Tuesday 17.05.22, 17:00-20:00, R037/2006 AS2 (Maarintie 8) Department of Computer Science, Aalto Univesity

This problem sheet consists of two pages and six problems. The maximum score is 30. The score per problem is indicated in parentheses. You are allowed to answer in Finnish, Swedish, or English. But because we are short of graders knowing Finnish and Swedish, we kindly request that you use English. Please write clearly and leave a wide left or right margin. Pens, pencils, erasers, and rulers are the only allowed equipment.

If you want us to use the results of the 2021 course assignments in the final grading, please indicate so on the first page of the examination. By default, we will use the results of the 2022 assignments.

1. (2p)

Gestalt laws. Sketch arrangements of these six shapes by rotating and displacing them so that they:

(a) Appear as much as possible as one unit.

(b) Appear as much as possible as two units.

The shapes must not overlap, and the gap between them should be roughly the same (about the width of the lines). There is no need to write an explanation—we will grade only your sketch.

2. (4p)

Colors. Imagine that you are making a scatter plot of the World's countries to show the relation between two socioeconomic indicators (say inflation rate and unemployment rate) and you want to highlight the continents of the countries (i.e., a nominal variable) by different colors. Describe (in less than a page) how you would reason when selecting colors.

3. (4p)

Factors affecting visual search. Consider strings of around 90 non-white letters, numbers, and common symbols containing one "**5**". Assume it is typeset with a standard sans-serif font (Helvetica, Arial, etc.) in a fixed size and weight, like this example:

hFR9L.wH7kLJN2gs-JSp---+-hdh–}ooo5ooooemz2w4$asDG$dfjsky8bK[][[[[[[11!!b3jfdKLSlli{Bhd

(a) Describe at least three ways to make a string where the "**5**" is more hidden from visual search than in the above example.

(b) Describe a string where it would as easy as possible to spot the "**5**".

Answer with general principles. You can make example strings to illustrate your points, but not longer than five symbols.

4. (10p)

Essay. Write a (2–3 page) essay on one (but not more than one) of these three topics:

- Tufte's principles of data visualization.
- The use of dimensionality reduction for data visualization.
- Techniques for presenting both context and details in a visualization.

Write your essay in complete sentences. Structure it into paragraphs. Explain all of the technical terms and write it in a manner understandable to a fellow student—someone having the necessary prerequisites to take this course but has not taken it.

5. (5p)

Glyph design.

(a) What are pre-attentive visual features, and why are they important in visualization? Explain and demonstrate by drawing at least four distinct pre-attentive visual features.

(b) Design a glyph that shows four features (temperature, air pressure, wind speed, and wind direction) for a location on a map and demonstrate it by a drawing. One should perceive the features as efficiently as possible, and it should be possible to position several glyphs in different geographic positions on a map. Discuss your design choices from the viewpoint of human perception and the properties of the resulting visualization. What are the concepts one needs to take into account?

6. (5p)

Visualization principles. The figure to the right visualizes the export of bananas from different countries over 12 years. (The text is in German, but you don't have to understand it.)

(a) Describe at least three ways that it violates the design principles taught in class.

(b) Describe and sketch how you could make a better visualization of this data.