Web Search Assistant

A Knowledge Base Application

Ed Powers, Ann Lee, Magdi Kamel
Naval Postgraduate School, Monterey CA
Overview

- Web Search Assistant
- Assumptions and Motivations
- Architecture
- User Interface
- Design Decisions
Web Search Assistant

- What is it for?
  - Assist a user in composing search terms for use in a Web portal

- What does it do?
  - Data Mining of OWL KB
    - Query the KB and find nodes that match user’s search term (via Jena)
    - Allow users to traverse the ontology KB graph, including inferred nodes (via Racer)
    - Allow users to lookup the definitions of the terminology they are browsing (via WordNet)
  - Web-based user interface
Web Search Assistant

How are we assisting Web search?
- Help a user map a concept or thought to jargon needed for Web search
- Help a user discover terminology in a domain
- Help a user feel confident that the terms they are finding are relevant

Why?
- Getting productive results from a Web search portal can be difficult when you are unfamiliar with the domain knowledge of a subject
  - No metadata for web content
  - Navigate through brute force indexing
Motivation for Project

- Attempt to create an application that can leverage a KB in a simple way
  - Learn about the middleware tools used to interface with a KB
- Participate in building an application that would be useful enough to motivate further ontology development
Assumptions

- Ontologies are valid and available
- Ontologies are of manageable scale
- Ontologies are marked up in OWL
Users

Who is the audience for the application?

- Average Web surfer
- Does not need to know about OWL or other kind of KB
- Has the need to find terminology to “zero in” on Web content in an unfamiliar domain
Web Search Assistant

What are the benefits of OWL Ontologies?

- Depict explicit Knowledge Representation (KR) of domain
  - Represent a real world domain in terms of objects and properties
- Use of semantics to depict relationships between classes and between individuals
- Ontologies are machine processed stores of human interpreted knowledge
- OWL is extended RDF/XML and is suitable for Web medium
Architecture

User

Search Assistant Application + KB

Web Search Portal (Google, etc)
Architecture
Architecture

- Tomcat Application Server
  - Java Servlets
- Racer Server
  - JRacer API
- Jena Libraries
  - OWL API
- WordNet
  - JWNL Java WordNet DB Interface
Architecture: Model, View, Controller

Diagram:
- Jena OWL API
- Java Servlets
- RACER Server
- WordNet
- Application Server (Tomcat)
- (local) OWL ontology
- OWL ontology
- "Controller"
- "View"
- "Model"
Example of Geography Ontology
User Interface

- Initial screen is simple input HTML form
### User Interface

![Image of Search Assistant](image)

**Search Assistant**

**Search String:** "City"

"City" is a Class

<table>
<thead>
<tr>
<th>Parents of &quot;CITY&quot;</th>
<th>Children of &quot;CITY&quot;</th>
<th>Siblings of &quot;CITY&quot;</th>
<th>Instances of &quot;CITY&quot;</th>
<th>Attributes of &quot;CITY&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body of land</td>
<td><strong>Def</strong></td>
<td><strong>Sel</strong></td>
<td><strong>Def</strong></td>
<td><strong>Sel</strong></td>
</tr>
<tr>
<td>Capital City</td>
<td><strong>Def</strong></td>
<td><strong>Sel</strong></td>
<td><strong>Def</strong></td>
<td><strong>Sel</strong></td>
</tr>
<tr>
<td><strong>City State</strong></td>
<td><strong>Def</strong></td>
<td><strong>Sel</strong></td>
<td><strong>Def</strong></td>
<td><strong>Sel</strong></td>
</tr>
<tr>
<td>Continent</td>
<td><strong>Def</strong></td>
<td><strong>Sel</strong></td>
<td><strong>Def</strong></td>
<td><strong>Sel</strong></td>
</tr>
<tr>
<td>Mexico City</td>
<td><strong>Def</strong></td>
<td><strong>Sel</strong></td>
<td><strong>Def</strong></td>
<td><strong>Sel</strong></td>
</tr>
<tr>
<td>Rio de Janeiro</td>
<td><strong>Def</strong></td>
<td><strong>Sel</strong></td>
<td><strong>Def</strong></td>
<td><strong>Sel</strong></td>
</tr>
<tr>
<td>State</td>
<td><strong>Def</strong></td>
<td><strong>Sel</strong></td>
<td><strong>Def</strong></td>
<td><strong>Sel</strong></td>
</tr>
<tr>
<td>Cape Town</td>
<td><strong>Def</strong></td>
<td><strong>Sel</strong></td>
<td><strong>Def</strong></td>
<td><strong>Sel</strong></td>
</tr>
</tbody>
</table>

User Interface

Search Assistant

Search String: "City State"

"City State" is a Class

<table>
<thead>
<tr>
<th>Parents of &quot;CITY STATE&quot;</th>
<th>Children of &quot;CITY STATE&quot;</th>
<th>Siblings of &quot;CITY STATE&quot;</th>
<th>Instances of &quot;CITY STATE&quot;</th>
<th>Attributes of &quot;CITY STATE&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>City</td>
<td>Capital City</td>
<td>Singapore</td>
<td></td>
<td>Located in Country</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Has Capital</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Has President</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Has Language</td>
</tr>
</tbody>
</table>
User Interface

The noun **singapore** has 3 senses (no senses from tagged texts)

1. Singapore, capital of Singapore -- (the capital of Singapore; one of the world's biggest ports)
2. Singapore, Republic of Singapore -- (a country in southeastern Asia on the island of Singapore; achieved independence from Malaysia in 1965)
3. Singapore -- (an island south of the Malay Peninsula)
User Interface
User Interface

Search Assistant

"Singapore" is an instance belonging to Class: City States

<table>
<thead>
<tr>
<th>Class of &quot;SINGAPORE&quot;</th>
<th>Parent Class of &quot;SINGAPORE&quot;</th>
<th>Siblings of &quot;SINGAPORE&quot;</th>
<th>Attribute names of &quot;SINGAPORE&quot;</th>
<th>Attributes values of &quot;SINGAPORE&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>City State Def Sel</td>
<td>City</td>
<td>Vatican City Def Sel</td>
<td>Located in Country Def Sel</td>
<td>Singapore Def Sel</td>
</tr>
<tr>
<td></td>
<td>Country Def Sel</td>
<td></td>
<td>Located in Continent Def Sel</td>
<td>Asia Def Sel</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Has Capital Def Sel</td>
<td>Singapore Def Sel</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Has President Def Sel</td>
<td>S.P. Nathan Def Sel</td>
</tr>
</tbody>
</table>
User Interface
Design Decisions Pending.

- How much of the restrictions and OWL semantics would be helpful to the users?
  - cardinality
  - equivalentClass
  - differentFrom
  - sameAs

- Visual reference to KB graph traversal
Conclusions

- Build it and they will come...
Questions/Comments