Written exam

vrije Universiteit

Course: Zelforganisatie
Date: December 18, 2009
Lecturer: Dr. M.C. Schut

Remarks

- During the exam, you are allowed to keep
  1. the hardcopies of the papers,
  2. your notes and
  3. the "Programming Collective Intelligence" book

  with you in order to consult for answering the questions of the exam.
- You are not allowed to use your laptop, telephone or any other digital medium (e.g., ebook reader) during the exam.
- Figures and Tables from the articles that are referred to in the questions, are included in the exam after the last question.
- You are advised to spend no more than 5-6 lines for your answer per question (i.e., you don't get extra points for very long answers that *may* include the correct answer, you can better be short and to the point).
- Your answers can be in Dutch or English.

Calculating your grade

- The grade for the written exam is calculated as follows: you get max. 1 point per question (i.e., max 9 in total) + 1 point = max 10 points.

Question 1

Article: Coherent moving states in highway traffic
Author(s): Dirk Helbing & Bernardo A. Huberman

- In Figure 1, you see the travel time distribution versus travel time under 4 different densities. In which graph (a, b, c or d) do you see the *coherent moving state* (the 'solid block') and explain what is in this graph from which this shows.

Question 2

Article: Coherent moving states in highway traffic (note: same article as question 1)
Author(s): Dirk Helbing & Bernardo A. Huberman

- In this article, it is mentioned that taking over and braking causes traffic jams (moving traffic jam fronts, synchronized congested traffic). Explain what this means in terms of self organisation.

Question 3

Article: Kohonen network (scholarpedia, printout)
Author(s): Teuvo Kohonen and Timo Honkela

- Describe a typical problem that can be solved or represented by means of a Kohonen network (or: self-organising map). If you cannot think of a single example, briefly describe the kinds/class of problems that can be solved by means of this method.

Question 4

Article: The Ant System: Optimization by a colony of cooperating agents

Author(s): Marco Dorigo, Vittorio Maniezzo and Alberto Colorni

- For the main algorithm of the Ant system, point out and describe the two main self-organising properties. For the properties, you have to choose from the ones mentioned in class: adaptive, global-local, emergence, interaction, robust, rules, redundancy, randomness.

Question 5

Article: Particle Swarm Optimization (PSO)

Author(s): James Kennedy and Russell Eberhart

- The introduction of this article mentions that the BOIDS model of Reynolds (1987) has been (among others) the starting point of PSO. Describe 2 similarities between BOIDS and PSO.

Question 6

Article: Simulating dynamical features of escape panic

Author(s): Dirk Helbing, Illes Farkas and Tamas Vicsek

- Figure 3 shows the effect of the so-called *panic parameter p*.
    a) Explain briefly what this parameter means.
    b) Looking at graphs b, c and d – what is the best value of this parameter and why?

Question 7

Article: Emergent Polyethism as a Consequence of Increased Colony Size in Insect Societies

Author(s): Jacques Gautrais, Guy Theraulaz, Jean-L. Deneubourg and Carl Anderson

- This article introduces "fixed response thresholds" models for division of labour. But the models in the rest of the article do not have fixed thresholds. What is the mean reason that the thresholds change over time? In which parts of the model (Section 2) do we see these changing thresholds again?

Question 8

Article: Self-Organized Shape and Frontal Density of Fish Schools

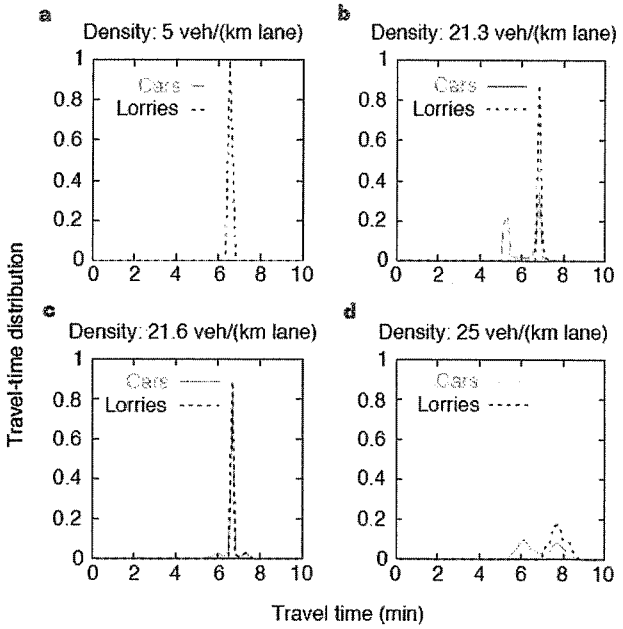
Author(s): Charlotte K. Hemelrijk & Hanno Hildenbrandt

- In Table 2 there are a number of hypotheses that do not have a reference for empirical data, but n.a. (not available) instead. With respect to the research presented in this article, what does this mean?

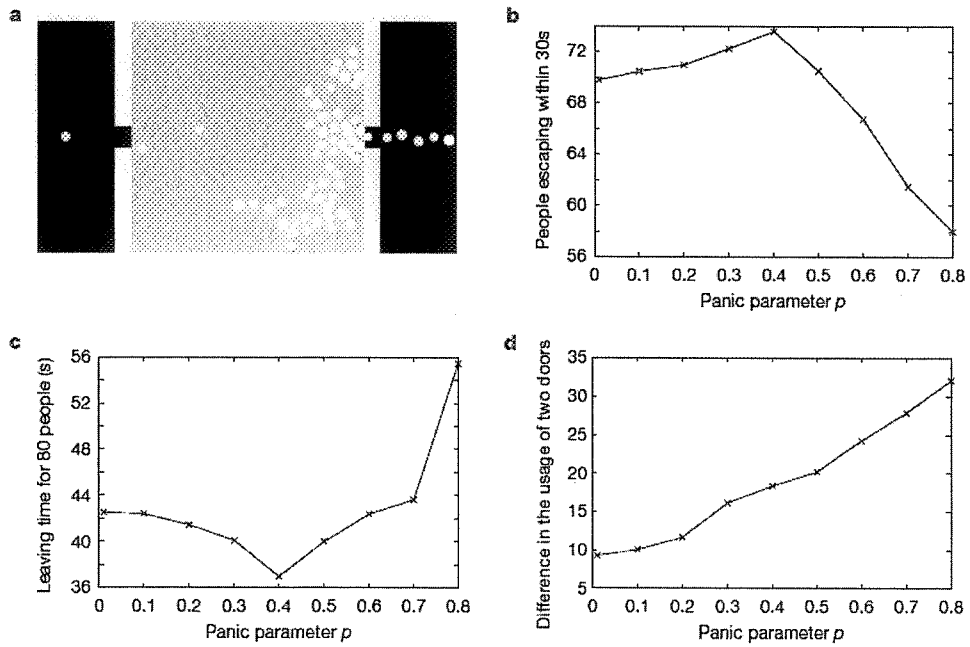
Question 9

- Imagine the problem of designing a class room schedule on the VU: you have to schedule a number of classes (with different number of attending students) over time in rooms of different sizes. What self-organising algorithm is best to use for solving this problem and why? You have to choose from Kohonen network (que 3), Ant system (que 4) and Particle Swarm Optimisation (que 5).

Article: Coherent moving states in highway traffic
Author(s): Dirk Helbing & Bernardo A. Huberman
Figure 1



Article: Simulating dynamical features of escape panic
Author(s): Dirk Helbing, Illes Farkas and Tamas Vicsek
Figure 3



Article: Self-Organized Shape and Frontal Density of Fish Schools
Author(s): Charlotte K. Hemelrijk & Hanno Hildenbrandt
Table 2

Table 2: A list of model based hypotheses related to the origin of an oblong school form and high frontal density

Model-based hypotheses	Empirical data
1. Group size	
a. larger groups are denser	(Breder 1954; Keenleyside 1955; Nursall 1973; Partridge 1980; Partridge et al. 1980)
b. larger groups are more oblong	(Axelsen et al. 2001)
c. their densest core is located more forward	n.a.
d. their core is denser	n.a.
e. their tail (25% and 50% at back) is denser	n.a.
2. Cruise Speed	
a. Slower groups are less polarised	(Inagaki et al. 1976)
b. they are more oblong	(Partridge 1980)
c. their densest core is loser	n.a.
d. their tail is denser	n.a.

n.a., not available.