COURSE DESCRIPTION CARD - SYLLABUS

Course name
Game Programming [N2Inf1-ZTI>PGIER]

Course

Field of study
Computing

Year/Semester
1/2

Area of study (specialization)
Advanced Internet Technologies

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
16

Laboratory classes
18

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

dr inż. Paweł Wojciechowski
pawel.wojciechowski@put.poznan.pl

Lecturers

dr inż. Paweł Wojciechowski
pawel.wojciechowski@put.poznan.pl

Prerequisites

The student starting this course should have basic knowledge of programming, three-dimensional computer graphics, computer networks, artificial intelligence and mathematics in the field of operations on vectors and matrices. They should also have the ability to solve basic problems in the field of algorithmics, optimize the program code and the ability to obtain information from the indicated sources.

Course objective

Provide students with basic knowledge about the problems encountered when programming video games, in terms of the operation of graphics engines and physics, both two and three dimensional, the operation of artificial intelligence scripts and low-level programming of visual effects, animation techniques and three-dimensional modeling. Developing students" skills to prepare a three-dimensional model of a given object along with its animation.

Course-related learning outcomes

Knowledge:
1. has an ordered, theoretically founded general knowledge in the field of: functionality of two and three-dimensional graphics engines, the way of describing the world for artificial intelligence scripts in

games, three-dimensional graphics processing pipeline.
2. has detailed knowledge of the architecture and operation of 3D graphics engines knows the basic requirements for physics simulation and combining it with visualization.
3. knows the basic techniques of animation of 3D models, knows an example tool used to model three-dimensional objects.
4. has a basic understanding of trends in the evolution of three-dimensional computer graphics and graphics cards

Skills:
1. is able to obtain information from literature, documentation and a discussion forum on the UnrealEngine 4 engine (in Polish and English), integrate them, interpret them and use alternative solutions to those given during classes.
3. can solving engineering tasks such as programming a simple game, integrate knowledge from various areas of computer science (e.g. object-oriented programming, artificial intelligence methods, network programming, data processing of three-dimensional objects) and other scientific disciplines such as physics.
4. is able to assess the usefulness and the possibility of using individual versions of UnrealEngine 4 modules.
5. can assess the usefulness of 3D graphics engines supporting the programmer in the process of implementing the game, including the advisability of their use.

Social competences:
understands that in the area of computer games, knowledge and skills very quickly become obsolete, hence there is a need for continuous learning

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
There is an artificial intelligence scripting tournament during the lecture. The lecture ends with an exam. The laboratories are divided into 3- 4 stages related to specific issues. Each of them requires an implementation of relatively short task which must be presented to the teacher. These tasks are not assessed. Additionally, each student carries out a final project, which is a computer game implemented in the selected technology.

Programme content

The course presents the construction of modern game engines on the example of Unreal Engine 5. The classes cover the handling of basic functions such as scene construction, actor behavior software, in-game character cotrolling and user interface (GUI) development. Part of the class is devoted to creating custom character models and animations in Blender3D and exporting them to UE5. In addition, students learn about issues related to artificial intelligence in computer games.

Course topics

Lecture:
The issues of artificial intelligence in games are presented on the basis of the evaLUAtion project prepared during the classes in previous years. The lecture presents the basic assumptions of the environment, the problem of the script"s interaction with the environment and the description of the game environment from the script level.
Introduction to the UnrealEngine. Building resources for two-dimensional games - preparing pictures and animating sprites as well as resource management. Interaction of game objects with the environment. Overview of the types of objects in the game and their properties. Introduction of physical properties of selected objects, including methods of limiting simulation to two dimensions.
Principles of 3D modeling on the example of the Blender3D application.Introduction to the tool, basic model properties, texturing methods, types of lighting, bump mapping. Types of animations in 3D graphics on the example of Blender. Keyframe concepts, types of interpolation, armature animation and Shape Keys deformations. Rules for exporting models and animations to the UnrealEngine engine. Using the model in the process of building a 3D game and importing a standard character into the

engine.
Properties of the 3D game engine, basic transformations of objects, import of models from Blender, animations, terrain creation system. The use of physics. Presentation of problems and possibilities of their solutions.
Overview of the 3D graphics pipeline, the evolution of graphics cards, their programming languages, introducing basic concepts.
Laboratory classes are divided into thematic blocks:
Artificial intelligence, during which students will learn about the evaLUAtion environment for learning how to write combat scripts in LUA. Each student prepares a team of three characters, who then participates in the final tournament.
Introduction to the UnrealEngine - the use of basic tools, blueprints - the example of implementing a simple platform game using a model and textures prepared in a Blender3D.
Discussion of issues related to the physics module in the UE5 environment - basic mechanisms of collisions, motion and dependencies between objects. Handling of basic events generated during object collisions. Introduction to the concept of physical materials.
Overview of materials and introduction to the particle system. The use of user interface elements (GUI).
Introduction to the use of C ++ for game implementation.

Teaching methods

1st lecture: multimedia presentation, along with a demonstration of the following software: evaLUAtion, Blender, UnrealEnigne4
2. laboratory exercises: solving tasks involving the use of selected technologies, fighting scripts tournament

Bibliography

Basic
1. Perełki programowania gier t. 1, 2 i 3, DeLoura M., Helion, 2002
2. Fizyka dla programistów gier, Bourg, D.M., O"Reilly; Associates, 2003
3. Mathematics for 3D Game Programming and Computer Graphics, Third Edition, Lengyel, E., Course Technology PTR, 2011
4. Programming Game AI by Example, Buckland, M., Jones Bartlett Publishers, 2004
5. Game Coding Complete 4 edition, McShaffry, M., Graham, D., Course Technology PTR, 2012
6. Język Cg. Programowanie grafiki w czasie rzeczywistym, Fernando, R., Kilgard, M.J., Helion, 2003
7. Blender. Kompendium, Kuklo, K., Kolmaga, J., Helion, 2007
8. Animacja komputerowa Algorytmy i techniki, Parent, R., PWN, 2011
Additional
1. GPU Gems: Programming Techniques, Tips, and Tricks for Real-Time Graphics, Fernando, R. (Series Editor), Addison Wesley Professional, 2004
2. GPU Gems 2: Programming Techniques for High-Performance Graphics and General-Purpose Computation, Pharr, M., Fernando, R. (Series Editor), Addison Wesley Professional, 2005

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	36	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	64	2,50