

About us

- Vrije Universiteit Amsterdam
- Department of Computer Science (170)
- Artificial Intelligence Section (35)
- Computational Intelligence group (11)
- Emergent Collective Intelligence research
<http://www.cs.vu.nl/ci/eci/>

NEW TIES project

New and **E**mergent **W**orld models
Through **I**ndividual, **E**volutionary and **S**ocial learning

Main data sheet

- FP6, IST FET Open, STREP
- 36 months
- 1 September 2004 – 31 August 2007
- 5 partners from 3 countries
- Budget is \pm 1.6 M€
- Web: www.newties.org

Participants

- VU, Amsterdam, NL
A. Eiben (coordinator), R. Griffioen (RA), C. Tzolov (WP)
- ELTE, Budapest, H
A. Lorincz, A. Bontovics & G. Hevizi (RA's)
- Napier, Edinburgh, UK
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- Surrey, Guildford, UK
N. Gilbert, R. Schuster (RA)
- Tilburg, NL
P Vogt, F. Divina (RA)

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History

- Inspiration from Stanislaw Lem's *Non Serviam* (English translation in *Douglas R. Hofstadter and Daniel C. Dennett (Editors), The Mind's I*)
- Original aim: create (initiate + have evolve/emerge) an artificial society with high mental and linguistic capabilities. See whether/when/how they start wondering about the origins of their world and themselves.
- Extreme: see if they ask themselves if WE exist.

Main objectives from Annex I

1. To develop an artificial society with an emergent culture.
2. To realise a powerful "emergence engine" consisting of a well-balanced combination of individual learning, evolutionary learning, and social learning.
3. To develop, evaluate, and use a range of social learning mechanisms that allow sharing knowledge with other members of the population.

Objective 1: emergent culture

Sub-objectives:

1. To identify which system components carry the knowledge structures that make up world models.
2. To develop mechanisms to monitor the development of world models.

Discussion: what is culture?

Objective 2: emergence engine

Sub-objectives:

1. To develop an understanding of the mutual effects of the three types of learning on each other and on the development of the individuals and the whole population.
2. To develop mechanisms for adjusting the balance between the three types of learning.

Objective 3: social learning

Sub-objectives:

1. To set up communication mechanisms and investigate their effects on the efficiency of social learning mechanisms.
2. To implement a framework enabling the emergence of the communication and cooperation essential to social learning. (language evolution)

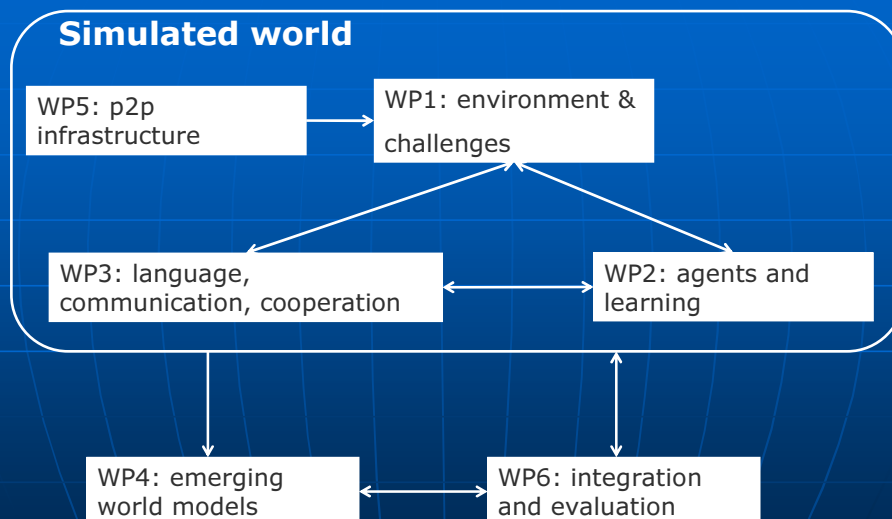
Approach

- Create multi-agent system that can learn and survive in demanding environments
- Construct environments drawing on sociological, anthropological literature
- Give populations several challenges, adaptation & survival → success
- Compare emerged strategies to human strategies in similar circumstances
- NB: Fundamental difference with "engineering approach" as in social robotics (Mars example)

Technology

- We envision enormous scale-up w.r.t. present systems concerning:
 - Number of agents
 - Complexity of agents
 - Complexity of environment (to lesser extent)
- We use 5 x 10 (12) computers in a p2p network to support computations
- Leverage on DREAM project (FP5, IST FET Open, 2000-2003, www.dr-ea-m.org)

Project structure (tech part)



Ideas about the environment

- Grid/graph world
- Locations & roads
- Energy (food)
- Time (sun)
- Various resources

Ideas about challenges 1

1. The Kula Ring: A complex system of visits and exchanges among the Trobriand Islanders. Expected outcome: establishment of a 'gift-exchange' system in which not only food but also tokens are exchanged.
2. Herders in a semi-arid area: Herders and their cattle move to where food is available, leaving exhausted areas until the grass has re-grown. Expected outcome: Agents leave uneaten food when they move away, even if they leave hungry.

Ideas about challenges 2

3. Central place theory: offered to explain the size and spacing of cities that specialize in selling goods and services. Expected outcome: Agents settle into spatial clusters separated by relatively empty areas. The size of the clusters is power law distributed.
4. Branding: complex goods (with many distinct attributes), many producers and consumers imply search problems that can be "solved" by branding. Expected outcome: Agents generate an additional tag or distinguish an existing tag and use this to label agents. This leads to differences in behaviour towards those agents that are labelled and those that are not.

Ideas about agents

- Agents possess "physical" (e.g., memory size, maximum lifetime, fertility rate) and "mental" features that determine their behaviour
- Mental features can be carried by (parameterised) decision procedures, represented in a symbolic, neural, ...form – the controller
- Mental parameters can be part of the agents'
 - genetic makeup, thus permanent during lifetime (talkativeness) or
 - mental state, thus changing over time (e.g., willingness to mate)
- Same for physical properties:
 - Part of genome, thus permanent (e.g., gender)
 - Part of condition, thus variable (e.g., fertility)

Ideas about learning 1

Individual or lifetime learning

- Performed by the agents independently, although possibly involving other agents
- Agents process the data corresponding to the situations encountered (including their own (re)actions)
- Learned thing changes their controller in order to improve its performance in similar situations in the future
- From the **knowledge transfer** point of view, the learning agent is a **sink**

Ideas about learning 2

Evolutionary learning

- Physical and mental attributes that belong to the individuals' genome are inheritable
- These attributes undergo variation (mutation and recombination) and selection, hence they are subject to evolution
- The learned knowledge here is in the form of superior values and value combinations for the given genes
- **Vertical knowledge transfer**, down along the line of successive generations.

Ideas about learning 3

Social learning

- Agents share knowledge they learn individually by explicitly “telling” it to each other
- Agents collectively develop knowledge that covers different situations they are encountering.
- Distributed data mining analogy
- Communication protocol & network seem to have important roles
- This amounts to horizontal knowledge transfer