

This problem sheet consists of two pages and eight 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.

1. **Gestalt laws.** Starting from this configuration of 12 circles:



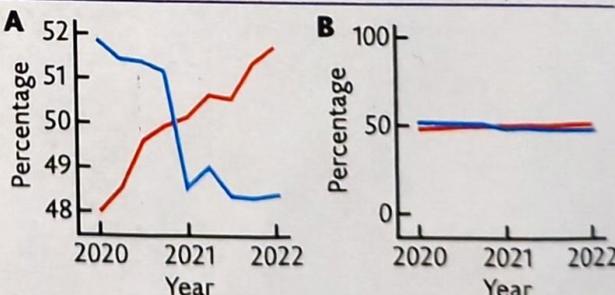
(3p) (a) By moving precisely five circles, and using a Gestalt law, draw a new, static configuration that appears composed of two units.
 (b) Repeat problem (a) using a different Gestalt law.
 (c) Assume you are instead making a moving image. How can you undo your efforts in (a) and (b)? I.e., describe how can you make these configurations appear like one unit again?

2. **Colors.** Assume you want to use color to distinguish between five categories of data points represented by filled circles. How does the size of the symbol affect the optimal choice of color?
 (2p)

3. **Acuity.** Telling whether or not two line segments are aligned is an example of where human vision can achieve superacuity (also known as hyperacuity). Answer very briefly (1-2 sentences per sub-problem):
 (2p) (a) What does this mean in terms of the visual system's performance?
 (b) What is required of our visual system to achieve superacuity? (In addition to normal visual acuity.)

4. **Essay.** Write a (2-3 page) essay on one (but not more than one) of these two topics:
 > The past, present, and future of information visualization.
 > The purpose and challenges of interactive data visualization.
 (10p) Imagine the reader to be a fellow student at the beginning of the course—someone with the necessary prerequisites to take this course but who has not taken it.

5. **Statistic plotting techniques.** Consider the two line plots of two variables to the right. Panel B shows the entire scale from 0 to 100%, whereas A is a 25-fold zoom.
 (3p) (a) What is the main advantage of plotting the data as in panel A compared to plotting it as panel B?
 (b) In what sense could it be misleading to plot the data as in panel A compared to plotting it as in B?
 (c) Even though one could get the benefits of both panels by plotting both, that could be a bad idea. Why?



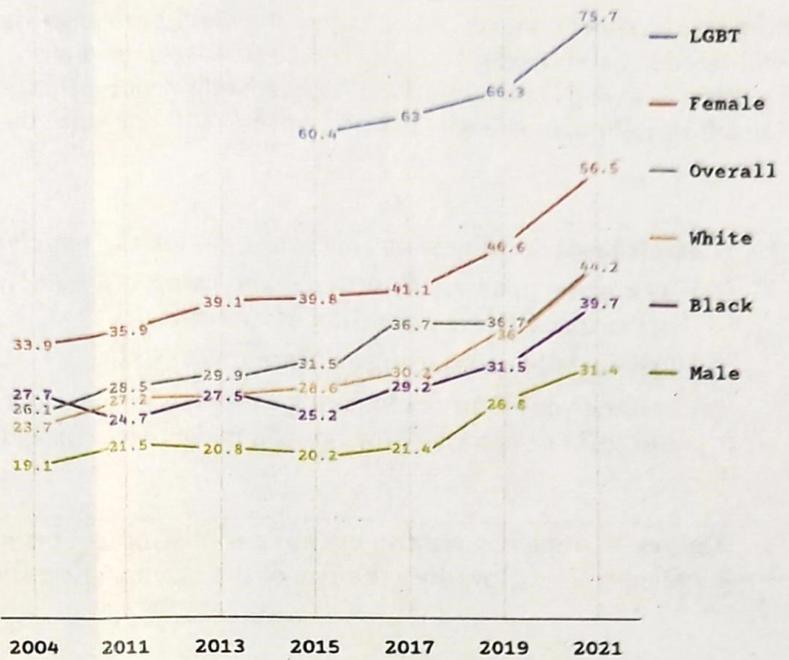
Year	Blue Line (%)	Red Line (%)
2020	51.5	48.0
2021	48.5	50.5
2022	48.5	51.5

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2022	48.5	51.5

6. **Glyph design.**
 (5p) (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 to illustrate three socioeconomic variables of Finnish municipalities—population (varying between 100 and 650,000), municipal tax rate (ranging between 16% and 24%), and age distribution (percentages in three age classes). 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.

7. Visualization principles. The plot to the right shows the fraction of youth who experienced symptoms of depression. Mention at least two weaknesses of the plot and how one could improve them.

(2p)



8. Visualization principles.

(3p)

(a) Discuss briefly how this infographic fails to “communicate complex ideas with clarity, precision and efficiency” (Tufte’s definition of graphical excellence).

(b) Construct a question that would take significantly longer to answer with this visualization compared to if the data was presented in a simple bar graph.

