Course title: Artificial Intelligence, Creativity, and the Arts
Language of instruction: English
Professor: Rafael Ramirez
Professor's contact and office hours: Anytime by appointment
Course contact hours: 45
Recommended credit: 6 ECTS credits
Course prerequisites: there are no prerequisites for this course

Language requirements: Recommended level in the European Framework B2 (or equivalent : Cambridge Certificate if the teaching language is English, DELE or 3 semesters in the case of Spanish)

Course focus and approach:
This course will discuss the impact of technology, and in particular of artificial intelligence (AI), in the arts. Students will learn the fundamentals of AI and understand the implication of these techniques in the arts.

Course description:
Students will learn the fundamentals of Artificial Intelligence and understand the implication of these techniques in the arts, as well as AI techniques that can be used to make sense of human gesture, musical audio, and other real-time data. The focus will be on learning about algorithms, software tools, and best practices that can be immediately employed in creating new real-time interactive systems in the arts.

Learning objectives:
At the end of this course the students will be able to:

- Understand what artificial intelligence is, its potential and limitations, and its areas of application, especially in the arts.
- Distinguish between supervised and unsupervised learning.
- Understand the mechanisms for extracting features
- Get familiar with modern machine learning algorithms useful in an arts context.
- Learn and get hands-on experience with AI techniques that are well-suited for music, dance, visual art, and interactive systems especially for human motion analysis and audio analysis
- Apply AI to creative processes.
- Understand the application of AI and the arts in health and well-being.

Course workload:
The course will include lectures, readings, exams and hands-on activities. Lectures will present the theory, readings will be used both to introduce topics, as well as to go in depth in certain areas, exams will evaluate the knowledge acquired and hands-on activities will apply the knowledge gained during the lectures.

Teaching methodology:
The course consists of five main components:

- Discussions about the new role of AI in society and in the arts
- Concept learning based on hands-on exercises
- Projects with practical applications
- Invited talks by experts using AI in the arts
- Final project

Discussions on the new role of AI in society and in the arts*:* This component introduces Artificial Intelligence and how it is changing the society as a whole, and in particular the arts (music, dance, painting, etc.) and the creative processes. Students will read texts about this topic and will participate in discussions around them.

Concept learning based on hands-on exercises: This component introduces the basic concepts of the course through exercises. After a brief and intuitive explanation, the students will directly carry out exercises on the computer applying artificial intelligence in an art context. Slides will be used to complement the explanations which will be distributed to students as class notes and study material. The explanations and the hands-on exercises will be interactive to motivate and stimulate critical thinking among the students.

Projects with practical application: Students will apply the concepts learnt to implement small art projects. In this component, students will work on a practical problem well defined by the teacher and will be supervised during the process. At the beginning of this process the teacher will clearly explain the objectives of the project and will give instructions on how to achieve those objectives. Students may work in groups if necessary. The projects allow students to put into practice the concepts learned.

Invited talks by experts using AI in the arts*:* Experts and professionals working and applying AI to the arts will be invited to present their work as invited talks. These talks will provide students with a clear view of current work in the area as well as provide insights and ideas for their own projects.

Final project: The final component of the course will consist of a project chosen by the students in artificial intelligence applied to the arts. The project will be carried out in groups and each group will choose a topic of their interest and apply the techniques learned during the course, supervised by the teacher. Each group will present the methodology and results of their project to the rest of the students.

Assessment criteria:
Midterm exam: 20%
Midterm project: 20%
Final exam: 30%
Final project: 30%

Class participation: 10%

Midterm exam: this will cover both, open questions about the implication and relationship of AI and the arts, as well as concrete questions about the techniques and concepts presented in class.
Midterm project: this will consist of a small project integrating the design of a music interface, the construction of features using appropriate sensors, and the application of AI techniques to process the features to produce sound as output.
Final exam: this will include questions about the whole course content.
Final project: this will be similar to the Midterm project but in a larger scale and with a clear artistic or therapeutic goal.

BaPIS absence policy

Attending class is mandatory and will be monitored daily by professors. Missing classes will impact on the student's final grade as follows:

Absences	**Penalization**
Up to two (2) absences	No penalization
Three (3) absences	1 point subtracted from final grade (on a 10-point scale)
Four (4) absences	2 points subtracted from final grade (on a 10-point scale)
Five (5) absences or more	The student receives an INCOMPLETE ("NO PRESENTADO") for the course

The BaPIS attendance policy **does not distinguish between justified or unjustified absences**. The student is deemed responsible to manage his/her absences.

Only absences for medical reasons will be considered justified absences. The student is deemed responsible to provide the necessary documentation. Other emergency situations will be analyzed on a case by case basis by the Academic Director of the BaPIS.

The Instructor, the Academic Director and the Study Abroad Office should be informed by email without any delay.

Classroom norms:

- No food or drink is permitted in class.
- Students will have a ten-minute break after one one- hour session.

Weekly schedule

Week 1: Introduction

- What is artificial intelligence and machine learning?

- What is it good for?
- Artificial intelligence in the arts
- Artistic and interactive applications in which AI can be a tool for creativity

Week 2: Classification, Part I

- Basics of classification,
- How to use it to make sense of complex data in a meaningful way?
- Instance-based learning: the nearest-neighbour algorithm

Week 3: Classification, Part II

- Interpretable AI: the decision trees algorithm
- AI free open source tools: Weka, Wekinator
- Real-time AI for artistic creativity

Week 4: Regression, Part I

- Fundamentals of regression
- How can we use it for creating continuous mapping and controls?
- Linear regression
- polynomial regression

Week 5: Regression, Part II

- neural networks
- How to use regression algorithms to create new types of interactions?
- Hands-on practice exploring regression algorithms
- Application of regression algorithms to build your own systems

Week 6: Design Considerations

- what it means to build a good classifier
- Decision trees (revisited)
- Support vector machines
- how learning algorithms can be integrated into your own creative work
- Application of classification algorithms to build your own projects

Week 7: Sensors and Features

- How to apply machine learning to work with multimodal real-time data,
- Audio, video, game controllers, and sensors
- Making sense of the data from different inputs
- Designing feature extractors that make machine learning easier
- developing feature extractors

Week 8: Working with Time

- Algorithms for data over time
- Dynamic time warping
- Gesture following

- Gesture following in the arts
- Appling temporal modeling algorithms to real-time sensor data

Week 9: Machine Learning Practice in Practice and Project

- Overfitting
- Error analysis
- Project design and implementation

Week 10: Health and Well-being implications of the arts

- Art, music and health
- Art Therapy
- Music Therapy
- Implications in stroke rehabilitation, emotional disorders, autism

Last revision: April 2021.

Required readings:

Course reading pack prepared by professor.

Recommended bibliography:

Boden, M. 1991. The Creative Mind: Myths and Mechanisms. New York: Basic Books.
Boden, M. (ed.) 1994. Dimensions of Creativity Cambridge, MA: The MIT Press.
Boden, M. 2009. "Computers models of creativity." AI Magazine 30(3): 23–34.
Bretan, M., and Weinberg, G. 2016. "A survey of robotic musicianship." Commun. ACM 59(5): 100–109.
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Bharucha, J. 1993. "MUSACT: A connectionist model of musical harmony." In Machine Models of Music, S. M. Schwanauer and D. A. Levitt (eds.). Cambridge, MA: The MIT Press, 497–509.
Colton, S., López de Mántaras, R., and Stock, O. 2009. "Computational creativity: Coming of age." Special issue of AI Magazine 30(3): 11–14.
Colton, S. Halskov, J., Ventura, D., Gouldstone, I., Cook, M., and Pérez-Ferrer, B. 2015. "The Painting Fool sees! New projects with the automated painter." International Conference on Computational Creativity 2015: 189–196
Dalmazzo D and Ramírez R (2019) Bowing Gestures Classification in Violin Performance: A Machine Learning Approach. Front. Psychol. 10:344. doi: 10.3389/fpsyg.2019.00344
Gervás, P. 2009. "Computational approaches to storytelling and creativity." AI Magazine 30(3): 49–62.
McCormack, J. 2014. "Balancing act: variation and utility in evolutionary art." In Evolutionary and Biologically Inspired Music, Sound, Art and Design. Lecture Notes in Computer Science, Vol. 8601. Heidelberg: Springer, 26–37
McCormack, J., and d'Inverno, M. 2012. Computers and Creativity. Heidelberg: Springer.
Mitchell, T.M., Machine Learning, Springer
Ortega FJM, Giraldo SI, Perez A and Ramírez R (2019) Phrase-Level Modeling of Expression in

Violin Performances. Front. Psychol. 10:776. doi: 10.3389/fpsyg.2019.00776
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Ritchie, G. D. 2009. “Can computers create humour.” AI Magazine 30(3): 71–81.
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Ramirez, R., Maestre, E., Serra, X. (2011). Automatic Performer Identification in Celtic Violin Audio Recordings, Journal of New Music Research, 40(2): 165–174.
Ramirez, R., Maestre, E., Serra, X. (2010). Automatic performer identification in commercial monophonic Jazz performances, Pattern Recognition Letters, 31: 1514-1523.
Ramirez, R., Perez, A., Kersten, S, Rizo, D., Román, P., Iñesta, J.M. (2010). Modeling Violin Performances Using Inductive Logic Programming, Intelligent Data Analysis, 14(5): 573-586.
Ramirez, R., Hazan, A., Serra, X. (2008). A Genetic Rule-based Expressive Performance Model for Jazz Saxophone, Computer Music Journal, 32(1): 38-50.
Turing, A. M. 1950. “Computing machinery and intelligence.” Mind LIX(236): 433–460.
Ian H. Witten, Eibe Frank, Mark A. Hall, Data mining: practical machine learning tools and techniques
Yee-King, M., and d’Inverno, M. 2014. “Pedagogical agents for social music learning in crowd-based socio-cognitive systems.” In Proceedings of the First International Workshop on the Multiagent Foundations of Social Computing, AAMAS-2014. Paris, France.