Computer Science Department
cs.salemstate.edu

CSC 246 Information Visualization **4 cr. DII Q**

Instructor: TBA **Office:** location **Phone:** (978) 542-extension
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Section	Time	Room	Final Exam
nn	days and times	location	date and time
Lnn	days and times	location	

Catalog description:

This course presents the basic science and techniques behind information visualization, introducing fundamental concepts concerning the use of color, image processing, computer graphics, and scientific visualization. The course describes the principles of visual perception, information data types, and visual encoding of data representations, and then focuses on the study, design, and development of visualization techniques for the analysis, comprehension, explanation, exploration, and manipulation of large collections of datasets. The latest visual representation methodologies and state-of-the-art visualization tools including programming language(s) and visualization libraries and toolkits will be applied in the course to help understand the subject and to design and generate visual interpretation of large amounts of complex data collected from diverse areas such as physics, chemistry, biomedical studies, meteorology, geospatial research, business, etc. Students will form teams to participate in group projects that emphasize interdisciplinary interaction and cooperation, in order to analyze and solve real world quantitative problems. Four lecture hours per week, plus additional project time outside of class.

Prerequisites: One Mathematics course chosen from MAT 108, MAT 110, MAT 120, and MAT 208 and above; plus CSC 110 or CSC 201J, or equivalent programming experience and permission of Department Chairperson.

Goals:

The purpose of this course is to introduce basic concepts of scientific visualization and to apply the latest visualization techniques in the real world problems encountered in science, engineering, and business. The goals of this course are:

CG01: to develop an appreciation for the latest development of information visualization;
CG02: to understand the concepts of analyzing, manipulating, and presenting complex data in an intuitive form;
CG03: to understand the visualization techniques of producing insightful visual contents;
CG04: to give students experience in collecting, analyzing, processing, interpreting, and presenting data;
CG05: to give students experience in applying visualization techniques and tools in real world quantitative problems.

Objectives:

Upon successful completion of the course, a student will have:

CO01: demonstrated basic knowledge of human visual perception, cognitive issues, and color vision;
CO02: demonstrated basic knowledge of computer graphics and image processing;
CO03: described characteristics of datasets and experienced with real data in a broad view of the rich world of information visualization;
CO04: demonstrated knowledge of and skills in collecting, analyzing, interpreting, and presenting data;
CO05: compared information visualization to scientific visualization;
CO06: described visualization methodologies and techniques used in the manipulation of complex data, i.e., in color encoding, encoding of values and relations, trees and networks, maps, higher-dimensional data, etc.
CO07: demonstrated basic knowledge of volume rendering and scalar, vector tensor visualizations;
CO08: applied visualization principles and techniques in projects (using visualization tools/API/library and/or one programming language) which are related with at least two different areas, for example, biomedical studies, geosciences, physics, chemistry, meteorology, business, … and etc.

Program Objective vs. Course Objective matrix

Program Objective (condensed form)	CO01	CO02	CO03	CO04	CO05	CO06	CO07	CO08
PO-A: apply knowledge of computing and math		✓	✓	✓	✓	✓	✓	✓
PO-B: analyze a problem and define its computing requirements			✓	✓	✓	✓	✓	✓
PO-C: design, implement and evaluate applications						✓	✓	
PO-D: function effectively in teams to accomplish a common goal			✓					✓
PO-E: professional, ethical, and social responsibilities				✓				✓
PO-F: communicate effectively with a range of audiences			✓					✓
PO-G: local and global impact of computing on people and society						✓	✓	✓
PO-H: need for continuing professional development	✓			✓	✓	✓	✓	✓
PO-I: use current techniques, skills, and tools		✓	✓	✓	✓	✓	✓	✓
PO-J: apply theory and principles to model and design systems						✓	✓	✓
PO-K: apply design and development principles in constructing software			✓			✓	✓	✓

Topics:

- Introduction **GV1(2), GV2(2), GV3(1.5), GV4(1), GV5(2), GV7(1.5)**
  - human visual perception
  - cognitive principles
  - color theory
  - data and image models
  - computer graphics
    - coordinate system
    - geometric modeling
    - transformations
    - projection
    - rasterization
    - visibility
    - shading and materials
- Data representation **GV9(3)**
  - dataset
  - data structures and types
  - data attributes
- Scientific visualization **GV9(5), GV11(1.5)**
  - visualization pipeline
    - data acquisition and
    - filtering
    - mapping
    - rendering
  - scalar field visualization
    - color mapping
    - contouring
    - isosurfaces
    - volumetric illumination

- vector field visualization
  - hedgehogs and glyphs
  - streamlines, streaklines, parthlines (particle traces), and time lines
- image processing and visualization
- volume rendering

- Information visualization **GV9(10)**
  - color visualization
  - encoding values
  - encoding relations
  - graphs, glyphs, charts
  - trees and networks
  - higher-dimensional data
  - representation
  - presentation
  - interaction
  - information visualization vs. scientific visualization
- Applications **GV9(6), GV11(3)**
  - visualization libraries, APIs and toolkits
  - geospatial visualization
  - biomedical visualization
  - business visualization
  - social visualization
  - visualization in the areas of arts, science, engineering such as physics, chemistry, astronomy, meteorology, archaeology, seismology, oceanography, computational fluid dynamics, and/or materials research.
  - visualization on the web

Assignments: Four to seven homework assignments will be given to help understand visualization topics and their related concepts. Four to six projects will be given to reinforce the concepts and techniques covered in the class. Paper reading and presentation are also a part of the course work.

Quizzes, Tests and Examinations: there will be two examinations: a midterm exam administered in the middle of the semester and a comprehensive final exam administered during the final exam period.

Grading: The course grade will be determined using the following approximate weights: homework, 30%; projects, 35%; paper reading and presentation, 5%; midterm and final exams, 30%. There will penalties for late submissions of homework and programming assignments.

Assessment Mechanism / Course Objective matrix

	Exam Questions	Homework Problems	Projects	Papers
CO01	✓	✓		✓
CO02	✓	✓	✓	
CO03	✓	✓		
CO04	✓	✓	✓	
CO05	✓	✓		
CO06	✓	✓	✓	
CO07	✓	✓	✓	
CO08	✓	✓	✓	✓

Bibliography:

Main texts:

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Academic Integrity Statement:

"Salem State University assumes that all students come to the University with serious educational intent and expects them to be mature, responsible individuals who will exhibit high standards of honesty and personal conduct in their academic life. All forms of academic dishonesty are considered to be serious offences against the University community. The University will apply sanctions when student conduct interferes with the University primary responsibility of ensuring its educational objectives." Consult the University catalog for further details on Academic Integrity Regulations and, in particular, the University definition of academic dishonesty.

The Academic Integrity Policy and Regulations can be found in the University Catalog and on the University website (http://catalog.salemstate.edu/content.php?catoid=13&navoid=1295#Academic_Integrity). The formal regulations are extensive and detailed - familiarize yourself with them if you have not previously done so. A concise summary of and direct quote from the regulations: "Materials (written or otherwise) submitted to fulfill academic requirements must represent a student's own efforts". *Submission of other's work as one's own without proper attribution is in direct violation of the University's Policy* and will be dealt with according to the University's formal Procedures. *Copying without attribution is considered cheating in an academic environment - simply put,* ***do not do it!***

University-Declared Critical Emergency Statement:

In the event of a university-declared emergency, Salem State University reserves the right to alter this course plan. Students should refer to www.salemstate.edu for further information and updates. The course attendance policy stays in effect until there is a university-declared critical emergency.

In the event of an emergency, please refer to the alternative educational plans for this course, which will be distributed via standing class communication protocols. Students should review the plans and act accordingly. Any required material that may be necessary will have been previously distributed to students electronically or will be made available as needed via email and/or Internet access.

Equal Access Statement:

"Salem State University is committed to providing equal access to the educational experience for all students in compliance with Section 504 of The Rehabilitation Act and The Americans with Disabilities Act and to providing all reasonable academic accommodations, aids and adjustments. **Any student who has a documented disability requiring an accommodation, aid or adjustment should speak with the instructor immediately.** Students with Disabilities who have not previously done so should provide documentation to and schedule an appointment with the Office for Students with Disabilities and obtain appropriate services."

Note: This syllabus represents the intended structure of the course for the semester. If changes are necessary, students will be notified in writing and via email.