CS 6260 : VISUALIZATION

Semester Hours:	3.0	*Contact Hours:* 3
Coordinator:	Jong Kwan "Jake" Lee	
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%)

    o Overview and value of visualization

    o The big picture

- Data Abstraction and Task Abstraction (~10%)

- o Data types, attribute types, semantics
- o Analyzing tasks abstractly, actions (analyze, produce, search, query)
- Analysis and Mark & Channels (~10%)
  - o Levels of design, validations
  - o Expressiveness and effectiveness, effectiveness
- Rules of Thumb in Visualization (~15%)
  - o Justifying 3D, 2D
  - o Memory and attention, animation and side-by-side views
  - o Resolution, responsiveness
- Tables, Networks and Trees (~10%)
  - o Keys and values, categorical regions
  - o Spatial axis orientation, spatial layout density
  - o Matrix, link marks, hierarchy marks
- Spatial Data (~10%)
  - o Geographic data, scalar fields, vector fields, tensor fields
- Map Color and Other Channels (~5%)
  - o Color theory, colormaps, channels
- Views (~10%)
  - o Manipulating views (selecting elements, changing viewpoint, reducing attributes)
  - o Juxtapose and coordinate views
  - o Partition, layers
- Reduce Items and Attributes (~10%)
  - o Filtering, aggregate
- Visualization Tools/Libraries (~15%)
  - o E.g., Tableau, D3, Qt, Python, Processing (sketchbook SW), Volume rendering library, controP5 library, etc.

EXAMPLE PROJECTS

- **Data Exploration and Analysis via Visualization Tool**
  - o Use a visualization tool to help users visually explore complex data and confirm hypothesis about the data.

- o 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**
  - o Time series data are used very often these days, e.g., in medicine, finance, history, climatology, etc.
  - o Implement/develop an interactive viewer for looking at time series that explores several different visual representations.
- **Exploring Multidimensional Data**
  - o Multidimensional data exploration is a challenging task in visualization.
  - o 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
  - o Aggregate multidimensional data into clusters of similar data points
- **Transfer Function Design**
  - o Implement a volume renderer for 3D volume dataset
  - o 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