CS-E4840 INFORMATION VISUALIZATION

Examination

16 April 2021

The examination has 5 questions, 6 points each. You must answer to all 5 questions to get full points. This question paper consists of 3 pages. You can answer in Finnish, Swedish, or English. We however kindly request that you answer in English.

The answers must be returned as PDF files in MyCourses before the end time of the examination. To avoid missing the deadline, it is recommended to separately submit the answer to each question once it is ready, or to make preliminary submissions (the last one overwriting an earlier version). At the end, remember to use the final submit button before you leave.

Preferably write answers with computer and attach possible hand-drawn images as scans or photographs. Alternatively you may write answers on paper and scan/photograph all pages. In that case, please write clearly and leave wide margins.

You should work independently. Lecture notes and other material is allowed, but no plagiarism.

If you want us to take into account the results of the 2020 course assignments in the final grading then please indicate so in the first page of the examination! This will speed up the grading process, because by default we will just use the results of the 2021 assignments.

The results will be announced in MyCourses.

Question 1: Concepts

Briefly explain the following concepts, and describe how they are used (or otherwise are relevant) in information visualization:

(a) Gibson's affordance theory

(b) visual acuity

(c) box plot

(d) semiotics of graphics

(e) re-expression

(f) gamut

Instructions for question 1. Write in full sentences. Concept definitions should give a precise meaning of a term where available, or mention the most important aspects of a broad concept if a precise definition is not available. Concise definition of a single concept typically requires a few lines, written in a readably sized font/handwriting.

Question 2: Colour in visualisation

(a) Briefly describe the opponent colour theory.

(b) There are different types of color blindness. Explain their physiological causes and their effects on visual perception.

(c) What should you take into account when making visualizations for color blind. Give examples of different cases and techniques.

Question 3: Graphics design

(a) Analyze the visualizations (a)...(g) in Figure 1. What Gestalt laws are effective in each case and how do they perceptually organize the graphical elements.

(b) In which cases above there are more than one relevant laws applicable? Do they agree on grouping the elements, and do they appear as integrable or separable features?

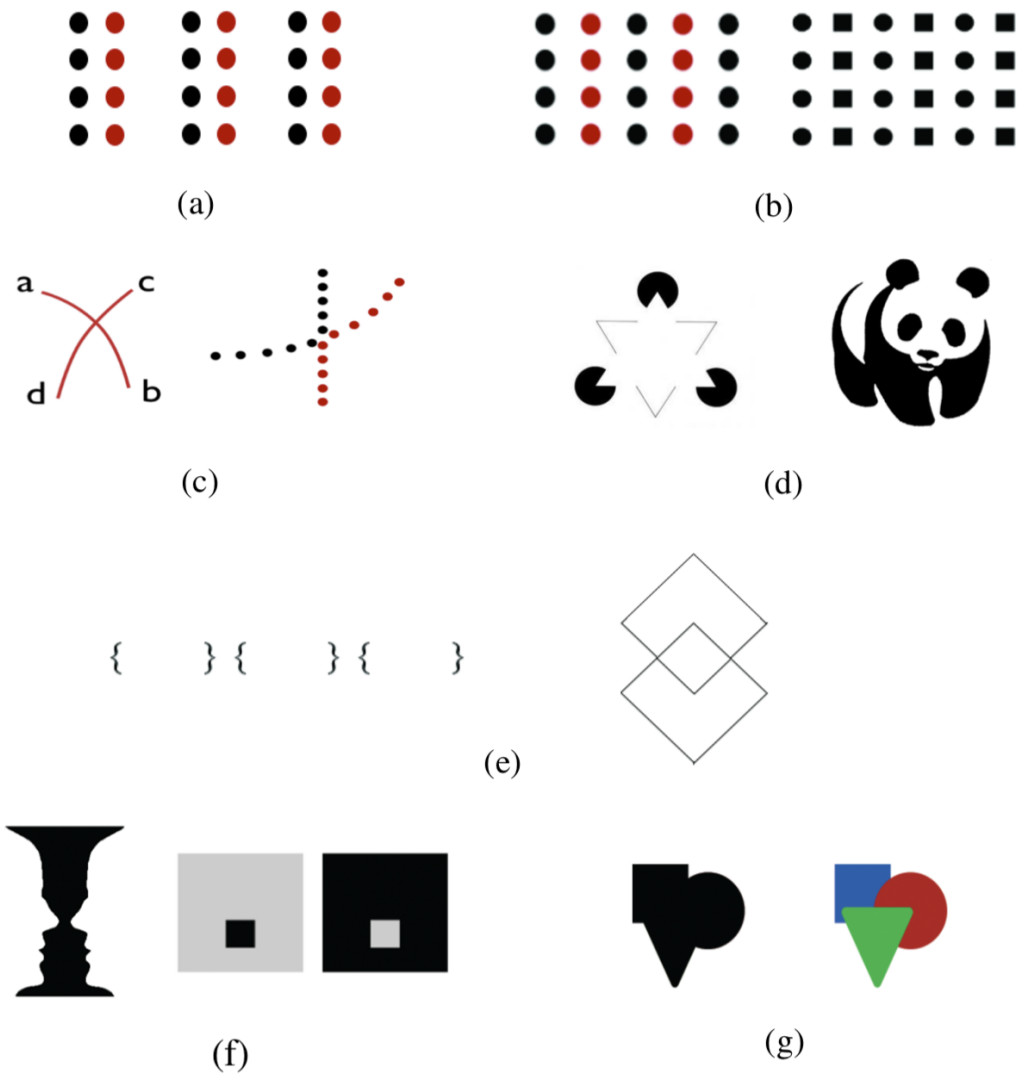

Figure 1: Gestalt laws in action.

Question 4: Dimensionality reduction Consider the problem of embedding the 2-dimensional data set shown in Figure 2 into one dimension. The letters in the scatterplot are just for clarity and to make it easier to answer to this question: you can think them as class labels which do not affect how the embeddings and related quantities in items (a)–(c) are computed.

(a) Make a visual sketch and explain briefly how the principal component analysis (PCA) would reduce the dimensionality of the dataset in Figure 2. What is the criterion for the PCA projection?

(b) Make a visual sketch and explain briefly how the ISOMAP would reduce the dimensionality of the dataset in Figure 2. What is the principle of ISOMAP and how the ISOMAP embedding differs from the PCA embedding?

(c) Define *stress*, *precision*, and *recall* (as used in dimensionality reduction). How would these three measures compare for the embeddings obtained in items (a) and (b) above. Explain how these measures would be calculated (but you do not have to compute numeric values here).

Question 5: Essay

Write an essay on topic "Techniques for presenting both context and details in a visualization.".

Instructions for question 5. Write in full sentences. Structure your answer into paragraphs. Explain all of the technical terms that are used in your essay. The essay should be written in a manner understandable to your fellow student—who would have the necessary prerequisite information to take this course, but has not taken it—and who has asked to tell him or her about the topic of the essay.

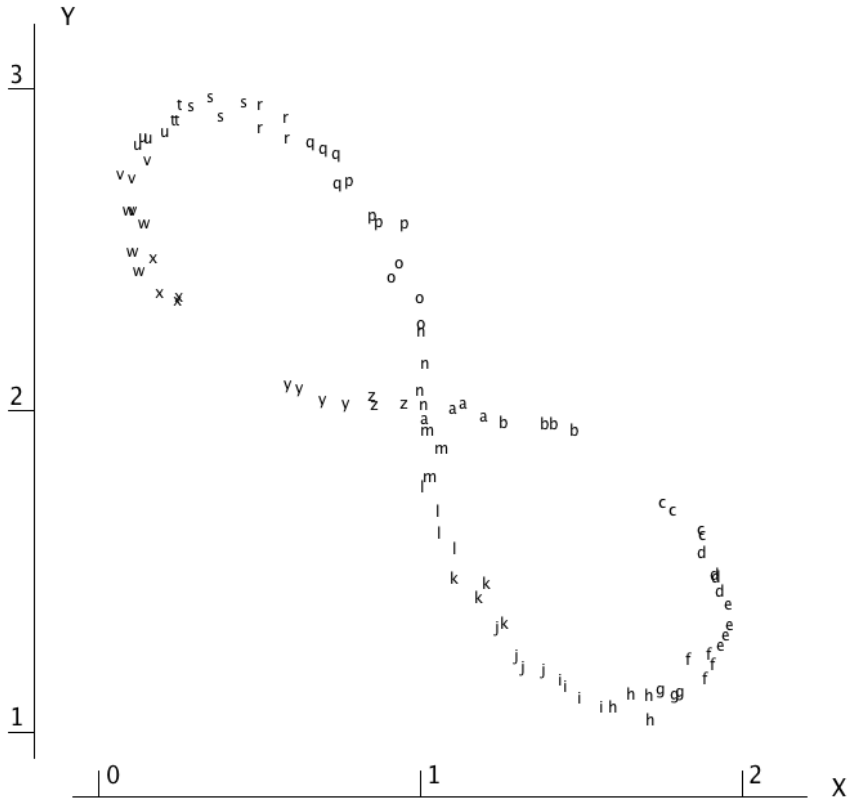

Figure 2: A 2D lemniscate data set.