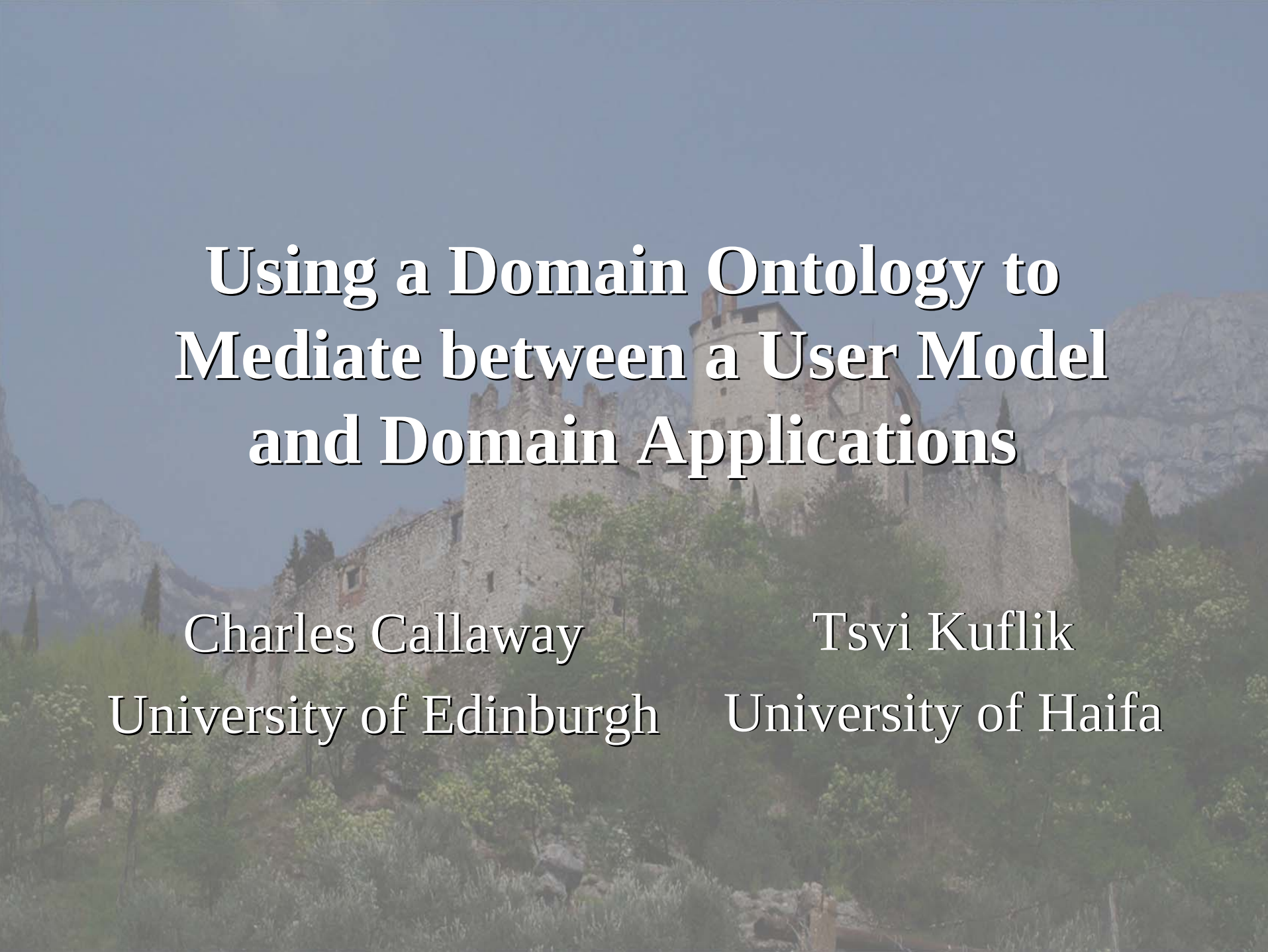

Using a Domain Ontology to Mediate between a User Model and Domain Applications

Charles Callaway
University of Edinburgh

Tsvi Kuflik
University of Haifa

Information Presentation

- Information providers have a lot of information to convey to their users
- Those users want only some of that information, presented in a meaningful way
- Thus information filtering and synthesis have become significant research areas
- Interactive applications that do this can be great sources of data for user models when users iteratively choose from filtered items

The Museum Domain

- Visitors see exhibits in some order (sequential, random, …)
- There is often not space on museum labels to put all interesting information
- Mobile technology can be used to enhance the experience with adaptive multimedia presentations

The Museum's Requirements

- But museums have additional interests besides the exchange and enhancement of information with their visitors
- Museums are also interested in being "sticky", where visitors are involved even after returning home, will want to return to the museum, or encourage others to visit
- Museum applications with user models can help both the museums and the visitors

An Expected Interaction

An interaction scenario might then be:

- The visitor enters the museum and gets a PDA
- The visitor provides basic UM seed data
- The visitor explores the museum, requesting information from the PDA on exhibits
- The visitor sees presentations, with the ability to cancel them or express interest in them
- When finished, the visitor returns the PDA and is given a customized printed report

Mobile Museum Presenter

- Uses infrared beacons to infer position and orientation
- Shows interactive movies that conveys the museum's content
- Allows the visitor to choose what information they see
- Cross-referenced by topic to allow the visitor to explore connections to other exhibits

Gathering User Model Data

- What:
  - Stereotypes (from age, occupation, etc.) via questionnaire when the visitor arrives
  - Interactions (exhibits and movies chosen), recorded by a user log as choices are made
- How? (intrusive vs. non-intrusive)
- Can enough data be collected for personalization? How intrusive must we be in order to collect enough?

The Museum's Requirements

- We can help museums be "sticky" while improving visitors' experiences
- One way is to create an individualized, adaptive post-visit report of a visitor's tour
- The report can help the visitor remember what they saw and link it to other information
- Ensuring the report is individualized makes it more likely the visitor while read it, take it home, and show it to friends.

Report Generation

At the end of the visit, a single-page report is printed before they leave the museum:

- Multimodal (email, paper)
- Containing text, images and hyperlinks
- Multilingual (English and Italian) as most visitors to major museums are international
- Containing relevant information that was missed, especially personalized information
- Recommendations for further information

Sample Report

Visit to the Buonconsiglio Museum

Tuesday, February 10th, 2004

This report is a summary of your visit to the **Buonconsiglio Museum**. Your visit was dedicated to the Cycle of Months in the Torre Aquila.

First you looked at a **fresco** which represents the month of January. The main theme of this fresco is a snowball fight. In the foreground two aristocratic groups are having a snowball fight. The whole scene is set in a snow-covered landscape. This scene is the first representation of this type in history.

Then you moved to a fresco which represents the month of February. The theme of this fresco is a tournament. Four **knights** are jousting against four other knights below the curtain walls.

This choice of a tournament for the month of February is related to jousts and revelries that took place in Carnival time. You seemed interested in this fresco. You spend long time in front of it and asked for additional information about **aristocracy**.

Then you moved to a fresco which represents the month of November. The main theme of this fresco are varied Autumn activities. Swineherds are driving pigs through the town walls. Hunters are busily engaged in bear hunting. **Trento** is host to many autumn events, such as the **Polenta Festival** and many nearby towns have **Wine Festivals**.

For further information about knights and tournaments:

The frescos of knights at the Castello Rodengo

Battle scenes at the Castello Avio

Other Castles in Trentino like the Buonconsiglio:

Beseno

Stenico

Thun

This report is a summary of your visit to the Buonconsiglio Museum. Your visit was dedicated to the Cycle of Months in the Torre Aquila.

You first looked at a fresco which represents the month of January. The main theme of this fresco is a snowball fight in the foreground by two aristocratic groups. The whole scene is set in a snow-covered landscape, the first representation of this type in history.

Then you moved to the fresco representing the month of February. The theme of this fresco is a tournament. Four knights are jousting against four other knights below the curtain walls.

Report Generation

- Such a report needs to aid the user in associating each paragraph with an exhibit
- It is also essential that the visitor understand that the report is individualized
- Variation can help accomplish this:
  - Different visitor paths through the space
  - Organization (sequential, thematic, …)
  - Perspective (artistic, historical, …)
  - Clustering and abstracting visitor interests to interpolate over missing user model data

Flow of Information

- The mobile presenter uses a knowledge base and initial user model stereotype, which is then refined by choices made during the visit
- The knowledge base is used to infer an interest model from the user model
- The interest model drives the report generator
- The two applications are completely discrete; only the mobile system changes UM data
- The report generator has no control over how the user model data is gathered or represented

Resulting User Model

Moved in front of January for 223.0s
  Started January-Fresco Overview
    Completed Presentation on HUNTERS
    Completed Presentation on CASTLE
      Stopped Presentation on CASTLE-WALLS

Moved in front of February for 192.0s
  Started February-Fresco Overview
    Completed Presentation on TOURNAMENT
      Completed Presentation on KNIGHTS
    Stopped Presentation on SPECTATORS
    Completed Presentation on BLACKSMITH

Exploiting the User Model

- The user model is not rich enough by itself to drive report generation
- It doesn’t know what abstract topics the visitor is really interested in
- Thus it can’t assemble a report centered around the visitors’ interests
- It also can’t supply the types of factual and narrative details needed in a report

Knowledge Base and Ontology

The report generator employs a KB:

- Unlike the user model, the KB can supply the requisite details for the report
- There is no existing text corpus that could replace the knowledge it contains
- It provides a common conceptual framework between the user model and applications like the mobile presenter and report generator
- It is organized around a hierarchical ontology

The Interest Model

- The user model does not tell us what exhibits in the museum the visitor is interested in, but only what he or she has seen
- It also does not describe what abstract concepts, such as gothic architecture, are interesting, especially across many exhibits
- Ideal personalized reports that are interesting to visitors are organized around these abstract topics, using specific items as supporting facts

Initial to Extended Interest Model

Initial

HUNTERS +
HUNTING-DOGS +
BADGERS +
SNOW +
CASTLE +
CASTLE-WALLS -

Extended

ARISTOCRACY +
ARIST.-ACTIVITIES +
ANIMALS +
WINTER +
ARCHITECTURE -
BATTLE -

Necessary Interest Model Operations

- Filtering: Removing or retaining particular interests that satisfy a filter condition, such as all artwork elements containing animals or farm implements.
- Clustering: Grouping similar interests under more abstract hierarchies, such as *aristocrats* from *lords* and *knights*.
- Sorting: Placing a series of interests in some logical order.
- Splitting: Separating similar items into groups depending on an external element, such as when similar items are distributed across multiple exhibits.
- Searching: Looking through the KB for items similar to a given interest, to populate the text with additional details.

Clustering in the Interest Model

- Describing individual interests in the report may result in multiple paragraphs about very similar elements
- We can implement a clustering algorithm instead, so that paragraphs describe abstract concepts with specific details of interest
- Clustering depends heavily on the ontology and knowledge base

Implementation

- Produces full page reports about 11 frescos in the *Castello Buonconsiglio* museum
- The reports can be in English or Italian
- Anecdotally, we have seen a large amount of variation in tests
- Has not been evaluated
  - User satisfaction?
  - Quantitative measurement of variation?
  - Return museum visits or web site hits?

Conclusions

- Report generation is beneficial to both museums and their visitors
- The text in these reports can currently only be produced with knowledge-based methods
- An interest model can be inferred from the user model collected by another application
- The KB helps bridge these applications
- Standardized operations (services) on the interest model can improve report quality

Adaptive Conclusions: Personalized Web Search

- Report generation is beneficial to both museums and their visitors
- Bag of words approaches do not work well when generating presentations with text
- KB-based interest models can be more fine-grained, but require much more effort
- Few web search applications use user models produced by another application, or have their user models used by another application

Adaptive Conclusions: Information Retrieval

- Report generation is beneficial to both museums and their visitors
- Information retrieval methods are not well adapted to organization and synthesis of textual presentations
- WordNet is not a substitute for a domain ontology or lexicon
- But initial stereotypical knowledge that is further refined is useful in both areas

Adaptive Conclusions: Group Collaboration

- Report generation is beneficial to both museums and their visitors
- Group user models may lead to homogenous presentations where only “average” or “bland” presentations are produced
- Museums want to present only expert information, not what is added by visitors
- Techniques for social collaboration may backfire if visitors are not compatible