

**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:** None

**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:

1. Understand what artificial intelligence is, its potential and limitations, and its areas of application, especially in the arts.
2. Distinguish between supervised and unsupervised learning.
3. Understand the mechanisms for extracting features
4. Get familiar with modern machine learning algorithms useful in an arts context.
5. 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
6. Apply AI to creative processes.
7. Understand the application of AI and the arts in health and well-being.

**Course workload:**

The course will include lectures, readings, presentations, labs, 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 labs 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 labs and 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:**

Presentations: 20%  
 Projects/Labs: 20%  
 Midterm exam: 20%  
 Final exam: 30%  
 Class participation: 10%

**Presentations:** Students will be required to read articles about the course topics and discuss them with the rest of the class.

**Projects/Labs:** this will consist of a small projects integrating the design of music interfaces, and the application of AI techniques to process inputs to produce sound and art. Students will create AI-based systems with a clear artistic or therapeutic goals.

**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.

**Final exam:** this will include questions about the whole course content.

**Class participation:** Students will always be encouraged to participate actively in discussions and debates, and their participation will be taken into account for their final mark.

**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)
- 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
- Applying temporal modelling 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: May 2022.**

**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.
- Bentley, P. J., and Corne, D. W. (eds.). 2001. *Creative Evolutionary Systems*. Burlington, MA: Morgan Kaufmann.
- 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
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- 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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- Ramirez, R., Maestre, E., Serra, X. (2012). A Rule-Based Evolutionary Approach to Music Performance Modeling, *IEEE Transactions on Evolutionary Computation*, 16(1): 96-107.
- 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.