INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Computer Graphics			Field of study	Computer Science		
Bachelor in	Informatics Engineering			School	School of Technology and Management		
Academic Year	2021/2022	Year of study	2	Level	1-2	ECTS credits	6.0
Type	Semestral	Semester	2	Code	9119-706-2202-00-21		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			30	-	30	-	-	-	-	-

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): Leonel Domingues Deusdado, Daniel Baptista Martinho Gomes

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Understand the concepts, techniques, technologies and architectures for Computer Graphics (CG).
2. Understand the technologies for the synthesis of two-dimensional images and three-dimensional scenes with medium and high realism.
3. Identify the bases of computer graphics and its main points, its functions and how they articulate.
4. Learn, develop and animate computer-aided design in 2D and 3D.
5. Know how to use specific software for modeling and animation.
6. Build and evaluate solutions and architectures for 2D and 3D computer graphics applications, achieve a high level of quality and / or performance in accordance with the requirements of the problem.

Prerequisites

Before the course unit the learner is expected to be able to:
1. Understand the logic of Algorithms and Data Structures
2. Understand the C Programming Language

Course contents

Production of 3D Graphics - History and Concepts, Geometric Transformations, Parametric Curves, Lighting, Textures, Optimization Techniques, Performance Analysis, Practical Applications of Computer Graphics.

Course contents (extended version)

1. Production of 3D Graphics:
   - Brief historical overview
   - 3D models: geometry and materials
   - Image manipulation
2. Geometric Transformations:
   - Pipeline graph of geometric transformations
   - Placement of models in the scene: translation, rotation and scale
   - The camera, positioning and orientation
   - Projections: perspective and orthographic
3. Parametric Curves:
   - Non-Planar objects
   - Casteljau, Bezier and Splines algorithms
4. Lighting:
   - Global Lighting vs Local Lighting
   - Algorithms of Global Lighting
   - Algorithms of Local Lighting
   - Lighting Components
   - Normals
   - Material Definition
   - Shadows: Shadow mapping and Shadow Volumes
5. Textures:
   - Texture Coordinates
   - Geometric Transformations
   - Sampling
6. Optimization Techniques:
   - Geometry: view frustum culling, occlusion culling, levels of detail
   - Spacial Partition: Octrees, BSPs, Portals
   - Primitives: sending command sets, primitive types
7. Performance Analysis:
   - Graphic Pipeline
   - Identification of bottlenecks
   - Profiling
8. Practical Applications of Computer Graphics:
   - OpenGL in C++
   - Blender
   - Virtual Reality : Unity3D VR

Recommended reading

1. Computação Gráfica: Geração de Imagens (volume1); Eduardo Azevedo, Aura Conci; Elsevier, 2003-2008
2. Computer Graphics : Principles and Practice; James D. Foley, . . . [et al.], Reading : Addison-Wesley Publishing Company , 1997
3. OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4. 3; Dave Shreiner, John M. Kessenich; Graham Sellers, Bill Licea-Kane; Person Education - Inc, 2009
4. Manuais e Tutoriais Web Blender; http: //www. blender. org/education-help/ - 2020
5. Sebenta da Disciplina 2021-2022; Leonel Deusdado

Teaching and learning methods

Mainly affirmative/interrogative (open variant) method in the theoretical lessons. Interrogative and experimental methods in practical lessons(60 hours). Out of classes (100 hours): individual and group study of the lesson subjects, reading of the bibliography, resolution of practical assignements.

Assessment methods

1. Final Exam - 40% ((Minimum grade 7 Values) - (Regular, Student Worker) (Final, Supplementary, Special)
2. Pratical Works - 60% - (Regular, Student Worker) (Final, Supplementary, Special)

Language of instruction

1. Portuguese
2. English

Electronic validation

Leonel Domingues Deusdado	José Luís Padrão Exposto	Luísa Maria Garcia Jorge	Paulo Alexandre Vara Alves
07-03-2022	12-03-2022	22-03-2022	25-03-2022