration Court, specialist in the Technology, Information and Communications sector and Developer of an advanced software platform for modelling business risks and economic projections, valuation of companies & portfolios and for building advanced risk & value information systems for Directors.

Public Activity and Teaching

He has been part of the Advisory Committees of eMobility and SIMO. He was a member of the Jury of the National eMobility Prize and participated in the Competitiveness Forums of Madrid and Castilla y León.

Instructor and speaker in numerous courses and seminars, national and international, of a general nature and related to his areas of specialization. Lecturer in various Business Management Master courses in subjects related to advanced economic and statistical analysis as well as organizer of the Master eBusiness of the Universidad Pontificia de Comillas, Speaker in the Executive Education Program of ESADE and in the Executive MBA of AEDE Business School in the subjects of "Information Systems", "Technological Environment" and "Systems Architecture".

He has published articles on business and technical content topics in newspapers such as Expansión, Cinco Días, Gaceta de los Negocios, Actualidad Económica, Dinero, etc., and directed or participated, as author or coordinator, in the publication of various books on issues of quality, organization and information technology (Las empresas del click / The Clickable Corporation [1999, Actualidad Económica], La Calidad en España/Quality in Spain [1995, Cinco Días]) and collaborated in the development of others (The organization in the information age: Learning, Innovation and Change [1995, IESE])

He was listed in the year 2000 by Actualidad Económica in the ranking of the 100 most relevant people on the Internet and eBusiness in Spain.

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Office Hours

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SUBJECT DESCRIPTION

Artificial Intelligence (AI) has moved into the mainstream driven by advances in cloud computing, big data, open-source software, and improved algorithms.

AI technologies are fundamentally altering how we work, live, and manage businesses. They will increase labour productivity and boost consistently the worth of value-added economic activity across the world, over the next decade.

Therefore, AI is becoming a core, transformative path that is changing the way we think about every aspect of our lives. It is impacting industry and becoming pervasive and embedded in our everyday lives. Most excitingly, this is a field that is still in its infancy: the AI revolution has only just begun.

Machine Learning is currently one of the cornerstones of AI development. As we collect more and more data and tackle that data with better and faster algorithms, we can use ML to build increasingly accurate models and to answer increasingly complex, previously intractable questions.

In a nutshell, ML research aims to build computer systems that learn from experience. Learning systems are not directly programmed by a person to solve a problem, but instead they develop their own program based on examples of how they should behave, or from trial-and-error experience trying to solve the problem. These systems require learning algorithms that specify how the system should change its behavior as a result of experience. Researchers in ML develop new algorithms, and try to understand which algorithms should be applied in which circumstances.

ML is an exciting interdisciplinary field, with historical roots in computer science, statistics, pattern recognition, and even neuroscience and physics and is currently leading the path in successful approaches that have converged and delivered rapid theoretical advances and real-world applications and solutions.

From this, it will come as no surprise that the ability to work with and fully utilize ML will be a skill that is set only to increase in value. In this course, we will explore various real-world scenarios and learn how to apply relevant (essential) ML algorithms to a wide range of problems.

LEARNING OBJECTIVES

The main objective of this course is to introduce students to the exciting field of ML and to set up a framework of knowledge that will allow them to make informed analysis of the opportunities and challenges for its successful application in Business.

To achieve this, we will focus on helping students grasp a sound understanding of Machine Learning techniques such as data transformation and algorithms that can find patterns in data and apply machine learning algorithms to tasks of their own design.

It encompasses knowledge about:

- the fundamentals and theoretical principles of this discipline,
- the most relevant algorithms used in practice,
- the engineering process for the development and management of this type of projects and
- the understanding of the difficulties, obstacles and challenges to be faced in this path.

Therefore, it will combine both a theoretical and conceptual approach with a hands-on technical understanding of the different stages of these type of ML projects keeping always a clear perspective of the business issues and opportunities and the future evolution and innovations from the current state of the art.

To streamline the technical/computational requirements, we will concentrate on the implementations using Python, and a level of complexity ranging from basic to intermediate.

So, it tries to achieve the right balance or results for students with experience in Python, who have not yet studied Machine Learning topics, and who are aware enough of the current trends and challenges in business and industries.

You will learn how to make informed decisions about the type of algorithms you need to use and how to implement those algorithms to get the best possible results. If you want to build versatile applications that can make sense of images, text, speech, or some other form of data, this course will definitely serve you well and will kickstart your future progress in this field.

The course starts with the most basic ML concepts and progressively builds on these concepts to solve increasingly difficult problems. It will use the initial knowledge gleaned during the beginning chapters as a foundation to allow the reader to explore and tackle some of the more complicated problems.

My personal objective is that by the end of the course, the student will have developed a solid understanding of many ML techniques and will have gained confidence about when to use these techniques.

We will focus on the ML methods that have proven valuable and successful in practical applications. This course will contrast the various methods, with the aim of explaining the circumstances under which each is most appropriate. We will also discuss basic issues that confront any machine learning method.

This course aims to developing a complete view of the current field (and its possible future projections), exploring the foundations and core concepts of intelligent agents and systems, the nature of their learning and adaptation features and the ways or strategies to deploy them effectively to solve technical or business problems. It will help the students to distinguish the hype from real practical possibilities, and at the end will allow them to better understand and foresee disruptive technologies and the role that ML may have in their development cycle.

As key takeaways, the students will get to understand how ML is being used in practice to manage customer experiences, operations, and business support functions based on use cases from a variety of companies and industries and learn from real-world examples (simplified for teaching purposes) about the nature of the technical principles and tools applied.

The ideas developed and cultivated in this course are intended to provide an enduring perspective that can help future leaders make sense of an increasingly important arsenal of new solutions and resources to enhance their strategies and business results.

Specifically, this course is designed to achieve several objectives:

1. Acquire a contextual understanding of ML, its history, and evolution, helping you to make relevant predictions for its future trajectory.
2. Understand the profound and strategic changes that the current and future advances in the field of ML will introduce in the technological and business environments and appreciate how ML represents a key source of competitive advantage for Firms.
3. Analyze the features and components of the ML solutions and understand the approaches for designing and implement ML solutions and assess the challenges, difficulties and risks in their successful deployment
4. Evaluate the appropriateness of a business application for predictions, optimization, natural language processing, robotics, computer vision and other emergent areas.
5. Know how to stay continuously updated of the new trends and advances in the ML field

I will be personally proud as a teacher if you walk away with:

- A strong conceptual understanding of the technologies behind ML and the main algorithms.
- The ability to identify and assess the possibilities for ML in your organisation and build a business case for its implementation.
- ...and a strong desire to go deeper and learn more

TEACHING METHODOLOGY

This program will try to put you in a good starting point for becoming a well-rounded ML/AI Manager, experiencing how to build Machine Learning models and apply them to data sets in fields like finance, healthcare, education, and more.

We have tried to organize the different knowledge blocks integrating the conceptual and theoretical background first, then moving into practice/tutorials examples and then framing assignments of assorted levels of complexity.

We expect students to work 3 to 8 hours/week on average. This is a rough estimation of total hours the average student may take to complete all required coursework, including lecture and project time (Actual hours may vary depending on the individual student and each specific stage of the course)

After the course, students should be able to use Python and some relevant libraries (pandas, matplotlib, scikit-learn, tensorflow, pytorch...) to access and analyze data from several different data sources, build predictive models using a variety of unsupervised and supervised machine learning techniques and perform feature engineering to improve the performance of machine learning models. They will also be able to optimize, tune, and improve algorithms according to specific metrics like accuracy and speed and compare the performances of learned models using suitable metrics.

The course will be both lecture and example-based, and will include group in-class discussions to promote learning and understanding of the course material in a variety of formats.

The course will follow a tailored path for AI Managers that will lead them from the concepts and theory that support the building of ML, the tools, techniques and drivers that make their implementation possible and the type of business and industry solutions that can be effectively deployed with them.

The course will have 6 main elements:

Lectures: We will explain the theoretical ideas, concepts and methods involved and will try to check on-time the correct understanding of the key elements. Questions and feedback will be the basic tool for this interactive dialog, in order to guarantee that the message gets across.

Examples/Tutorials/Cases: We will use profusely cases and examples related to the theory (and preparatory for the Assignments). Questions and what-if interactive analysis will be encouraged.

Discussions: as one critical skill for your future is how you present your work, we will encourage from time to time, for the relevant concepts in each section, some group discussions. A few of them will be announced in advance and will require some preparation from each student.

Assignments: practical exercises for experimenting with ML algorithms and techniques

Exams: There will just one formal test/exam, and a "test-exam" assignment will be included to get students used to answer questions about ML in different types of formats

Group work: For the final part of the course the student will have to work in a small group for preparing a final project presentation.

Assignments:

The best way to learn about a machine learning method is to program it yourself and experiment with it. So, the assignments will generally involve implementing machine learning algorithms, and experimentation to test your algorithms on some data. You will be asked to summarize your work, and analyze the results.

The implementations will be done in Python, creating Jupyter notebooks, and the structure and review criteria will be reported for each specific job.

Though they are considered as individual work, the "individual assignments" will be realized (and delivered jointly) in small groups that will be defined by an special algorithm that will dynamically form the groups for each assignment ensuring that no two students will be assigned more than once together and trying to optimize and combine the skills of each one based on their previous results to maximize cross-learning, Therefore, collaboration on the assignments is only allowed (and enforced) within each group. Each student/group is responsible for his or her own work. Discussion of assignments and programs should be limited to clarification of the handout itself, and should not involve any sharing of pseudocode or code or simulation results.

The only exception will be for the Final Group Assignment, for which another specific algorithm will try to create optimized groups based on the preferences informed by each student.

The schedule of assignments is included in the syllabus and in general will correspond to the sessions planned as "with assignment" except for exceptions required for the best development of the content.

Assignments are due at the beginning of class/tutorial on the due date. Because they may be discussed in class that day, it is important that you have completed them by that day.

Optionally, some of the assignments could have the form of a "bake-off" (a competition between machine learning algorithms). We will give everyone some data for training a machine learning system, and you will try to develop the best method. We will then determine which system performs best on some unseen test data.

Exams:

There will just one formal test/exam. However, as an especial practice/assignment the students will have a series of test-exams to get them prepared for answering questions about ML (multiple-choice, true-false or open questions). These test-exams will be either automatically scored by the machine or in some cases will require a self-evaluation or self-assessment. So, they are a type of simulation of an open-book exam on all material covered up to that point in the lectures, tutorials, required readings, and assignments, but eventually there could be topics not covered in any of these that will require some online investigation or other type of research to find out (or understand) the possible answers. The final scoring of this "assignment" will be based on the number of test-exams done (freely decided by each student), their average results, and the degree of progressive improvement/learning shown.

[Most of] The questions for the final test/exam will be selected from the ones used for the practice

Attendance:

We expect students to attend all lectures, and all practice/tutorials. This is especially important because we will cover material in class that is not included in the reference readings. Also, the tutorials will not only be for review, practicing and answering questions, but new material and concepts will also be covered or explained.

IE University teaching method is defined by its collaborative, active, and applied nature. Students actively participate in the whole process to build their knowledge and sharpen their skills. Professor's main role is to lead and guide students to achieve the learning objectives of the course. This is done by engaging in a diverse range of teaching techniques and different types of learning activities such as the following:

Learning Activity	Weighting	Estimated time a student should dedicate to prepare for and participate in
Lectures	16.7 %	25.0 hours
Discussions	6.7 %	10.0 hours
Exercises in class, Asynchronous sessions, Field Work	53.3 %	80.0 hours
Group work	10.0 %	15.0 hours
Individual studying	13.3 %	20.0 hours
TOTAL	100.0 %	150.0 hours

AI POLICY

Generative artificial intelligence (GenAI) tools may be used in this course for research, ideation, generating an outline, proofreading, grammar check, coding, generating diagrams or knowledge graphs and/or image generation, with appropriate acknowledgement.

GenAI can also be used for the Assignments and the practice of preparation of the Exam, but it will not be allowed during the final Exam.

Such use is encouraged with the goal of developing an informed critical perspective on potential uses and generated outputs, so the student is responsible for any errors or omissions and the validation of the outputs of GenAI. A clear lack of attention to this task could be taken into account negatively in the process of correcting and grading the work.

AI is a tool, but one that you need to acknowledge using. Failure to do so is in violation of academic honesty policies. Acknowledging the use of AI will not impact your grade.

Suggested format to acknowledge the use of generative AI tools:

"I acknowledge the use of [AI systems link] to [specify how you used generative AI]. The prompts used include [list of prompts]. The output of these prompts was used to [explain how you used the outputs in your work]".

If you have chosen not to include any AI generated content in your assignment, the following disclosure is recommended:

"No content generated by AI technologies has been used in this assignment"

METHODOLOGY

The following description of the material covered is tentative.

An attempt will be made to cover all listed topics.

However; the pace in the classes will depend on the group performance and the recent advances in the field.

PROGRAM

SESSION 1 (LIVE IN-PERSON)

INTRODUCTION

The basic concepts about AI and its application in ML will be introduced. General definition of Intelligence, knowledge representation, basic algorithms and the analysis of typical intractable problems and heuristics approaches.

Book Chapters: Machine Learning Engineering (Chapter 1: Introduction) (See Bibliography)

SESSION 2 (LIVE IN-PERSON)

THE ANATOMY OF A MACHINE LEARNING PROJECT

Exploration of the general pipeline for ML projects. Definition of project scope, goals, domain knowledge required and multidisciplinary team formation.

Book Chapters: Machine Learning Engineering (Chapter 2: Before the Project Starts) (See Bibliography)

SESSION 3 (LIVE IN-PERSON)

THE IMPORTANCE OF DATA. DATA COLLECTION AND PREPARATION

Analysis of typical data issues (missing values, imputation, risks of data leakage, outliers, etc) Data transformation (hot encoding and other methods).

Book Chapters: Machine Learning Engineering (Chapter 3: Data Collection and Preparation) (See Bibliography)

SESSION 4 (LIVE IN-PERSON)

FEATURE ENGINEERING [Assignment: DATA PREPARATION ASSIGNMENT]

The concept of feature. Feature extraction and feature selection (methods available). Complexity analysis and dimensionality reduction.

Book Chapters: Machine Learning Engineering (Chapter 4: Feature Engineering) (See Bibliography)

SESSION 5 (LIVE IN-PERSON)

FUNDAMENTAL ALGORITHMS

Taxonomy of main algorithms. Supervised vs Unsupervised. Parametric vs Non-parametric. Instance-based vs Model-based. Manual feature extraction vs Representational methods. Reflex vs state and variable based models. General principles: Loss functions and gradient descent.

SESSION 6 (LIVE IN-PERSON)

ANATOMY OF A ML ALGORITHM. SUPERVISED MODEL TRAINING - THE BASICS

General architecture. Training methods. Task analysis (regression vs classification). Performance metrics. Overfitting and generalization.

Book Chapters: Machine Learning Engineering (Chapter 5: Supervised Model Training (Part 1) and Chapter 6: Supervised Model Training (Part 2) (See Bibliography)

SESSION 7 (LIVE IN-PERSON)

A FIRST BASIC PRACTICE [Assignment: ASSIGNMENT]

End to end practical case. From EDA to model training and validation. Testing of various classical machine learning algorithms.

SESSION 8 (LIVE IN-PERSON)

UNSUPERVISED LEARNING

General architecture and algorithmic approach. Principal component analysis and clustering. Main concepts. Performance metrics. Types of use. Concepts of similarity, entropy and other related functions.

SESSION 9 (LIVE IN-PERSON)

A MORE ADVANCED PRACTICE

Managing imbalanced classes. Sampling biases. Handling uncertainty (epistemic vs aleatoric).

SESSION 10 (LIVE IN-PERSON)

ASSIGNMENT REVIEW

Dissection and discussion of sample solutions. Exploration of main difficulties.

SESSION 11 (LIVE IN-PERSON)

ML INTEGRATION. PIPELINES, ENSEMBLE METHODS, HYPER-TUNING

Ensemble methods. Pipelines of algorithms. Methods for hyper-parameter tuning. The future of AutoML. Bayesian optimization of parameters.

SESSION 12 (LIVE IN-PERSON)

A FIRST PRACTICAL OVERVIEW OF TYPICAL APPLICATIONS

End to end practical case of business application. Main concepts in play. General strategy for successful implementation.

SESSION 13 (LIVE IN-PERSON)

MODEL EVALUATION

Extended analysis of validation methods. Cross-validation, Leave-one-out... Cases of use. Performance metrics and consistency. Bias-variance tradeoffs.

Book Chapters: Machine Learning Engineering (Chapter 7: Model Evaluation) (See Bibliography)

SESSION 14 (LIVE IN-PERSON)

PERFORMANCE METRICS

Review and comparison of performance metrics. Supervised vs unsupervised. Accuracy, F-alpha score, Sensitivity and Specificity. Generalization to multi-class and multi-label classification.

SESSION 15 (LIVE IN-PERSON)

MODEL DEPLOYMENT AND MAINTENANCE - AN INTRODUCTION/OVERVIEW

Model life-cycle. Data and concept drift.

Book Chapters: Machine Learning Engineering (Chapter 8: Model Deployment and Chapter 9: Model Serving, Monitoring, and Maintenance) (See Bibliography)

SESSION 16 (LIVE IN-PERSON)

NEURAL NETWORKS AND DEEP LEARNING

Introduction to perceptron and multi-layer perceptron. Inner workings and mathematical foundation of a neural network. Forward and Backward propagation. Automatic differentiation. Gradient descent and its adaptive variants. Main hyperparameters. Dropouts and other regularization techniques.

SESSION 17 (LIVE IN-PERSON)

NEURAL NETWORKS. REPRESENTATION LEARNING

Representation learning techniques. Conceptual explanation through practical examples. Representational models. Typical well-known architectures and their uses.

SESSION 18 (LIVE IN-PERSON)

PRACTICE RECAP [Assignment: ASSIGNMENT]

How to code a NN. Basic concepts: tensors and gradient tapes. Activation functions and Optimizers. General design principles.

SESSION 19 (LIVE IN-PERSON)

REINFORCEMENT LEARNING. AN INTRODUCTORY OVERVIEW

Introduction to intelligent agents based on the state-action-reward paradigm. Temporal differences and Bellman optimality equation. From iterative value functions optimization to policy gradients algorithms. Analysis of a practical example case of use.

SESSION 20 (LIVE IN-PERSON)

SEQUENTIAL MODELING. FROM TIME SERIES ANALYSIS TO DEEP NN MODELS

Specific issues in time/sequential data feature engineering. Basic techniques involved. Example-based analysis of the different approaches and principles for sequential modeling and their evolution in the Machine Learning field.

SESSION 21 (LIVE IN-PERSON)

TRANSFER LEARNING AND CONTRASTIVE LEARNING. THEORETICAL BASIS AND PRINCIPLES

Shallow training, principles and concepts and introduction to basic fine-tuning techniques. Perspectives for transfer learning multi-task learning

SESSION 22 (LIVE IN-PERSON)

SUMMARIZING SOME MACHINE LEARNING BEST PRACTICES. SOME PROBLEMS AND SOLUTIONS [Assignment: GROUP ASSIGNMENT]

Application of the solutions explored to different types of problems. Explainability and Interpretability. End-to-end practical case analysis. ML/DL Business Function Application

SESSION 23 (LIVE IN-PERSON)

DEEP GENERATIVE MODELS [Assignment: EXAMINATION PRACTICE. BE PREPARED TO ANSWER QUESTIONS ABOUT ML]

Exploration of some of the novel architectures in this field. Contrastive learning, cross-embeddings and its new applications. Text-to-image and text-to-video. A brief analysis of Generative Adversarial Networks and Diffusion Models

SESSION 24 (LIVE IN-PERSON)

ADVANCED PRACTICE

Advanced Practice Recap

SESSION 25 (LIVE IN-PERSON)

APPLIED MACHINE LEARNING. THE INDUSTRY VIEW

High level exploration of business cases and applications across different industries.

SESSION 26 (LIVE IN-PERSON)

EXTENDED PRACTICE. CASE REVIEW

Dissection and discussion of sample solutions. Exploration of main difficulties.

SESSION 27 (LIVE IN-PERSON)

REAL WORLD BUSINESS APPLICATIONS. OTHER FORMS OF LEARNING. CHALLENGES AND RISKS. STEPS AHEAD

Analysis of current research in the field and expected breakthroughs. Summary of risks: from adversarial attacks to mesa-optimization disalignment.

Book Chapters: Machine Learning Engineering (Chapter 10: Conclusion) (See Bibliography)

SESSION 28 (LIVE IN-PERSON)

TEST/EXAM

Concept summary review examination. Not to be considered as a final exam. Its score will be added to the rest of the evaluation items. No minimum passing grade required.

SESSION 29 (LIVE IN-PERSON)

GROUP PROJECTS - PRESENTATIONS (A)

Presentations, discussion and Q&A of group projects

SESSION 30 (LIVE IN-PERSON)

GROUP PROJECTS - PRESENTATIONS (B). WRAP-UP

Presentations, discussion and Q&A of group projects

EVALUATION CRITERIA

We will behave as professionals. This means that I expect you to come to class prepared to discuss as if this was a meeting in your company. This is a small group, so we will take advantage of it doing a lot of direct interaction. Come prepared to class and be inquisitive.

As stated before, attendance to the classes is important and to help you with the right incentives approximately one third of your grade will come from this attendance, another one third will be obtained through your individual assignments and the final third will be gained through class participation (including group interactions and discussions) and from the final group work and presentation.

The following table summarizes the Ongoing grading (maximum) for each of the sessions and assignments:

SESSION	LECTURE	Participatio n	I.Assignmen t	G.Assignm ent	Test/Exa
MLF_01	INTRODUCTION	4			
MLF_02	THE ANATOMY OF A MACHINE LEARNING PROJECT	4			
MLF_03	THE IMPORTANCE OF DATA. DATA COLLECTION AND PREPARATION	4			
MLF_04	FEATURE ENGINEERING	4			
MLF_05	FUNDAMENTAL ALGORITHMS	4			
MLF_06	ANATOMY OF A ML ALGORITHM. SUPERVISED MODEL TRAINING - THE BASICS	4			
MLF_07	A FIRST BASIC PRACTICE [Assignment: ASSIGNMENT]	4	70		
MLF_08	UNSUPERVISED LEARNING	4			
MLF_09	A MORE ADVANCED PRACTICE	4			
MLF_10	ASSIGNMENT REVIEW	4			
MLF_11	ML INTEGRATION. PIPELINES, ENSEMBLE METHODS, HYPER-TUNING	4			
MLF_12	A FIRST PRACTICAL OVERVIEW OF TYPICAL APPLICATIONS	4			
MLF_13	MODEL EVALUATION	4			
MLF_14	PERFORMANCE METRICS	4			
MLF_15	MODEL DEPLOYMENT AND MAINTENANCE - AN INTRODUCTION-OVERVIEW	4			
MLF_16	NEURAL NETWORKS AND DEEP LEARNING	4			
MLF_17	NEURAL NETWORKS. REPRESENTATION LEARNING	4			
MLF_18	PRACTICE RECAP [Assignment: ASSIGNMENT]	4	70		
MLF_19	REINFORCEMENT LEARNING. AN INTRODUCTORY OVERVIEW	4			
MLF_20	SEQUENTIAL MODELING. FROM TIME SERIES ANALYSIS TO DEEP NN MODELS	4			
MLF_21	TRANSFER LEARNING AND CONTRASTIVE LEARNING. THEORETICAL BASIS AND PRINCIPLES	4			
MLF_22	SUMMARIZING SOME MACHINE LEARNING BEST PRACTICES. SOME PROBLEMS AND SOLUTIONS [Assignment: GROUP ASSIGNMENT]	4		70	

MLF_23	DEEP GENERATIVE MODELS [Review Session: EXAMINATION PRACTICE. BE PREPARED TO ANSWER QUESTIONS ABOUT ML]	4	40		
MLF_24	ADVANCED PRACTICE	4			
MLF_25	APPLIED MACHINE LEARNING. THE INDUSTRY VIEW	4			
MLF_26	EXTENDED PRACTICE. CASE REVIEW	4			
MLF_27	REAL WORLD BUSINESS APPLICATIONS. CHALLENGES AND RISKS. STEPS AHEAD	4			
MLF_28	TEST/EXAM	4			180
MLF_29	GROUP PROJECTS - PRESENTATIONS (A)	4		50	
MLF_30	GROUP PROJECTS - PRESENTATIONS (B). WRAP-UP	4			
		120	180	120	180
		20%	30%	20%	30%

criteria	percentage	Learning Objectives	Comments
Final Exam	30 %		
Individual Assignments	30 %		
Group Assignment	12 %		
Group Presentation	8 %		
Participation	20 %		

RE-SIT / RE-TAKE POLICY

Each student has four chances to pass any given course distributed over two consecutive academic years: ordinary call exams and extraordinary call exams (re-sits) in June/July.

Students who do not comply with the 80% attendance rule during the semester will fail both calls for this Academic Year (ordinary and extraordinary) and have to re-take the course (i.e., re-enroll) in the next Academic Year.

Evaluation criteria:

- Students failing the course in the ordinary call (during the semester) will have to re-sit the exam in June / July (except those not complying with the attendance rule, who will not have that opportunity and must directly re-enroll in the course on the next Academic Year).
- The extraordinary call exams in June / July (re-sits) require your physical presence at the campus you are enrolled in (Segovia or Madrid). There is no possibility to change the date, location or format of any exam, under any circumstances. Dates and location of the June / July re-sit exams will be posted in advance. Please take this into consideration when planning your summer.
- The June / July re-sit exam will consist of a comprehensive exam. Your final grade for the course will depend on the performance in this exam only; continuous evaluation over the semester will not be taken into consideration. Students will have to achieve the minimum

passing grade of 5 and can obtain a maximum grade of 8.0 (out of 10.0) – i.e., “notable” in the in the re-sit exam.

- Retakers: Students who failed the subject on a previous Academic Year and are now re-enrolled as re-takers in a course will be needed to check the syllabus of the assigned professor, as well as contact the professor individually, regarding the specific evaluation criteria for them as retakers in the course during that semester (ordinary call of that Academic Year).

The maximum grade that may be obtained in the retake exam (3rd call) is 10.0.

After ordinary and extraordinary call exams are graded by the professor, you will have a possibility to attend a review session for that exam and course grade. Please be available to attend the session in order to clarify any concerns you might have regarding your exam. Your professor will inform you about the time and place of the review session. Any grade appeals require that the student attended the review session prior to appealing.

- Students failing more than 18 ECTS credits in the academic year after the June-July re-sits will be asked to leave the Program. Please, make sure to prepare yourself well for the exams in order to pass your failed subjects.
- In case you decide to skip the opportunity to re-sit for an exam during the June / July extraordinary call, you will need to enroll in that course again for the next Academic Year as a re-taker and pay the corresponding extra cost. As you know, students have a total of four allowed calls to pass a given subject or course, in order to remain in the program.

BIBLIOGRAPHY

Compulsory

- Andriy Burkov. (2020). *Machine Learning Engineering*. Sept/2020. True Positive Inc.. ISBN 9781999579579 (Digital)

This new book by Andriy Burkov is the most complete applied AI book out there. It is filled with best practices and design patterns of building reliable machine learning solutions that scale. Andriy Burkov has a Ph.D. in AI and is the leader of a machine learning team at Gartner. This book is based on Andriy's own 15 years of experience in solving problems with AI as well as on the published experience of the industry leaders.

Recommended

- Andriy Burkov. (2019). *The Hundred-page Machine Learning Book*. ISBN 199957950X (Digital)

A successful task in reducing all of machine learning to 100 pages. Well chosen topics, both theory and practice, that will be useful to practitioners providing a solid introduction to the field.

BEHAVIOR RULES

Please, check the University's Code of Conduct [here](#). The Program Director may provide further indications.

ATTENDANCE POLICY

Please, check the University's Attendance Policy [here](#). The Program Director may provide further indications.

ETHICAL POLICY

Please, check the University's Ethics Code [here](#). The Program Director may provide further indications.

