CPE/CSC 471 – Introduction to Computer Graphics

1. CPE/CSC 471 – Introduction to Computer Graphics

2. credit units 4 contact hours 6

3. Course Coordinator: Zoë Wood

4. Textbook (or other required material):
   Peter Shirley, “Fundamentals of Computer Graphics”

5. a. Course Description:
   Graphics software development and use of application programming interfaces for 3D
   graphics. The graphics pipeline, modeling, geometric and viewing transforms, lighting and
   shading, rendering, interaction techniques and graphics hardware. 3 lectures, 1 laboratory.
   Crosslisted as CPE/CSC 471.

   b. Prerequisite: CPE/CSC 357.

   c. Required/Elective/Selective Elective for CPE, CSC, EE, SE
   
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6. a. Course Learning Objectives
   The student will be able to:
   • Describe the graphics pipeline (algorithms) and the basic implementation of the pipeline
     in modern hardware (and graphics libraries)
   • Describe and apply coordinate transforms and affine transformations and understand the
     application of such transforms using a vertex shader
   • Describe and apply basic geometric computations involving points, lines, planes and
     triangles related to spatial queries
   • Program basic data structures to represent a mesh (including applying transforms and
     necessary data for shading)
   • Describe and implement rasterization (algorithm, stage in the graphics pipeline, and
     relationship to fragment shaders)
   • Describe and implement basic hierarchical animation
   • Describe and compute local shading models (Blinn-Phong, etc.)
   • Describe and apply basic texture mapping
   • Identify the application of more advanced computer graphics (including rendering,
     animation, real time and visualization)
   • Translate mathematics (linear algebra and vector computations) into a higher level
     programming language
   • Use a major graphics toolkit/API to implement a program that builds an interactive 3D
     computer program
b. Level at which Student Outcomes are addressed
(“B” = Basic level, “I” = Intermediate level, “A” = Advanced level)

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7. Major Topics Covered: (number of lecture hours per)

- The graphics pipeline (4.5 hours): Geometry front end; Raster back end
  - Modeling objects (3 hours)
  - Points, lines, polygons, and planes
  - Smooth surfaces
  - Triangle meshes (indexed face sets)
  - Volumes
  - Curves
- Modeling transformations (4 hours)
  - Translation, rotation, and scale
  - Composition of transformations
  - Hierarchical modeling
- Illumination and Shading (5 hours)
  - Diffuse and specular reflectance (2 hours)
  - The Blinn-Phong lighting model (1 hour)
  - Geometry and normals (.5 hours)
  - Texturing (1 hour)
- Projection (1.5 hours): Perspective and parallel; The viewing transformation, & virtual camera
- Clipping to the screen (1.0 hours)
- Rasterization/Scan-conversion of primitives (2.0 hours): Barycentric Coordinates triangle rasterization
- Hidden-surface removal (1.0 hours): Z-buffering
- Perception: The human visual system (0.5 hours)
- The GPU (2.5 hours): General organization of the GPU, including programming the GPU via shaders
- Advanced topics (1 hour): animation, geometric modeling, advanced rendering