CS241: Fundamental Computer Graphics

Contact information:

Class schedule:	GIBRAN: M 2:00pm-3:20pm, W 2:00pm-3:20pm
Professor:	Dr. Gary Herron
Email:	gherron@digipen.edu
Web page:	http://faculty.digipen.edu/~gherron
Phone:	425-895-4418
Office Hours:	Monday-Thursday, 12:30-2:00

Course Description:

This course is intended to cover the contents of CS200 and CS250 in a single semester. It covers the algorithms and mathematical elements needed to generate and render 2D and 3D scenes. This includes the graphics pipeline, 2D and 3D coordinate systems and their transformations, homogeneous coordinates and perspective calculations, scan-conversion algorithms, basic collision detection techniques, and an introduction to OpenGL programming.

Course Objectives and Learning Outcomes:

Upon successful completion of this course, students will have implemented the full graphics pipeline, including 3D transformations, perspective, clipping, scan-conversion/Z-buffer, and basic texture mapping. In addition, they will have a comprehensive knowledge of the mathematics governing these processes.

Recommended Textbook:

Real-Time Rendering, third edition, Akenine-Möller, Haines, Hoffman, ISBN: 978-1-56881-424-7

Grading:

The course grade will be computed from 5 programming projects and a collection of (approximately 5-6) written assignments.

- 5 programming projects: 50%
  - Project 1: 3D transformations
  - Project 2: Polygon Clipping
  - Project 3: Scanline Z-buffer
  - Project 4: Texture Mapping
  - Project 5: Hierarchical Modeling
- Homework assignments: 50%

Late Policy:

Homework assignments are to be hand written or computer generated and printed, and handed in during class on the specified date. Projects are to be handed in via Moodle, and are due by midnight of the specified date. Late assignments will be assessed a 10% penalty per week up to a maximum of 30%, after which the the assignment will no longer be accepted.

Academic Integrity Policy:

Academic dishonesty in any form will not be tolerated in this course. Cheating, copying, plagiarizing, or any other form of academic dishonesty (including doing someone else's individual assignments) will result in, at the extreme minimum, a zero on the assignment in question, and could result in a failing grade in the course or even expulsion from DigiPen.

Disabled Student Services:

Students with physical, psychological, or learning disabilities that affect their ability to perform major life activities associated with this class may be eligible for reasonable accommodations under the Americans with Disabilities Act. If you have a documented disability please contact the Disability Support Services office to arrange for accommodations for this class.

Semester outline

with approximate timing in days

Overview of graphics pipeline (1 day)
- 3D coordinate systems: Model, World, Projection, Screen
- Modeling and viewing transformations
- Perspective and other projection transformations
- 3D clipping
- Window/Viewport transformations
- Scan conversions of points, lines, and polygons

Vectors in Computer Graphics (1 day)
- Vectors and operations (dot, cross, projections, angles)
- Plane and line equations
- 2D, 3D, and 4D(homogeneous) coordinate systems
- Vector*matrix and matrix*matrix operations

Pipeline -- 2D portion (2 days)
- Coordinate systems, world, viewing, and screen
- Window to viewport transformations

Pipeline -- 3D Transformations (4 days)
- 3D transformations for viewing
- Composition of transformations
- Perspective and parallel projections.

Clipping (3 days)
- Why homogeneous coordinates?
- Line clipping algorithms
- Polygon clipping algorithms

Scanline Z-buffer Algorithm (3 days)
- Basic polygon scan-conversion
- Edge and pixel coherence
- Z-buffer

Polygon object representations (2 days)
- Polygon meshes
- Polygon normals
- Plane equation computation

Pipeline -- Modeling portion (3 days)
- 3D modeling transformations
- Hierarchy of modeling coordinate systems

Quaternions
- Definition
- Basic operations
- Representing rotations

Bounding Volumes (4 days)
- Types: AABBs and OBBs, K-DOPs
- Representation
- Creation
- Intersection
- Transformation