CPSC 444 Computer Graphics Syllabus

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Term: Fall 2020

Description: Computer graphics techniques. Introduction to graphics hardware and software. Two-dimensional graphics methods, transformations, and interactive methods. Three-dimensional graphics, transformations, viewing geometry, object modeling, and interactive manipulation methods. Basic lighting and shading. Video and animation methods.

Objective:	Computer graphics is concerned with all aspects of producing pictures or images using a computer. We will explore the fundamentals used in computer graphics and use a graphics software system called OpenGL.
Prerequisite:	CPSC 340
Text:	• Interactive Computer Graphics: A Top-Down Approach with Shader Based OpenGL, 6th ed., Edward Angel, Dave Shreiner, 2011. • OpenGL: A Primer, 3rd ed., Edward Angel, 2007. • OpenGL Development Cookbook, 1st ed., Muhammad Mobeen Movania, 2013. • OpenGL 4 Shading Language Cookbook, 2nd ed., David Wolff, 2013. • OpenGL Quick Refernce API Version 4.5, Khronos Group, 2014. ▪ Other resources will be posted on the website.
Website:	http://www.opengl.org http://www.glprogramming.com/red/ The OpenGL Programming Guide - this online version documents older versions of OpenGL but still should be useful
Classroom	Online (Asynchronous Videos, Discussion Boards will be used for group evaluations) TopHat ($30) will be used for course work it will be linked with Canvas. Canvas will be used as a portal to Tophat. the following will all be available on canvas • Grades • Syllabus
Office Hours	I will hold office hours in discord and if needed we can carry over to zoom. I will take a poll about hours for online office hours in the first week. I will have office hours on campus MW TBA

Goals:
At the end of this course students should:
- Have a basic understanding of the core concepts of computer graphics.
- Be capable of using OpenGL to create interactive computer graphics.

- Understand a typical graphics pipeline.
- Have made pictures with their computer.

Topics:

- Introduction: History of computer graphics, graphics architectures and software, imaging: pinhole camera,human vision, synthetic camera, modeling vs rendering
- OpenGL: architecture, displaying simple two-dimensional geometric objects, positioning systems, working in a windowed environment
- Color: Color perception, color models (RGB, CMY, HLS), color transformations. Color in OpenGL. RGB and Indexed color.
- Input: working in a network environment, client-server computing; input measure, event, sample and request input, using callbacks, picking.
- Geometric transformations: affine transformations (translation, rotation, scaling, shear), homogeneous coordinates, concatenation, current transformation and matrix stacks.
- Three dimensional graphics: classical three dimensional viewing,specifying views, affine transformation in 3D, projective transformations.
- Ray Tracing.
- Shading: illumination and surface modeling, Phong shading model, polygon shading.
- Rasterization: line drawing via Bresenham's algorithm, clipping, polygonal fill, BitBlt. Introduction to hidden surface removal (z buffer).
- Discrete Techniques: buffers, bitblt, reading and writing bitmaps and pixelmaps, texture mapping, compositing.
- Advanced Topics.

Projects:

- There will be two course projects.. The first will be a midterm project due shortly. The second will be a final project due during the last week of class.
- All code and files required for the projects must be submitted to Canvas or Tophat.

Videos:

- In addition to the programming project and lab, each person record projects and labs showcasing their project.

Labs:

- Each week there will be a laboratory session that will cover the new techniques discussed in lecture each week. The lab assignments will be due by the end of the day each following Friday, giving you a full week to complete the lab.
- The lab assignments are intended to be done during the class time and should not require much time after the lab session. (This mean lecture will be approximately 2 hours each week with 1 hour for you to complete the lab)
- The assignments will build off of the labs so use the labs as a starting point for your assignments.

Exams:

- There will be two exams during the semester. The exams will divide the semester into approximate thirds.
- Make-up exams will be allowed only in accordance with University policy. Make-up exams resulting from illness require notification (email is fine) the day of the exam and a doctor's note when well. Make-up exams due to legitimate travel require advance notice and instructor's approval.

Grading:

The final course grade will be computed from the following course percentage breakdown:

- 15% Midterm Project

- 20% Final Project
- 15% Exam I
- 15% Exam II
- 20% Labs
- 15 % Videos

Programming Exercises: **NOTHING WILL NOT BE ACCEPTED LATE**

- You may use either C or C++.
- Your programs should compile and link with no warnings.
- You must use Visual C++ that is where all example will be programmed however if you figure out how to use xCode on a mac I can run those programs
- Your programs are to be written in good programming style and to be readable and understandable. For that purpose, follow the guidelines
    - Documentation:
        - Document your code!
        - In the head of each file write its name and a short description of the file's content.
        - Before declaring or implementing functions / methods describe it's purpose.
        - Document your code whenever you think it's not understandable enough.
        - Make your documentation short and clear.
    - Modulation:
        - Don't write too long functions.
        - Divide large blocks of code to several functions, to make things more readable.
        - Design your program before you begin coding it.
        - Avoid code repetition
    - Naming conventions:
        - Use meaningful names for functions and variables, even if you have to use long names.
        - Be consistent with your naming conventions. e.g., if you start functions with capital letter, keep it so with all your functions.
        - Note: the conventions of OpenGL, GLU and GLUT are to prefix their functions, types and macros with gl / GL / glu / glut. Therefore do not use these prefixes for the names you give in your code.

Course Outline

ICG: Interactive Computer Graphics: A Top-Down Approach with Shader Based OpenGL, 6th ed., Edward Angel, Dave Shreiner, 2011.
Primer: OpenGL: A Primer, 3rd ed., Edward Angel, 2007.
ODC: OpenGL Development Cookbook, 1st ed., Muhammad Mobeen Movania, 2013.
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DOW	Lecture Subject	Reading	Notes
Week 1	Welcome OpenGL 2.1 & GLFW: Primitives & Attributes	ICG 1.1-1.2 ICG 2.1-2.5 Primer 1.1-1.7, 2.4, 2.6, 2.11-2.14 Ref p1 OpenGL Command Syntax	Lab 0, Lab 1 and Survey Due by Friday
Week 2	Drawing in 2D Vertex Transformation Pipeline: Transformations, & Linear Algebra Animation & Interaction Callbacks	ICG 3.1, 3.3-3.4, 3.7-3.10, B.1-B.6, C.1-C.8 Primer 2.10, 5.8-5.9 SLC pp13-15 ICG 2.7, 2.11, 8.1-8.6	Lab 2 are due by Friday

Week 3	OpenGL Rendering Pipeline: Projection Camera Models & 3D Objects	ICG 1.3-1.5, 1.7, 2.6, 4.1-4.2, 4.4-4.7 Primer 2.9 ICG 2.10, 3.2, 4.3	Lab 03 Due
Week 4	OpenGL Rendering Pipeline: Clipping & Culling, Rasterization, Scissor Test Bézier Curves & Surfaces Bézier Curves & Picking	ICG 4.8, 6.1-6.12 ICG 6.6.3, 7.1, 10.1-10.6, 10.9-10.10 Primer 3.13, 9.1-9.3 Ref p6 Per-Fragment Operations	Lab 04 Due
Week 5	Raytracing w/ Global Illumination vs. Lighting w/ Local Illumination Types of Lights, Materials, & Shading Models Turn On The Lights	ICG 5.1, 5.3, 5.11, 11.2-11.3 Primer 6.1-6.2 ICG 5.2, 5.4-5.7 Primer 6.3-6.9	Lab 05 Due
Week 6	Texture Mapping Texture Filtering Texture That Teapot! (T^3)	ICG 7.5-7.6.4 Primer 8.1-8.3 Ref pp2-3 Textures and Samplers ICG 7.6.5-7.7, D.5 Primer 8.4-8.6, 8.8	Lab 06 Due
Week 7	Fixed Function Pipeline Review **Exam I** The Ticket Booth		
Week 8	OpenGL 3.3 - Shaders & VBOs Vertex Buffer Objects (VBOs) & Vertex Array Objects (VAOs) Roller Coaster Tycoon	ICG 9.3, 9.5 ICG 1.8, 2.8, A.2, D.2 Primer 4.5 ODC pp146-170 Ref p1 Buffer Objects, pp4-5 Vertex Arrays, p8 OpenGL Pipeline	**Lab 7 Due**
Week 9	Shader Programs & GLSL Doom MD5 Model Loader	ICG 3.12.2, A.1, D.8 Primer 10.1-10.7 ODC pp19-27 SLC pp17-25 Ref pp1-2 Shaders and Programs, p5 Vertex Attributes, pp9-12	

Week 10	Vertex & Fragment Shaders Vertex & Fragment Shaders Part II Space Jam	ICG 5.8-5.10, A.7 ODC pp28-37, 48-54, 107-122 SLC pp25-42, 57-80, 91-107, 117-123 Ref p4 Vertices	Lab 08 Due
Week 11	Particle Systems Geometry Shader Billboarded Point Sprites	ICG 7.11, 9.3-9.6 Primer 6.10 ODC pp171-179 SLC pp320-326 Ref p6 Per-Fragment Operations ODL pp37-44 SLC pp215-233	**Lab 09 Due**
Week 12	Vertex & Geometry Shader Techniques Collision Detection Marble Madness	ODC pp141-146	Lab 010 Due
Week 13	Fragment Shader Techniques Multipass & Framebuffer Objects (FBOs) Pleasantville	ODC pp98-106, 195-201 SLC pp107-109, 163-195 SLC pp154-159 Ref p4 Framebuffer Objects	Lab 11 Due
Week 14	Shader Programming Review **Exam II** Get Your Season Pass		
Week 15	Shadow & Environment Mapping Advanced Computer Graphics	ICG 4.10, 7.8-7.9 ODC pp85-97, 122-140 SLC pp126-148, 263-283 ICG 9.8-9.9, 11.9 SLC 124-136, 293-314	Lab 12 Due
Finals Week	Final Project Presentations		

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Course Participation

Each student's *active participation* in CPSC 444 is of utmost importance. An important part of each student's intellectual and creative growth takes place through effective communication between the instructor and the student and between the student and his or her peers. It is the responsibility of every student to stay in close touch with the professor throughout the semester and to actively participate in class discussions and activities.

Grading:
Mid term, grades will be based on a straight average of all grades given to that point. Students with averages of less than 70% and students who have not turned in all required assignments will receive an unsatisfactory grade. Final grades are based on the following scale.

- 95-100 A
- 90-95 A-
- 87-89 B+
- 82-86 B
- 79-81 B-
- 77-78 C+
- 72-76 C
- 69-71 C-
- 67-68 D+
- 60-66 D
- <60

Honor Code

I run all of my classes on the Honor Code system; in other words, I trust you to do your own work at all times. However, I expect students to work together in laboratory sections, which means you can help each other correcting syntax and logic errors. You cannot copy any code from one person's screen to another, however they can reference your notes for comparison and they can point out mistakes on your screen. All outside programming assignments must be done on your own. You can discuss logic is generally terms but no code specifics. You can ask for classmates if they recognize your syntax errors and give you advice on how to fix them but they cannot copy any code from you. If you have even the slightest doubt that an activity violates the Honor Code - don't do it.

Disability Policy:

The Office of Disability Resources has been designated by the college as the primary office to guide, counsel, and assist students with disabilities. If you receive services through the Office of Disability Resources and require accommodations for this class, make an appointment with me as soon as possible to discuss your approved accommodation needs. Bring your accommodation letter, along with a copy of our class syllabus with you to the appointment. I will hold any information you share with me in strictest confidence unless you give me permission to do otherwise. If you have not contacted the Office of Disability Services and needed accommodations, their phone number is 540-654-1266. The office is located in Lee Hall, Room 401.

Title IX Statement

University of Mary Washington faculty are committed to supporting students and upholding the University's Policy on Sexual and Gender Based Harassment and Other Forms of Interpersonal Violence. Under Title IX and this Policy, discrimination based upon sex or gender is prohibited. If you experience an incident of sex or gender based discrimination, we encourage you to report it. While you may talk to me, understand that as a "Responsible Employee" of the University, I MUST report to UMW's Title IX Coordinator what you share. If you wish to speak to someone confidentially, please contact the below confidential resources. They can connect you with support services and help you explore your options. You may also seek assistance from UMW's Title IX Coordinator. Please visit http://diversity.umw.edu/title-ix/ to view UMW's Policy on Sexual and Gender Based Harassment and Other Forms of Interpersonal Violence and to find further information on support and resources.

Resources	Confidential Resources
On-Campus Tiffany W. Oldfield, J.D. Title IX Coordinator	Talley Center for Counselling Services – Lee Hall 106

Office of Title IX
Fairfax House
540-654-5656
toldfiel@umw.edu

Student Health Center
Lee Hall 112

Myranda Thomson
Title IX Deputy for Students
Area Coordinator
540-654-1184
mthomson@umw.edu
540-371-1666

Off-Campus
Empowerhouse
540-373-9373

RCASA

Classroom Recording

Classroom activities in this course may be recorded by students enrolled in the course for the personal, educational use of that student or for all students presently enrolled in the class only, and may not be further copied, distributed, published or otherwise used for any other purpose without the express written consent of the course instructor. All students are advised that classroom activities may be taped by students for this purpose. Distribution or sale of class recordings is prohibited without the written permission of the instructor and other students who are recorded. Distribution without permission is a violation of copyright law. This policy is consistent with UMW's Policy on Recording Class and Distribution of Course Materials

All students are expected to adhere to the following policies and expectations to mitigate risk and support the health and safety of the UMW community: MMDC--Monitoring, Masking, Distancing, Cleaning.

Self- Monitoring: all UMW students, faculty, and staff must self-monitor their health status and attest daily in **Eagle Health Survey.** Students should refrain from attending class and other on-campus events if they feel ill and are encouraged to seek appropriate medical attention for treatment of illness. Should you need to be absent from class due to illness, please inform the instructor so that a plan for making up missed work can be developed.

Face Coverings: face coverings which cover both the nose and mouth must be worn by all students, faculty, and staff, (except for those students with authorized exceptions granted by the Office of Disability Resources), and are required in all classrooms/lab/studios at all times, as well as inside buildings when in the company of others. **If a student does not have a mask or appropriate face covering, or an authorized exception, that student will not be permitted in class.** Masks are available at the University Center Information Desk and the Parking Desk in Lee Hall. See UMW's Face Covering Policy for face covering guidelines. Students should contact the Office of Disability Resources for approved exceptions to the face covering requirement.

Physical distancing: all classrooms, labs, studios and any other instructional areas are configured to provide appropriate physical distancing and have established occupancy limits; students MUST adhere to the physical distancing configuration of the classroom/lab/studio and not exceed the occupancy limits of the space at any time.

Self-Cleaning: students and faculty are expected to wipe down their work/seating areas when entering the instructional space and upon leaving; cleaning and disinfecting products such as sanitizing wipes are present in all classroom and meeting spaces, and throughout UMW buildings to support self-cleaning. The time between classes has been increased to 20 minutes to permit self-cleaning of learning spaces.

No food is permitted in classrooms and other instructional areas; drinks permitted in closed containers only and not in areas where expressly prohibited.

Failure to comply with UMW policies and expectations for face coverings, physical distancing, self-cleaning, and monitoring requirements will result in disciplinary action consistent with the Student Code of Conduct.