Domain-Specific Intelligent Search with Case-based BDI Agents

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Abstract

This paper presents the Web CBR-BDI agent architecture for effective and intelligent real-time search on well-demarcated domains on the WWW. The proposed architecture is based upon the integration of case-based reasoning (CBR) with the BDI agent architecture. The approach demonstrates the intelligent search capabilities of such agent based on the ability to learn from previous cases stored in a case memory, coupled with a domain-specific knowledge-base.

1. Architecture of Web CBR-BDI Agents

This research aims to demonstrate the efficacy of CBR-BDI agents in a well-demarcated domain by supporting the following features:

- **Efficient crawling:** ability to reuse knowledge from previous traversals, avoiding redundant and exhaustive search
- **Focused search:** utilization of domain-specific knowledge associated to well-demarcated logical domains on the WWW to support automated search guidance towards promising sites
- **Concept spanning ability:** capability of retrieving concepts that span more than a single Web page.

The proposed architecture (Olivia et al. 1999) not only accelerates the search process but also enhances resource discovery, finding a wider range of related pages that might not be retrieved using current Web-IR systems. Web CBR-BDI agents are designed to locate and extract topic-related information from target Web pages. The Web-CBR-BDI agent is implemented in a client-server architecture (fig. 1).

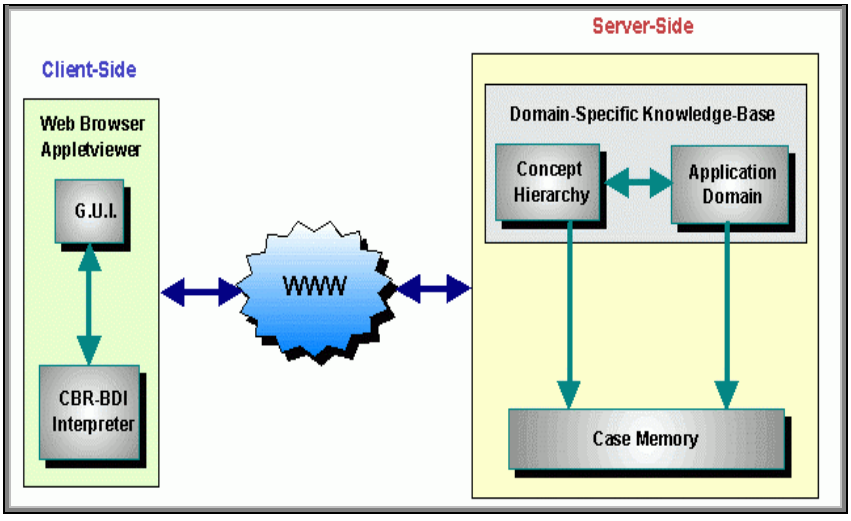

Figure 1. Core Components of Web CBR-BDI Agents

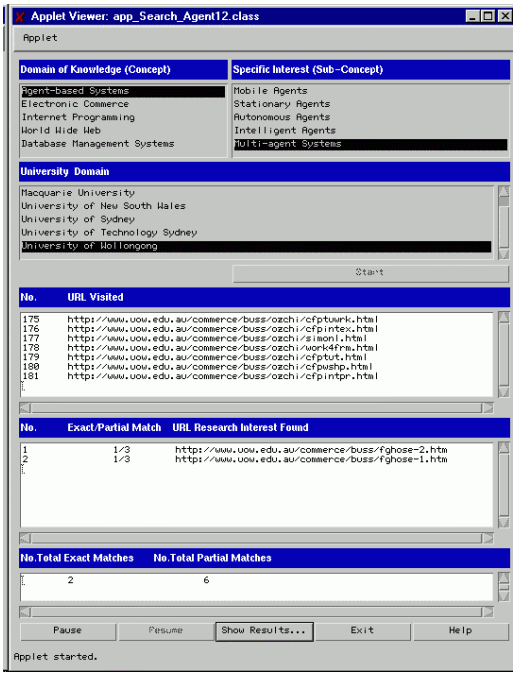

Figure 2. GUI Web CBR-BDI Agent

The implementation of a domain-specific knowledge-base contextual to the logical domain of interest coupled

with a case-memory in the server-side guides the search process to relevant and promising sites.

2.1 Domain-specific knowledge-base

The domain-specific knowledge-base is implemented in the form of a concept-hierarchy mapped to a well-demarcated application domain (e.g. educational, governmental institution, etc). The concept-hierarchy is composed of a set of keywords representing broad areas of expertise denoted as concepts. Attached to these concepts there are a set of keywords denoted as sub-concepts, representing specific sub-areas of expertise.

2.2 Case-Memory

Cases stored in the case memory are constructed in terms of the data structures of BDI agents (Rao and Georgeff 1995), together with the outcome of the intention performed (table 1). According to the basic philosophy of CBR, the solution of successful cases should be reused as a basis for future problems that present a certain similarity (Kolodner 1993). Similar cases are sorted by outcome status, directing the Web CBR-BDI agent to scan the most promising URLs, and leaves for the last stages of the search the less promising ones. The outcome URL leads the search directly to a promising URL from where to initiate the search, instead of traversing exhaustively the sub-webs of a particular site. Unsuccessful cases provide additional knowledge by preventing the agent from repeating similar actions that leads to unsuccessful results.

Belief	Well-demarcated domain to traverse (e.g. University domain)
Desire	Sub-Concept/Concept represents the specific/similar topic being searched (e.g. XML)
Intention	Focused search to concept-related entities in the application domain (e.g. faculties)
Outcome Status	Results of executed Intention (e.g. successful or unsuccessful)
Outcome URL	URL of concept-related entities in the application domain (e.g. Staff Link Directory of a faculty)

Table 1. Structure of the Case-Memory

3. Web CBR-BDI Agent Implementation

In our research prototype (fig. 2), Web CBR-BDI agents have been developed in JAVA™, designed to locate and extract information from Web pages of academics with specific research interests in a well-demarcated application domain such as Australian universities (Enguix et al. 1998). The concept-hierarchy is constructed based on the IEEE Internet Computing Classification Index and the ACM Computing Classification System, which is mapped to university academic-entities.

4.Conclusions

The current implementation of Web CBR-BDI agent has proved its efficacy in overcoming the limitations of current Web-IR systems by learning and reusing knowledge from cases stored in the case memory. The architecture provides guided search in any possible case towards relevant and promising sites. In addition, it is capable of performing a focused and staged search process to locate and extract concepts that span more than a single Web page. Another advantage is the flexibility supported by the domain-specific knowledge-base component, adaptable to any well-demarcated application domain on the WWW.

5. References

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