Modelling the participatory sense-making

Project proposal for the
Winter Workshop on Complex Systems 2015
(WWCS2015)

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Revision History

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Introduction

The idea of the project is to design and implement a pilot computational experiment able to indicate the emergence of self-organized coordination (i.e. complex system) from interaction among simple software agents. The project would be a small step within a broader 'Synthetic Cognitive Development' research programme (see [6] for detailed description) which joins philosophical, conceptual and computational approaches with the direction to understand and implement fundamental mechanisms of collective intelligence and cognition.

Research programme

It is worth to briefly describe the research programme for presenting the broader context of the proposed project. The programme combines four perspectives which are being advanced in parallel and complement each other:

Cognitive science perspective builds on the paradigm of cognitive development, sense-making, cognitive dissonance and the concept of distributed (collective) cognition.

Philosophical perspective is based on the philosophy of individuation and the mechanism of transduction of G. Simondon, and theory of enaction developed by Varela,

Thomson, Rosch, Di Paolo and others.

Conceptual model of cognition analyses emergent coordinated behaviour of groups of simple agents using concepts of boundary formation, hierarchy and scalability, value systems, antifragility as well as their information theoretic formalizations;

Computational perspective deals with the theoretical and practical problems of implementing the conceptual model in a computational medium, including questions of lossy information compression, the theory of distributed computing, review and analysis of leading cognitive architectures.

In addition to these perspectives the research programme deals with the application of the theoretical approach to cognitive science, psychology, social systems' governance, artificial general intelligence and more.

Project proposal

Goals of the project

We would like to achieve the following goals with the proposed project:

1. Develop a strong experimental design appropriate for a pilot implementation during the WWCS2015 and potentially useful for the broad 'Synthetic Cognitive Development' research programme;
2. Research and select tools and technologies, specifically – an actor framework – for implementing the experimental design;
3. Research and select a tool for collecting and storing the full history of events during the simulation for the purpose of later analysis; we are interested not only in testing certain hypothesis with the experiment, but also in analysing the dynamics of interactions asking why and how certain things happen during it;
4. Make a pilot implementation if allowed by time and results of above activities;

Preliminary design

The preliminary idea for the design of the experiment is to simulate a *participatory sense-making* [1] of a number of individual developmental agents. Developmental agents can be designed using the principles of *Enactive Cognitive Architecture* [2] which is in turn based on *autotelic principle* used by Luc Steels in 'Talking Heads' experiments of the emergence of language [5]. It may be even possible to utilize pre-programmed developmental agents of creators of Enactive Cognitive Architecture (e.g. e-ernest self-motivated agent). Participatory sense-making in the context of this project is understood as a process leading to emergence of coordinated behaviours of otherwise individual agents through their continuous interaction. Coordinated behaviour in this case emerges due to the creation of shared meanings among agents, not unlike the case of emergence of

language [5]. It may also mean the acquisition of these meanings by the newly introduced agent to the group of agents which already had created coordinated behaviour among themselves.

Activities of the project

Activities needed to implement the design and carry out the experiment are:

(1) Adapt ECA (enactive cognitive architecture) or a ready made software agent for the purposes of the project; a software agent should be implemented without any pre-defined behaviours except for the ability to interact with other agents and develop behaviours motivated by the autotelic principle (as opposed to the principle of reinforcing desired behaviours);

(2) Design and implement a framework for agent interactions. Usually, software agents are implemented in a certain clearly defined environment and learn to behave optimally with respect to it (e.g. navigate the maze, avoid obstacles, etc.) therefore are said to be learning the "correct" representation of their environment. We would like take another approach where everything that exists outside an agent are interactions with other agents. Therefore the environment of any agent are other agents which learn their environment in the same way. Therefore 'environment' is the totality of progressively negotiated shared meanings of signals among all interacting agents - the result of *participatory sense-making* process. The natural way for implementing interactions among agents is to use the message passing algorithm in the form of actor framework (e.g. GPars, Akka or other).

(3) Design and implement the experimental set-up in terms of minimally needed assumptions about agent behaviours and interactions, including:

- the list of possible interactions between agents;
- the list of initial preferences of agents (leading to self-motivated behaviours and learning);
- ... (?);

(4) Ideally, the simulation framework should be able to log all the events of the interactions between agents into certain readable history for the analysis. It is not clear whether we will be able to implement this functionality during WWCS20015 which depends on the success of previous activities.

Previous work

The proposal for the project builds on the current work with agent based modelling framework Challprop and the underlying challenge propagation model [3, 4].

Related WWCS2015 projects

- Understanding Smart Grids;
- Quantifying the complexity of complex systems;
- Networks beyond Graphs;

References

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[4] Heylighen, F., Busseniers, E., Veitas, V., Vidal, C., and Weinbaum, D. R. (2012). Foundations for a mathematical model of the global brain: architecture, components, and specifications. Technical Report 2012-05. Available from: Link.

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