CS 5390 Data Visualization
Shirley Moore, Instructor
Review Guide for Qualifying Exam to be given May 22, 2015

Visual Perception
Why do designers of visualizations need to understand human visual perception?
Why is consideration of low-level feature perception so important to visual design?
How can we make features distinct (i.e., cause them to "pop out")?

Color
Explain the concepts of hue, saturation, and luminance.
Explain categorical, diverging, and sequential color maps and give an example of where you would use each type.
What are the requirements for color maps that work for people with color blindness?

Visualizing Tabular Data
Choose an appropriate visualization technique for a given tabular data set
Interpret visualizations of tabular data
Explain centroid-based clustering and how it can be used together with scatterplots and parallel coordinates visualizations

Visualizing Graph Data
Explain the difference between trees and general graphs (networks).
Choose an appropriate visualization technique for a given graph data set.
How does a force-directed graph layout algorithm work?
Compare and contrast node-link and adjacency matrix views of graphs.

Scientific Visualization
Sketch and describe the scientific visualization pipeline.
Explain the Phong lighting model.
Explain the difference between flat and Gouraud shading.

Scientific Data Representation and Mapping
Explain how a sampled continuous function can be reconstructed using basis functions.
Describe appropriate cell types and basis functions for a given domain.
Carry out bilinear interpolation for a 2D rectangular or triangular cell.
Compare and contract uniform, rectilinear, structure, and unstructured grids.

Visualizing Scalar Attributes
List and describe various ways of visualizing scalar attributes.
Define isocontour.
Describe the marching squares (cubes) algorithm for computing isocontours and demonstrate a given step given an example.

Visualizing Vector Attributes
List and describe various ways of visualizing vector attributes.
Interpret visualizations of divergence and curl (vorticity).
Explain why random sampling produces better vector glyph visualizations.
Interpret warp plots.
Explain how streamlines and streamtubes are constructed.
Describe what parameters you can vary to optimize a 3D streamline visualization.

Visualizing Tensor Attributes
Give a working definition of a tensor attribute. Give an example.
Explain why diffusion tensor magnetic resonance imaging (DT-MRI) can be used to visualize neural fibers.
Explain how eigenvector-eigenvalue analysis is used for tensor visualization.
Interpret eigenvector-eigenvalue analysis results.
Interpret tensor visualizations.

Volume Visualization
Most volume rendering techniques have two components: a so-called *ray function* and a separate *transfer* or *classification* function. Describe these two components, and also the way they interact with each other to yield the final volume-rendered image. Give an example.

Flow Visualization
Describe and compare streamlines, streaklines, and pathlines for flow visualization. Explain the difference between steady and unsteady flow. Given equations for the velocity components for a fluid flow, carry out the first couple of time steps for calculating a streamline through a point.