INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Artificial Intelligence			Field of study	Computer Science		
Bachelor in	Informatics Engineering			School	School of Technology and Management		
Academic Year	2023/2024	Year of study	3	Level	1-3	ECTS credits	6.0
Type	Semestral	Semester	1	Code	9119-706-3103-00-23		

Workload (hours)	162	Contact hours	T -	TP 60	PL -	TC -	S -	E -	OT -	O -

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): Paulo Duarte Ferreira Gouveia, Jose Paulo Machado Da Costa

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. demonstrate some domain of the Python programming language
2. build a predictive model supported by one of the machine learning algorithms
3. understand the differences and relationships between Classification and Regression (two types of Supervised Learning)
4. use distance metrics for prediction in Clustering (a type of Unsupervised Learning)
5. evaluate the performance of models with appropriate metrics
6. use cross-validation to find a better model
7. explore the main machine learning algorithms, for the classification and regression, available in the SciKit-learn package

Prerequisites

Before the course unit the learner is expected to be able to:
program in an object-oriented language.

Course contents

Study of the Python language. Python packages for Machine Learning: NumPy, Pandas, Matplotlib, Seaborn and Scikit-Learn. Knowledge discovery in database (KDD). Supervised and unsupervised learning. Main machine learning algorithms: k-nearest neighbors (KNN), decision trees, random forests, support vector machines (SVM), neural networks and k-means. Dimensionality reduction.

Course contents (extended version)

1. Introduction to the Python programming language
   - variables, control structures, strings, functions, modules and packages
   - main data structures
   - list comprehensions and generator expressions
2. Object Oriented Programming with Python
   - classes, initializer methods, static members and type of encapsulation supported
   - inheritance and polymorphism
   - iteration and persistence of objects
3. Extending Python for Machine Learning
   - NumPy
   - Pandas
   - Matplotlib
   - Seaborn
   - Scikit-Learn
4. Context of Machine Learning
   - knowledge discovery in database - KDD
   - preprocessing
   - data mining
   - types of learning
   - predictive models
   - main machine learning algorithms
   - performance evaluation metrics
   - cross-validation evaluation
5. Supervised Learning
   - linear regression
   - logistic regression
   - decision trees
   - random forests
   - support vector machines - SVM
   - k-nearest neighbors - KNN
   - neural networks
6. Unsupervised learning
   - clustering using K-Means
7. Dimensionality Reduction
   - principal component analysis (PCA)
   - decomposition into singular values (SVD)
   - manifolds

Recommended reading

1. Aprendizagem Computacional em Engenharia. Catarina Silva e Bernardo Ribeiro, Imprensa da Univ. Coimbra, 2018.
2. Python Machine Learning. Wei-Meng Lee, John Wiley & Sons, Inc. , 2019
3. Scikit-learn Cookbook – Over 80 recipes for machine learning in Python with scikit-learn. Second Edition, Julian Avila & Trent Hauck, Packt, 2017
4. A Byte of Python. Swaroop C H, 2016, https: //python. swaroopch. com
5. Programação em Python. Ernesto Costa, FCA, 2015.

Teaching and learning methods

This course is composed by theoretical-practical lectures, divided into two kinds of periods: expository periods during which the theoretical contents are presented and explained based on practical examples; implementation periods during which the students put in practice the knowledge acquired in the expository periods.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary)
   - Practical Work - 50%
   - Final Written Exam - 50% (the minimum grade of 5 points is required)
2. Alternative 2 - (Regular, Student Worker) (Special)
   - Final Written Exam - 100%

Language of instruction

1. Portuguese
2. English

Electronic validation

Paulo Duarte Ferreira Gouveia	Tiago Miguel Ferreira Guimaraes Pedrosa	Luísa Maria Garcia Jorge	José Carlos Rufino Amaro
04-10-2023	07-10-2023	25-10-2023	31-10-2023