Model checking coalitional games in shortage resource scenarios

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Verification of multi-agents systems (MAS) has received much attention within the computer science community over the past ten years. In this scenario, systems are naturally modelled as game arenas. Therefore, an obvious choice for the specification formalisms is represented by the *Alternating-time Temporal Logic* (ATL), a logic oriented towards the description of collective behaviors and used as specification languages for open systems.

Recently, extensions of ATL have been proposed, enhancing the language with constructs to support verification of MAS with limited resources. The idea is that agent actions consume and/or produce resources, thus the choice of a given action by an agent is subject to the availability of the resources. Among such extensions, we mention the *Resource-Bounded Alternating-time Temporal Logics* (RB-ATL) by Alechina et al., and Bulling and Farwer's *Resource-Bounded Agent Logics* (RAL).

We introduce and study a new formalism, called *Priced Resource-Bounded Alternating-time Temporal Logic* (PRB-ATL), which is inspired to the ones mentioned above. We show that the model checking problem for PRB-ATL is EXPTIME-complete, by providing

- an EXPTIME algorithm solving it and
- a reduction from the acceptance problem for *Linearly-Bounded Alternating Turing Machines*, known to be EXPTIME-complete, to the model checking problem for PRB-ATL.

Since the proposed algorithm runs in exponential time in the number of agents, the number of resources, and the size of the representation of the maximum component occurring in the initial resource availability vector (assuming binary representation for it), three reductions are required in order to prove the inherent difficulty of the problem with respect to the three parameters. We exhibit two of such reductions; the problem of finding the third reduction is still open.