



AI in Digital Entertainment

1. Características generales

Docente:	Dr. Markus Eger (markus.eger@ecci.ucr.ac.cr)
Nombre:	AI in Digital Entertainment
Sigla:	PF-3341
Créditos:	4
Horas:	4 horas de teoría
Requisitos:	ninguno
Correquisitos:	ninguno
Clasificación:	Curso propio
Ciclo:	Electiva
Horario:	Viernes 17:00–21:00 hrs, aula 6-6
Consulta:	Viernes 14:00-14:55 hrs (oficina 3-23)

2. Descripción

Games are often the driving force behind the development of new Artificial Intelligence techniques, because they provide a constrained, low-risk environment with a built-in performance measure. Additionally, the creation of games is often time-consuming and expensive, and also benefits from advances in AI. In this class we will be discussing AI techniques used for game play, including classical AI approaches such as planning, and Machine Learning techniques such as Monte Carlo Tree Search. Additionally, we will talk about AI for procedural content generation, and how it can be used to improve the development process. The focus of the class will be on recent advances presented at the relevant conferences for the area, but will also include the necessary background information.

3. Objetivos

Objetivo general

In this class, the students will become familiar with various contemporary AI techniques researched in academia and their applications in games.

Objetivos específicos

1. Learn about classical AI behavior techniques, such as Behavior Trees and Planning and their application to NPC behavior in games.
2. Learn about intelligent agents and experimental uses of them, such as for the generation of narratives.
3. Learn about basic Machine Learning techniques, including Neural Networks and Unsupervised Learning and their application to games.
4. Learn about procedural content generation in games.

4. Contenidos

Objetivo	Eje temático	Desglose
1,2	AI Behavior	AI agents that make decisions in an intelligent way. Behavior Trees. Decision Trees. Planning.
2	Intelligent Agents	Narrative Generation. Intentional behavior of agents. Belief modeling.
2	Game Trees	Agents that play games optimally. Game tree search. Monte Carlo Tree Search.
3	Machine Learning Basics	Optimization, Regression, Classification and their applications in games.
3	Machine Learning Techniques	Artificial Neural Networks for AI agents, vector models as a representation technique. Reinforcement Learning techniques. Clustering. Recommender Systems
4	Procedural Content Generation	Grammars for text- and object generation. Answer Set Programming and Constraint Satisfaction problems. Markov Chains.

5. Evaluación

Aspecto evaluativo	Porcentaje
Project	50%
• Project proposal	10%
• Prototype	10%
• Final submission and report	20%
• Project presentation	10%
Paper presentation	30%
Quizzes and participation	20%

6. Metodología

This course emphasizes active participation by the students, both in the form of presentations as well as discussions. Each week, the instructor will give a lecture about a particular AI technique and assign a paper for all students to read until the next week. One student will then give a 20-30 minute presentation about the paper's contents, which is followed by an open discussion. Each student the week's research paper beforehand in order to be able to participate in the discussion. To verify that the students have read the papers, each class will start with a short quiz about the paper's contents. The students can get up to 15% from the quizzes, and up to 15% for participating in the discussions, but not more than 20% combined.

The course also provides students with the opportunity to apply the learned techniques as part of a project. Students will work on their projects individually, and can choose from one of four different types of projects:

- The implementation of an AI technique presented in a contemporary research paper which was presented at an appropriate venue, such as the AAAI conference on AI in Interactive Digital Entertainment, or the IEEE conference on Computational Intelligence in Games.
- The implementation of an agent for a game of the student's choice. The instructor advises to use a game with an open source implementation, so that the student can focus on developing their AI agents.
- Working on an entry to an AI competition held at a major conference, such as the Hearthstone AI competition at the IEEE conference on Computational Intelligence in Games. For this task, the student may use existing agents as the basis, as long as they can show that their work resulted in a measurable improvement.
- Implementing a procedural content generator, which automatically generates interesting and novel artifacts. The instructor can provide suggestions for which kinds of generators are appropriate.

The students are expected to come up with a suggestion for the project, and can discuss it with the instructor before submitting a 2-4-page project proposal which contains a summary of the necessary background information, the goal of the project and how it will be evaluated. The students also have to submit a prototype of their project to demonstrate that they are making sufficient progress towards their goal, and a final version including a 2-6 page report about their results. In the last class, the students are also expected to present their results in class.

All submitted work is required to be written in English, including code comments and variable names. Late submissions will not be accepted, except in accordance with article 24 of the Reglamento de Régimen Académico Estudiantil de la UCR.

Plagiarism will not be tolerated for any reason. The nature of this course makes is likely and often even necessary that the students will base their project work on existing research, but the student is responsible for clearly marking where their own contributions end and what the source of the material they are basing their work on is. The instructor reserves the right to refer cases of plagiarism to the corresponding instances at UCR as specified in the Reglamento de Orden y Disciplina Estudiantil de la UCR

7. Cronograma

#Clases	Actividades	Fechas
1	Curriculum discussion, project description and introduction	15/3
1	AI behaviors	22/3
1	Planning	29/3
1	Narrative Generation	5/4
1	Intentionality	12/4
1	Belief Modeling	26/4
1	Game Trees and Uncertainty	3/5
1	Machine Learning	10/5
1	Neural Networks	17/5
1	Vector Models	24/5
1	Reinforcement Learning	31/5
1	Unsupervised Learning	7/6
1	Grammars	14/6
1	ASP/CSP	21/6
1	Noise and Fractals	28/6
1	Project presentations	5/7

8. Software

En el curso se utilizarán las siguientes herramientas:

Software	Descripción
Unity 3D	Motor de juego
Blender	Herramienta para creación de gráficos tridimensionales
Piazza	Foro

9. Bibliografía

1. Unity tutorials: <https://unity3d.com/learn/tutorials>
2. Unity manual: <http://docs.unity3d.com/Manual/index.html>
3. [Artificial Intelligence and Games](#), Georgios N. Yannakakis and Julian Togelius (free PDF available)
4. [Procedural Content Generation in Games](#), Noor Shaker, Julian Togelius, and Mark J. Nelson (free PDF available)