Teaching guide

IDENTIFICATION DETAILS

Degree:	Business Analytics
Field of Knowledge:	Social and Legal Science
Faculty/School:	Law, Business and Governance
Course:	Machine Learning
Type:	Optional
ECTS credits:	3
Year:	4
Code:	5355
Teaching period:	Seventh semester
Area:	IT applied to Business Analytics
Module:	Disciplinary Training
Teaching type:	Classroom-based
Language:	English
Total number of student study hours:	75

Teaching staff	E-mail
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SUBJECT DESCRIPTION

This course provides a broad introduction to machine learning. It will cover deep supervised, unsupervised and reinforcement learning.

The student has already covered some supervised and unsupervised learning algorithms in data mining courses. This course focusses exclusively on deep learning: machine learning using neural networks. We will explore different architectures, including fully connected feed forward nets, encoders and decoders, recurrent and

recursive neural nets, convolution, and generative adversarial nets (GANs). The last part of the course will be an introduction to reinforcement learning.

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We will also explore how Machine Learning provides awesome results dealing with human language.

GOAL

The main objective of the course is to provide students with the knowledge required to understand, model and train neural networks that can learn supervised tasks.
The student will also learn to apply reinforcement learning to obtain policies that result in efficient agent actions in their interaction with environments.
The specific objectives of the subject are:

- Understand the key concepts of deep learning (neurons, layers, activation functions, backpropagation) applied to supervised learning.
- Develop the necessary skills to create machine learning tasks .
- Generate, and deploy machine learning models using Pytorch framework.

PRIOR KNOWLEDGE

The subject will build on the knowledge acquired by the student in the following subjects:

- Introduction to Statistics and Probability,
- Algorithms
- Programming
- Algebra
- Data Mining.

We will use Python as programming language. Prior of Python knowledge is mandatory. A level equivalent to Programming II (Business Analytics) is expected, as well as fluent use of at least one IDE (Integrated Development Environment) and Git.

COURSE SYLLABUS

Part I Introduction

- Introduction to Machine Learning.
- Pytorch and Tensors.
- Neural Network Foundations.
- Graph computation.

Part II Deep learning

- Fully connected nets.
- Convolutional neural nets
- Machine Learning Optimizations hacks.

- Measuring model performance.
- Machine Learning project architecture.

Part III Natural Language Processing.

- Sequential data processing: recurrent and recursive neural nets
- Attention Mechanism.
- Introduction to LLMs.

EDUCATION ACTIVITIES

ML is demanding both in terms of conceptual understanding and programming (data structures and algorithms). We will blend theory and code throughout the lectures. As new concepts are built on concepts presented in previous lectures, it is important to maintain a constant level of dedication throughout the course. Students are required to bring a computer to class with Python (most recent stable version), an IDE (your favourite, I use Spyder) and Git installed. If you don't' have it, we will provide you a guideline in the first class.
Code will be distributed using a dedicated GitLab repository (create an account if you don't already have it).
We will use live coding and build, modify, and extend code from the textbooks o created by the lecturer. Students are expected, at the beginning of each class, to have the environment open and access to a recent version of the repository. Individual work will be required to prepare the class by reading the corresponding sections of the textbook and familiarizing with the code that will be discussed in class: the lecturer will assume some familiarity with the code that will be used during the lecture. It is therefore a requirement to study the main sections of the code BEFORE class, using a Flipped Learning Approach.
During the live coding sections of the class, students will sometimes work in pairs to develop or modify code. There will be at least one graded Assignments. Questions will refer to key concepts or code discussed in earlier classes. The idea of the Assignments to provide early feedback both to the student and the professor. Assignments are individual work and plagiarism will be controlled. A student may be asked, at any time, to reproduce the code submitted (with identical or similar data) and/or explain his or her code/answers. If the student is not able to do so, the University will consider that the student has not submitted original, individual work as required by this teaching guide for quizzes, assignments, and the final exam.
Plagiarism, as well as the use of illegitimate means in the evaluation tests, will be sanctioned in accordance with the provisions of the Evaluation Regulations and the University's Coexistence Regulations.

DISTRIBUTION OF WORK TIME

CLASSROOM-BASED ACTIVITY	INDEPENDENT STUDY/OUT-OF-CLASSROOM ACTIVITY
30 hours	45 hours

SKILLS

Basic Skills

Students must have demonstrated knowledge and understanding in an area of study that is founded on general secondary education. Moreover, the area of study is typically at a level that includes certain aspects implying knowledge at the forefront of its field of study, albeit supported by advanced textbooks

Students must be able to apply their knowledge to their work or vocation in a professional manner and possess skills that can typically be demonstrated by coming up with and sustaining arguments and solving problems within

their field of study

Students must have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgments that include reflections on pertinent social, scientific or ethical issues

Students must be able to convey information, ideas, problems and solutions to both an expert and non-expert audience

Students must have developed the learning skills needed to undertake further study with a high degree of independence

General Skills

Capacity for achieving objectives, problem-solving and decision-making in the environment of quantative and qualititative mass data.

Capacity for critical, self-critical, analytical and reflexive thought.

Specific skills

Know how to manage quantative and computer tools for decision-making.

Be able to understand the basics, paradigms and techniques of intelligent systems, and analyse, design and build computer systems, services and applications which use these techniques in the field of big data.

LEARNING RESULTS

Understand and use tensors and computational graphs

Understand the foundations of every single step of an algorithm based on Machine Learning

Capacity to describe and analyze different neural net architectures and select the best design for a given supervised, unsupervised and reinforcement learning task.

Develop and apply deep machine learning models to solve problems and evaluate their performance.

LEARNING APPRAISAL SYSTEM

Evaluation items, ordinary call:
[1] Written exam covering theory and practice: 60% of the final gradee
[2] Assignments (individual work based on case): 30% of the final grade
[3] Class attendance and participation (10%) of the final grade
Criteria to pass: -

- At least a 5 (out of 10) in the written exam -
- At least an average grade of 5 (out of 10) in the weighted average of in class activities [2] and assignments [3]

Assignments will have a due date. Students can submit late after this due date and up one week after the due date, but the grade of the late assignments will be reduced daily by 5% as a penalty, up to a maximum of 35%. No submissions will be allowed after 1 week.
Presenting all assignments and class quizzes is not a requirement, but the grade of a missed assignment will be zero and will be averaged with the rest of the submissions. Alternative evaluation system: For students with an approved academic waiver or UFV students participating in an exchange program: student may obtain an academic waiver for reasons of work, incompatibility of schedules, illness or others deemed by the Career Directorate, from the Academic Coordination Office, providing the required documentation. Once granted, both the affected teacher and the student who has requested it from the Office of Academic Affairs (“Coordinación Académica”) will be officially notified. In any case, it is the student's responsibility to be aware and follow the requirements of the course, as well as its evaluation system. For students in second or successive enrollments: these students may benefit from the continuous assessment system, as long as they meet all the requirements, including class attendance. Otherwise, they must follow the alternative evaluation system. They don’t need to file the request for an academic waiver, but they must notify the corresponding professor by email so that they can take the alternative evaluation system into account.
Students, who are exempt from the obligation to attend class, either because of the second or successive enrollments, or because they have express authorization from the Direction of the Degree, will be evaluated using the same evaluation system. 5% of class participation may be obtained by attending at least three tutorials with the teacher responsible for the course.
Evaluation extraordinary call: Students who have not reached the minimum grade in the exam [1], having therefore failed in the ordinary call, may opt to retake the exam in the extraordinary call.
Students who fail one or both parts in the extraordinary call will have to retake the course in its entirety (all parts) in the new ordinary call.
Plagiarism, as well as the use of illegitimate means in the evaluation tests, will be sanctioned in accordance with the provisions of the Evaluation Regulations and the University's Coexistence Regulations.

BIBLIOGRAPHY AND OTHER RESOURCES

Basic

Eli Stevens, Luca Antiga Deep Learning with Pytorch 1st Ed.

Additional

Ian Goodfellow, Joshua Bengio. Deep Learning (adaptative computation and Machine Learning). 2nd.