CS405/805-001, Fall 2020
Computer Graphics

Instructor: Xue Dong Yang
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Lecture hours: Monday, Wednesday, and Friday, 14:30 – 15:20
Other time by appointment

Textbook: Selected Journal and Conference Papers, and lecture Notes

Note: This class is a cross-listed class. Part I and II are same for both CS405 and CS805 students. Part III is for CS805 students only.

Grading Scheme for CS405

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<tr>
<th>Assignment</th>
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<td>Assignments</td>
<td>3 X 10% = 30%</td>
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<tr>
<td>Midterm</td>
<td>40%</td>
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<tr>
<td>Project</td>
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TOTAL 100%
Instructor’s discretion +/- 5%

Grading Scheme for CS805

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<th>Assignment</th>
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<td>Presentation</td>
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TOTAL 100%
Instructor’s discretion +/- 5%
Course Outline:

Part I: Lecture Contents

- **Overview of the Three Generations of Rendering Techniques:**
  - First Generation (60’s-70’s): Polygon scan-converting
  - Second Generation (80’s -): Ray-tracing
  - Third Generation (90’s -): Global Illumination

- **3D viewing transformations:**
  - Overview of coordinate systems in 3D computer graphics
  - Homogeneous coordinates
  - Basic transformation matrices
  - 3D viewing transformation matrix: method I
  - 3D viewing transformation matrix: method II
  - Other transformation matrixes
  - Assignment 1: construction of transformation matrices

- **Ray-Tracing:**
  - Basic illumination models
  - Ray construction
  - Intersection between ray and elementary geometric shapes
  - Overview of acceleration techniques for ray-tracing
  - Assignment 2: Implementation of the basic ray-tracing algorithm

- **Volume Rendering**
  - Shading principle for 3D density field
  - Sampling and interpolation of discrete 3D density data
  - Integration of semi-transparent values along a ray
  - Volume rendering algorithm for discrete 3D density data (CT, MRI, etc)
  - Assignment 3: Implementation of the basic volume rendering algorithm

- **Advanced modeling techniques for complex phenomenon**
  - Particle systems (e.g. water, smoke, etc.)
  - Hypertexture

- **Midterm Exam.**
Part II: Term Project (Both CS405 and CS805)

- Each student is required to do a programming type project.
- Two sample projects will be provided which are extensions of Assignments 2 or 3 respectively.
- Students are encouraged to do a project related to their own thesis research topics.
- There will be a minimum requirement for the scope and technical depth of the project.
- A theoretical type project may be considered upon approval.

Part III: Student Presentation (CS805 Only)

- Each student will give one presentation on a related topic based on one or more journal/conference paper(s).
- A list of papers will be provided. In addition, student may suggest papers outside the list.
- Topic for each student must be pre-approved sufficiently ahead of the presentation.
- To make the marking more uniform and less subjective, a suggested structure, format and marking criteria for presentation will be provided.