CS 6260 : VISUALIZATION

Semester Hours: 3.0  Contact Hours: 3
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Text: VISUALIZATION ANALYSIS AND DESIGN
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SPECIFIC COURSE INFORMATION

Catalog Description:
The course discusses the principles, methods, and techniques for effective visual analysis of data. Many aspects of visualization, including techniques for both spatial and non-spatial data, are explored. The course topics include an overview of principles from perception and design, a framework for discussing, critiquing, and analyzing visualization, and visualization techniques and methods for a broad range of data types. Hands-on visualization experience using visualization systems and tools are included. Analytic tasks are also performed on the visualization literature. Prerequisites: Admission to MS in CS program, admission to MS/PhD in DS program, or permission of instructor. Credit cannot be earned for both DATA 6260 and CS 6260.

Course type: ELECTIVE

SPECIFIC COURSE GOALS

- I am able to explain the basic principles in visualization design.
- I am able to use visualization methods for both spatial and non-spatial data.
- I am able to analyze the visualization design choices for different problems.
- I am able to apply data item and attribute reductions for visualization.
- I am able to utilize popularly used visualization systems and tools.

LIST OF TOPICS COVERED

- Introduction to Visualization (~5%)
  - Overview and value of visualization
  - The big picture
- Data Abstraction and Task Abstraction (~10%)
- Data types, attribute types, semantics
- Analyzing tasks abstractly, actions (analyze, produce, search, query)

- Analysis and Mark & Channels (~10%)
  - Levels of design, validations
  - Expressiveness and effectiveness, effectiveness

- Rules of Thumb in Visualization (~15%)
  - Justifying 3D, 2D
  - Memory and attention, animation and side-by-side views
  - Resolution, responsiveness

- Tables, Networks and Trees (~10%)
  - Keys and values, categorical regions
  - Spatial axis orientation, spatial layout density
  - Matrix, link marks, hierarchy marks

- Spatial Data (~10%)
  - Geographic data, scalar fields, vector fields, tensor fields

- Map Color and Other Channels (~5%)
  - Color theory, colormaps, channels

- Views (~10%)
  - Manipulating views (selecting elements, changing viewpoint, reducing attributes)
  - Juxtapose and coordinate views
  - Partition, layers

- Reduce Items and Attributes (~10%)
  - Filtering, aggregate

- Visualization Tools/Libraries (~15%)
  - E.g., Tableau, D3, Qt, Python, Processing (sketchbook SW), Volume rendering library, controP5 library, etc.

EXAMPLE PROJECTS

- **Data Exploration and Analysis via Visualization Tool**
  - Use a visualization tool to help users visually explore complex data and confirm hypothesis about the data.
Formulate and answer a series of specific questions about a specific data, and then, create a final visualization that is designed to communicate the findings about the data.

**Exploring Time Series Data**
- Time series data are used very often these days, e.g., in medicine, finance, history, climatology, etc.
- Implement/develop an interactive viewer for looking at time series that explores several different visual representations.

**Exploring Multidimensional Data**
- Multidimensional data exploration is a challenging task in visualization.
- Implement the Parallel Coordinates (widely used visual representation) with the support of the following interactivities: filtering the data across multiple attributes, reordering the axes, inverting the axes.
- Aggregate multidimensional data into clusters of similar data points.

**Transfer Function Design**
- Implement a volume renderer for 3D volume dataset.
- Design transfer functions for specific volume dataset with your own control panel widget.

**RECOMMENDED REFERENCES**

- Information Visualization: Perception for Design, 3rd ed., by Colin Ware, Morgan Kaufmann.
- Visual Thinking for Design, 1st ed., by Colin Ware, Morgan Kaufmann.
- Visualizing Data: Exploring and Explaining Data with the Processing Environment, 1st ed., by Ben Fry, O’Reilly Media.