Applying Learning Style Models to Prioritize Conflicting Goals

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Abstract.

In this paper, we explicitly consider a learning style model to extend a goal-oriented requirements analysis method in order to characterize stakeholders' preferences in communication processes. The success of applying this method depends on the definition of the goals involved, and on the prioritization and selection among conflicting goals. Our proposal focalises on the resolution of this kind of conflicts studying the way people perceive, understand, learn and process information. The characterisation we consider would help analysts in situations where preferences, goals and skills, among relevant stakeholders are mismatched.

1. Introduction

Requirements Elicitation Techniques have widely used a family of goal-oriented requirements analysis (GORA) methods [2][4][5][7] as an approach to refine and decomposing the needs of customers into more concrete goals that should be achieved. Additionally, in the field of Requirements Engineering, goal-modelling approaches have received much attention in recent years by researchers and practitioners alike [10]. Such recognition has led to a whole stream of research on goal modelling, goal specification, and goal-based reasoning for multiple purposes, such as requirements elaboration, verification or conflict management. For example, one of these approaches uses scenarios to discover goals, where the discovery process is centred on the notion of Requirement Chunk (RC), which is a pair <Goal, Scenario> [8].

A goal is defined as "something that some stakeholder hopes to achieve in the future" [1], and it is expressed as a clause with a main verb and several parameters, which play different roles with respect to the verb. A scenario is "a possible behaviour limited to a set of purposeful interactions taking place among several agents" [1]. Then, scenarios are composed of one or more actions whose combination describes the behaviour of a complex system of agents. Actions can be of two types: atomic actions, which are interactions from one agent to another affecting some parameter; and flow of actions, which are refined into sequence, concurrency, iteration and alternative in order to compose several actions.

However an aspect that needs further discussion is how to consider goals when conflicts between stakeholders' perspectives arise. To deal with this situation, our proposal extends a version of a Goal-Oriented Requirements Analysis Method called AGORA [4], which is a top-down approach, with information of stakeholders' characteristics to resolve goals with conflicts. An AGORA goal graph is an attributed version of AND-OR goal graphs, whose parts can be described as follows:

- Attribute values are attached to nodes and edges, in addition to structural characteristics of the graph. There are two types of attributes:

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- A contribution value is attached to an edge to express the degree of the contribution of the goal to the achievement of its connected parent goal, and
- A preference matrix is attached to a node, i.e. a goal, and stands for the degree of preference or satisfiability of the goal for each stakeholder

- Rationale can be attached to an attribute as well as a node and an edge. It represents decomposition decisions associated to goal refinement and attribute value definition.

The stakeholders attach the value subjectively. However, they can use some systematic techniques, such as the Goals-Skills-Preferences Framework [3] and the AHP method [9], to assign more objective values. The contribution values and preference matrices help to choose suitable sub-goals. Basically, when a sub-goal is connected to an edge having a high contribution, it can be a candidate to be chosen as a successor of his parent goal.

The procedure to construct an AGORA goal graph involves decomposing initial goals, considered the needs of the customers, into sub-goals one after another. It is possible to have more than one sub-goal of a parent goal, and it is also possible to use two types of decomposition corresponding to the logical combination of the sub-goals – one is AND-decomposition and the other is OR-decomposition. In AND-decomposition, unless all of the sub-goals are achieved, their parent goal cannot be achieved or satisfied. On the other hand, in OR-decomposition, when at least one sub-goal is achieved, its parent goal can be achieved.

The contribution value of an edge stands for the degree of the contribution of the sub-goal to the achievement of its parent goal, while the preference matrix of a goal represents the preference of the goal for each stakeholder. The contribution value expresses how many degrees the sub-goal contributes to the achievement of its parent goal, and the higher the value is, more contribution the sub-goal provides.

A preference matrix expresses what degree a stakeholder prefers to a goal or it is satisfied, and is attached to a goal. Each of the value takes an integer from -10 to 10. Each stakeholder does not only attach the preference value on his own, but also estimates the preference values of other stakeholders. As a result, the preference of a goal is represented in the form of a matrix.

On the other hand, Cognitive Informatics has recently emerged as a promising area for dealing with inter-personal communication and behaviour. Z. Shi and J. Shi [11] describe Cognitive Information (CI) and cognition as follows: "Cognitive informatics studies intelligent behaviour from a computational point of view in terms of updated research efforts and progresses of brain science and neuroscience. CI is the interdisciplinary study of cognition. Cognition includes mental states and processes, such as thinking, reasoning, remembering, language understanding and generation, visual and auditory perception, learning, consciousness, emotions, etc".

As a part of cognitive informatics, some learning style models classify people according to a set of behavioural characteristics. This classification is used to discover common characteristic of stakeholders. For example, the Felder-Silverman Model [12] classifies people into the following categories:

- *Sensing or Intuitive,*
- *Visual or Verbal,*
- *Active or Reflective,*
- *Sequential or global*

This classification depends on the behavioural characteristics of learning. As a result of the classification, each person gets a rank for each category that suggests his or her preference. The preference for each category may be strong, moderate, or mild, showing how the analyst can determine which tool is appropriate for communication between stakeholders by using visual/verbal and reflective/active categories of stakeholders [6].

An AGORA's preference matrix includes the preference degree for each stakeholder, so we can identify the conflicts among them by analysing the variance on the diagonal elements of the matrix. In case of conflicts, we propose to extend the graph by considering concepts of Cognitive Informatics, more precisely learning models, to characterize stakeholders' preferences on communication. In the following section, we present our extension of the AGORA graph. Conclusions and future work are presented in the final section.

2. Cognitive Prioritization of Goals

There are two types of conflicts on goals that can be detected in an AGORA method; one is the conflict between goals and the other one is the conflict on a goal between stakeholders. The extension we propose uses the latter.

The variance of each column in the preference matrix of AGORA graphs can be used to recognize the gap of understanding. This kind of stakeholders' misunderstanding or misleading goal frequently results in inappropriate decomposition of the goal. If the variance is higher to a certain extent, the stakeholders have misunderstood or mislead the goal implied. Thus when the analyst finds a diagonal of the preference matrix of a goal with large variance, the relevant stakeholders would be forced to negotiate for the conflict resolution of the goal. In these cases we propose to take advantages of stakeholders' characteristics to perform conflict negotiation. To do so, we consider the use of the categorisation of communication tools based on the Felder-Silverman model.

A table to classify people in terms of Visual/Verbal and Active/Reflective categories is presented in Figure 1 [6].

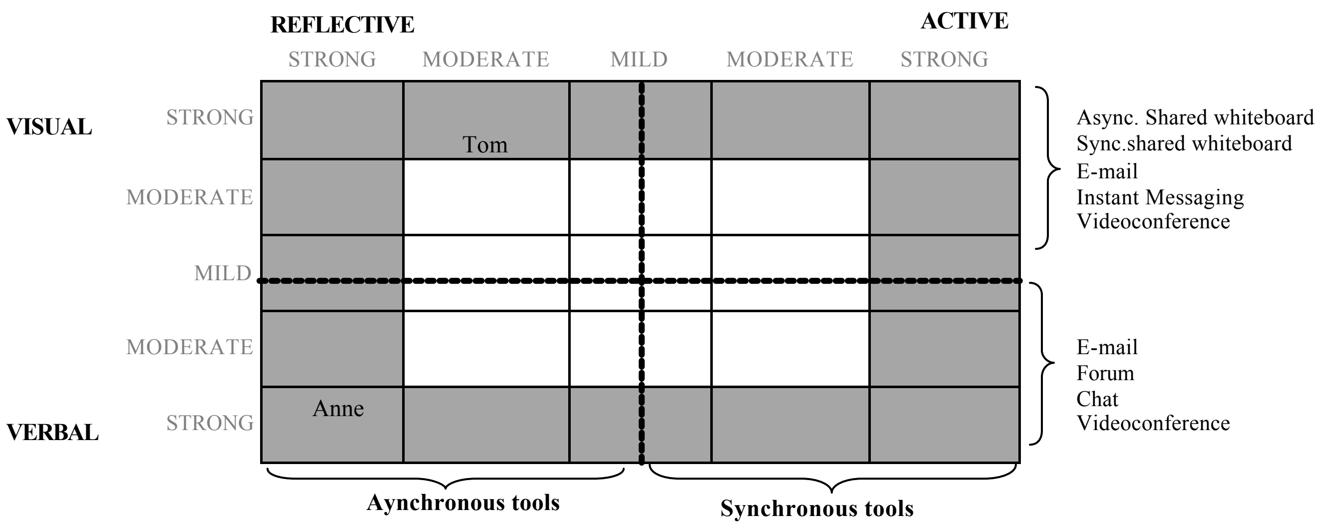

Figure 1

The figure above shows an association between the Felder-Silverman Model categories and groupware tool sets. With this table the analyst can determine which tool is appropriate for each stakeholder. As an example, if a person has a very strong preference for the visual dimension of the category visual/verbal, then the recommendation will be: assign groupware tools like shared whiteboard and videoconference. These people will be more comfortable working with media that let them take advantage of their visual abilities. The table is based mainly on strong preferences, since communication between stakeholders with mild or moderate preferences may not be significantly affected.

We propose to extend the mentioned classification to consider behavioural characteristics such as Sensing/Intuitive and Global/Sequential. These behavioural characteristics are not relevant in communication tools, but they are particularly important in the way people think and process information. We are currently working on a method to analyse people's characteristics as a taxonomy.

Thus, the preference matrixes with large variance would be associated to a technique (or a set of techniques) in order to analyse characteristics of stakeholders implied in the definition and commitment of a specific goal. Our method aims at improving communication and consequently reducing misunderstandings.

3. Conclusion and Future Work

The construction of AGORA graphs depends on communication-intensive tasks. This method involves stakeholders with diverse needs, preferences and characteristics. In any situation where two or more people must interact, diverse opinions arise; and the analyst has to discover common issues to facilitate negotiation of conflicting goals. We have used the Felder-Silverman Model to identify stakeholders' characteristics considering an analogy between stakeholders presented in the construction of the method and roles of learning models.

Now, we are working on the way this characterization will be taken on. Our extension would help analysts in situations where preferences, goals and skills, among relevant stakeholders are mismatched. Although this proposal is based on an extended AGORA method, it can also be used along with the KAOS meta model presented in [2].

4. Acknowledgments

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5. References

[1] CREWS Team. The CREWS glossary, CREWS Report 98-1. http://SUNSITE.informatik.rwth-aachen.de/CREWS/reports.htm.

[2] Dardenne, A. van Lamsweerde, and S. Fickas. Goal-directed Requirements Acquisition. Science of Computer Programming, 20:3–50, 1993.

[3] B. Hui, S. Lisakos, and J. Mylopoulos. Requirements Analysis for Customizable Software: A Goals-Skills-Preferences Framework. In Proceedings of the 11th IEEE International Requirements Engineering Conference, pages 117–126, 2003.

[4] H. Kaiya, H. Horai, and M. Saeki, AGORA: Attributed Goal-Oriented Requirements Analysis Method, Proceedings of the IEEE International Conference on Requirements Engineering, 2002, pp. 13-22.

[5] E. Kavakli and P. Loucopoulos. Goal Driven Requirements Engineering: Evaluation of Current Methods. In Proceedings of the Eighth CAiSE/IFIP8.1 International Workshop on Evaluation of Modeling Methods in Systems Analysis and Design, pages 1–10, 2003.

[6] A. Martín, C. Martínez, N. Martínez-Carod, G. Aranda, and A. Cechich. Classifying Groupware Tools to Improve Communication in Geographically Distributed Elicitation. IX Congreso Argentino en Ciencias de la Computación, CACIC 2003, La Plata, 6-10 Octubre 2003, (942-953).

[7] J. Mylopoulos, L. Chung, and E. Yu. From Object-Oriented to Goal-Requirements Analysis. Communications of the ACM, 42(1):31–37, 1999.

[8] C. Rolland, C. Souveyet, and C. Ben Achour, "Guiding Goal Modelling using Scenarios", IEEE Transactions on Software Engineering, 24(12), 1998, pp. 1055-1071.

[9] T.L. Saaty. The Analytic Hierarchy Process. McGraw-Hill, 1990.

[10] A. van Lamsweerde. Goal-Oriented Requirements Engineering: A Guided Tour. In Proceedings of the Fifth IEEE International Symposium on Requirements Engineering (RE'01), pages 249–259, 2001.

[11] Z., Shi, J. Shi. Perspectives On Cognitive Informatics. In Proceedings of the Second IEEE International Conference on Cognitive Informatics. (ICCI´03), pages 129-137, 2003.

[12] R. Felder , B. Soloman . Learning styles and strategies. http://www.ncsu.edu/felder-public/ILSdir/styles.htm (North Carolina State University)