CMPSC 458
Fundamentals of Computer Graphics

Catalog Data:
Fundamentals of Computer Graphics (3)
Fundamentals of computer graphics: input/output devices, transformation, projection, clipping, hidden line/surface elimination. Prerequisite: CMPSC 311; MATH 220; MATH 230 or MATH 231.

Typical Textbook:

Course Objectives:
CMPSC 458 introduces the basic concepts of computer graphics and raster based methods. It also provides the necessary mathematical background for introductory computer graphics and demonstrates the application of computer science and matrix theory to graphics. It also offers an opportunity for students to formulate and implement applications of computer graphics. This course further allows students to develop programming skills in computer graphics by programming assignments. This course will also expose the students to current areas of research in Computer Graphics.

Primary Course Outcomes:
Upon completion of the course, students should possess the following skills:

• Given a description of a two or three dimensional transformation, students should be able to derive its matrix representation using homogeneous coordinates.
• Given a problem related to visualization, students should be able to choose the appropriate theoretical framework, and programming tools to solve the problem.

Relationship to Undergraduate Program Outcomes:
CMPSC 458 supports the following program outcomes:

• Be able to discuss major trends in industry and current research activities within the discipline.
• Demonstrate independent learning by using unfamiliar computer systems, test equipment, and software tools to solve technical problems.
• Develop a modest (on the order of a thousand lines of code) software application, using appropriate data structures and algorithms.

Required Topics:
• Introduction to computer graphics. Background math requirements overview. (~2.5 hrs)
• Two and three dimensional transformations. Homogeneous coordinates systems.
• Barycentric coordinates. (~3 hrs)
• Viewing. Orthographic and perspective projections. (~1.5 hrs)
• Curves and surfaces. Implicit, explicit and parametric forms. Normals and gradients. Splines.
• Physical interpretation for splines. (~2.5 hrs)
• Shading Models. Gouraud and Phong shading models. (~1.5 hrs)
• Hidden surface elimination. Painter’s algorithm. Z-Buffer. (~1.5 hrs)
• Lighting, Color and Human Vision Perception. (~1.5 hrs)
• Sampling, antialiasing and global illumination models (~3 hrs)
• Texture synthesis, analysis and manipulation. (~2.0 hrs)
• Image-based Rendering (IBR). Non-Photorealistic-Rendering. Mosaicing (~ 3 hrs)
• Animation. Quaternions (~2.0 hrs)

Class Format:
Two lectures per week. Each lecture is 75 minutes.
Professional Component: CMPSC 458 is designed to aid in the professional development of engineers and scientists by developing skills in the area of computer graphics. Students will develop hands-on experience by completing several non-trivial software systems using current techniques. Students will also be exposed to current areas of research in computer graphics.

Evaluation: 20 – 30% proctored assessments (exams)
40 – 60% unproctored programming assessments.
20 – 30% unproctored written assessments

Suggested breakdown based on 100 pts as follows:
10 Midterm
15 Final
50 Programming projects
25 Written homework

Programming Assignments: Tentative Schedule

<table>
<thead>
<tr>
<th>Goals</th>
<th>Assigned</th>
<th>Due</th>
<th>Worth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to OpenGL</td>
<td>L4</td>
<td>L7</td>
<td>10</td>
</tr>
<tr>
<td>Complex animation using OpenGL</td>
<td>L7</td>
<td>L13</td>
<td>15</td>
</tr>
<tr>
<td>Distribution Ray Tracing</td>
<td>L17</td>
<td>L23</td>
<td>30</td>
</tr>
<tr>
<td>Texture Synthesis</td>
<td>L23</td>
<td>L29</td>
<td>35</td>
</tr>
</tbody>
</table>

Author: Yanxi Liu, Roberto Lubliner
Last Revised: January 31, 2008