CPS 533 Scientific Visualization

Fall 2008

TR: 5:30 – 7:00 pm (Edward 107)

Instructor: Wensheng Shen
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Office hour: TR 1:00 (pm) – 3:00 (pm) or by appointment

Prerequisite: knowledge of linear algebra and experience in computer programming

Textbook: The Visualization Toolkit, 4th edition
Authors: Will Schroeder, Ken Martin, and Bill Lorensen
Pulisher: Kitware
ISBN: 1-930934-19-X

References: (1) The Visualization Handbook (available on line)
Editors: Charles Hansen and Chris Johnson
Pulisher: Elsevier

(2) VTK Users Guide
Pulisher: Kitware (http://www.kitware.com/products/vtktextbook.html)

Description: Scientific visualization refers to the process of presenting various data in the form of computer graphics and interpreting the information represented by the data. This course introduces many important topics in scientific visualization, the concepts of visualization and human vision system, the hardware and software basics of computer graphics, visualization pipeline, data representation in computer graphics, algorithms in rendering 2D and 3D geometry, image processing, as well as applications of visualization in science and technology. In particular, a computer software library, *Visualization Toolkit (VTK)* is discussed and used as a tool to perform the task of visualization by object-oriented programming in C++ or Tcl/tk.

Objectives: This course presents principles, algorithms, methods, and programming techniques for visualizing datasets that come from measurements and computations in science, engineering, economy, and business. Outcomes of a successful completion of this course include: to understand computer graphics as basic for visualization, to know the procedures in visualization, to present multidimensional (2D and 3D) dataset in

computer graphics, to understand and apply algorithms in surface and volume rendering, to visualize a dataset being given, to extract useful information from a dataset, to apply visualization techniques in medical image, and to build specific applications with C++ and Tcl/tk.

Topics: The topics in this course include computer graphics (camera, lights, geometric primitives, color theory, texture mapping, volume rendering), data representation (data structure, cells, data attributes, coordinate transformation, interpolation function, derivative calculation, geometric operation), visualization algorithms (scalar generation, color mapping, vector field display, triangle strip generation, polygon decimation, feature extraction, implicit modeling), image processing, and object-oriented programming by VTK.

Grading: Homework assignments (50%)
Projects (30%)
Midterm (10%)
Final exam (10%)

Average	100 – 90.0	87.0 – 89.9	83.0 – 86.9	80.0 – 82.9	77.0 – 79.9	73.0 – 76.9
Grade	A	A-	B+	B	B-	C+
Average	70.0 – 72.9	67.0 – 69.9	63.0 – 66.9	60.0 – 62.9	57.0 – 59.9	<57.0
Grade	C	C-	D+	D	D-	E

Note: extra credits may be given in home and project assignments as well as tests. Final exam may be replaced by a project.

Assignment policy: Homework assignments given in class will be due in two weeks and project assignments given in class will be due in four weeks after they are assigned. Late assignments can be accepted with a penalty at a rate of 10% per day. ***No makeup tests and no incompletes. A missed test will receive 0 points.*** Exceptions to these rules, at instructor's discretion, apply to cases of illness, personal tragedy, or extraordinary circumstances beyond a student's control, if it is documented to instructor's satisfaction. Arrangement for such an exception needs to be discussed with the instructor.

Attendance: Students are expected to attend all classes. Some of the material may not be contained in the textbook. If a student misses a class, it is his/her responsibility to get class notes and handouts. Absences will be excused for documented illness, official representation of the College, an unfortunate death of a close relative, religious holiday, and other circumstances beyond student's control.

Authorship: Students are allowed to discuss ideas and help others by explaining concepts and possible solutions. All the work that is submitted, however, must be performed by individual students independently. Students must provide appropriate citations for any text fragments in books, journals,

conference proceedings, web-based resources, etc. that have been used in their assignments. Students also need to acknowledge any help from others. A student is considered cheating if he/she submits materials as his/her own work that is not entirely his/her own work, or if he/she intentionally provides an answer to another person. If cheating has been detected, the student will receive a zero grade for that assignment. Further disciplinary procedures may also be considered.

Policies: Students with documented disabilities may be entitled to specific accommodations. SUNY Brockport's Office for Students with Disabilities makes this determination. Please contact the Office for Students with Disabilities at 395-5409 to inquire about obtaining an official letter to the course instructor detailing approved accommodations. The student is responsible for providing the course instructor with the official letter. Faculty and staff work as a team with the Office for Students with Disabilities to meet the needs of students with disabilities

Weekly Schedule

Week 1	Aug. 26	Class begin, syllabus, Chapter 1: introduction
	Aug. 28	Chapter 2: Object-Oriented Program in C++
Week 2	Sept. 2	Chapter 2: Object-Oriented Program in C++
	Sept. 4	Chapter 3: Computer Graphics Primer
Week 3	Sept. 9	Chapter 3: Computer Graphics Primer
	Sept. 11	Computer lab --- chapter 3
Week 4	Sept. 16	Chapter 3: Computer Graphics Primer
	Sept. 18	Chapter 4: The Visualization Pipeline
Week 5	Sept. 23	Chapter 4: The Visualization Pipeline
	Sept. 25	Computer lab --- chapter 4
Week 6	Sept. 30	Chapter 5: Basic Data Representation
	Oct. 2	Chapter 5: Basic Data Representation
Week 7	Oct. 7	Chapter 6: Fundamental Algorithms
	Oct. 9	**Midterm exam**
Week 8	Oct. 14	Fall break
	Oct. 16	Computer lab --- chapter 5
Week 9	Oct. 21	Chapter 6: Fundamental Algorithms
	Oct. 23	Chapter 6: Fundamental Algorithms
Week 10	Oct. 28	Chapter 7: Advanced Computer Graphics
	Oct. 30	Computer lab: Chapters 5 & 6
Week 11	Nov. 4	Chapter 7: Advanced Computer Graphics
	Nov. 6	Chapter 7: Advanced Computer Graphics
Week 12	Nov. 11	Chapter 8: Advanced Data Representation
	Nov. 13	Computer lab: Chapters 7 & 8
Week 13	Nov. 18	Chapter 8: Advanced Data Representation
	Nov. 21	Chapter 9: Advanced Algorithms
Week 14	Nov. 25	Chapter 9: Advanced Algorithms
	Nov. 26 -28	Thanksgiving break
Week 15	Dec. 2	Chapter 10: Image Processing
	Dec. 5	Computer lab: Chapters 9 & 10