T-61.5010 Information Visualization Examination

May 18th, 2011

To pass the course you must also pass the term project (assignment). Results of this examination are valid for one year after the examination date. To get full points you must complete all of the problems 1–5. All of the problems have an equal weight. There are 50 points in this exam in total.

Answer preferably in English. Please write clearly and leave a wide left or right margin. No extra material (calculator, lecture notes etc.) is allowed. Please write your answers preferrably using preferably a ballpoint pen.

PLEASE ANSWER EACH QUESTION ON A DIFFERENT SHEET!

Instructions for the essays: Write in full sentences and structure your answer in paragraphs. 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) who has asked you to tell him/her about the topic of the essay.

The results will be posted to the course Noppa home page on June 18th 2011, at latest. No other announcement will be made.

There are 6 (six) pages in this examination. You can keep this paper.

1 Multiple choices questions

The following questions have each different proposed answers. Only one of them is correct. **You have to give your answer along with your confidence ("High" or "Low") for each answer.** Grading for each of these multiple choices questions is then:

- **+2** if answer is right and confidence is high

- **+1** if answer is right and confidence is low

- **0** if answer is missing

- **-1.5** if answer is wrong and confidence is low

- **-3** if answer is wrong and confidence is high

Write on your answer sheet the correct answer (A, B, C, D,...), along with the confidence you have (High, Low) for that question; e.g "A, Low" is a proper way of answering a question. **Missing confidence for a question will be treated as "Low".** Total score for this question is between **-10 AND 10** (TOTAL SCORE OF THE EXAM IS ON 50).

Question 1

In human perception, sensory symbols are

- A) Understandable without learning and processed quickly
- B) Hard to learn and capable of rapid change and cross-cultural
- C) Hard to learn and capable of rapid change and culture-specific
- D) Resistant to instructional bias and capable of rapid change and culture-specific
- E) None of the answers above is correct

Question 2

According to the CIE system of color standards, in the chromaticity diagram

- A) Any set of three non-aligned colored lights specifies a triangle. All points within the triangle can be represented as a mixture of the given lights
- B) Any set of three non-aligned colored lights specifies a triangle. Only points on the edges of the triangle can be represented as a mixture of the given lights
- C) None of the realizable colors fall within the spectrum locus (the set of chromaticity coordinates representing single wavelength colors)
- D) All the answers above are correct
- E) None of the above answers is correct

Question 3

In the theory of pre-attentive features, the conjunction search of two pre-attentive attributes

- A) is always pre-attentive
- B) is never pre-attentive
- C) is not always pre-attentive
- D) does not exist
- E) None of the above answers is correct

Question 4

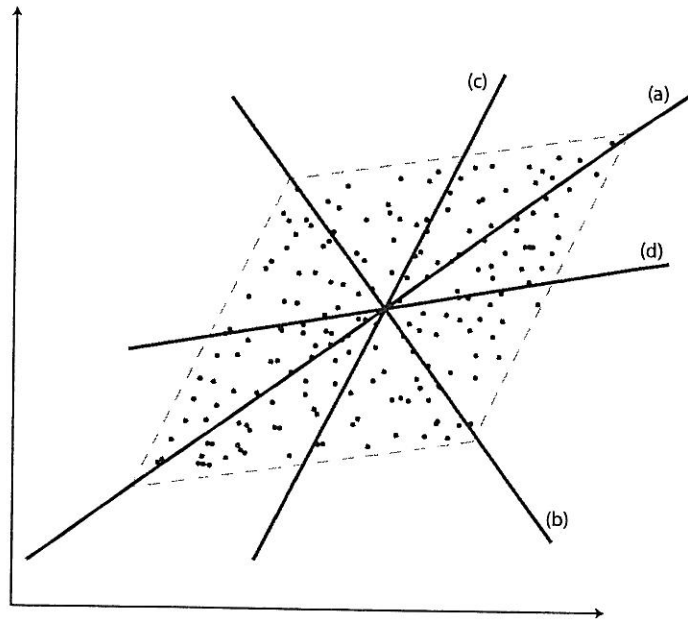The third principal component for PCA (Principal Component Analysis) in this figure (Figure 1) is given by:

Figure 1: Which of the four lines is the third Principal Component ?

A) line a

B) line b

C) line c and d

D) line d

E) PCA cannot be computed for this type of data

F) None of the above answers is correct

Question 5

The definition of the cost function σ_r for CCA (Curvilinear Component Analysis) is (where d denotes the Euclidean distance between points in the original space (x) and in the projection (y), and $F(d, \lambda_y)$ equals unity if $d < \lambda_y$ and 0 otherwise):

A) $\sigma_r = \sum\limits_{i<j} (d(x_i, x_j) - d(y_i, y_j))^2 F(d(y_i, x_j), \lambda_y)$

B) $\sigma_r = \sum\limits_{i<j} (d(x_i, x_j) - d(y_i, y_j))^2 F(d(x_i, y_j), \lambda_y)$

C) $\sigma_r = \sum\limits_{i<j} (d(x_i, x_j) - d(y_i, y_j))^{-1/\sqrt{-d}}$

D) $\sigma_r = \sum\limits_{i<j} (d(x_i, x_j) - d(y_i, y_j))^{-3/d} F(d(y_i, x_j), \lambda_y)$

E) None of the above answers is correct

2 Depth Cue theory

Based on the piece of art (Figure 2) below:

- Discuss and explain briefly the Depth Cue theory;

- List and explain at least 5 depth cues (there might more/less than 5 depth cues in this piece of art). You have to give the proper name for the depth cues you explain.
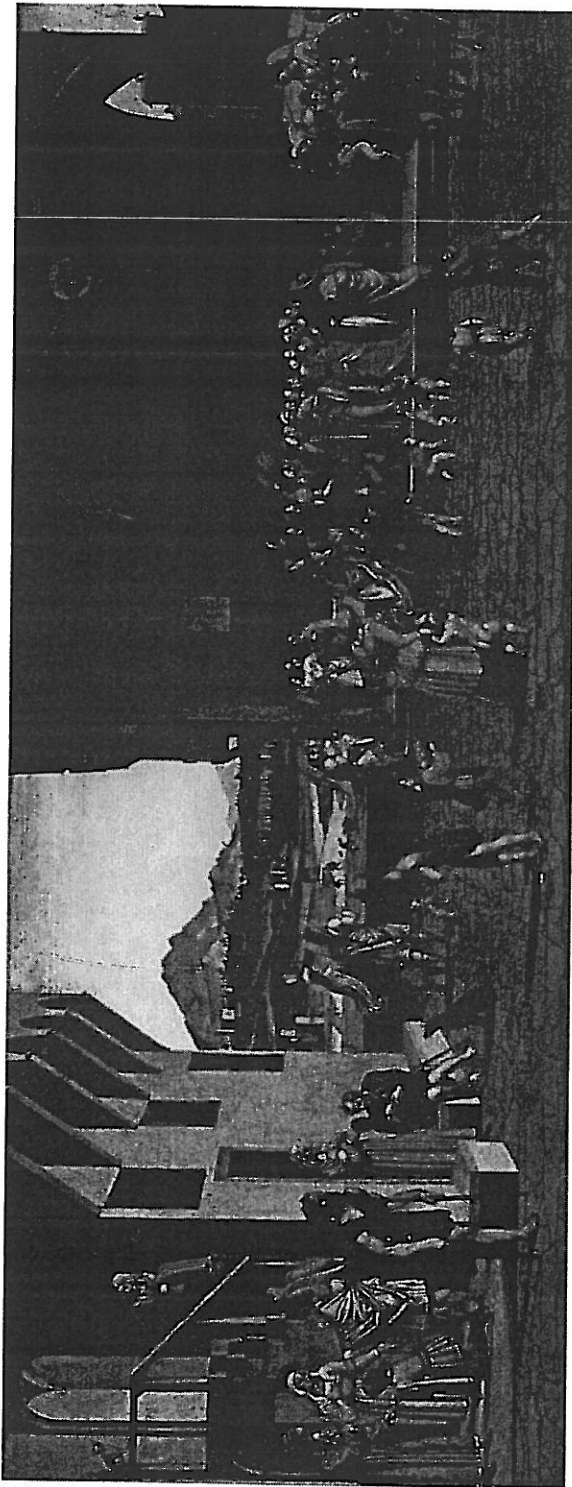
Figure 2: Scenes from the Story of Tobias, by Giuliano Bugiardini, c. 1500, Staatliche Museen, Berlin (from Web Gallery of Art).

3 Concepts definitions

Define and explain in maximum 3 lines all of the following concepts:

- Precision (in dimensionality reduction)

- Chart Junk

- Gibson's Affordance Theory

- Self-Organizing Maps (for dimensionality reduction)

- Saccadic Movements

4 Essay 1

Let us assume that you have a high dimensional data set that you want to analyze.
You want to perform dimensionality reduction and visualization of the reduced data.
Describe, in detail, the methodology you will follow. Include the pre-processing steps, post-processing steps, quality criteria, dimensionality reduction methods, etc. that you would use.

Maximum 3 pages, explain **all the technical terms** that are used in your essay.

5 Essay 2

According to the visual attention theory, what are the ways or choices that allow information to pop-up (active from the low-level point of view).

Maximum 2 pages, explain **all the technical terms** that are used in your essay.

NOTE: Both essays are compulsory !