Course Description

Catalog:
Study computer visualization principles, techniques and tools used for explaining and understanding information; includes visualization algorithms, techniques, and applications

Objectives:
Study visualization principles and algorithms to explore, transform and view data/information as computer graphs or images to gain understanding and insight into the data/information

Understand/develop/apply a wide range of visualization methods (tools) to visualize a variety of datasets (from medical, to geological, to biological, to financial from simulations, experiments and other sources).
Course Materials: Books

  www.opengl.org

- OpenGL A Primer, 3rd Edition by E. Angel, 2005


- Computer Visualization: Graphics techniques for Scientific and Engineering Analysis by R. S. Gallagher, 1994

- The Visualization Toolkit: An object-oriented approach to 3D graphics by W. Schroeder et al., 1997

- Information Visualization by R. Spence, 2001
Course Materials (Contd.)

• Lecture notes
  – Posted on
    moodle.lsu.edu
    www.csc.lsu.edu/~karki

• Research papers
  – Distributed/referred during class
  – Student presentation

• Web sources
  – Referenced in lecture notes
Prerequisite

- CSC 7300 or equivalent
- Consent of instructor
  - Computer graphics
  - Programming in C/C++
  - Algebra, Calculus
Grading Policy

• Grading Items:
  – Homework assignment: 20 %
  – Paper presentation: 10 %
  – Project/programming: 15 %
  – Midterm exam (option of makeup exam): 25 %
  – Final exam: 30 %

• Grading Scale:
  – A = 90 % or more
  – B = 78 % to 89 %
  – C = 65 % to 77 %
  – D = 50 % to 64 %
  – F = below 50 %
Rules/Regulations

• Class attendance is highly encouraged.

• Late submissions of homework/programming assignments will be penalized.

• Academic dishonesty will be treated seriously.
  – Need to work independently.
Contact Information and Office Hours

• Office
  – 283 Coates Hall, Department of Computer Science
• Email
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• Phone
  – 578-3197

• Regular office hours
  – 1 pm to 3 pm (Monday and Wednesday)
• Special office hours
  – Any time by appointment
Course Outline: Major Topics

- General introduction
- Computer graphics for visualization
- Scientific visualization
- Information visualization
- Virtual reality
General Introduction

- Definition and concept of visualization
- Visualization types and applications
- Visualization issues
- Available programs and APIs
Computer Graphics for Visualization

- OpenGL
- Drawing geometric objects
- Viewing
- Color
- Lighting
- Special topics
Scientific Visualization

• Isosurface rendering
• Volume rendering
• Vector and tensor visualization
• Software- and hardware-based approaches
• Large-scale data visualization
• Case studies
Information Visualization

- Internal models
- Data representation
- Interaction and exploration
- Presentation
- Connectivity
Virtual Reality

- CAVE, ImmersaDesk, CAVE library

- Virtual reality modeling language (VRML)

- Learning about Louisiana Immersive Technologies Enterprise (LITE)
Sample Questions: Set 1

Answer “True” or “False” to the following statements:

• The OpenGL’s color state remains unaffected by a `glColor()` call within a display list.

• A vertex shader program allows the user to manipulate the processing of fragments.

• In the splatting algorithm, the weight of the contribution of each data sample to each pixel is determined by the value of the footprint function.

• When a non-regular grid is mapped to a regular grid, rays cast from the image plane remain as straight lines in the computational space.

• Bifocal display is one case of focus+context approach.
Short-answer questions:

• How does OpenGL support hidden-surface removal? State it’s two advantages.

• Give four specific examples of datasets, state their data types and give one visualization technique for each dataset.

• How do you determine the nature of the critical points in a vector field? Elaborate your answer with different cases.

• Describe the basics steps in the operation of the shear-warp factorization-based volume rendering. Is this algorithm suitable for parallel implementation? Justify your answer.

• What is Star Coordinates plot? Display the two six-dimensional data of A(2,3,5,1,4,6) and B(6,4,3,6,8,0) using this plot.
Set 3

Questions-based on papers presented by students in the class:

- How does the curvature-based transfer function differ from the conventional transfer function in terms of definition and usefulness?

- Describe two types of ambiguities you can find in the Marching Cubes’ based isosurface extraction with examples. How can you avoid the ambiguity?

- What is the major approximation that the near-phong quality quadratic shading makes to speed up shading?

- What is the microarray data? In the directed graph representation of the data, what do the nodes and arrows represent?

- What is the problem with parallel coordinates for large-scale multivariate data? How do you overcome it?
Set 4

- Solve the following ray-casting problem.

The scalar values at eight vertices of the voxel of unit length (a=1) are
f1=5.0, f2=5.1, f3=5.2, f4=4.6
f5=4.9, f6=5.1, f7=5.3, f8=4.7

The ray is sampled at three points
P1(0.2,0.3,0.8), P2(0.5,0.5,0.5), P3(0.8,0.7,0.2)

Color and opacity of the cast ray before it hits P1 is (0,0,0,0)

Using the given transfer function, compute the color of the ray after it leaves P3 by compositing from back-to-front order.