Course guides  
804245 - IAVJ - Artificial Intelligence

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: 2021  
ECTS Credits: 6.0  
Languages: Catalan, Spanish, English

LECTURER

Coordinating lecturer: Escudero, Gerard

Others: Ysard, Jordi

PRIOR SKILLS

Knowledge about graf theory and coding in C++

TEACHING METHODOLOGY

During each class, the lecturer will first show the students the theory behind the problem that needs solving. Together with the students, the lecturer will explore the different solutions that exist in the present that solve and simplify the complexities of real time applications like video games.

LEARNING OBJECTIVES OF THE SUBJECT

- Understand the basis of classic Artificial Intelligence areas like genetic algorithms and neural networks.
- Good knowledge of the most common AI techniques used in video games like hierarchical state machines and rule systems.
- Get familiar with advanced navigation tools like sectorization.
- Explore the newest methods in video game AI like Behavior Trees and Planners.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>18,0</td>
<td>12.00</td>
</tr>
<tr>
<td>Guided activities</td>
<td>12,0</td>
<td>8.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h
## 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:** 25h 30m  
Theory classes: 12h  
Self study: 13h 30m
# ACTIVITIES

## Project 1

**Description:**
Implementation of the behaviour of two agents focusing on the concepts:
- Navigation system
- Pathfinding system
- Decision-making systems with Behaviour Trees

**Specific objectives:**
- Navigation system
- Pathfinding system
- Decision-making systems with Behaviour Trees

**Material:**
Slides of the subject.

**Delivery:**
Unity Project + Report

**Full-or-part-time:** 20h
Self study: 20h

## Project 2

**Description:**
Implementation of an agent's behaviour using reinforcement learning with mlagents.

**Specific objectives:**
Reinforcement Learning.

**Material:**
Slides of the subject.

**Full-or-part-time:** 20h
Self study: 20h

## Exercise 1

**Description:**
Implementation of the Flocking algorithm.

**Specific objectives:**
Flocking

**Material:**
Slides of the subject.

**Delivery:**
Unity project.

**Full-or-part-time:** 3h
Self study: 3h
Exercise 2

Description:
Implementation of the behavior of an agent with planning techniques with AIPlanner.

Specific objectives:
GOAP

Material:
Slides of the subject.

Delivery:
Unity project.

Full-or-part-time: 3h
Self study: 3h

Exercise 3

Description:
Configuration of a Convolutional Neural Network.

Specific objectives:
CNN

Material:
Slides of the subject.

Delivery:
Unity Project.

Full-or-part-time: 3h
Theory classes: 3h

Exercise 4

Description:
Implementation of a tactical system and formation movement.

Specific objectives:
- Tactics
- Formation movement

Material:
Slides of the subject.

Delivery:
Unity project.

Full-or-part-time: 3h
Self study: 3h

GRADING SYSTEM

First assignment about steering behaviors, pathfinding and decision taking using behavior trees with a weight of 40%.
Second assignment about machine learning with a weight of 30%.
Class exercises (flocking, GOAP, CNN and tactics) with a weight of 20%.
Attitude and class participation will weight 10% of the final grade.
BIBLIOGRAPHY

Basic: