VNIVERSITAT DE VALÈNCIA

Course Guide
36480 Fundamentals of Computer Graphics

COURSE DATA

Data Subject	
Code	36480
Name	Fundamentals of Computer Graphics
Cycle	Grade
ECTS Credits	6.0
Academic year	2020 - 2021

Study (s)

Degree	Center	Acad. year	Period
1407 - Degree in Multimedia Engineering	School of Engineering	2	First term

Subject-matter

Degree	Subject-matter	Character
1407 - Degree in Multimedia Engineering	14 - Gráficos y Audio por Computador	Obligatory

Coordination

Name	Department
MARTINEZ GIL, FRANCISCO	240 - Computer Science

SUMMARY

The subject *Foundations of Computer Graphics* is part of Computer Graphics and audio matter. Its overall objective is to introduce the students in the foundations and the basic techniques used in the generation of bi-and three synthetic images in graphics applications. It is a compulsory subject that is taught quarterly basis in the second year of the degree of Bachelor in Multimedia Engineering during the first quarter. The curriculum consists of a total of 6 ECTS.
The course has two main theoretical and practical. Need to expose students to the theoretical basis on which these techniques are based to be able to cope with problems or unforeseen contingencies in the tools and libraries available. Moreover, it is imperative that students become familiar through practice, with standard forms of work in these fields using one of the most used tools and libraries that exist to generate charts.
The student should be able to manage the technical vocabulary of these fields and to evaluate and argue pros and cons of using the various techniques presented. Besides, the student should use the contents presented to propose solutions to specific problems of the subject. In this regard, the oral presentations of proposed topics and sessions of problems in this group are intended to assist the student in the task of synthesis, abstraction and understanding necessary for the proper assimilation of the content.
The dynamics of the class is participatory. The dynamics of theoric classes consist on establish a student-

teacher and student-student dialogue through formulation of issues by both the teacher and the student. In the problems classes, activities that encourage group discussion and oral presentation by students will be developed . In laboratory work is carried out through in teams of two people and presented to the teacher preferably through a dialogue that promotes a reasoned explanatory argument. The tutoring sessions are voluntary but are an important part of the accommodation the student to the dynamics of the subject and they are the place not only to answer specific questions about the concepts presented, but also to raise any problem or difficulty in any aspect of the subject.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

The course, given its basic nature, does not need a specific background, although it is recommended have completed the courses of Informática, Programación and MatemáticasI and II. The first two serve to equip students with skills in the use of libraries and coding programs. The last two give the student the ability to understand the geometric problems and use mathematical formalism that arise in the course.

OUTCOMES

1407 - Degree in Multimedia Engineering

- G1 - Be able to relate and structure information from different sources and to integrate ideas and knowledge. (RD1393/2007)
- G2 - Have the learning skills needed to undertake further studies or to gain further training with a certain degree of autonomy. (RD1393/2007)
- G4 - Be able to integrate into working groups and collaborate in multidisciplinary environments and be able to communicate properly with professionals from all fields.
- I2 - Know, design and make an efficient use of the data types and data structures that are most suited to solving a problem.
- MM1 - Have knowledge and ability to understand essential facts, concepts, principles and theories related to multimedia systems including all the disciplines covered by these systems.
- MM2 - Be able to understand and manage the different technologies involved in multimedia systems, both from the point of view of hardware and electronics and of software.
- MM3 - Be able to implement methodologies, technologies, processes and tools for the professional development of multimedia products in a real context of use by applying the appropriate solutions for each environment.

- MM9 - Program correctly in the different specific languages of multimedia systems taking into account time and cost restrictions.
- MM12 - Know current 2D and 3D graphic systems and their application to multimedia developments.
- MM28 - Be able to solve problems with initiative, decision-making and creativity and to communicate and transmit the knowledge, abilities and skills of a multimedia engineer.

LEARNING OUTCOMES

This course allows for the following learning outcomes:
1. Distinguish and locate the various processes involved in the generation of graphics within the graphical model of the pipe.
2. Develop the ability and insight in bi and three-dimensional geometry.
3. Knowing the basic common structure that have the graphics libraries and to identify and manage the types of data structures used in graphics rendering.
4. Using a standard graphics library for developing graphical applications that can be integrated into other applications.
5. Know the basic structure of a program that interacts with the user.
6. Being able to choose from depending on specific graphics application, the algorithms more suitable for some processes the graphics pipeline.
7. Diagnose and identify the process or processes involved in the failure or malfunction of a graphics application.
8. Understand and handle basic bibliographic sources for the material handling and advanced information sources (minutes of meetings, conferences, journals and discussion forums own specialty).
9. Promote and develop the ability to group work and the division thereof into specialized groups
10. Being able to organize and communicate results and procedures regarding the scope of knowledge of computer graphics

To complement the above results, this subject also to acquire the following skills and social skills:
Having a functional modular view of the problem of image synthesis.
Knowing the treatment algorithms of the different processes that occur in the graphics rendering pipeline. Being able to adapt them to specific problems.
Know and use the OpenGL graphics standard library.
Understand and manage specific bibliographic sources of matter.
Develop communication skills and group work in the field of development of graphics applications and multimedia visual communication.
Integrate skills learned synthesis graphics within general coding skills to create multimedia programs.
Adapt knowledge acquired in previous programming and in mathematics and physics to the context of the synthesis Graphics

It will also promote the development of several generic skills, among which include:

Capacity for analysis and synthesis.
Ability to argue from rational and logical criteria.
Ability to communicate properly and organized.
Ability to develop a problem in a systematic and organized.
Ability to work and personal time distribution.

Ability to work in groups.

DESCRIPTION OF CONTENTS

1. Introduction to Computer Graphics

Areas of application of synthetic graphics.
The graphics pipeline
Graphics Hardware: Model raster graphics devices.
Graphics hardware: GPUs

2. Introduction to Modelling

Geometric Modeling. Fundamental concepts. faces, normal vectors,...
Polygonal Modeling. Indexed and double indexed representations, tables.
Basic Polygonal Structures.

3. Geometric Transformations

Basic 2D geometric transformations. Homogeneous coordinates.
Transformations known the end position. Direction cosines.
Basic 3D Geometric Transformations
The transformations in the OpenGL library

4. View Transformation

World window and Viewport.
Algorithms for 2D Clipping
Transformation of 3D view.
View Volume
The transformation of view in the OpenGL library

5. Planar linear Projections

Parallel and Perspective Projections
General matrix projection
Implementation of the Projection transformation
Implementation in the OpenGL library

6. Primitive drawing and pixel operations

Line drawing algorithms
Algorithms for circles.
Filling figures. Filling XY Alg.
Filling by seed Alg. based on bilinear fill with various colors
Hiding Algorithm Z-buffer

7. Lab. Practice

Practice 1: OpenGL and GLUT graphic libraries and event-driven programming
Practice 2: Using a 3D modeler
Practice 3: 3D affine transformations
Lesson 4: Transforming 3D view
Practice 5: Projections
Lesson 6: Drawing Primitives
Lab 7: Algorithms filling / Project
Lab 8: Project

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	20,00	100
Classroom practices	10,00	100
Development of group work	8,00	0
Study and independent work	12,00	0
Preparing lectures	35,00	0
Preparation of practical classes and problem	15,00	0
Resolution of case studies	20,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The development of the subject is structured around three work environments: learning with the teacher (theory sessions, problems and face-to-face tutoring), laboratory sessions and group work.

Group learning with the teacher

Theory sessions will use the master class model. In them the teacher will expose the fundamental contents of the subject, using the audiovisual means at his disposal (presentations, transparencies, blackboard, demonstrations).

In the problem sessions, the dynamics will be eminently directed by the student. Students are expected to participate in explaining the proposed problems. For this, previously the teacher will indicate what day is going to be dedicated to solving problems and what problems are to be solved, so that the student attends these classes with the problem statement prepared in advance.

Team work.

Throughout the course, students will carry out different classroom activities in pairs or in larger groups. In these activities, apart from the assimilation of content, they are focused on collaborative work learning. Where the students must explain and convince the rest of the group and distribute the tasks.

Laboratory sessions

In the laboratory sessions the OpenGl graphic library will be used as well as additional software to carry out the proposed work. The work will be reviewed in the sessions of tutorials arranged for this purpose in which the students will explain the realization of the practice to the teacher and a dialogue will be maintained about technical aspects involved in the development of the same.

These laboratory sessions will be organized around working groups made up of a maximum of two people.

Tutoring

Students will have a schedule of tutoring whose purpose is to solve problems, questions, and the presentation of the proposed work in the laboratory. The schedule of these tutorials will be indicated at the beginning of the academic year. They will also have the opportunity to clarify some doubts by email or discussion forums by using the "Virtual Classroom" tool, provided by the University of Valencia.

EVALUATION

Evaluation System
This system encourages students to participate regularly in training activities, evaluating theoretical activities, problem sessions, presentation of work and lab activities.

It is mandatory that the student notify the difficulties to attend the presential classes, to be specifically instructed about the evaluation mode. The student must communicate these diffuculties along the two first weeks of the course.

In the normal evaluation (daily class attendance), the marks will have the following weights

Theoretical activities: With a total weight of 50%. Exams (80%) . Other activities (lectures, works about a subject, activities inside the classroom)(20%)

Problems: 10% of the total weight

Labs: 40 % of the total weight

The minimum mark to weight each of the concepts of the table above to be evaluated is 4.5

First call:

One or several partial exams will be carried out along the term plus a final exam.

The final mark of the Exams part is calculated as:

Nota_media = 0.3 *Partial_Exams + 0.7 * Examen_Final

It is necessary to get a 4.5 mark in each exam to weight the correspondent term. On the contrary, the mark for this exam will be 0 in the calculation of the formula.

In the case of none partial exam is carried out and/or the presented class activities or problems are less or equal than 70%, the student will be evaluated with this alternative mark distribution:

Partial exams: 10%

Problem exercices: 10%

Final Exam: 50%

Lab. 30%

Second call:

-The percentages will be the same than those of first call. However, the marks obtained in the partial exams are not considered, being substituted by the mark obtained in the final exam of this second call.

- they won't be re-evaluated in this second call the following items: work about a subject, activities in the classroom and lab. work

-Parts non re-evaluated won't be subjected to the restriction of getting a minimum mark

To get a 4.5 mark in the Final exam is mandatory.

The implementation of practices and their attendance is mandatory. Special cases should be discussed with the teacher .

REFERENCES

Basic

- Computer Graphics. Foley, Van Dam, Feiner, Hughes. Addison-Wesley. 2nd. Edition . 1995
- Fundamentals of computer graphics. Shirley, Ashikhmin, Marschner. A K Peters. CRC Press. 3th Edition. 2009
- Computer Graphics using OpenGl. Hill , Kelley. 3Th Edition. Prentice Hall. 2006

Additional

- OpenGL Programming Guide: The official guide to learning OpenGL. Shreiner. Addison-Wesley Professional. 7th Edition. 2009
- Computer Graphics with OpenGL (4th Edition) (Segunda edición en castellano) . D. Hearn, M.P. Baker, W. Carithers. Ed. Pearson. 2010
- Foundations of 3D Computer Graphics. Gortler, S.J. MIT Press 2012

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

The teaching methodology for this subject will follow the model approved by the Academic Committee of the GII / GIM degrees (https://go.uv.es/catinfmult/ModeloDocenciaGIIGIM). If the facilities are closed because of COVID-19 pandemics, the scheduled lectures will be replaced by synchronous online sessions within the assigned time slots of the course, using the tools provided by the university.
If the facilities need to be closed due to the pandemics causing any of the evaluation exercises to be held at ETSE-UV, these exercises will be substituted by equivalent exercieses held online using the tools provided by the university. The weights for each activity will remain the same as specified in the teaching guide.