

# Simulating Agent Societies with PRESAGE

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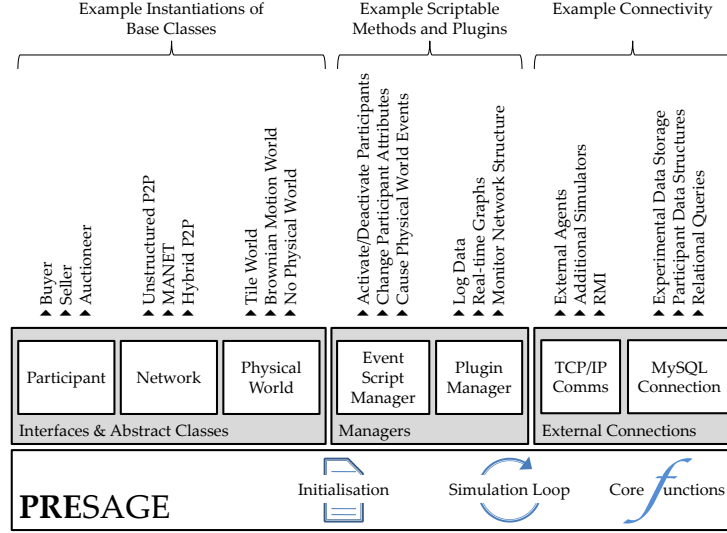
**Abstract.** PRESAGE is a simulation platform for rapid prototyping of Agent Societies. It enables designers to investigate the effect of agent design, network properties and the physical environment on individual agent behaviour and long-term collective global performance. This paper reviews a series of experiments in various domains, including e-commerce, ad hoc networks, and colored trails.

## 1 Introduction

PRESAGE is a simulation platform for rapid prototyping societies of agents. It offers designers a flexible and generic set of Java classes, interfaces and tools with which they can simulate agent societies. This facilitates systematic experimentation over the parameter space to determine the effect of agent design, network properties and the physical environment on individual agent behaviours, social relationships between agents, and long-term collective global performance. We have used it to study the socio-cognition of components, the evolution of network structures, and the adaptation of conventional rules, in various domains, including e-commerce, ad hoc networks, and intellectual property rights.

It is relatively straightforward to develop a prototype in PRESAGE. It is necessary first to define agent participant types: this can be done by extending the abstract class supplied with PRESAGE (to guarantee compatibility with the simulation calls and provide core functionality like message handling etc.) or by defining a new class. Then the network properties and physical world are defined, using or extending the given base classes. Finally, additional plugins and event scripts can be written for a number of uses including altering parameters, visualisation, data logging and user interface.

The PRESAGE architecture is illustrated as a software stack (Fig. 1) depicting the base simulation module, the interfaces and abstract classes, simulation managers, and the platform's connectivity to external processes. Above this we have given some examples of how the user could utilise each of the classes and modules e.g. an auction scenario operating over a unstructured P2P network with/without a physical world. As PRESAGE is a platform for developing testbeds, it is neutral to the specific scenario, enabling the platform to be used in a variety of agent based experimental tasks. In this “demo paper”, in the next section, we illustrate several applications of the platform in independent testbeds for experimenting with agent societies.



**Fig. 1.** Representation of the platform Architecture

## 2 Demonstrator Applications

PRESAGE has been used in the following experiments with agent societies:

*Trust and Economics in Decentralised Trading:* In this application of PRESAGE we study the use of socio-cognitive theories of trust and reputation for regulating behaviour in an agent-mediated marketplace which was both unmoderated and dynamic [1]. As well as demonstrating how distributed socio-cognitive mechanisms could approximate centralised solutions, this work illustrates the platform’s ability to support complex interactions between heterogeneous agents in the context of a simulated e-commerce environment.

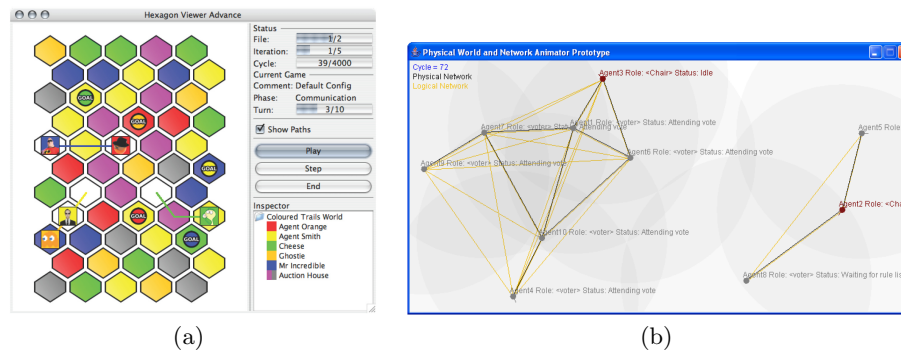
*Coloured Trails and IPR:* To demonstrate PRESAGE’s physical world environment we have developed an agent society version of the Harvard Coloured Trails [2] scenario, with colours and trails serving as an abstract representation of Intellectual Property (IP) concepts. We are using this test environment to investigate the provision of legal services such as Regulatory Compliance, Alternative Dispute Resolution and Law Making in agent societies (see Fig. 2a).

*Collaborative information filtering on unstructured P2P networks:* PRESAGE is used to simulate an agent society whereby peers self-organise the P2P overlay network based on their peer models such that the network itself becomes a collaborative information filter. This has been used to investigate the effect of different agent preference distributions and peer selection models on the structure of the emergent network and the population’s welfare distributions.

*Resource management:* In certain types of network, for example in virtual organization and ad hoc networks, it is a common problem to define a ‘fair’ collective decision-making mechanism for the allocation of a common resources and to

safeguard against either the over exploitation or under utilisation of resources. PRESAGE has been used as the basis of three investigations in this domain:

- Local inter-agent negotiation, combined with sanction and trust mechanisms, have been used to provide pareto optimal resource utilisation, diminishing the effects of illegal and anti-social behaviour on the collective welfare.
- A simulation was developed to investigate the use of a voting protocol to address the problems of hand-over and cluster formation in MANETs. This demonstrated how service delivery can be maintained in a MANET, where only a fraction of the society may be present, there is no centralised record of the decisions, and all the network nodes change over time (see Fig. 2b).
- PRESAGE has been used to investigate the adaptation of rules over time to optimise resource management in a network environment which is highly volatile.



**Fig. 2.** a) Colored Trails and IPR tile world b) Voting in MANET's

### 3 Summary

We have described the agent society simulation platform PRESAGE, and application domains which can be demonstrated. More information is in [3]. This work has been undertaken as part of the EU-funded ALIS project(IST 027968).

### References

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