Helping end users understand and control intelligent agents

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• Making user interface adaptation in multi-device environments understandable to end users  
  [Fabio Paternò, Christian Sisti, & Giuseppe Zichitella]

• Transparency and controllability in user interfaces that adapt during run-time  
  [Matthias Peissner & Thomas Sellner]

• The role of explanations in assessing and correcting personalized intelligent agents  
  [Todd Kulesza, Margaret Burnett, Simone Stumpf, & Weng-Keen Wong]
Examples of agents

Recommender systems

Figure 3 shows the user interface of the tool for customization. It groups various types of properties. Some concern general attributes (e.g., font attributes), others refer to specific interactor types (e.g., radio buttons, listboxes). Then, we have the attributes that can have an impact on whether or not to perform page splitting and to what extent.

Figure 4 shows the result of adaptation on the example page with the parameters shown in Figure 3.

As you can see the result consists of three mobile pages, in the first one a couple of links (circled in red) to access the other two have automatically been included. However, if the customization parameters are changed, for example increasing the vertical tolerance and indicating that the scrolling to avoid is vertical, then we can obtain the results shown in Figure 5, in which only two mobile presentations are generated.

Adaptive interfaces

Classifiers

Recommender systems

Transparency ➤ Adaptive interfaces ➤ Classifiers ➤ Recommenders
Problems people face

- Trust & acceptance
- Usability & consistency
- Controllability

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How can explanations of the system’s features & reasoning (i.e., transparency) help end users?

Transparency ➤ Adaptive interfaces ➤ Classifiers ➤ Recommenders
Dear Customer,

It has come to our attention that your account Billing Information records are out of date. That requires you to update your Billing Information. Failure to update your records will result in account termination.

Click on the reference link below and enter your login information on the following page to confirm your Billing Information records...

Click on [http://store.apple.com](http://store.apple.com) confirm your Billing Information records.

Thanks,
Apple Customer Support
Just last week...

Is this spam?

Dear Customer,

It has come to our attention that your account Billing Information records are out of date. That requires you to update your Billing Information. Failure to update your records will result in account termination.

Click on the reference link below and enter your login information on the following page to confirm your Billing Information records...

Click on http://store.apple.com confirm your Billing Information records.

Thanks,
Apple Customer Support

Transparency helps us...

- **Understand** classifiers

- **Feel satisfied with** recommendations
  [Sinha 2002]

- **Act upon recommendations**
  [Herlocker et al. 2000, Cramer et al. 2008]

- **Work faster with** context-aware programs
  [Dearman et al. 2007]
But it also leads us to...

- **Misuse** agents in situations where they are unreliable
  [Dzindolet et al. 2003, Lim 2012]

- **Perceive a higher cost to working with the agent**
  [Bunt et al. 2012]
## Types of transparency

<table>
<thead>
<tr>
<th>Category</th>
<th>Type of explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ontological</td>
<td>What is…?</td>
</tr>
<tr>
<td>Mechanistic</td>
<td>How does it work?</td>
</tr>
<tr>
<td>Operational</td>
<td>How do I use it?</td>
</tr>
<tr>
<td>Design rationale</td>
<td>Why does it work like this?</td>
</tr>
</tbody>
</table>

[Haynes et al. 2009]
## What can be transparent?

<table>
<thead>
<tr>
<th>Source</th>
<th>Type of explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML model</td>
<td>Static explanation of how the classifier works</td>
</tr>
<tr>
<td>ML reasoning</td>
<td>Dynamic explanation of what the classifier currently “thinks”</td>
</tr>
<tr>
<td>Real-world evidence</td>
<td>Human-observable reasons for classification (including context)</td>
</tr>
</tbody>
</table>

[Lacave & Díez et al. 2003]
Transparent adaptations

- **MICA** [Bunt et al. 2007]
  - User always in control
  - Makes recommendations
- **MyUI** [Peissner & Sellner]
  - Mixed initiative approach
  - Customizations based on patterns

Transparency ➤ **Adaptive interfaces** ➤ Classifiers ➤ Recommenders
Transparent adaptations

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Transparency ➤ Adaptive interfaces ➤ Classifiers ➤ Recommenders
Controlled adaptations

• Paternò, Sisti, & Zichitella
• MARIA to model logical content
• Users can specify preferences and constraints for adaptation

Architecture of the Solution

We exploit the model-based framework M aria for performing a more semantically-oriented transformation. The framework provides abstract (independent of the interaction modality) and concrete (dependent of the interaction modality but independent of the implementation languages) languages. Such languages share the same structure but with different levels of refinements. A user interface is composed of a number of presentations. In each presentation there are groupings that identify the main logical parts and contain the interface elements, which are called interactors. Examples of interactors are navigators (allow moving from one presentation to another), activators (allow triggering functionality)…

Our solution is based on an adaptation server, which provides a number of functionalities:

- Reverse engineering, it automatically parses the content of the Web page and the associated style sheets and scripts, and builds a corresponding concrete logical description;
- Orchestrator, it receives contextual information and depending on it decides which adaptation transformation to apply;
- Adaptation, the graphical concrete description provided by the reverse module is transformed into a concrete description adapted for the target device, there are various adapters for each target platform;
- Generation, an implementation of the concrete description for the target device is generated.

The figure illustrates the architecture of our approach.
Transparent classifiers

- Why... explanations more effective than Why not... or How to...  
  [Lim et al. 2009]

- When dimensionality is high, there are still barriers to control 
  [Kulesza et al. 2011]
• Why... explanations more effective than Why not... or How to...
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Transparent classifiers

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“Explanatory debugging”

Transparency ➤ Adaptive interfaces ➤ Classifiers ➤ Recommenders
"Explanatory debugging"

```
2
Um, I think the first thing I should check are whether these grades match what they're supposed to match. So the letter grade is of the total possible points...which is here.

Where is the total possible points?
```

```
4
Let me look at this crazy statement. [looks at formula associated with G12]
```

```
5
It's giving it an F for an average of 79 which does not seem correct. Maybe I'll try one of these buttons.
```
“Explanatory debugging”

Sunday, May 6, 12
“Explanatory debugging”

Transparency ➤ Adaptive interfaces ➤ Classifiers ➤ Recommenders

Explanatory debugging

AutoCoder 1.0.3

1. Um, I think the first thing I should check are whether these grades match what they're supposed to match. So the letter grade is of the total possible points...which is here.

2. Where is the total possible points?

3. The word “where” followed by the character “?” in this or the preceding segment often means a segment is “Seeking Info”.

4. Absence of “don’t” in this or the preceding segment often means a segment is “Seeking Info”.

5. Highlight text in a segment to create a new suggestion here

Show more computer suggestions

Start a new suggestion

Let me look at this crazy statement. [looks at formula associated with G12]

It's giving it an F for an average of 79 which does not seem correct. Maybe I'll try one of these buttons.

Info Gained

Seeking Info

None
"Explanatory debugging"
Other forms of transparency

EnsembleMatrix
[Talbot et al. 2009]

ManiMatrix
[Kapoor et al. 2010]

Transparency ➤ Adaptive interfaces ➤ Classifiers ➤ Recommenders
• Combination of scaffolding and in-situ learning important for control
  [Kulesza et al. 2012]

• Reasons for recommendations can increase satisfaction & follow-up actions
  [Sinha 2002, Swearingen & Sinha 2002]

• Explanations can have negative impact on expert users
  [McNee et al. 2003]
Steering recommenders

- Interaction effectiveness depends on user characteristics
  [Knijnenburg et al. 2011]

- Cost/benefit ratio improves as users understand the system’s mechanics
  [Kulesza et al. 2012]
### Lim’s guidelines

#### Table 5.6: Design prescription of which intelligibility types to implement depending on the circumstances encountered by and functionality of the candidate context-aware application.

<table>
<thead>
<tr>
<th>Explanation Type</th>
<th>General</th>
<th>Application Behavior Inappropriateness</th>
<th>Situation Criticality</th>
<th>Application Goal-Support Role</th>
<th>Application Recommender Role</th>
<th>Number of Context Externalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
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<td></td>
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<tr>
<td>Output</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>High</td>
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<tr>
<td>Why</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Value</td>
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<td></td>
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<tr>
<td>Why Not</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Value</td>
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<td></td>
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<tr>
<td>How</td>
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<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Value</td>
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<td>What If</td>
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<td>Low</td>
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<td>Value</td>
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<td>What Else</td>
<td>Low</td>
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<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Value</td>
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<td>Visualization</td>
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<td>Situation</td>
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<td>Low</td>
<td>Value</td>
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</tbody>
</table>

= recommended, = highly recommended

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[Lim & Dey 2009]
Conclusion

- How can we improve existing techniques?
- What works best for end users?
- How generalizable are these solutions?