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804232 - FIS2VJ - Physics II

Coordinating unit: 804 - CITM - Image Processing and Multimedia Technology Centre

Teaching unit: 804 - CITM - Image Processing and Multimedia Technology Centre

Academic year: 2019

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

ECTS credits: 6 Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: De La Torre Sangrà, David

Others: Hernández, David

Prior skills

Knowledge about Physics and coding in C++

Degree competences to which the subject contributes

Generical:

CGFC1VJ. (ENG) Dissenyar, desenvolupar, seleccionar i avaluar aplicacions i sistemes informàtics d'o per a videojocs, assegurant la seva fiabilitat, seguretat i qualitat, d'acord amb principis ètics i a la legislació i normativa vigent.
CGFB2VJ. (ENG) Interpretar y dominar los conceptos básicos sobre las leyes generales de la mecánica, la termodinámica, los campos y las ondas y el electromagnetismo; y su aplicación para la resolución de problemas propios de la ingeniería.
CGFB1VJ. (ENG) Resoldre els problemes matemàtics que puguin plantejar-se en l'enginyeria. Aplicar els coneixements sobre: àlgebra lineal; geometria; càlcul diferencial i integral; mètodes numèrics; estadística.

Transversal:

05 TEQ N1. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

Teaching methodology

The weekly theory lectures consist in 2 hours (1 session of 2 h).
During the sessions:
- Theory lectures (new concepts and basic tools, with application examples)
- In-class tutorials

Activities schedule may change, depending on the difficulty of the exercises and the corresponding contents. The supporting material to be used will be available at the virtual campus site.

Learning objectives of the subject

- To understand the structure of the Box 2D and Bullet libraries.
- Knowledge on how to create games based on physics simulations in both 2D and 3D.
- To be able to apply physical models to video games and simulations in both 2D and 3D.

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Study load

Total learning time: 150h	Hours large group:	34h	22.67%
	Hours medium group:	16h	10.67%
	Hours small group:	0h	0.00%
	Guided activities:	10h	6.67%
	Self study:	90h	60.00%

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Content

Box2D integration

Learning time: 15h

Theory classes: 6h
Self study : 9h

Description:
- Analyzing the Box2D API.
- Integration plan.
- Binding creation in C++.
- Collision detection.
- Physics simulation.

Creation of a videogame with 2D physics

Learning time: 15h

Theory classes: 6h
Self study : 9h

Description:
- Defining goals and limitations.
- Creating a environment for simulations.
- Coding the interactive elements.
- Victory conditions.

Integration of Bullet3D

Learning time: 15h

Theory classes: 6h
Self study : 9h

Description:
- Analyzing the API of Bullet3D.
- Integration plan.
- Binding creation in C++.
- Collision detection.
- Physics simulation.

Creating a video game using 3D physics

Learning time: 20h

Theory classes: 8h
Self study : 12h

Description:
- Definition of the goals and limitation of racing games.
- Creating the environment for the simulations.
- Car creation.
- Victory conditions.

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Physics Review

Learning time: 20h

Theory classes: 8h
Self study : 12h

Description:
Review of the physical concepts given in Physics 1 and basics calculus tools:
- Overview on vectorial and differential calculus
- Coordinate systems. Relative position of physical bodies in the 3D space and collisions.
- Kinematics 1D, 2D and 3D.
- Dynamics: motion under forces, non-frictional and frictional systems.
- Momentum balance and collisions 1D and 2D (purely elastic, inelastic, breakage)

Rigid Body Dynamics

Learning time: 40h

Theory classes: 16h
Self study : 24h

Description:
Description of kinematics and dynamics of the rigid body
- Review on matrix calculus
- Momentum conservation. Angular momentum.
- Center of mass. Inertia.
- Rotational movement 2D and 3D: Pure translation and pure rotation. Acceleration field. Instantaneous rotational axes: Eulerian and quaternion approaches. Versors.
- Rotational dynamics 2D and 3D: forces and torques.
- Rigid body transformation: 2D and 3D displacement and rotation, deformation.

Harmonic Movement

Learning time: 15h

Theory classes: 6h
Self study : 9h

Description:
Basics on harmonic oscillations
- Harmonic movement equations
- Travelling and damped waves.
- Sound and light. Light properties: velocity, propagation, reflection, refraction and diffraction

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Qualification system

The qualification of the subject will be obtained following a system of continuous evaluation.
The weight of each part is as follows:

Partial Exams 20%
Final Exam 25%
Practice Box2d 15%
Practice Bullet 30%
Participation and attitude 10%

The approved one is obtained when obtaining a note of 5 in the final grade weighted according to the previous criterion.
If you do not present an exam or practical exercise, you will get a score of 0.
If the subject is not passed, there is the possibility of presenting a re-evaluation exam. The maximum grade in the reassessment will be 5 and only the theoretical part will be reassessed.

Regulations for carrying out activities

In- class exercises:
During the theory lectures, students will develop exercises to be discussed and solved in the same lecture. These exercises act as training to do the Tutorial Exercises (individual).

Tutorial Exercises (TE):
At the beginning of each package, the corresponding tutorial exercises (TE) will be delivered, and should be submitted within the indicated deadline, in pdf format. Complementary material (Excel, Matlab, Phyton), if convenient, should be submitted as well.

Bibliography

Basic:

Parberry, I. Introduction to game physics with Box2D. Boca Raton: CRC Press, 2013. ISBN 9781466565760.

Tipler, P.A. Física para la ciencia y la tecnología. 6ª ed. Barcelona [etc.]: Reverté, 2010. ISBN 9788429144284.

Agulló i Batlle, Joaquim. Mecànica de la partícula i del sòlid rígid. 3a ed. cor. i ampl. Barcelona: OK Punt, 2002. ISBN 8492085061.