Research project

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Students required: *1*

Best strategy to identify opponents' profiles in multi-agent systems

The problem of assuring systems correctness is particularly felt in hardware and software design, especially in safety-critical scenarios. When we talk about a safety-critical system, we mean the one in which failure is not an option. To face this problem, several methodologies have been proposed. Amongst these, model checking [1] results to be very useful. This approach provides a formal-based methodology to model systems, to specify properties via temporal logics, and to verify that a system satisfies a given specification.

Notably, first applications of model checking just concerned closed systems, which are characterized by the fact that their behavior is completely determined by their internal states. Unfortunately, model checking techniques developed to handle closed systems turn out to be quite useless in practice, as most of the systems are open and are characterized by an ongoing interaction with other systems. To overcome this problem, model checking has been extended to multi-agent systems. In the latter context, temporal logics have been extended to temporal logics for the strategic reasoning such as Alternating-time Temporal Logic (ATL) [2], Strategy Logic (SL) [3], and their extensions.

However, when specifying properties for multi-agent systems, both ATL and SL have a significant weakness: they assume each agent has a known profile. Yet, some multi-agent settings require agents with different profiles, such as different personality traits in social structure modeling, different types of robots in robot fleets, different client versions in protocol analysis, or attackers with different levels in cybersecurity. A preliminary attempt to address this issue was presented in [4]; however, this approach does not consider probabilities associated with profiles, and further investigation is necessary to develop an optimal solution.

The aim of this project is divided in four macro steps:

1. Analyze the state of the art on formal verification for multi-agent systems with an emphasis on the concept of agent profiles.

2. Extend strategic logics with probability on profiles and reasoning about them.

3. Provide a verification algorithm for the new proposed logic.

4. Develop a module in the VITAMIN tool [5] that can solve the verification problem for the new logic proposed.

Bibliography

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