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RationalGRL: A Framework for Argumentation and Goal Modeling

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Abstract Goal modeling languages capture the relations between an information system and its environment using high-level goals and their relationships with lower level goals and tasks. The process of constructing a goal model usually involves discussions between a requirements engineer and a group of stakeholders. While it is possible to capture part of this discussion process in a goal model, for instance by specifying alternative solutions for a goal, not all of the arguments can be found back in the resulting model. For instance, the discussion on whether to accept or reject a certain goal and the ultimate rationale for acceptance or rejection cannot be captured in current goal modeling languages. Based on a case study in which stakeholders discuss requirements for a Traffic Simulator, we apply argumentation techniques from artificial intelligence to a goal modeling approach. Thus, we combine a traditional goal modeling approach, the Goal-oriented Requirements Language (GRL), with a formal Practical Reasoning Argument Scheme (PRAS) for reasoning about goals into a new framework (RationalGRL). RationalGRL provides a methodology, formal semantics and tool support to capture the discussions and outcomes of the argumentation process that leads to a goal model.

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1 Introduction

Requirements Engineering (RE) is an approach to assess the role of a future information system within its environment. An important goal in RE is to produce a consistent and comprehensive set of requirements covering different aspects of the system, such as general functional requirements, operational environment constraints, and so-called non-functional requirements such as security and performance.

Among the "early-phase" requirements engineering activities are those that consider how the intended system should meet organizational goals, why it is needed, what alternatives may exist, what the implications of the alternatives are for different stakeholders, and how the interests and concerns of stakeholders might be addressed [43]. These activities fall under the umbrella of goal modeling. There are a large number of established RE methods using goal models in the early stage of requirements analysis (overviews can be found in [23,37]). Several goal modeling languages have been developed in the last two decades as well. The most popular ones include $i*$ [43], Keep All Objects Satisfied (KAOS) [38], the NFR framework [7], TROPOS [17], the Business Intelligence Model (BIM) [20], and the Goal-oriented Requirements Language (GRL) [1].

A goal model is often the result of a discussion process between a group of stakeholders. For small-sized systems, goal models are usually constructed in a short amount of time, involving stakeholders with a similar background. Therefore, it is often not necessary to record all of the details of the discussion process that led to the final goal model. However, goal models for many complex, real-world information systems – e.g., air-traffic management systems, systems that support industrial production processes, or government and healthcare services – are not constructed in a short amount of time, but rather over the course of several workshops with stakeholders and requirements engineers. Developing goal models for such complex and large systems is not a trivial task and can be very cumbersome. In such situations, failing to record the discussions underlying a goal model in a structured manner may harm the success of the RE phase of the system development process.

The first challenge for the goal modeling phase, particularly in large projects, is related to its dynamic nature: goal models continuously change and evolve. Stakeholders' preferences are rarely absolute, relevant, stable, or consistent [25]. Stakeholders may change their opinions about a modeling decision in between two modeling sessions, which may require revisions of a goal model. If the rationales behind these revisions are not properly documented, alternative ideas and opposing views that could potentially lead to