ACADEMIC YEAR: 2015/2016

Course Number COMP371		**Course Title** Computer Graphics	
Department Computer Science and Software Engineering	**Semester** Fall 2015	**Type** Elective	**Credits** 4.00
Level Undergraduate	**Prerequisites** COMP 232 or COEN 231; COMP 352 or COEN 352		
Schedule Class – Tue @ 17:45 – 20:15, FG-B055 Labs – Wed, Mon @ 16:15 – 18:05			
Instructor Charalambos Poullis	**Office Hours** Wed. , 14:00-16:00 and by appointment	**Office** EV3.183	**Email** charalambos@poullis.org
Teaching Assistant Eric Provencher Frank Tutino	**Office Hours** Wed @ 16:15 - 20:15 Mon @ 16:15 - 20:15	**Office** H817 H819	**Email** eric.comp371@gmail.com FrankTutino@hotmail.ca

COURSE DESCRIPTION

This course introduces basic techniques and concepts for 3D computer graphics and gaming, including 2D and 3D transformations, modeling and representation, illumination and shading, rendering, texturing, animation, physics-based animation, and the state-of-the art software tools. The student will learn fundamental algorithms and techniques, and gain experience in graphics programming; in particular, how to program in OpenGL, a powerful software interface used to produce high-quality computer-generated images of 2D and 3D objects.

COURSE OBJECTIVES

The primary objective of the course is to provide a comprehensive introduction to computer graphics and the related programming principles required when designing and developing computer graphics software. More specifically the course aims to cover the following:

- Introducing the programming principles and algorithms used in computer graphics
- Designing, developing, testing and debugging of computer graphics applications
- Learning the modern GPU architecture
- Gaining practical experience with the graphics library, OpenGL.

LEARNING OUTCOMES

By the end of this course, students will be able to:

- identify the core concepts in computer graphics and explain the graphics pipeline i.e. the sequence of steps required to generate a 2D image from a 3D scene
- employ programming principles, data-structures and algorithms of computer graphics for modeling and rendering
- compare, criticize and assess state-of-the-art techniques in computer graphics
- develop OpenGL applications

COURSE CONTENTS

- Introduction to computer graphics and graphics hardware.
- Introduction to graphics API and graphics systems architecture.
- Mathematics of 2D and 3D transformations, and 2D and 3D viewing.
- Color and basic rendering algorithms.
- Visual realism and visibility.
- Illumination and shading, global illumination techniques, and textures.
- Introduction to curves and surfaces, and 3D object modelling.
- Introduction to computer animation.

TEACHING METHOD

The course comprises of weekly lectures and practical training; both in the form of labs and individual assignments. ***It is emphasized that attendance to the lectures and labs is compulsory.***

ASSESSMENT

Assignments (x3)	3 x 15%
Midterm	25%
Final Project (x1)	30%

Midterm: The midterm exam will take place on Tuesday, October 27th 2015.

Assignments/Final project: The goal of the assignments is to gain practical experience in programming 3D computer graphics with OpenGL. There are three programming assignments and one final project. Please refer to the schedule for the assignment descriptions and due dates. All assignments and final project must be completed to pass the course. The assignments may have a small amount of extra credit. All assignments must be done ***individually***.

Submission: The assignments should be submitted by midnight on the day they are due. Assignments submitted within the 7 days following the initial deadline will also be accepted for grading however, there will be a deduction of 2 points from the total assignment grade and [if applicable] no extra credit will be given. Any assignment submitted past those 7 days will receive a grade of 0.

Example: If the initial deadline was on Oct 13th and you submit your assignment anytime between Oct 14th and Oct 20th, then the maximum grade you can receive is 8 out of 10. If you submit on Oct 21st or later, then the grade is 0.

RECOMMENDED TEXTBOOK

Computer Graphics with Open GL (4th Edition) by Donald D. Hearn and M. Pauline Baker, ISBN-13: 978-0136053583.

COURSE SCHEDULE

The list below provides a summary of the material that will be covered during the course as well as a tentative schedule. Labs will support topics covered in the lectures and provide hands-on exercises.

Lectures/Date	Topic	Book chapter(s)	Notes
1. September 8th	• Syllabus • Introduction to Computer Graphics	Ch. 1	
2. September 15th	• Input and Interaction • Geometric Objects and Transformations	Ch. 2, 20	Assignment 1
3. September 22nd	• Viewing • Hierarchical Modeling	Ch. 3, 10, 11	
4. September 29th	• Curves and Surfaces I • Curves and Surfaces II	Ch. 13, 14	Assignment 1 due date Assignment 2
5. October 6th	• Lighting and Shading • Shading in OpenGL	Ch. 17	
6. October 13th	• Texture Mapping • Clipping	Ch. 8, 10, 18	
7. October 20th	• Rasterization	Ch. 7	Assignment 2 due date

8. October 27th	MIDTERM EXAM		
9. November 3rd	• Ray Tracing I • Ray Tracing II	Ch. 21	Assignment 3
10. November 10th	• Spatial Partitioning Data Structures • Global Illumination	Ch. 15, 21	
11. November 17th	• Keyframe Animation • Quaternions and Rotations	Ch. 9, 12	
12. November 24th	• Physically-based Models • Discrete Techniques	Ch. 6, 15	Assignment 3 due date
13. December 1st	• Programmable Shaders	Ch. 22	

ONLINE DISCUSSION FORUM

This term we will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. If you have any problems or feedback for the developers, email team@piazza.com.

Find our class page at: https://piazza.com/concordia_university/fall2015/comp371/home

GRADUATE ATTRIBUTES

As part of either the Computer Science or Software Engineering program curriculum, the content of this course includes material and exercises related to the teaching and evaluation of graduate attributes. Graduate attributes are skills that have been identified by the Canadian Engineering Accreditation Board (CEAB) and the Canadian Information Processing Society (CIPS) as being central to the formation of Engineers, computer scientists and information technology professionals. As such, the accreditation criteria for the Software Engineering and Computer Science programs dictate that graduate attributes are taught and evaluated as part of the courses. The following is the list of graduate attributes covered in this course, along with a description of how these attributes are incorporated in the course.

Knowledge base: Knowledge of computer graphics and graphics hardware. Introduction to graphics API and graphics systems architecture. Mathematics of 2D and 3D transformations, and 2D and 3D viewing. Color and basic rendering algorithms. Visual realism and visibility. Illumination and shading,

global illumination techniques, and textures. Introduction to curves and surfaces, and 3D object modeling. Introduction to computer animation.

Problem analysis: Use mathematical models as basis for the implementation of problems requiring computer graphics. Analyze the requirements and constraints of the problem in order to determine what design and implementation solutions will be used.

Design: Design and compose computer graphics components involving many aspects such as stated in the course description.

Use of tools: Use specific computer graphics software development APIs to develop elaborated applications, make an educated decision on the tools and APIs to use based on the established requirements, constraints and design.

Communication skills: Work as a team in the development of an elaborated software development project using computer graphics software and programming tools.