

A computational logic model...



...for the description, analysis and verification of global and open societies of heterogeneous computees

The SOCS (SOcieties of Computees) project aims at providing a solid scientific foundation for the design of Global Computing systems.

Global Computing is a new technological vision where computing environments are composed of autonomous computational entities whose activity is not centrally controlled but is decentralised instead, either because global control is impossible or at times impractical, or because the entities are created or controlled by different owners. The computational entities may also be mobile, and the environment is open and evolves over time. Moreover, the behaviour of the entities may be heterogeneous and vary over time, and the entities may need to operate with incomplete information about the environment.

SOCS objectives

- To deliver novel descriptions of computational Global Computing entities, with heterogeneous knowledge, goals, and patterns of behaviour and interaction.
- To describe systems of such entities, capable of interacting in a global, open, and dynamically changing Global Computing environment.
- To provide tools for the specification, analysis and verification of properties of entities and their systems.

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technologies

Approach

In trying to achieve these objectives, SOCS interprets the Global Computing vision as follows. Entities are defined via Computational Logic, which is used to define their internal organisation, reasoning and their interactions. We call the entities **computees**, standing for “agents in computational logic”, and the systems composed of such entities **societies of computees**, as they are characterised by “social rules” governing the computees interaction and operation in the presence of each other.

SOCS has developed logic-based models for computees and their societies, integrating extensions of a number of existing Computational Logic techniques for temporal reasoning in a changing environment, hypothetical reasoning for dealing with incomplete information and agents’ communication, and argumentation for decision-making.

Achievements

SOCS developed the declarative **KGP** model for **computees** whose internal state consists of:

- a knowledge base (K) to reason with,
- goals (G) to be achieved, and
- plans (P) to achieve the goals.

Computees pursue their goals while being alert to the environment and adapt their goals and plans to any changes that they perceive, by exploiting their reasoning capabilities. Computees may be heterogeneous in their behaviour. Heterogeneity is achieved by a modular, flexible, and declarative specification of control.



Computees interact within **societies**. Interactions are declaratively specified via a society model, defined in terms of

- a knowledge base,
- a set of social rules representing interaction protocols,
- an operational framework based upon hypothetical reasoning to achieve the society’s goals, verify the compliance of computees’ behaviour with respect to the interaction protocols, and verify properties of these protocols.



Society Infrastructure



Using the underlying operational framework the society generates expectations about the ideal social behaviour of computees. The compliance of the observed behaviour of the computees is verified against such expectations at run time.

We have identified a number of **properties** of computees and their societies, such as those related to the formal characterisation of profiles of behaviour by computees and conformance to interaction protocols by computees within societies. The social operational framework has also been exploited in order to automatically prove properties of interaction protocols.

To experiment with the logical models and their properties we have developed **PROSOCS** (PROgramming SOcieties of Computees), a prototype platform supporting the implementation and deployment of societies of computees. The platform has been applied successfully in test-bed scenarios with a Global Computing flavour, both for individual computees and their interactions in terms of protocols. The scenarios range from auctions, e-commerce, and ambient intelligence settings.

