AGORA: Attributed Goal-Oriented Requirements Analysis Method

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Contents

• Introduction

• How to analyze requirements with AGORA
  – using Small Example

• How to Predict the quality of a requirements specification document.
  – IEEE Standards 830
  – Quality Model for source code by McCall

• Conclusion and Future Works
GORA (Goal Oriented Requirements Analysis)

• Structural Decomposition of Goals,
  – decrease ambiguity.
  – concrete goals.

• Goal graph: a representation of such structure.

• GORA is useful to elicit, analyze and specify requirements.
Problems of GORA in General

• No clear criteria for goal decomposition.
• No clear way to resolve conflicts among goals.
• No clear way to select a most suitable goal from alternatives.
• No clear way to predict the quality of a req. document during analysis.
AGORA: An extended version of GORA

- Attributed Goal-Oriented Requirements Analysis = AGORA
- Attaching values to nodes and edges of the Goal Graphs
  - Edge: Contribution Value: How the sub-goal(s) contribute to the super-goal.
  - Node: Preference Value (matrix): How each stakeholder prefer the node(=goal)
    - predicting preferences of others.
  - Description of the reason for values (Rationale)
Analyzing Requirements with AGORA

• A simple example about constructing AGORA graph
  – comprehensive explanation of the notation and the procedure can be found in Proceedings.
A simple example:
WEB account system

A WEB account sub-system to register customers for e-business or e-learning

• For International use.
• For customers having Email account.
• Of course, High-quality.

They are initial needs, so they become initial goal.
Goal Decomposition (normal GORA)

- For international use
- For customers having Email accounts
- Web account system of high quality

- Easy to register an account
  - Everyone can register
  - one can complete to register immediately
  - No identification

- Safe
  - Identification
  - others do not register me
Contribution Value in AGORA

• It is attached to an edge.
• It expresses the degree of the contribution of the goals to the achievement of its connected parent goal.
• Range: -10 .. 0 .. +10 (harmful .. unrelated .. good)
Attaching Contribution Values

For customers having Email accounts

For international use

Web account system of high quality

Easy to register an account

Everyone can register

Safe

No identification

others do not register me

Identification

+10

+7

+10

+7

+3

+10
Analyzing Conflicts among goals

- For international use
  - Easy to register an account
    - one can complete to register immediately
      - Difficult to avoid this conflict
        - possible to resolve this conflict
          - No identification
            - Identification
              - Safe
                - others do not register me
                  - Web account system of high quality
                    - For customers having Email accounts
                      - +10
                        - +7
                          - -7
                            - +10
                              - +7
Resolve Conflict by decomposition

For international use

For customers having Email accounts

Easy to register an account

Everyone can register

No identification

Safe

Web account system of high quality

Anyone who have Email accounts can register

+5
+10

+7

+3

+10

-10

-7

Identification

Because ‘Everyone’ is not an initial goal, it may be weakened.
Resolve other Conflicts 1/2

For international use

Easy to register an account

For customers having Email accounts

Everyone can register

one can complete to register immediately

No identification

Identification

Web account system of high quality

Safe

For customers having Email accounts

Anyone who have Email accounts can register

+5
+10
+7
+3
+10
+10
+7
-10
-7
+5
+10
+7
+3
 Resolve Conflicts 2/2

For international use

For customers having Email accounts

Easy to register an account

Everyone can register

one can complete to register immediately

No identification

Identification

Identification by return of Email

Identification by SSN

Web account system of high quality

Safe

SSN = Social Security Number

Only a customer knows his own SSN, and we have a sub system to verify SSN.
Analyzing More Conflict

- Easy to register an account
- Safe
- Identification
- Web account system of high quality
- Identification by SSN
- Identification by return of Email

For international use

- For customers having Email accounts
- Everyone can register
- One can complete to register immediately
- Others do not register me
- No identification
- Identification

- SSN is used only in US.

+5 +10  +7  +3  +10  +5  +10  +5  +10  +7  +7  +10

+10  +10  -7
Preference Matrix

• It is attached to a goal.
• It stands for the degree of preference of each stakeholder to the goal.
• Each stakeholder should predict preferences of others.
  – Diagonal values are for themselves.
• Range: -10 .. 0 .. 10 (dislike .. unconcern .. prefer)
• It is not attached to all goals.

Evaluatee

\[
\begin{array}{ccc}
C & A & D \\
C & 8 & -7 & 0 \\
A & 10 & 10 & -10 \\
D & 5 & -10 & 0 \\
\end{array}
\]

Evaluator

C = Customer
A = Administrator
D = Developer
Example of preference matrix

- Everyone can register: +5
- Anyone who have Email accounts can register: +10
- Others do not register me: -10
- Identification by SSN: +7
- Identification by return of Email: +10

Preference matrix:

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>A</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>8, -7, 0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>10, 10, -10</td>
<td></td>
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</tr>
<tr>
<td>D</td>
<td>5, -10, 0</td>
<td></td>
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</tbody>
</table>

Imaging a return of Email manually
Imaging a return of Email automatically
Resolving misunderstanding by decomposition.

Everyone

Register immediately

Others do not register me

Identification

Identification by return of Email

Identification by SSN

Anyone who have Email account

No identification

+10

+7

+10

+10

+7

+10

By return of Email automatically and immediately

<table>
<thead>
<tr>
<th>C</th>
<th>A</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>8, 0, 0</td>
<td>10, 10, -10</td>
<td>5, 10, -10</td>
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</tbody>
</table>
Input user name and Email address

Issue an OTP and send it by Email

Register formally with the OTP

Reusable edges and arcs are deleted.

A Customer needs no less than three steps for registration.
Predicting the quality of Req. documents

- We can not know the quality until the analysis is finished.
- During the analysis, we want to improve the quality of analysis process based on the predicted quality of req. documents.
- In AGORA, we predict the quality of req. documents based on the values attached to an AGORA graph.
Quality characteristics of Requirements Documents

  - Correctness
  - Unambiguity
  - Completeness
  - Consistency
  - Verifiability
  - Modifiability
  - Traceability
  - Ranked for Importance and Stability

- It is difficult (or impossible) to measure them directly from a document.
Quality Factor by McCall

- McCall categorized the factors of source code quality.
  - Example: Correctness, Reliability, Efficiency..........

- It is hard to measure them directly, so he gave the following equation by calculating the factors indirectly.

  \[
  \text{Factor} = \sum (\text{Coefficient}_i \times \text{Metrics}_i)
  \]

- In AGORA, we export this idea into requirements documents.
Quality Factors and Metrics in Requirements Documents

- **Quality Factors**: using the factors appeared in IEEE standards and Davis book.
- **Metrics**: defining by the shape of the goal graph and the values attached to goals and edges.
## Coefficients for Req. Doc.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Metrics</th>
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**Example:**
Correctness = 0.5 * Sat + 0.3 * Pos + 0.2 * Cup

Set of these values above is an example, the values will be different in each analyst.
Metrics

• Vdv: The average of variance of vertical values in the preference matrix.

• How stakeholders share same preference or not.
  – $Vdv = 1 - \text{(the average of variance)}$
Factor: Unambiguity

• **Def:** A req. document has only one interpretation.

• This factor is directly calculated from the value of Vdv.

• Vdv = 0.14 in the following leaves, they are very ambiguous.

<table>
<thead>
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<th>Input user name and Email address</th>
<th>Issue an OTP and send it by Email</th>
<th>Register formally with the OTP</th>
</tr>
</thead>
<tbody>
<tr>
<td>8, 7, 0</td>
<td>-2, 10, 0</td>
<td>-3, 7, 0</td>
</tr>
<tr>
<td>8, 10, -3</td>
<td>0, 10, -5</td>
<td>0, 10, -3</td>
</tr>
<tr>
<td>5, 10, -5</td>
<td>0, 10, -8</td>
<td>0, 10, -5</td>
</tr>
</tbody>
</table>
Summary

• Propose a notation and techniques for Extended GORA, AGORA.
• Propose a way to predict the quality of req. document using AGORA graph.
Future works

• Propose a seamless way to convert goal graphs to a requirements document.
  – One of the idea is to regard leaves in a AGORA graph as a Use cases in a Use case diagram.

• Method and Tool to support AGORA.
  – Communication between stakeholders and analysts.
  – Patterns and Heuristics for constructing a goal graph.

• Method to decide the values in a AGORA Graph.
That’s All, Thank you