

Memory STSM

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Abstract. During my stay at UTS in Sydney in January 2010 I've worked with John Debenham in two topics. First the preparation of an ARC Discovery research project proposal. Second on the concept of ecological rationality as suggested by Nobel Award winner Hajek, and its application to agreement technologies. In particular to the definition of second order communication primitives.

1 ARC Proposal

I've written the main text of a proposal (SODS: Self-management in Open Distributed Systems) to be developed between 2011 and 2013 with Professors John Debenham and Simeon Simoff. The abstract is as follows.

Building self-managing open distributed systems is an urgent need in nowadays networked society. The combination of Virtual Institutions, argumentation and mining techniques as the solution to self-management is the scientific hypothesis that will be tested in SODS. We will show how socially organised groups of autonomous agents can govern such distributed systems and adapt them to their changing environment. To make the self-management operational we will develop an agent architecture with introspective and mining capabilities that will allow an agent to analyse its local environment, self-modify, and argue with other agents about the convenience of modifying their common governance model. An open experimental platform will be delivered and the results on self-management will be applied to two use cases that require that individual agents adapt to the changing environment and that groups of agents agree on changing their governance model. We will perform experiments using a mix of human and software agents to better understand the subtleties of self-management.

In SODS we will ground the theoretical research derived from the overall goal as expressed in the abstract in two case studies that match in a unique way the above set of characteristics. (See the case studies' description in Figure 1.) The case studies also help in strengthening the connections between Australia and EU research activities.

- **Case Study 1: Diplomacy Agent Testbed.** Developed at IIIA-CSIC, Barcelona, this testbed enables agents to play the game Diplomacy with humans and other agents. It will be used in SODS to experiment with (single) agent evolution. To play Diplomacy an agent must develop an understanding of the motivations of other players by observing their actions, and their subtle

<p>Case Study 1: Diplomacy. It is a classical board game (created in 1954) where players incarnate European powers at the beginning of the XXth Century that fight to dominate the continent. It is a game without chance moves and where negotiation/argumentation is the only tool of players, as no strategic playing can be reasonably made given its huge search space. Secretly or not, players negotiate co-ordinated attacks, peace treaties or generic alliances. Decisions on actions are then concurrently announced and the position of the units over the board modified according to some clearly established rules. The fulfilment of the negotiated agreements can thus be observed as well as the overall state of the game. Trust on the behaviour of the other players can therefore be built up.</p>
<p>Case Study 2: LiquidPub. It is a platform supporting a new way of scientific creation and dissemination funded by the European Union, www.liquidpub.org. The classical way scientific publications are produced, evaluated and credited, is being challenged by the use of modern computer science technologies. In particular, software versioning tools and reputation mechanisms make it realistic to think on a publication process where the publications are ‘liquid’, in the sense that they are persistently accessible over Internet and modified along time. Credit is then given to authors based on opinions, reviews, comments or simply the number of downloads of the different versions of his/her publications. This would produce many beneficial results, for instance, to reduce the current large number of very similar publications (i.e. salami papers) or to organise conferences by just searching for the most prestigious liquid publications satisfying certain keywords. The concept of a ‘liquid journal’ or ‘liquid conference’ can be simply understood as a virtual institution where the governance of the review/publishing process is determined by a number of well established procedures that can change along time.</p>

Fig. 1. Description of the case studies.

behaviours, as well as the reactions of other agents to their actions. Then the agent must adapt or evolve its own actions and behaviours in response to these observations.

- **Case Study 2: LiquidPub.** This case will be used to experiment with (multi) agent evolution. It is very challenging as the openness is potentially very high (the whole evolving scientific community of authors and reviewers) as well as its dynamics (opinions are generated all the time, papers are transformed into new versions). Differently to Diplomacy, in this case study, the governance of the interaction may change along time. The current infrastructure developed in the EU project LiquidPub (www.liquidpub.org) only allows for human participation. We will extend the infrastructure in this project to introduce agents that will mine the context and human behaviour patterns to implement self-management procedures. Again, the infrastructure is available though the IIIA-CSIC participant that is a partner in the EU project.

2 Ecologically Rational Agents

An ecological model of rationality is based on two basic notions: *everything* in the world is constantly changing and not *all* facts can be known by an agent. This rationality model is inline with an evolutionary view:

- **Knowledge evolves** (A philosophic point of view) The philosophers of science have long argued about what claims (i.e. knowledge) in a theory can be supported. Poppers view on the progress of knowledge sees falsifiability as the main driving force, and knowledge as an evolving body that follows a process in which a number of theories compete to account for a problem situation. When a set of theories is set, falsification is then the process that makes some theories fail, while allowing others to survive. In his view survival does not mean truth but fitness to the situation. The notion of truthlikeness is for Popper a notion of verosimilitude ($V(a) = T(a) - F(a)$) that accounts for the comparison between the truth content of theory a and the falsity content of a, which permits to rank theories. Although Popper would reject a complete theory as soon as empirical evidence would go against it, Kuhn would consider that scientists tolerate a certain level of anomalies for a long time until a revolution happens in which a complete new theory is accepted and an old one rejected. The reconciliation point made by Lakatos would be that scientific theories contain a hard core that contains the most crucial claims of the theory (and that by using common sense will be considered as facts) plus a protective belt of auxiliary hypothesis that in case of contradiction with the facts will be modified or removed while keeping the central core, of course until a major difficulty is found that leads to a drastic change of the core. In all cases, knowledge is dynamic and not necessarily incremental, and what was considered a fact yesterday may not be considered a fact today.
- **Individuals evolve** (A neuroscience point of view) Human individuals change due to their interaction with the environment. They learn how to behave through a number of basic learning processes (habituation, sensitization, conditioning) and they use their conscience to modify their view of the world (preferences, beliefs) as several psychological theories have proposed (e.g. Freud or Thagard). The learning process, that is, the evolution of individual behaviour, is caused by the environment the individual is placed in (e.g. a child practising five hours a musical instrument will certainly improve her abilities and will modify the ‘wiring’ in her brain) and by her genetic content that will make certain learning processes more efficient. Every perception produces subtle changes in the structure and intensity of the individual’s neural pathways.
- **Societies evolve** (An economic point of view) Institutions¹ are seen by Hayek as being the result of the accumulated wisdom of our forebears and are therefore to be respected. They are the product of years of social evolution by which they have been adapted, modified and experimented with, to make them what they are now. The social evolutionary process is persistent in response to an ever changing world. The mechanism by which social evolution occurs is as a result of the interactions between the self-interested agents

¹ Institutions are taken the broad sense to include mechanisms such as the “English auction” and ‘real’ institutions like the stock exchange or the fish market.

that populate them² — i.e. the law of natural selection at work. Institutions inhabit a competitive context with other institutions. The best fitted ones are those that survive.

There is an evident impossibility to ‘predict’ what will be the result of an experiment trying to invalidate a claim, what will be the impact of a perception in a human’s brain, or what will be the consequences of a certain institutional rule. Thus, (uncontrolled) evolution and its associated unpredictability are *fundamental* characteristics in human interactions.

The previous arguments, applied to humans and human societies, are even stronger when we face the design of *software agents*. If knowledge is dynamic and evolves along time, this will certainly be also the case for beliefs, or intentions of agents that will change constantly due to the interaction with the environment (or with evolving societies of humans). The same structure of the environment where agents and services appear and disappear all the time, and where every active component of the environment is not necessarily persistent in its goals or intentions, makes the view of the world imperfect and necessarily evolving along time.

Constructivist approaches, as those taken by Game Theory or Classical Logic, are influenced by both a platonic and aristotelian points of view. For Plato all the observations of a phenomenon (e.g. behaviour, shape, ...), are ‘imperfect’ realisations of an ‘ideal’ that represents the true phenomenon. The ‘ideal’ essence exists independently of the imperfect realisations. Aristotle had a completely static view of human societies and institutions. For him all human activities were the result of deliberate organisation of human actions by an organising mind. No notion of evolution or change was present in his thinking. The influence of platonism and aristotelism, specially by the adoption of his view by the church, lasted until the 18th Century, when the basis for the formulation of the evolutionary thinking in modern science was established.

An ecological approach is grounded on a fundamental evolutionary view that denies the existence of the platonic ‘ideal’ or the aristotelian static world, and that accounts for each observation as *genuine* and in *context*. The ‘order’ in an ecological approach is obtained by means of socially agreed upon conventions that *evolve* along time, much in line with the electronic institution approach [?].

A constructivist approach, based on the above mentioned essentialist and static views of the world is thus highly inappropriate for software construction.

Based on this view, an initial proposal to model communication primitive in multiagent systems is being proposed with the aim to submit it to one of the AAMAS workshops as a joint paper.

² In what ever role or capacity.