Written exam

Course:	Collective Intelligence
Date:	February 9, 2011
Lecturer:	Dr. M.C. Schut

Remarks

- During the exam, you are allowed to keep a) the hardcopies of the papers, b) your notes and c) 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, tablet or any other digital medium (e.g., ebook reader) during the exam.
- 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).
- You make the exam on your own, not in groups.
- Your answers can be in Dutch or English.

Calculating your mark

- The mark 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 *"Particle Swarm Optimization (PSO)" by Kennedy and Eberhart*
A PSO algorithm has two main components – pbest and gbest.

a) Briefly describe both components.
b) What do these components correspond to in a self-organising system (similar to what we saw in panic behaviour studies)?

Question 2 *"Diversity and Adaptation in Populations of Clustering ants" by Lumer and Faieta*
This article describes how to use the brood-sorting technique to solve *practical* clustering problems.

a) Explain how to use this technique to cluster movies on a website where users can rate movies that they have watched.
b) In general, why or why not would you need a diverse population, short-term memory and/or behavioral switches?

Question 3 *"The Ant System" by Dorigo, Maniezzo and Colorni*
This article considers the use of ant foraging techniques for solving a Traveling Salesman Problem. Figure 2 (page 4, also included below) shows the idea behind *artificial ants*, the starting point for the Ant System.

a) Explain this Figure in your own words.
b) Give at least one *practical* application of the Ant System.

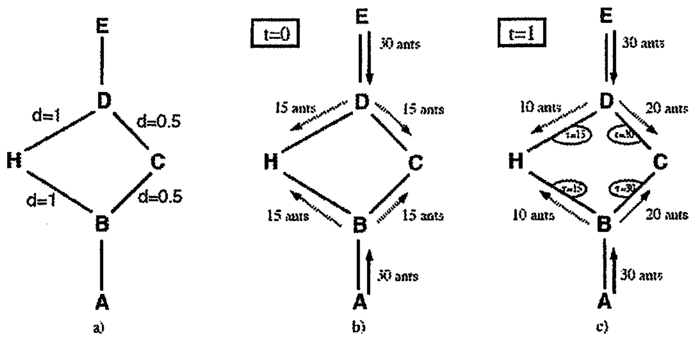

Figure 2 An example with artificial ants.

<u>Question 4</u> *"Kohonen network" (scholarpedia, printout) by Kohonen and Honkela*
You can use a Kohonen network (or: self-organising map SOM) to display a multi-dimension space (eg. a colour space, where each colour consists of [red, green, blue] values) in a 2-dimensional way. We have seen other *dimension-reduction* algorithms in this course. Give at least 2 reasons why you would use a SOM algorithm over any of the other algorithms.

<u>Question 5</u> *"Coherent moving states in highway traffic" by Helbing and Huberman*
The first part of this paper (Figures 1-3) explains a theoretical study into 'solid-block formation' on highways; the second part of the paper (Figure 4) concerns a validation of this study. There is a problem with how this validation has been done – what is this?

<u>Question 6</u> *"Emergent Polyethism ... Insect Societies" by Gautrais et. al*
For the behavioral specialisation model in this paper, 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.

<u>Question 7</u> *"Self-Organized Shape ... Fish Schools" by Hemelrijk and Hildenbrandt*
This paper has quite an exceptional setup: the authors `correct' for an earlier model that was criticised for being unrealistic. Despite the model being more realistic now, do the authors report on actual new findings or insights? What is the added value of this paper over the previous paper?

<u>Question 8</u> *"Simulating dynamical features of escape panic" by Helbing et. al*
Regarding the phenomenon of panic behaviour, the authors of this paper are physicists who model a sociological phenomenon (i.e., panic). Describe in your own words how the physical model for particle systems was used for analysing panic behaviour of people.

<u>Question 9</u>
A well-known self-organising phenomenon is the spread of an epidemic (flu, for example), because it only involves local interactions (i.e., a virus is infectuous), it is robust (hard to stop), and adaptive (can change when threatened). Imagine that you want to make a model in order to analyse this phenomenon. What model do you think is best then and why – the one used in the traffic study (que 5), the insect model (que 6), the fish model (que 7), or the panic model (que 8) ?