CNG 477 Introduction to Computer Graphics
Computer Engineering
METU-NCC
Spring 2013-2014
Syllabus

Instructor:
Assoc. Prof. Dr. Tolga CAN - tcan@ceng.metu.edu.tr - Office: TBA
Office Hours: Friday 12:30-13:30 and Friday 16:30-17:30

Time and Place:
Fridays 13:40-16:30, T-111

Course Description:
Hardware and software components of graphics systems. Output and filled data primitives. 2D and 3D geometric transformations. Two dimensional viewing: viewing pipeline, clipping, and windowing. Three dimensional viewing: viewing pipeline, viewing parameters, projections, viewing transformations, clipping, visible surface detection. Introduction to illumination models and surface rendering.

Course Objectives:
CNG 477 Introduction to Computer Graphics introduces the basic concepts of computer graphics and raster based methods. It also provides the necessary theoretical background for introductory computer graphics and demonstrates the application of computer science 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.

Prerequisites:
No formal prerequisites. However, C/C++ programming, basic linear algebra and analytic geometry knowledge are required.

Text book:

Reference Books:
Grading:
- Programming Assignments: 30% (10% each)
- Midterm: 30%
- Final: 40%

Programming Assignment Policies:
- Each programming assignment can be submitted up to 3 days late. Each late day incurs a penalty of 10 points.
- Programming assignment will not be postponed.

Cheating Policy:
- No teamwork is allowed in assignments. Cheaters will be punished according to university regulations.

Course Outline:

Week 1
Introduction (goals) – 1 hr
Images, displays, and human vision – 2 hrs
  - Image properties
  - File formats and encodings
  - Color spaces
  - Gamma and gamma correction
  - Luminance
  - Human visual system

Week 2 – 3
Ray tracing – 6 hrs (HW1 assigned at the end of third week: duration 2 weeks)
  - Camera/image plane properties
  - Ray equations
  - Ray sphere/triangle intersections (barycentric coordinates)
  - Surface shading (diffuse, specular, ambient)
  - Shadows
  - Recursive ray tracing (reflective materials)

Week 4
Forward pipeline overview - 1 hr
Transformations – 2 hrs
  - Translation (homogeneous coordinates)
  - Scaling
  - Rotation (all in 3D)

Week 5
Viewing – 3 hrs
  - External camera transformations (duality with model transformations)
  - Orthographic projection
  - Perspective projection
- Viewport transformation

**Week 6**
Clipping, culling – 3 hrs
- Line clipping (in 3D)
- Polygon clipping (in 3D)
- Backface culling
- Frustum culling

**Week 7**
Rasterization – 3 hrs
- Line rasterization
- Triangle rasterization
- Interpolation of vertex attributes

**Week 8**
Shading (Flat, Gouraud, Phong) – 1 hr (HW2 assigned at the end of eighth week: duration 2 weeks)
Texture mapping – 2 hr
- Texture mapping a sphere (to show the idea of parametrizing a 3D surface with 2 parameters)
- Texture mapping a triangle (using barycentric coordinates)
- Nearest neighbor, bi-linear interpolation
- Mipmapping

**Week 9**
Hidden surface removal – 1 hr
- Z-buffer
Curves and surfaces – 2 hrs
- Cubic polynomials
- Hermite curves

**Week 10**
Curves and surfaces – 1 hr
- Bezier curves
- Continuity
- Splines
- Hermite, Bezier surfaces
Model representations (mesh, hierarchical representations) – 2 hr

**Week 11-12-13**
Shaders (vertex and pixel shaders) – 3 hr (HW3 assigned at the end of the twelfth week: duration 2 weeks)
Vertex arrays, buffers, indexed rendering

**Week 14**
Graphics in the real world
- Blender
- Unity