Credit Hours: 3

Contact Hours: This is a 3-credit course, offered in accelerated format. This means that 16 weeks of material is covered in 8 weeks. The exact number of hours per week that you can expect to spend on each course will vary based upon the weekly coursework, as well as your study style and preferences. You should plan to spend 14-20 hours per week in each course's reading material, interacting on the discussion boards, writing papers, completing projects, and doing research.

Faculty Information: Faculty contact information and office hours can be found on the faculty profile page.

COURSE DESCRIPTION AND OUTCOMES

Course Description:

This course provides an overview of foundational computer graphics and visualizations topics.

Course Overview:

Graphics and Visualization will provide an overview of foundational computer graphics and visualizations topics. Students will develop an understanding of rendering, foundational modeling, geometric modeling, and computer animation in constructing simple organic forms. Primary emphasis will be on using the appropriate modeling approaches with respect to space and time complexity, and the quality of images, through the construction of computer graphics/visualizations.

Course Learning Outcomes:

1. Explain common uses of digital presentation to humans.
2. Discuss how images can be represented by pixels.
3. Develop foundational visualizations.
4. Contrast modeling approaches with respect to space and time complexity, and the quality of images.
5. Use common animation software to construct simple organic forms.
6. Discuss why human-centered software development is important and conduct a simple usability test.

PARTICIPATION & ATTENDANCE

Prompt and consistent attendance in your online courses is essential for your success at CSU-Global Campus. Failure to verify your attendance within the first 7 days of this course may result in your withdrawal. If for some reason you would like to drop a course, please contact your advisor.

Online classes have deadlines, assignments, and participation requirements just like on-campus classes. Budget your time carefully and keep an open line of communication with your instructor. If you are having technical

problems, problems with your assignments, or other problems that are impeding your progress, let your instructor know as soon as possible.

COURSE MATERIALS

Required:

Angel, E., & Shreiner, D. (2015). *Interactive computer graphics: A top-down approach with WebGl* (7th ed.). Upper Saddle River, NJ: Pearson. ISBN13: 9780133574845

NOTE: All non-textbook required readings and materials necessary to complete assignments, discussions, and/or supplemental or required exercises are provided within the course itself. Please read through each course module carefully.

COURSE SCHEDULE

Due Dates

The Academic Week at CSU-Global begins on Monday and ends the following Sunday.

- **Discussion Boards:** The original post must be completed by Thursday at 11:59 p.m. MT, and peer responses posted by Sunday at 11:59 p.m. MT. Late posts may not be awarded points.
- **Opening Exercises:** Take the Opening Exercise before reading each week's content to see which areas you will need to focus on. You may take these exercises as many times as you need. The Opening Exercises will not affect your final grade.
- **Mastery Exercises:** Students may access and retake Mastery Exercises through the last day of class until they achieve the scores they desire.
- **Critical Thinking:** Assignments are due Sunday at 11:59 p.m. MT.

WEEKLY READING AND ASSIGNMENT DETAILS

Module 1

Readings
- Chapter 1 in *Interactive Computer Graphics: A Top-Down Approach with WebGl*
- Tutorials Point Simply Easy Learning. (2018). Computer graphics basics. Retrieved from https://www.tutorialspoint.com/computer_graphics/computer_graphics_basics.htm

Opening Exercise (0 points)

Discussion (25 points)

Mastery Exercise (10 points)

Critical Thinking (30 points)
Choose one of the following two assignments to complete this week. Do not do both assignments. Identify your assignment choice in the title of your submission.

Option 1: Computer Graphics (with WebGL)

Computer graphics deals with all aspects of producing pictures or images using a computer. The field began humbly 50 years ago, with the display of a few lines on a cathode-ray tube (CRT); now, we can generate images by computer that are indistinguishable from photographs of real objects. We routinely train pilots with simulated airplanes, generating graphical displays of a virtual environment in real time. Feature-length movies made entirely by computer have been successful, both critically and financially. For this assignment, discuss the evolution of computer graphics for the last 50 years, and how WebGl fits in this picture.

In your answer, specifically think of and give a real-life scenario where:

- Computer graphics improve the movie industry.
- Using computer enhanced graphics is better than the earlier alternatives.

Your paper should meet the following requirements:

- Be two pages in length, not including an APA title page and APA reference page.
- Include at least one reference from the readings or an outside source. The CSU-Global Library is a good place to find your sources.
- Follow the CSU-Global Guide to Writing and APA.

Option 2: Computer Graphics (with OpenGL)

Computer graphics deals with all aspects of producing pictures or images using a computer. The field began humbly 50 years ago, with the display of a few lines on a cathode-ray tube (CRT); now, we can generate images by computer that are indistinguishable from photographs of real objects. We routinely train pilots with simulated airplanes, generating graphical displays of a virtual environment in real time. Feature-length movies made entirely by computer have been successful, both critically and financially. For this assignment, discuss the evolution of computer graphics for the last 50 years, and how OpenGl fits in this picture.

Your paper should meet the following requirements:

- Be two pages in length, not including an APA title page and APA reference page.
- Include at least one reference from the readings or an outside source. The CSU-Global Library is a good place to find your sources.
- Follow the CSU-Global Guide to Writing and APA.

Portfolio Project Reminder

Be sure to review the Portfolio Project Description and Portfolio Project Rubric in the Module 8 folder for details.

Module 2

Readings

- Chapter 2 in *Interactive Computer Graphics: A Top-Down Approach with WebGl*
- IDC-Online. (2013). *Technical references. OpenGL primitives and attributes.* Retrieved from http://www.idc-online.com/technical_references/pdfs/information_technology/OpenGL_Primitives_and_attributes_Approximating_a_sphere.pdf

Opening Exercise (0 points)

Discussion (25 points)

Mastery Exercise (10 points)

Critical Thinking (60 points)

Choose one of the following two assignments to complete this week. Do not do both assignments. Identify your assignment choice in the title of your submission.

Option 1: Primitives and Attributes (Sierpinski Gasket)

This week's discussion has introduced working with graphics programming, particularly with respect to primitives and attributes. One of these applications is the Sierpinski gasket. Discuss the Sierpinski gasket and run the appropriate program to produce the gasket.

In your answer, specifically think of and give a real-life scenario where:
- The Gasket can be utilized.
- Recursion can/cannot be applied.

Your paper should meet the following requirements:
- Be two pages in length (screenshots), not including an APA title page and APA reference page.
- Include at least one reference from the readings or an outside source. The CSU-Global Library is a good place to find your sources.
- Follow the CSU-Global Guide to Writing and APA.

Option 2: Primitives and Attributes (Clip Coordinates)

This week's discussion has introduced working with graphics programming, particularly with respect to primitives and attributes. One of these applications is the Sierpinski gasket. Discuss the clip coordinates and how they related to the Sierpinski gasket. Then run the appropriate program to produce the gasket. In your answer, specifically think of and give a specific/real-life scenario on how:
- The clip coordinates send information to the rasterizer.
- Outside objects are handled.

Your paper should meet the following requirements:
- Be two pages in length (screenshots, if necessary), not including an APA title page and APA reference page.
- Include at least one reference from the readings or an outside source. The CSU-Global Library is a good place to find your sources.
- Follow the CSU-Global Guide to Writing and APA

Module 3

Readings
- Chapter 3 in *Interactive Computer Graphics: A Top-Down Approach with WebGl*
- Tutorials Point Simply Learning. (n.d.). Computer animation. Retrieved from https://www.tutorialspoint.com/computer_graphics/computer_animation.htm

Opening Exercise (0 points)

Discussion (25 points)

Mastery Exercise (10 points)

Critical Thinking (70 points)

Choose one of the following two assignments to complete this week. Do not do both assignments. Identify your assignment choice in the title of your submission.

Option 1: Physical Input Devices

This week's discussion has introduced working with interaction, particularly with respect to various input and logical devices. In this assignment, discuss the various physical input devices that you read about in your text.

In your answer, specifically think of and give a real-life scenario where:
- One of the devices is critical.
- One of the devices is necessary but may not necessarily be critical.

Your paper should meet the following requirements:
- Be two pages in length (screenshots, if necessary), not including an APA title page and APA reference page.
- Include at least one reference from the readings or an outside source. The CSU-Global Library is a good place to find your sources.
- Follow the CSU-Global Guide to Writing and APA.

Option 2: Logical Input Devices

This week's discussion has introduced working with interaction, particularly with respect to various input and logical devices. In this assignment, discuss the various logical devices that you read about in your text.

In your answer, specifically think of and give a real-life scenario where:
- One of the devices is critical.
- One of the devices in necessary but may not necessarily be critical.

Your paper should meet the following requirements:
- Be two pages in length (screenshots, if necessary), not including an APA title page and APA reference page.
- Include at least one reference from the readings or an outside source. The CSU-Global Library is a good place to find your sources.
- Follow the CSU-Global Guide to Writing and APA.

Module 4

Readings
- Chapter 4 in *Interactive Computer Graphics: A Top-Down Approach with WebGl*
- Tutorials Point Simply Easy Learning (n.d.). *Computer graphics tutorial: Polygon filling algorithm.* Retrieved from https://www.tutorialspoint.com/computer_graphics/polygon_filling_algorithm.htm

Opening Exercise (0 points)

Discussion (25 points)

Mastery Exercise (10 points)

Critical Thinking (70 points)

Choose one of the following two assignments to complete this week. Do not do both assignments. Identify your assignment choice in the title of your submission.

Option 1: Convex Hull

This week's discussion has introduced working with geometric objects and transformations, particularly with respect to scalars, points, and vectors. In this assignment, briefly discuss a convex hull and write a WebGL program that produces a convex hull.

In your program:

- Include screenshots your working program.
- Submit all the source files of your working program.

Your paper should meet the following requirements:

- Be two pages in length (screenshots), not including an APA title page and APA reference page.
- Include at least one reference from the readings or an outside source. The CSU-Global Library is a good place to find your sources.
- Follow the CSU-Global Guide to Writing and APA.

Option 2: Colored Cube

This week's discussion has introduced working with geometric objects and transformations, particularly with respect to scalars, points, and vectors. In this assignment, briefly discuss a colored cube and write a WebGL program that produces a colored cube.

In your program:

- Include screenshots your working program.
- Submit all the source files of your working program.

Your paper should meet the following requirements:

- Be two pages in length (screenshots), not including an APA title page and APA reference page.
- Include at least one reference from the readings or an outside source. The CSU-Global Library is a good place to find your sources.
- Follow the CSU-Global Guide to Writing and APA.

Module 5

Readings

· Chapter 5 in *Interactive Computer Graphics: A Top-Down Approach with WebGl*
· Tutorials Point Simply Easy Learning. (n.d.). *Computer graphics tutorial: Viewing & clipping.* Retrieved from https://www.tutorialspoint.com/computer_graphics/viewing_and_clipping.htm

Opening Exercise (0 points)

Discussion (25 points)

Mastery Exercise (10 points)

Critical Thinking (70 points)

Choose one of the following two assignments to complete this week. Do not do both assignments. Identify your assignment choice in the title of your submission.

Option 1: Interactive Viewer

This week's discussion has introduced viewing, particularly with respect to various projections and related functions. In this assignment, briefly discuss several viewing functions and then use the code snippet in Section 5.4.6 to design an interactive Viewer using WebGL.

In your program:
- Include screenshots your working program.
- Submit all the source files of your working program.

Your paper should meet the following requirements:
- Be two pages in length (screenshots), not including an APA title page and APA reference page.
- Include at least one reference from the readings or an outside source. The CSU-Global Library is a good place to find your sources.
- Follow the CSU-Global Guide to Writing and APA.

Option 2: Displaying Meshes

This week's discussion has introduced viewing, particularly with respect to various projections and related functions. In this assignment, briefly discuss meshes and related functions, and then use the code snippet in Section 5.9.1 to design an interactive WebGL program to display meshes as surfaces.

In your program:
- Include screenshots your working program.
- Submit all the source files of your working program.

Your paper should meet the following requirements:
- Be two pages in length (screenshots), not including an APA title page and APA reference page.
- Include at least one reference from the readings or an outside source. The CSU-Global Library is a good place to find your sources.
- Follow the CSU-Global Guide to Writing and APA.

Portfolio Project Milestone (25 points)

In your first four CTAs, chances are you missed a concept and did not earn all the possible points. This is an opportunity to correct any mistakes you may have made in the previous CTAs. Go back and make the appropriate corrections to one program of your choosing and Resubmit your programs with corrections (if necessary) that reflect feedback from your instructor. If no corrections are necessary, resubmit one program anyway and indicate that to your Instructor.

Module 6

Readings
- Chapter 6 in *Interactive Computer Graphics: A Top-Down Approach with WebGl*

- Illumination Models and Shading. (n.d.). Retrieved from
  https://www.cs.tau.ac.il/~dcor/Graphics/pdf.slides/shading13.pdf

Opening Exercise (0 points)

Discussion (25 points)

Critical Thinking (70 points)

Choose one of the following two assignments to complete this week. Do not do both assignments. Identify your assignment choice in the title of your submission.

Option 1: Approximating a Sphere Recursively

This week's discussion has introduced lightning and shading, particularly with respect to reflection and vector computations. In this assignment, briefly discuss a sphere object—which is used as an example of a curved surface to illustrate shading calculations. Then use the code snippet starting in Section 6.6 to design an interactive approximated and recursively subdivided sphere, using WebGL.

In your program:
- Include screenshots your working program.
- Submit all the source files of your working program.

Your paper should meet the following requirements:
- Be two pages in length (screenshots), not including an APA title page and APA reference page.
- Include at least one reference from the readings or an outside source. The CSU-Global Library is a good place to find your sources.
- Follow the CSU-Global Guide to Writing and APA.

Option 2: Approximating a Sphere Iteratively

This week's discussion has introduced lightning and shading, particularly with respect to reflection and vector computations. In this assignment, briefly discuss a sphere object—which is used as an example of curved surface to illustrate shading calculations. Then use the code snippet starting in Section 6.6 to design an interactive approximated sphere, using WebGL. This time use iteration instead of recursion, and discuss the challenges (if any).

In your program:
- Include screenshots your working program.
- Submit all the source files of your working program.

Your paper should meet the following requirements:
- Be two pages in length (screenshots), not including an APA title page and APA reference page.
- Include at least one reference from the readings or an outside source. The CSU-Global Library is a good place to find your sources.
- Follow the CSU-Global Guide to Writing and APA.

Module 7

Readings
- Chapter 7 in *Interactive Computer Graphics: A Top-Down Approach with WebGl*

· Karczmarczuk, J. (n.d.). Functional approach to texture generation. *University of Caen, France.* Retrieved from https://pdfs.semanticscholar.org/3a7d/2cc393c887406e62b8524868b18aba50f33e.pdf

Opening Exercise (0 points)

Discussion (25 points)

Mastery Exercise (10 points)

Portfolio Project Milestone (25 points)

In your last two CTAs, chances are you missed a concept and did not earn all the possible points. This is an opportunity to correct any mistakes you may have made in Modules 5 and 6 CTAs. Go back and make the appropriate corrections to both CTAs and resubmit your programs with corrections (if necessary) that reflect feedback from your instructor. If no corrections are necessary, resubmit them anyway and indicate that to your Instructor.

Module 8

Readings
· Chapter 8 in *Interactive Computer Graphics: A Top-Down Approach with WebGl*
· Teschner, M. (n.d.). Image processing and computer graphics rasterization. *University of Freiburg.* Retrieved from https://cg.informatik.uni-freiburg.de/course_notes/graphics_05_rasterization.pdf

Opening Exercise (0 points)

Discussion (25 points)

Portfolio Project (300 points)
There are two (2) options to complete the Portfolio Project. Choose only one (1) option to complete the assignment. Identify your assignment choice in the title of your submission.

Final Program Option 1
Study the hidden-surface removal problem and implement the **Z-Buffer algorithm** using WebGL. Clearly provide the details of your program, including the screenshots of your working program:
• Describe the object (primitive) that you are working with.
• Adequately comment about your source code.
Assemble your Lessons Learned Reflection, your source code, and screenshots of the application executing (and the results) into a single document. Submit your completed Portfolio Project by the posted due date.

Your Portfolio Project for CSC405 consists of the following:
• Module 5 Milestone (due in Module 5)
• Module 7 Milestone (due in Module 7)
• Lessons Learned Reflection (from all Modules)
• Final Program/CTA (choose one of two options).

In Week 8, the components left to complete your Portfolio Project are the **Lessons Learned Reflection** and the **Final Program**. Carefully review the requirements below.

Lessons Learned Reflection

Write a 2- to 3-page summary that outlines the lessons you have learned in this course. Reflect on how these lessons can be applied to a real-world problem or to specific real applications. Be sure to follow the CSU-Global Guide to Writing and APA formatting for your reflection summary.

Final Program Option 2

Study the hidden-surface removal problem and implement the **Painter's algorithm** using WebGL. Clearly provide the details of your program including the screenshots of your working program:

- Describe the object (primitive) that you are working with.
- Adequately comment about your source code.

Assemble your Lessons Learned Reflection, your source code, and screenshots of the application executing (and the results) into a single document. Submit your completed Portfolio Project by the posted due date.

Your Portfolio Project for CSC405 consists of the following:

- Module 5 Milestone (due in Module 5)
- Module 7 Milestone (due in Module 7)
- Lessons Learned Reflection (from all Modules)
- Final Program/CTA (choose one of two options).

In Week 8, the components left to complete your Portfolio Project are the **Lessons Learned Reflection** and the **Final Program**. Carefully review the requirements below.

Lessons Learned Reflection

Write a 2- to 3-page summary that outlines the lessons you have learned in this course. Reflect on how these lessons can be applied to a real-world problem or to specific real applications. Be sure to follow the CSU-Global Guide to Writing and APA formatting for your reflection summary.

Grading Scale	
A	95.0 – 100
A-	90.0 – 94.9
B+	86.7 – 89.9
B	83.3 – 86.6
B-	80.0 – 83.2
C+	75.0 – 79.9
C	70.0 – 74.9
D	60.0 – 69.9
F	59.9 or below

Course Grading
20% Discussion Participation
0%   Opening Exercises
8%   Mastery Exercises
37% Critical Thinking Assignments
35% Final Portfolio Project

For information on late work and incomplete grade policies, please refer to our **In-Classroom Student Policies and Guidelines** or the Academic Catalog for comprehensive documentation of CSU-Global institutional policies.

Academic Integrity
Students must assume responsibility for maintaining honesty in all work submitted for credit and in any other work designated by the instructor of the course. Academic dishonesty includes cheating, fabrication, facilitating academic dishonesty, plagiarism, reusing/repurposing your own work (see the CSU-Global Guide to Writing and APA for the percentage of repurposed work that can be used in an assignment), unauthorized possession of academic materials, and unauthorized collaboration. The CSU-Global Library provides information on how students can avoid plagiarism by understanding what it is and how to use the library and internet resources.

Citing Sources with APA Style
All students are expected to follow the CSU-Global Guide to Writing and APA when citing in APA (based on the most recent APA style manual) for all assignments. A link to this guide will be provided within most assignment descriptions in your course.

Disability Services Statement
CSU-Global is committed to providing reasonable accommodations for all persons with disabilities. Any student with a documented disability requesting academic accommodations should contact the Disability Resource Coordinator at 720-279-0650 and/or email ada@CSUGlobal.edu for additional information to coordinate reasonable accommodations.

Netiquette
Respect the diversity of opinions among the instructor and classmates and engage with them in a courteous, respectful, and professional manner. All posts and classroom communication must be conducted in accordance with the student code of conduct. Think before you push the Send button. Did you say just what you meant? How will the person on the other end read the words?

Maintain an environment free of harassment, stalking, threats, abuse, insults, or humiliation toward the instructor and classmates. This includes, but is not limited to, demeaning written or oral comments of an ethnic, religious, age, disability, sexist (or sexual orientation), or racist nature; and the unwanted sexual advances or intimidations by email, or on discussion boards, and other postings within or connected to the online classroom. If you have concerns about something that has been said, please let your instructor know.