

T-61.5010 INFORMATION VISUALIZATION

May 25, 2015.

To pass the course you must pass this written examination as well as the course assignment. Results of this examination will be valid for one year after the examination date.

This examination has five questions, 6 points each. You must answer in English, unless you have agreed otherwise with the lecturers at least two weeks prior to the examination. Please write clearly and leave a wide left or right margin. You can have a calculator, with memory erased. No other extra material is allowed.

The results will be announced in Noppa. This paper must be returned.

Each question should be answered on a fresh new page. Questions 1, 3, 5 should be written on one booklet (sheet of paper) and questions 2 and 4 on another, as different lecturers will mark these questions.

Question 1: Theory and practice of data graphics

- a) Briefly explain the term chart junk? (1.5p)
- b) Comment on using surface areas to represent numerical quantities. (1.5p)
- c) How could you improve the graphic shown in Fig. 1? Justify your choices using the design principles of Edward Tufte. (The graphic shows the atomic volumes vs. the atomic numbers of chemical elements.) (3p)

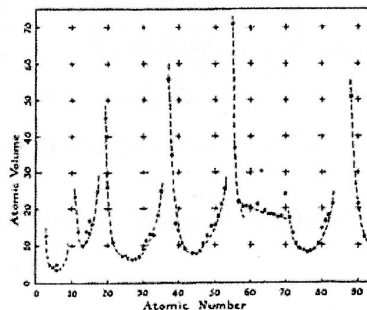


Figure 1

Question 2: Human perception

- 1. Compare and contrast sensory symbols versus arbitrary symbols. (2p)
- 2. Name the three types of neuron cells in the retina. Indicate how these cell types are connected and which are the first to be activated by the light falling on the retina. (1p)
- 3. Name the three distinct colour receptors of the human eye and the type of light each one is sensitive to. (1p)
- 4. Explain the integral and separable dimensions theory, and how this is applicable to glyph design. (2p)

Question 3: Object recognition, surface shapes, space

1. Fig. 2 displays four ways of showing the same surface graphically. Discuss ways to represent surface shapes in a graphic. (3p)
2. What are depth cues? Give at least 4 examples of depth cues? How can depth cues be used in modern graphical user interfaces (at least two examples)? (3p)

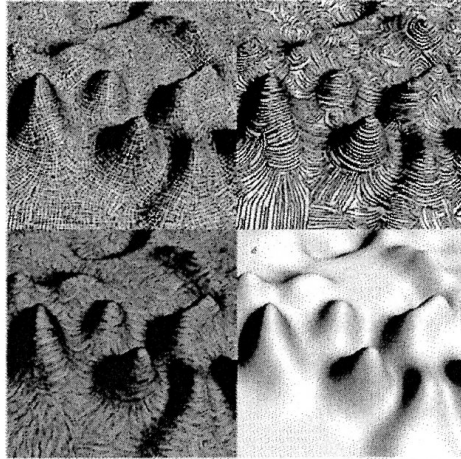


Figure 2

Question 4: Graph visualization and navigation

1. What is a node-link diagram and how is this related to a graph? (1p)
2. List four aesthetic criteria that make a graph layout easier to understand. (1p)
3. Briefly explain the force-directed graph layout algorithm. (1p)
4. What sort of graph is a tree? Name two types of diagrams that could be used to visualize a tree. (1p)
5. What is an adjacency matrix with respect to graphs? In what ways is it better than a node-link diagram? (2p)

Question 5: Dimensionality reduction

- a) Identify the 1st, 2nd and 3rd principal components Fig. 3? (1.5p)
- b) What are the limitations of PCA? (1.5p)
- c) Consider data points distributed in the shape of a cylinder, as shown in Fig. 4. Describe the output that would result by applying to the data a dimensionality reduction method that has (1) good precision, (2) good recall? Justify. (1.5p)
- d) Consider the following cost function

$$\sigma_r = \sum_{i < j} (p_{ij} - d_{ij})^2 F(d_{ij}, \lambda),$$

where p_{ij} is the distance in the input and d_{ij} in the output space. How should you select the function F such that the resulting dimensionality reduction method has high precision? Justify. (1.5p)

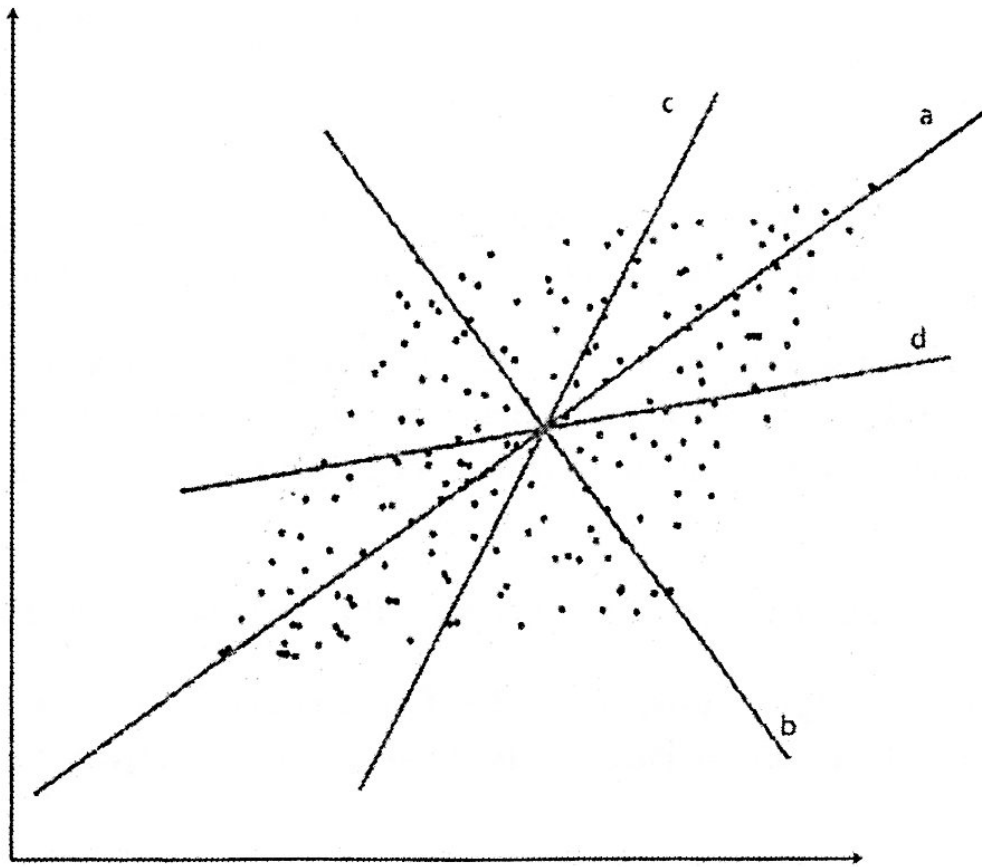


Figure 3

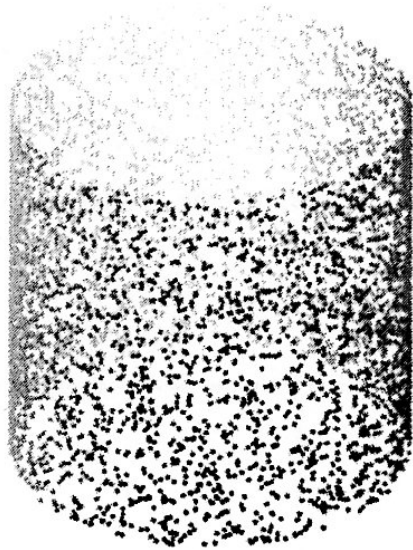


Figure 4