CSE 5544 (Approved): Introduction to Scientific Visualization

Course Description

Principles and methods for visualizing data from measurements and calculations in physical and life sciences, and transactional and social disciplines; information visualization; scientific visualization.

Prior Course Number: CSE 694L
Transcript Abbreviation: Intr Sci Vis
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Undergrad, Graduate
Student Ranks: Senior, Masters, Doctoral
Course Offerings: Spring
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 3.0 hr Lec
Expected out-of-class hours per week: 6.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: (CSE 5361 or CSE 541) or (CSE 5541 or CSE 581)
Exclusions: Not open to students with credit for CSE 694L
Cross-Listings:

The course is required for this unit's degrees, majors, and/or minors: No
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.0901
Subsidy Level: Doctoral Course

Programs

Abbreviation	Description
BS CSE	BS Computer Science and Engineering
MS CSE	MS Computer Science and Engineering
PhD CSE	PhD Computer Science and Engineering

Course Goals

Be competent with design principles of creating viable visualizations
Be competent with visualization algorithms and data structures
Be competent with creation of interactive visualizations
Be competent with the collection and processing of diverse collections of data
Be competent with including perceptual considerations into visualization systems
Be familiar with with practical applications of visualization

Be familiar with visualization needs of domains from science, medicine, and commerce
Be familiar with the critiques of visualization systems
Be familiar with gaining insights into visualization problems and phenomenon

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Introduction and historical remarks	1.0							
Abstract visualization concepts and the visualization pipeline	1.0							
Data acquisition and representation	2.0							
Principles of visual design	2.0							
Basic mapping concepts	1.0							
Focus+context, and navigation+zoom	1.0							
Perception and color theory	4.0							
Case study: trends application	1.0							
Visualization of matrices, graphs and trees	3.0							
Visualization of high-dimensional data and dimensionality reduction techniques	5.0							
Case study: bioinformatics	3.0							
Visualization of scalar fields (color maps, isosurface extraction, volume rendering)	3.0							
Case study: medical and biological imaging	3.0							
Visualization of vector fields (particle tracing, texture-based methods, vector field topology)	3.0							
Case study: flow visualizations	1.0							
Evaluation and Interaction models	2.0							
Visualization of Large data	1.0							
Visualization of spatio-temporal data	2.0							
Final Presentations	1.0							

Representative Assignments

Familiarity with visualization software
Interactive visualization of trend data
Interactive visualization of gene expression data
Scalar visualization of medical images and volumetric data
Vector visualization of flow data

Grades

Aspect	Percent
Laboratory assignments	40%
Midterm exam	20%
Final exam and/or projects	30%
Class participation	10%

Representative Textbooks and Other Course Materials

Title	Author
Visual Thinking for Design	Colin Ware
Visualizing Data	Ben Fry

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
**	a	An ability to apply knowledge of mathematics, science, and engineering.
***	b	An ability to design and conduct experiments, as well as to analyze and interpret data.
**	c	An ability to design a system, component, or process to meet desired needs.
**	d	An ability to function on multi-disciplinary teams.
*	e	An ability to identify, formulate, and solve engineering problems.
*	f	An understanding of professional and ethical responsibility.
***	g	An ability to communicate effectively.
*	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
**	i	A recognition of the need for, and an ability to engage in life-long learning.
**	j	A knowledge of contemporary issues.
**	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

BS CSE Program Outcomes

Course Contribution		Program Outcome
**	a	an ability to apply knowledge of computing, mathematics including discrete mathematics as well as probability and statistics, science, and engineering;
**	b	an ability to design and conduct experiments, as well as to analyze and interpret data;
*	c	an ability to design, implement, and evaluate a software or a software/hardware system, component, or process to meet desired needs within realistic constraints such as memory, runtime efficiency, as well as appropriate constraints related to economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability considerations;
**	d	an ability to function on multi-disciplinary teams;
**	e	an ability to identify, formulate, and solve engineering problems;
*	f	an understanding of professional, ethical, legal, security and social issues and responsibilities;
**	g	an ability to communicate effectively with a range of audiences;
*	h	an ability to analyze the local and global impact of computing on individuals, organizations, and society;
*	i	a recognition of the need for, and an ability to engage in life-long learning and continuing professional development;
*	j	a knowledge of contemporary issues;
**	k	an ability to use the techniques, skills, and modern engineering tools necessary for practice as a CSE professional;
*	l	an ability to analyze a problem, and identify and define the computing requirements appropriate to its solution;
**	m	an ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices;
**	n	an ability to apply design and development principles in the construction of software systems of varying complexity.

Prepared by: Bruce Weide