RationalGRL

Table of Contents

1. Introduction 1

2. Background: Argument Schemes and GRL 4

2.1. Argument Scheme for Practical Reasoning (PRAS) 4

2.1.1. PRAS Example 5

2.1.2. Motivation for using PRAS 5

2.3. GRL 5

2.3.1. Motivation for using GRL 5

3. Modifying PRAS for Goal Modeling and Mapping it to GRL 5

3.1. Argument Schemes and Critical Questions for Elements in a Goal Diagram 6

3.2. Metamodel specification of an argument schemes language 8

3.3. Transformation between argument schemes and GRL diagrams 8

3.3.1. Information Mappings 8

3.3.2. Formal Mappings 8

4. The RationalGRL Methodology 9

5. Example 9

6. Empirical Evaluation 10

6.1. Study Design 10

6.2. Study Measures 10

7. Results 10

8. Related Work 10

9. Conclusion 10

# 1. Introduction

**Motivation**

* Goal modeling is a process carried out in the *early requirements phase* of an information system. In this process, a requirements engineer (RE) usually works together with a group of *stakeholders* to capture the relation between the envisione information system and its environment, the vision and goals of the company, relevant actors, their dependencies, etc.
* The result of this process is a goal diagram. A goal diagram thus captures the result of discussions between stakeholders and the RE, and in this way contains the *end product* of this discussion process. However, it does not capture all the discussions that lead to the final model.
* This makes it difficult for other users to understand why certain choices in the goal diagram have been made. Moreover, it is not possible to reason about *change* of underlying arguments on the goal diagram, and visa versa. Such reasoning is useful for what-if analysis.
* There are a large number of proposals that try to structure the discussion process between stakeholders, but there are less proposal that actually combine it with goal modeling. Of those proposal that do combine discussions between stakeholders with goal modeling, most of them are informal (e.g., techniques from social sciences). Those that are formal often use formal argumentation (e.g., Jureta *et al,* Murukannaiah *et al.*), combined with some IBIS-like approach, focusing on issues and arguments for and against solutions for these issues.
* However, the relations between the discussions and the final goal diagram is often not detailed in those proposals. The mappings from discussions to goal diagrams are often informal and therefore imprecise.
* Furthermore, IBIS is a very general approach to tackling "wicked problems". It is not clear how elements in an IBIS model relate to elements in a goal model. IBIS uses different entities in its language than goal models.
* Finally, some proposal apply techniques from formal argumentation directly. Formal argumentation is useful for reasoning about conflicting *beliefs,* but it is well-known in both the philosophical and AI literature that reasoning about beliefs is fundamentally different from reasoning about goals (Atkinson, Walton, etc).
* Thus, there is no existing framework that captures the discussions between stakeholders with a clear and formal traceability from these discussions to the resulting goal diagram. Moreover, there is no tool support.

**Research Questions**

1. What is a suitable formal framework to capture discussions between stakeholders underlying a goal model?
2. What is a suitable methodology to integrate discussions between stakeholers with goal modeling, such that goal model elements can be traced back to underlying arguments?
3. What is the effect of changing arguments on the goal model, and visa versa?

**Methodology**

* Our methodology is to use AI techniques for practical reasoning to formalize the discussions between stakeholders about the goal model. More precisely, we start with the so-called *argument scheme for practical reasoning* (PRAS) of the form "Actor ashould perform action A which will realise goal G which promotes value V" as the underlying argument for goal models (Atkinson, 2005)..
* We develop *critical questions* to guide argumentation about a goal model. A critical question is a possible attack on an argument, and can be used by the RE to raise discussion points among the stakeholders. For instance, a critical question to a contribution link between an element E1 an E2 is: "Does the contribution has side-effects that contribute negatively to other elements?"
* Besides from formalizing the discussion process, we also aim to develop a methodology that integrates argumentation with goal modeling.
* As the goal modeling language of our choice, we use GRL, because of its reputation as an intentional standard, its tool support, and the fact that it has a well documented metamodel and implementation.

**Results**

* We modify PRAS in order to be able to capture arguments about elements of a goal diagram, and we propose associated critical questions, which can be used to guide discussions about goal diagram elements.
* We formalize the new argument scheme and critical questions into a meta-model.
* We develop a formal mapping from our meta model to the GRL meta model.
* We develop a methodology to construct goal diagrams and associated arguments in parallel. The key element of our approach is that we view elements of a goal diagram as arguments that can be argued about through critical questions. Thus, the process consists of constantly switching between constructing the goal diagram and rationalizing it with arguments.
* We use a formal semantics for the arguments in order to computer which arguments are accepted (IN) and which are not (OUT). If an argument for an element is accepted, it will appear in the goal diagram. If it is rejected, it will be disabled.
* We develop three *coherence conditions* on the goal diagram and underlying arguments. The model is *inconsistent* if an element of the goal diagram is accepted according to some argument, but rejected according to others. The model is *imprecisenes* if there are arguments that are not related to any element of the goal diagram. The model is *incomplete* if there are elements in the goal diagram that are not rationalized by any arguments.
* We develop a methdology to propagate changes in both arguments and goal diagrams.
* We implement our framework in jUCMNav, the Eclipse-based open source tool for GRL modeling. We implement the traceability links between arguments and GRL elements, and we implement the coherence conditions using OCL rules.

**Success Criteria**

* We evaluate RationalGRL via a study in which 20 subjects apply RationalGRL or GRL to develop a goal modeling in a information system concerning national security. Our success criteria is that RationalGRL is superior to GRL with respect to completeness and coverage of goal search; size of the goal model; ease of use; explicitness in the assumptions made; and repeatability of conclusions across subjects.
* As a side effect, RationalGRL may require more time than GRL, but this should be justified by improvements in quality.

# 2. Background: Argument Schemes and GRL

## 2.1. Argument Scheme for Practical Reasoning (PRAS)

Practical reasoning in computer science can be seen as based on the practical syllogism. An example taken from Kenny (1975):

K1 I'm to be in London at 4.15

If I catch the 2.30, I'll be in London at 4.15

So, I'll catch the 2.30

This rule is the basis of means-end, which is used in many applications in AI such as planning. However, Watson (...) suggests that such reasoning is not quite right. There may for instance be alternative ways of achieving the goal, or the action may have side effects that make a more preferred goal impossible. Atkinson suggests therefore to regard practical reasoning as a species of presumtive argument. Given an argument like K1, we have a presumtive reason for performing the action. This presumption can, however, be challenged and withdrawn. Subjecting our argument to appropriate challenges is how we hope to identify and consider the alternatives that require consideration, and determine the best choice for us, in the particular context.

Walton proposes to use argument schemes and critical questions as an account of presumtive reasoning. The idea here is that an argument scheme gives a presumption in favour of its conclusion. Whether this presumption stands or falls depends on satisfactory asnwers being given to the critical questions associated with the scheme.

Atkinson (2005) then refines this argument scheme in order to reason about goal in a more detailed way. She proposes the following argument scheme:

**AS1** In the circumstancesR,

we should peform action A,

to achieve new circumstances S,

which will realise some goal G,

which will promote some value V.

She suggests 16 critical questions that can be used to question AS1. The original critical questions are:

CQ1: Are the believed circumstances true?

CQ2: Assuming the circumstances, does the action have the stated consequences?

CQ3: Assuming the circumstances and that the action has the stated consequences, will the action bring about the desired goal?

CQ4: Does the goal realise the value stated?

CQ5: Are there alternative ways of realising the same consequences?

CQ6: Are there alternative ways of realising the same goal?

CQ7: Are there alternative ways of promoting the same value?

CQ8: Does doing the action have a side effect which demotes the value?

CQ9: Does doing the action have a side effect which demotes some other value?

CQ10: Does doing the action promote some other value?

CQ11: Does doing the action preclude some other action which would promote some other value?

CQ12: Are the circumstances as described possible?

CQ13: Is the action possible?

CQ14: Are the consequences as described possible?

CQ15: Can the desired goal be realised?

CQ16: Is the value indeed a legitimate value?

\*\* Give example \*\*

\*\* Explain formal semantics with transition systems \*\*

## 2.1.1. PRAS Example

\*\* Give some elaborate example here to explain how PRAS works. \*\*

## 2.1.2. Motivation for using PRAS

We use PRAS because it fits the domain. It is more applicable than formal argumentation, which is good for reasoning about conflicting beliefs, but not for reasoning about conflicting goals.

\*\* Explain much more \*\*

## 2.3. GRL

\*\*Explain GRL\*\*

## 2.3.1. Motivation for using GRL

\*\* Write this \*\*

# 3. Modifying PRAS for Goal Modeling and Mapping it to GRL

Although PRAS can be used to formalize arguments used in practical reasoning, it cannot directly be applied to capture the process of arguing about a goal diagram.

One important difference is that in goal modeling, we are not making plans, or scenarios, for the information system yet. Of course, stakeholders may use scenarios to guide their thoughts when discussing the goal model (\*\*add reference that uses stories to construct goal models\*\*), but in the end the planning of the information system only occurs after the goal model has been created. However, the argument scheme above implicitly contains a notion of planning, namely to go from one state to the next state. We are currently in circumstance R, and by doing action A we arrive in circumstance S.

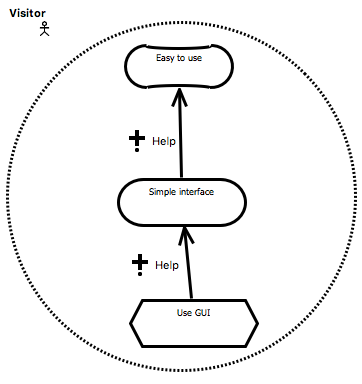
Moreover, there is no notion of "resources", or "tools", which are attributes that the actor uses to perform the action, in order to reach the goal. There are dependencies between actors, which is also an important element of GRL.

In GRL, realisation and decomposition links are more general than in PRAS. In fact, any GRL IE element can be realised/decomposed into any other GRL IE element. Therefore, we have to make these critical questions more general.

In order to understand this better, we first analyze what kind of arguments we can find in goal models in the next subsection. We then modify PRAS such that we can use it to argue about elements of a goal diagram in the subsection following that. Next, we provide a metamodel specification of the new language, and we map it to the GRL metamodel.

## 3.1. Argument Schemes and Critical Questions for Elements in a Goal Diagram

Consider the following simple GRL diagram:

****

We can detect various arguments in this diagram. In fact, each element and each relation can be see as an argument:

A1. Actor "visitor" has softgoal "Easy to use"

A2. Actor "visitor" has goal "Simple interface"

A3. Actor "visitor" can carry out task "Use GUI"

A4. Goal "Simple interface" contributes positively to softgoal "Easy to use"

A5. Task "Use GUI" contributes positively to goal "Simple interface"

We see that A4 can be seen as part of PRAS.

\*\* Explain here more about the relation with PRAS and these arguments above.

We now provide a mapping from elements and relations in GRL diagram to their arguments and critical questions. First, we provide arguments for elements.

|  |  |  |
| --- | --- | --- |
| GRL Element | Critical Questions | PRAS |
| Softgoal SG | Is the value indeed a legitimate value? | CQ16 |
| Goal G | Can the desired goal be realised? | CQ15 |
| Task T | Is the action possible? | CQ13 |
| Resource R | Is the resource available? | - |
| Actor A | Is actor A relevant?  Does actor A depend on other actors? | - |

Next, we propose arguments and critical questions for relationships.

|  |  |  |
| --- | --- | --- |
| GRL Relation | Critical Questions | PRAS |
| Task T contributes to goal G | Will the action bring about the desired goal?  Are there alternative ways of realising the same goal? | CQ3 |
| Goal G realises softgoal SG | Does the goal realise the value stated?  Are there alternative ways of promoting the same value? | CQ4 |
| Task T contributes to softgoal SG | Does the action have a side effect which demotes the value?  Does the action have a side effect which demotes some other value?  Does the action promote some other value?  Does doing the action preclude some other action which would promote some other value? | CQ8  CQ9  CQ10  CQ11 |

\*\* Explain here more why certain critical questions are ommitted \*\*

\*\* Think what we do with other relations. GRL admits many types of relations so we can also consider to add some generic ones \*\*

## 3.2. Metamodel specification of an argument schemes language

\*\* Provide the metamodel here \*\*

## 3.3. Transformation between argument schemes and GRL diagrams

## 3.3.1. Information Mappings

## 3.3.2. Formal Mappings

# 4. The RationalGRL Methodology

The methodology we propose in this paper is visualized below. There are two main activities, depicted in grey, namely "goal modeling" and "argumentation". These are two separate activities that are being done in parallel.

*consistency*

*condition*

Modify arguments

Answer critical questions

Modify argument graph

.....

Argument graph

Argument graph

Goal diagram

Modify diagram

View/add argument for element(s)

Goal modeling

Argumentation

# 5. Example

\*\* TODO: Finish this \*\*

Consider for instance the following discussion:

Stakeholder 1: "Our information system should definitely be easy to use"

Stakeholder 3: "Indeed, but it is also very important that it is fast"

Stakeholder 2: "Arent' these the same thing?"

Stakeholder 3: "I don' think so in general. An interface that is very easy to use may require more steps than a fast one"

Stakeholder 1: "That is true, but I think that in our case, because we have a very basic system, if our system is easy to use, it is also fast"

Stakeholder 2: "I agree."

Stakeholder 3: "Yes, that makes sense"

Thus, inititally stakeholder 3 argues that the system requires two separate softgoals, "fast" and "easy to use". Then, stakeholder 2 questions this, and stakeholder 3 provides a counterargument. However, stakeholder 1 counters this argument again, stating that in their system, they are actually the same thing.

# 6. Empirical Evaluation

## 6.1. Study Design

## 6.2. Study Measures

# 7. Results

# 8. Related Work

# 9. Conclusion