CS 535 Computer Graphics

Syllabus

(Fall 2024)

Required/Elective: Elective

Prerequisites: CS315, CS335, (CS321/CS322)

Syllabus (Fall 2024)

General Information

Topics Covered

Computer Facilities

Grading Policy

Course Summary & Program Outcomes

Plagiarism & Cheating

Important Dates

General Information

- Location: Mine and Minerals Research Bldg, Rm 112

Time: TR 12:30 – 1:45pm

Instructor: Dr. Fuhua (Frank) Cheng

OFFICE: DMB 303

OFFICE HOURS: TR 3:30pm-5:30pm
and by appointment

PHONE: (859) 257-6760

E-MAIL: cheng@cs.uky.edu

General Information

CLASS WEBSITE:

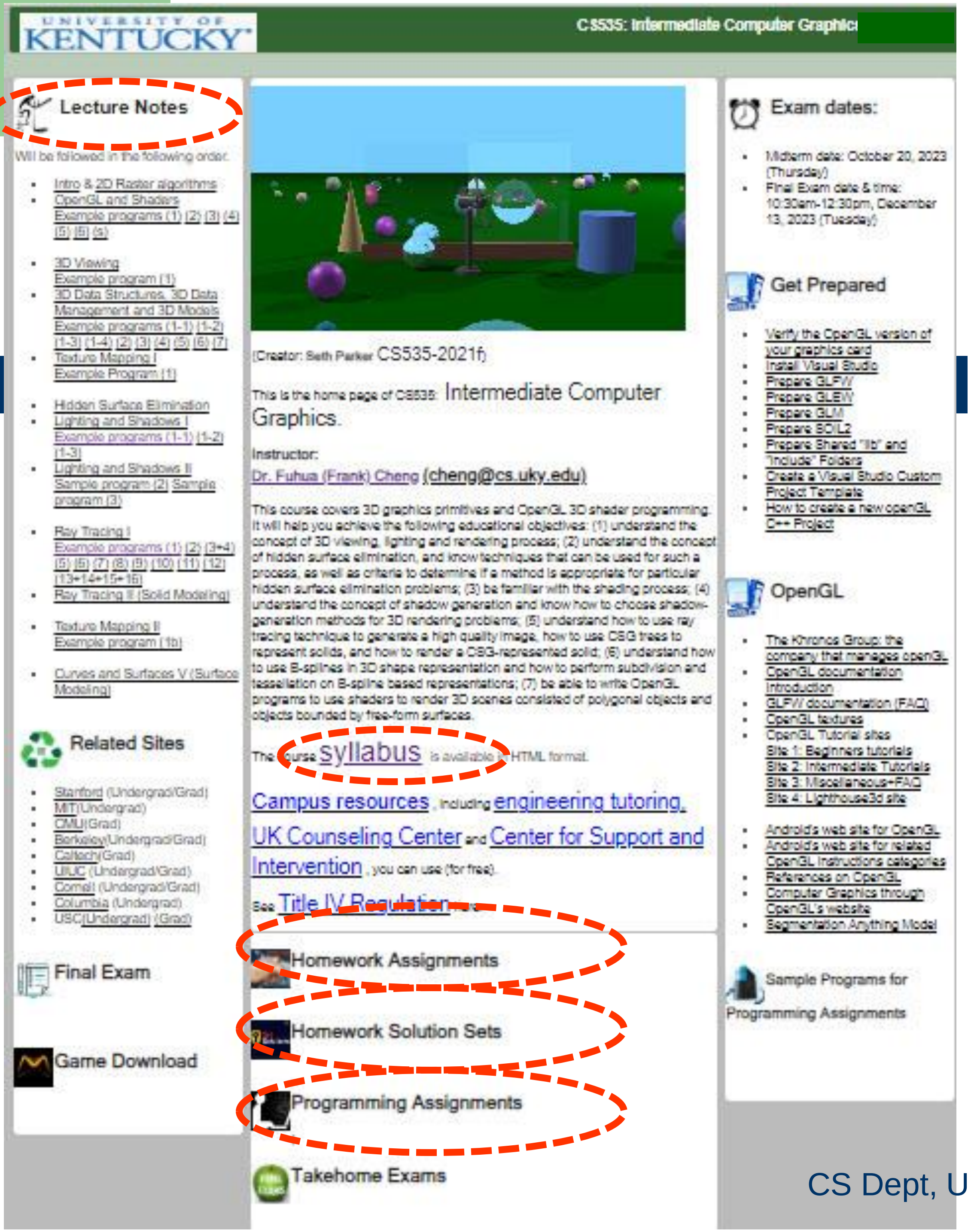
http://www.cs.uky.edu/~cheng/cs535/CS535-HomePage-2024f.htm

Or, go to my personal WEBSITE first:

http://www.cs.uky.edu/~cheng/

Then scroll down to 'Teaching' and click on 'CS 535'

CLASS WEBSITE:



UNIVERSITY OF KENTUCKY

CS535: Intermediate Computer Graphics

Lecture Notes

Will be followed in the following order.

- Intro & 2D Raster algorithms
- OpenGL and Shaders
  Example programs (1) (2) (3) (4) (5) (6) (s)
- 3D Viewing
  Example program (1)
- 3D Data Structures, 3D Data Management and 3D Models
  Example programs (1-1) (1-2) (1-3) (1-4) (2) (3) (4) (5) (6) (7)
- Texture Mapping I
  Example Program (1)
- Hidden Surface Elimination
- Lighting and Shadows I
  Example programs (1-1) (1-2) (1-3)
- Lighting and Shadows II
  Sample program (2) Sample program (3)
- Ray Tracing I
  Example programs (1) (2) (3+4) (5) (6) (7) (8) (9) (10) (11) (12) (13+14+15+16)
- Ray Tracing II (Solid Modeling)
- Texture Mapping II
  Example program (1b)
- Curves and Surfaces V (Surface Modeling)

Related Sites

- Stanford (Undergrad/Grad)
- MIT(Undergrad)
- CMU(Grad)
- Berkeley(Undergrad/Grad)
- Caltech(Grad)
- UIUC (Undergrad/Grad)
- Cornell (Undergrad/Grad)
- Columbia (Undergrad)
- USC(Undergrad) (Grad)

Final Exam

Game Download

(Creator: Seth Parker CS535-2021f)

This is the home page of CS535: Intermediate Computer Graphics.

Instructor:
Dr. Fuhua (Frank) Cheng (cheng@cs.uky.edu)

This course covers 3D graphics primitives and OpenGL 3D shader programming. It will help you achieve the following educational objectives: (1) understand the concept of 3D viewing, lighting and rendering process; (2) understand the concept of hidden surface elimination, and know techniques that can be used for such a process, as well as criteria to determine if a method is appropriate for particular hidden surface elimination problems; (3) be familiar with the shading process; (4) understand the concept of shadow generation and know how to choose shadow-generation methods for 3D rendering problems; (5) understand how to use ray tracing technique to generate a high quality image, how to use CSG trees to represent solids, and how to render a CSG-represented solid; (6) understand how to use B-splines in 3D shape representation and how to perform subdivision and tessellation on B-spline based representations; (7) be able to write OpenGL programs to use shaders to render 3D scenes consisted of polygonal objects and objects bounded by free-form surfaces.

The course syllabus is available in HTML format.

Campus resources, including engineering tutoring, UK Counseling Center and Center for Support and Intervention, you can use (for free).

See Title IV Regulation here.

Homework Assignments

Homework Solution Sets

Programming Assignments

Takehome Exams

Exam dates:

- Midterm date: October 20, 2023 (Thursday)
- Final Exam date & time: 10:30am-12:30pm, December 13, 2023 (Tuesday)

Get Prepared

- Verify the OpenGL version of your graphics card
- Install Visual Studio
- Prepare GLFW
- Prepare GLEW
- Prepare GLM
- Prepare SOIL2
- Prepare Shared "lib" and "include" Folders
- Create a Visual Studio Custom Project Template
- How to create a new openGL C++ Project

OpenGL

- The Khronos Group: the company that manages openGL
- OpenGL documentation Introduction
- GLFW documentation (FAQ)
- OpenGL textures
- OpenGL Tutorial sites
  Site 1: Beginners tutorials
  Site 2: Intermediate Tutorials
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  Site 4: Lighthouse3d site
- Android's web site for OpenGL
- Android's web site for related OpenGL instructions categories
- References on OpenGL
- Computer Graphics through OpenGL's website
- Segmentation Anything Model

Sample Programs for Programming Assignments

General Information

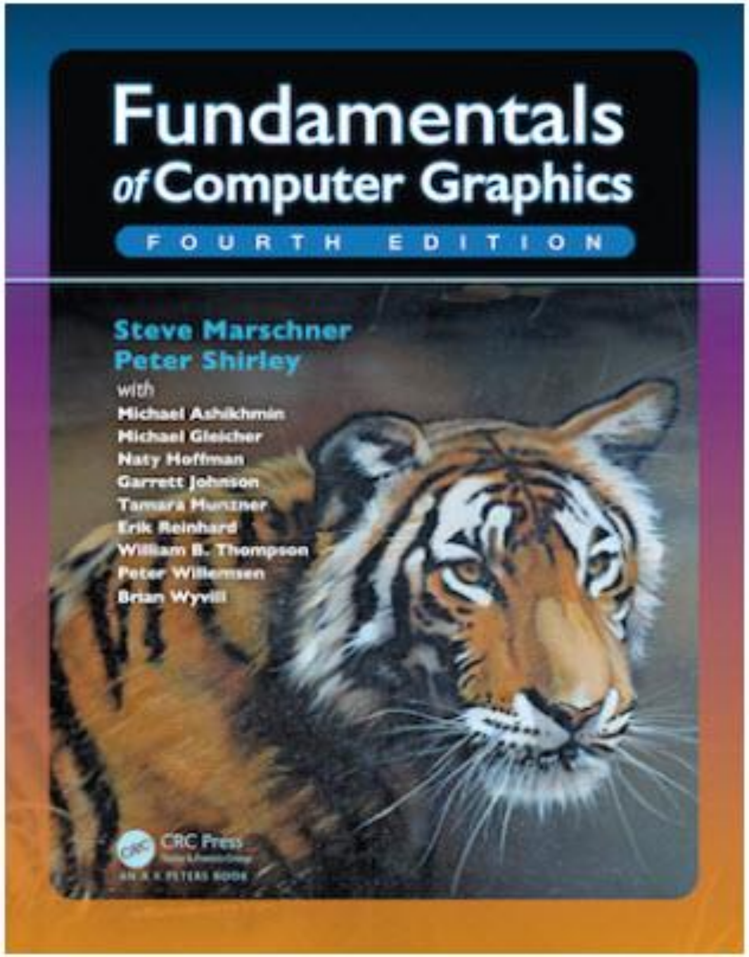
TEXTBOOK: Fundamentals of Computer Graphics (5th Edition)

by Steve Marschner and Peter Shirley

(publisher: A K Peters/CRC Press)

(ISBN-10 : 0367505037 **ISBN-13 :** 978-0367505035)

and my notes (can be downloaded from the class website)



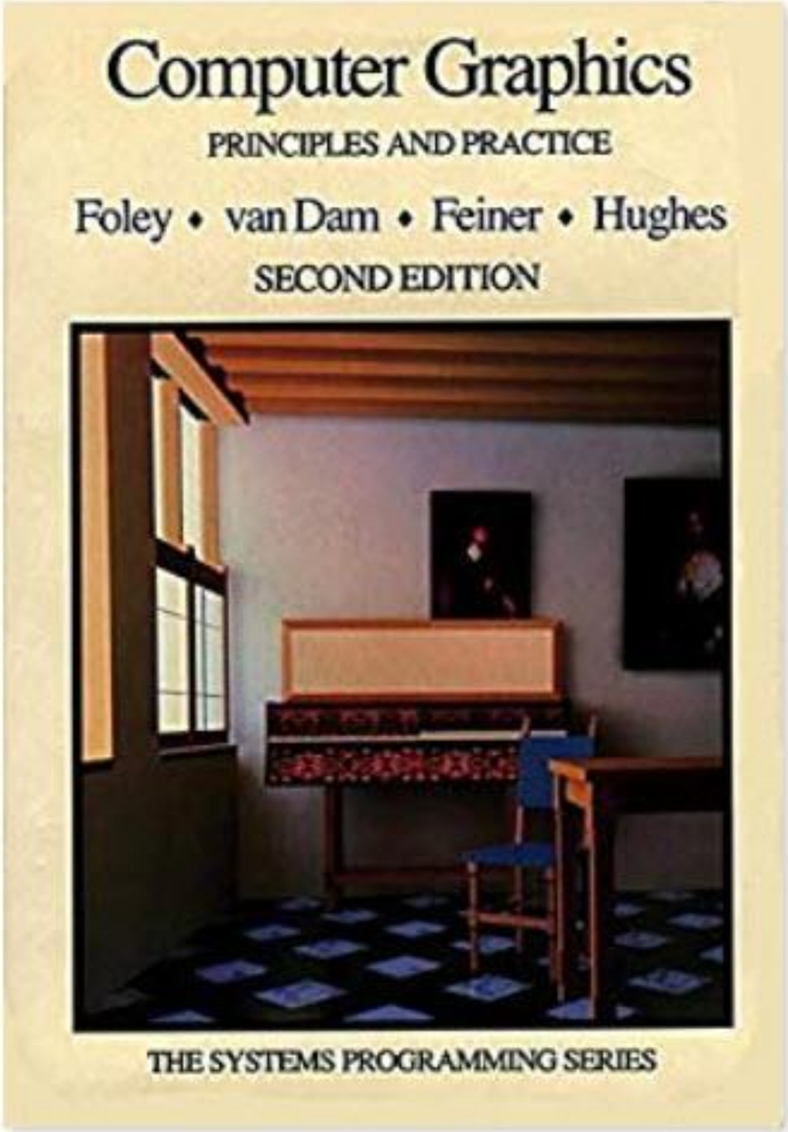
General Information

REFERENCE BOOKS:

Computer Graphics: Principles and Practice,

2nd edition in C

by Foley, van Dam, Feiner, and Hughes


Computer Graphics
PRINCIPLES AND PRACTICE
Foley • van Dam • Feiner • Hughes
SECOND EDITION
THE SYSTEMS PROGRAMMING SERIES

General Information

REFERENCE BOOKS:

COMPUTER GRAPHICS PROGRAMMING

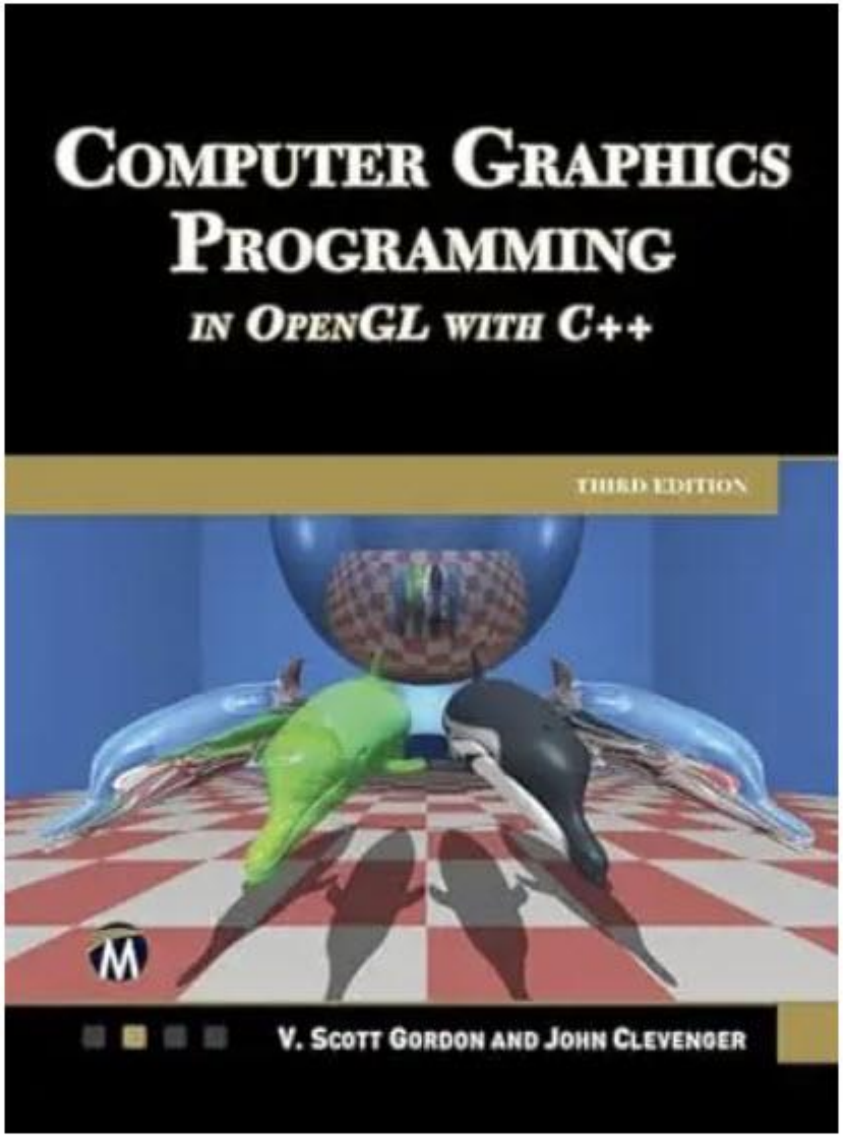
in OpenGL with C++

3rd Edition

by V. Scott Gordon

and

John Clevenger



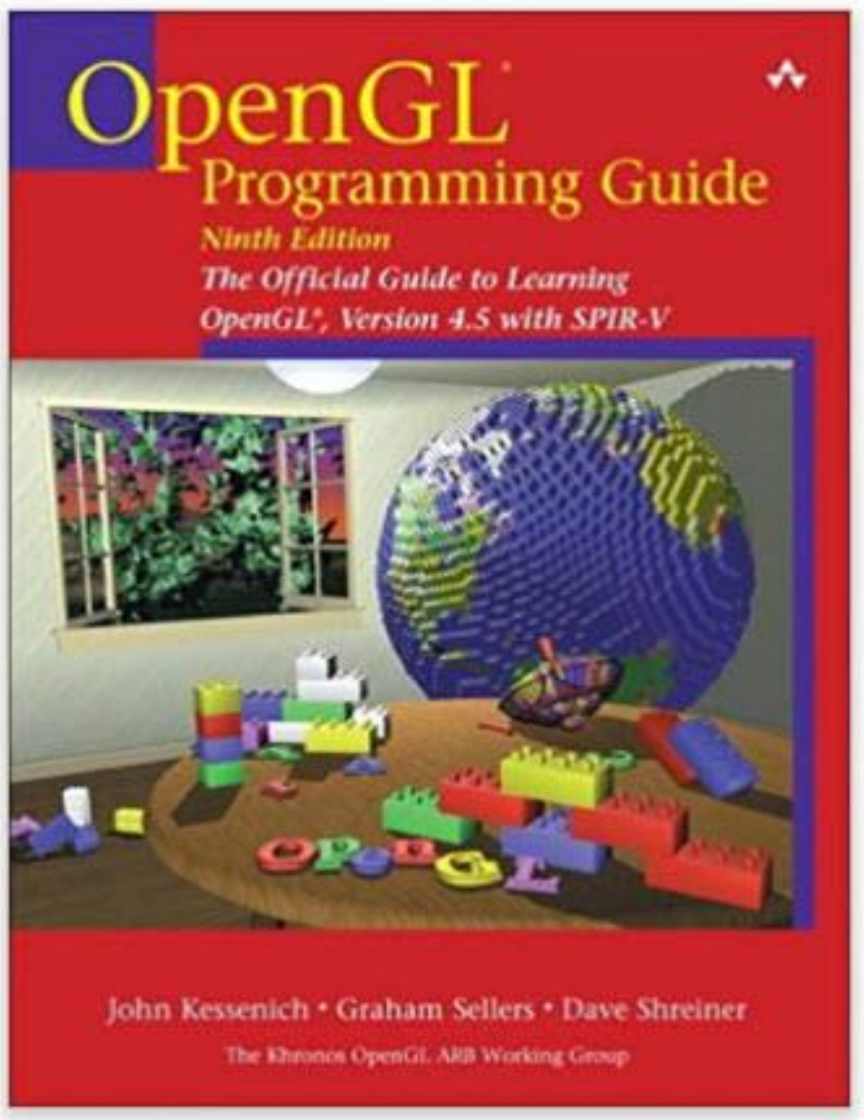
General Information

REFERENCE BOOKS:

OpenGL Programming Guide: The Official Guide to Learning OpenGL,

Versions 4.0 (8th Edition)

by Dave Shreiner, Graham Sellers, John Kessenich, Bill Licea-Kane


OpenGL
Programming Guide
Ninth Edition
The Official Guide to Learning
OpenGL®, Version 4.5 with SPIR-V
John Kessenich • Graham Sellers • Dave Shreiner
The Khronos OpenGL ARB Working Group

List of Topics:

Weeks 1:

Basics: graphics systems, modeling, rendering, input and interaction

2D Graphics: concept of RGBα and rasterization of polygons

Weeks 2-3:

OpenGL and Shaders: basic structure, utility libraries, callback function prototypes, examples

List of Topics:

Week 3-4:

3D Viewing: projections, geometric transformations, graphics transformation

Week 4-5:

3D Data Structures, 3D Data Management and 3D Models: face-table based, winged-edge data structure, scene graphs, Managing 3D data, and 3D models

Weeks 6:

Hidden Surface Elimination: overwriting, backface culling, Z-buffer, scan-line method, BSP-tree method

List of Topics:

Weeks 7-8:

Illumination, Shading (lighting) and Shadows: Gouraud shading, Phong shading, shadow volume method, shadow map method

Weeks 9-10:

Ray Tracing I: ray tracing, shadow generation, specular reflection, refraction, instancing

Weeks 10-11:

Ray Tracing II: Solid modeling, ray casting

List of Topics:

Week 12:

Texture Mapping:

Week 13-14:

Curves and Surfaces:

Computer Facilities:

You can either use your own computer or the computers in the Multilab to do programming assignments for this class.

Your userid for the Multilab will be mailed to you during the first week of the semester. If you did not get it, please send me email so I can send your userid to you again.

This is a Linux laboratory administered by the Computer Science Dept.

Computer Facilities:

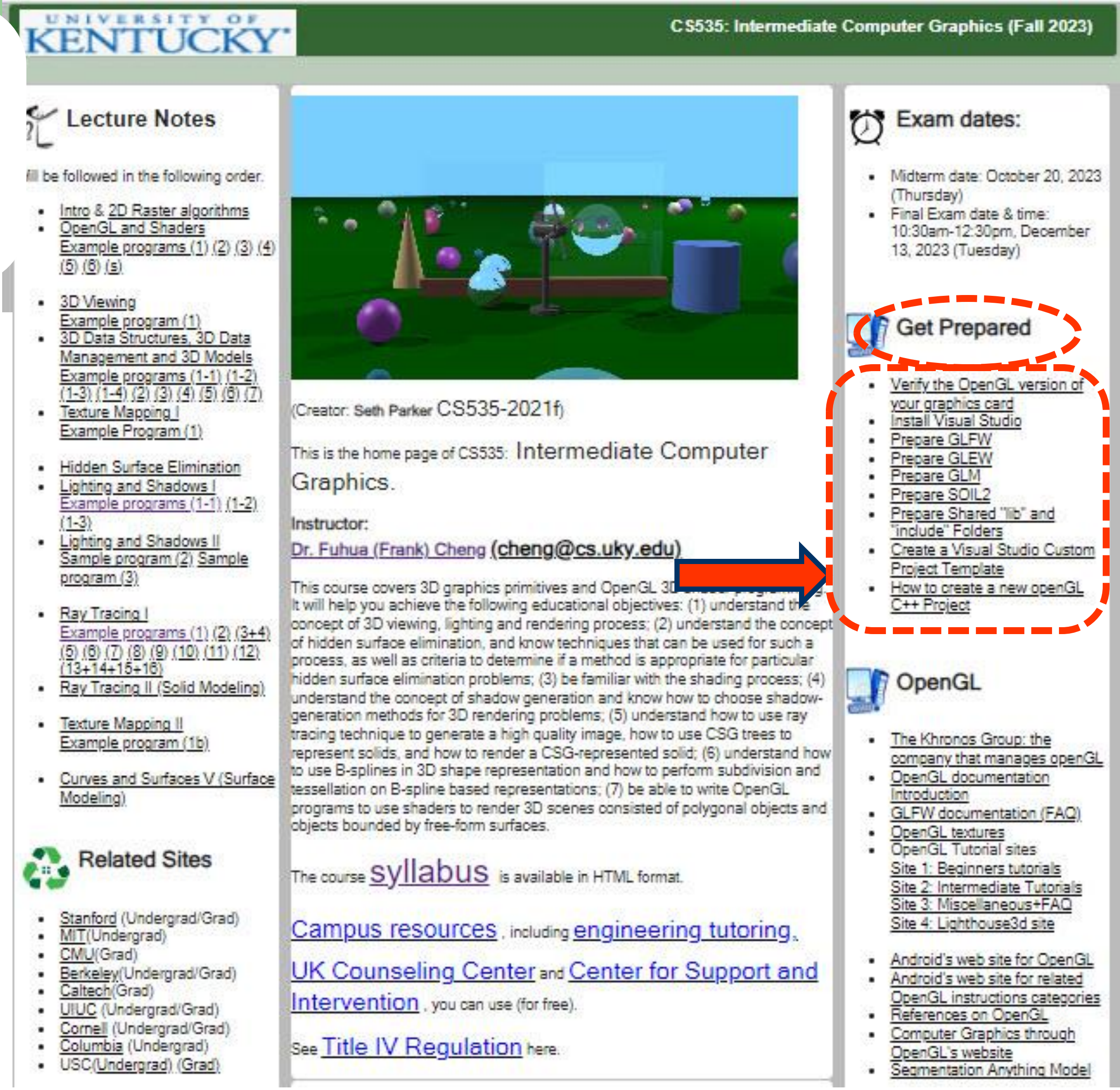
Lab Location: Hardyman Building

You may use alternative computer systems for developing and testing your work. But your submitted work must compile and run under the proper software environment.

This course uses OpenGL to support graphics operations.

Get Prepared:

- Follow the instructions given underneath "Get Prepared" to install all the header files and things you need for this class



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(Creator: Seth Parker CS535-2021f)

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- Segmentation Anything Model

Grading Policy:

Programming Assignments (3 assignments)---- 40%

Midterm ----- 20%

Final ----- 20%

Class attendance (extra credit) ----- 5%

Homework (6-8 assignments)----- 20%

- You get the attendance credit (5 points) if you miss at most two lectures in the semester

Grading Policy:

** Programming assignments may be done in C++. Example programs in C++ will be provided.

*** You may use ChatGPT or any GAI to help with your HW or programming assignments.

LATE PENALITY:

I will accept programs and homework up to two days late for a penalty of 20% (10% each day).

Grading Policy:

SCALE (graduate students):

90 -105 .... A

80 - 89 ..... B

70 - 79 C

SCALE (for under-graduate students)

86 -105 .... A

76 - 85 ..... B

66 - 75 C

56 - 65 ..... D

0 - 55 .... E

Course Summary & Program Outcomes:

This course covers 3D graphics primitives such as 3D viewing, 3D data structures, hidde line/ surface elimination, illumination and shading, and more advanced topics such as ray tracing, solid modeling, texture mappings, curves and surfaces, advanced raster graphics architecture and algorithms, and advanced modeling techniques if time permits.

Course Summary & Program Outcomes:

Specific skills:

- An understanding of the graphic system and shader programming (input devices, scan converstion, graphics storage, graphic processing unit, output devices, graphics pipeline and shaders)
- An understanding of 3D viewing (projections, geometric/graphics transformations)
- An ability to use appropriate data structures (face-table based, winged-edge data structure, scene graphs) to represent 3D objects and to manage 3D data and building 3D models

Course Summary & Program Outcomes:

Specific skills:

- An ability to apply appropriate techniques (overwriting, Z-buffer, scan-line method, BSP-tree method) to elliminate hidden lines/surfaces in 3D rendering process

- An ability to apply appropriate techniques (Gouraud shading, Phong shading, shadow volume method, shadow map method) to shade objects and to create shadows in the rendering process

Course Summary & Program Outcomes:

Specific skills:

- An ability to use appropriate mapping techniques to create textures for objects in the rendering process
- A fluency in graphic and shader programming using OpenGL as the supporting graphic system.

Plagiarism & Cheating:

Consult the following links for information on what constitutes an academic offense and on applicable penalties:

http://www.uky.edu/Ombud/

http://www.uky.edu/Ombud/Plagiarism.pdf

Important Dates:

First day of class - 8/27/2024 (Tuesday)

Last day to drop without a W or change grading option - 9/15/2024 (Sunday)

Midterm - 10/17/2024 (Thursday)

Fall Break - 10/28/2024-10/29/2024 (M&T)

Thanks Giving Holidays - 11/27/2024-11/30/2024 (Wednesday-Saturday)

Last day of classes - 12/10/2024 (Tuesday)

Final Exam – 10:30-12:30, 12/17/2024 (Tuesday)

End