Course guide
804245 - IAVJ - Artificial Intelligency

Last modified: 26/09/2024

Unit in charge: Image Processing and Multimedia Technology Centre
Teaching unit: 804 - CITM - Image Processing and Multimedia Technology Centre.

Degree: BACHELOR'S DEGREE IN VIDEO GAME DESIGN AND DEVELOPMENT (Syllabus 2014). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan, English

LECTURER

Coordinating lecturer: Bejarano, Edison

Others: Bejarano, Edison
Mateo, Ramon

PRIOR SKILLS

Knowledge about graf theory and coding.

TEACHING METHODOLOGY

During the classes, the lecturer will first present the theoretical and the problem to which we are looking for a solution. Together with the students, the lecturer will analyze existing solutions that solve the challenges of real-time applications such as video games.

The lecturer will provide source code that students can analyze and should complement and integrate into their own code for future use. After each session the teacher will pose possible improvements and challenges to the students to help and guide them in their autonomous learning hours.

LEARNING OBJECTIVES OF THE SUBJECT

- To be able to define artificial intelligence techniques for video games.

- To be able to explain and differentiate artificial intelligence techniques.

- Understand the basics of classical artificial intelligence such as genetic algorithms and neural networks.

- Master the artificial intelligence systems most applied to the world of video games such as scripting, hierarchical state machines and rule systems.

- To become familiar with advanced navigation systems such as sectorization.

- Explore the latest concepts such as behavioral trees and planners.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Guided activities	12,0	8.00
Hours large group	18,0	12.00

Type	Hours	Percentage
Hours medium group	30,0	20.00

Total learning time: 150 h

CONTENTS

AI Agent navigation

Description:
Kinetic movement
Map Markup
Steering behaviors
Coordinating movement for groups

Full-or-part-time: 21h 30m
Theory classes: 8h
Self study : 13h 30m

Pathfinding systems

Description:
The base of Dijkstra, A*
Navigation Mesh and sectorization
Path beautification
Common improvements on A*

Full-or-part-time: 21h 30m
Theory classes: 8h
Self study : 13h 30m

Perception Systems

Description:
Simulating senses
Level Markup techniques

Full-or-part-time: 11h 30m
Theory classes: 4h
Self study : 7h 30m

Decision making for videogames

Description:
Hierarchical state machines
Rule systems
Fuzzy logic
Scripting

Full-or-part-time: 16h 30m
Theory classes: 6h
Self study : 10h 30m

Advanced systems for decision making

Description:
Sharing information with Blackboards
SmartObjects
Behavior Trees
Planners

Full-or-part-time: 16h 30m
Theory classes: 6h
Self study : 10h 30m

Tactic and strategic systems

Description:
Code Structure
Waypoints Markup
Tactical Pathfinding

Full-or-part-time: 16h 30m
Theory classes: 6h
Self study : 10h 30m

Learning systems

Description:
Reinforced Learning
Neural Networks
Genetic Algorithms

Full-or-part-time: 20h 30m
Theory classes: 14h 30m
Self study : 6h

AI game design

Description:
Shooters and 3rd person
Driving
RTS
RPGs & Turn Based

Full-or-part-time: 23h 30m
Theory classes: 10h
Self study : 13h 30m

Language Models

Description:
Language models such as GPT(LLMs) for dialogue and scene generation.
Generation of visual content with diffusion models and LLMs.
Applications of generative AI in video games.

Full-or-part-time: 2h
Theory classes: 2h

ACTIVITIES

Exercises

Description:
Deberán entregarse ejercicios planteados en clase en los que se aplique o implemente lo tratado en teoría.
- Patrullar y deambular
- Flocking
- Interfaz y conocimiento del mundo
- Máquinas de estados finitos
- Árboles de comportamiento (ladrillos de comportamiento)
- Ejercicio de aprendizaje automático (regresión del movimiento de proyectiles)
- Agentes ML I
- Agentes ML II
- Árbol de comportamiento táctico
- Laboratorios extra:
- Introducción a Python (Instalación, entornos, librerías principales)
- Introducción a librerías(Os,Numpy, pandas, opencv)
- Introducción a Keras y Uso colaborativo y GPUs

Full-or-part-time: 34h 40m
Self study: 34h 40m

Project

Description:
Development of a scene with several agents using the techniques learned in class.

Full-or-part-time: 17h 20m
Self study: 17h 20m

GRADING SYSTEM

1. Participation and attitude towards learning: 10%.

2. Exercises: 50%.
- Pathfinding and navigation labs (12%)
- Decision making labs (16%)
- Machine learning lab (4%)
- Deep learning labs (12%)
- Extra labs (6%)

3. Project: 25%.
Development of a scene with several agents using the techniques learned in class.

4. Theoretical quizzes: 15%.
Perception and Navigation (6%)
- Movement and Pathfinding
- World interfacing and Knowledge
- Decision Making
Learning and optimization (5%)
- Machine Learning
- Optimisation
Strategic AI Design (4%)
- Strategy and Tactics
- Designing Game AI

Failed students (except for those who qualify as NP) will have the option to take the re-evaluation exam. The grade of this exam will replace the grade of the theoretical questionnaires. In case of passing the course after the re-evaluation, the maximum final grade will be a 5.

Irregular actions that may lead to a significant variation of the grade of one or more students constitute a fraudulent performance of an evaluation act. This action entails the descriptive grade of failure and a numerical grade of 0 for the ordinary global evaluation of the course, without the right to re-evaluation.

If the teachers have indications of the use of AI tools not allowed in the evaluation tests, they can summon the students concerned to an oral test or to a meeting to verify the authorship.

BIBLIOGRAPHY

Basic:
- Millington, Ian. AI for games . Third edition. Boca Raton : CRC Press, [2019]. ISBN 978-1-138-48397-2.

Complementary:
- Géron, Aurélien. Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow : concepts, tools, and techniques to build intelligent systems . Second edition. Sebastopol, CA : O'Reilly Media, Inc, September 2019. ISBN 9781492032649.
- Chollet, Francois. Deep Learning with Python. 2nd Edition. Manning, 2021.
- Lanham, Micheal. Hands-On Reinforcement Learning for Games. Packt, 2020.
- Newton, Peter L. i Feng, Jie. Unreal Engine 4 AI Programming Essentials. Packt Publishing, 2016. ISBN 978-1-78439-312-0.