Knowledge-Based Information Retrieval for Group Decision Support Systems

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Most Group Decision Support Systems do not include automated or even rudimentary information retrieval capabilities to aid users in making better decisions. Participants must often rely on the meeting facilitator for their information requirements, but it is difficult for the facilitator to comprehend the complex information requirements of the group members. A prototype knowledge-based information retrieval agent which supports a Group Decision Support System has been developed at the University of Mississippi. This prototype allows group members to query an on-line knowledge base of facts using normal English syntax, obviating the need for group members to know the location of relevant information or how to retrieve it. A case study of student groups using this information retrieval agent demonstrates the feasibility of the technique for the support of Group Decision Support Systems.

Group Decision Support Systems (GDSSs) are helping many organizations make better, quicker decisions (George, et al., 1992; Huber, 1984). These computer-based systems are typically implemented in a face-to-face environment on a local area network and are used by group members for the anonymous and simultaneous exchange of ideas and preferences. However, group members using these systems often have limited access to supporting information contained in on-line organizational databases, knowledgebases, or textbases (Conlon, et al., in press). Group members may be required to find necessary information themselves, or they may rely on the meeting facilitator to access the information. Group members may not know how to access information from on-line sources.

The facilitator may not be able to keep up with information requests and may have an inexact understanding of the group’s information requirements. In this paper, a prototype GDSS with integrated knowledge-based information retrieval support which alleviates these problems is presented. Using this system, group members obtain required information directly from the system through natural language based queries in much less time with greater accuracy.

The following section describes the information retrieval problems existing in current GDSSs, followed by the section on information retrieval using a knowledge-based approach. The proposed prototype which integrates a knowledge base with a GDSS and its advantages are discussed in detail in the section, Knowledge-Based Information Retrieval in GDSS. Then, a case study is presented which demonstrates the efficiency and effectiveness of the knowledge-based approach. The conclusion summarizes the paper.

Problems of Group Decision Support Systems

The inability to obtain desired supporting information or ignorance of the availability of this information is a major problem in many meetings. In a top-level management meeting in which executives from each functional division may be present, information requirements could include the sales for the previous month, production and inventory status, financial ratios, etc. If group members do not bring this information with them to the meeting, they may ask fellow meeting participants, staff personnel, or the group leader to
Information Retrieval Using a Knowledge Base

Many systems incorporate knowledge bases for information retrieval, of which RUBRIC (McCune, et al., 1985) and SCISOR (Jacobs and Rau, 1990) are perhaps the most similar to the system described later in this paper. These two knowledge-based text retrieval systems are described briefly below as an introduction to our knowledge-based system.

RUBRIC (RULE Based Retrieval of Information by Computer) consists of a knowledge-base of retrieval rules which provides automatic access to unformatted textbases. Heuristic weights are incorporated in each retrieval rule to improve the precision and recall (accuracy). When a query is presented by the user, RUBRIC’s modifier rule analyses the auxiliary and primary evidence present in the query to calculate the strength of the conclusion. RUBRIC sorts the source documents by the order of their calculated relevance and can give a detailed explanation why a particular document was selected, which helps in knowledge base maintenance.

SCISOR (System for Conceptual Information Summarization, Organization, and Retrieval) was designed primarily to extract information from on-line news stories regarding takeovers. Its design uses the semantic and key word approach of information retrieval. SCISOR performs text analysis and question answering in constrained domains, and queries can be in the form of normal English questions. SCISOR consists of a topic analyzer which filters irrelevant information and conducts lexical analysis involving key word searches and pattern matching on the filtered information. Weights are used with the key words in this stage. The pattern matching process in SCISOR is similar to the modifier rule of RUBRIC. The total score of the story is the sum of scores of positive, confirming patterns minus the sum of negative, refuting patterns.

A combination of language-driven (bottom-up) and conceptual (top-down) analysis is used to process the unformatted text. SCISOR’s TRansportable Understanding Mechanism Package (TRUMP) performs the bottom-up analysis and TRUMPET (TRUMPET) performs the top-down component of the analysis. After these analyses, the story is added to the central knowledge base. When queried, the conceptual retrieval component accesses information in the knowledge base by analyzing English questions in the same manner by matching questions to the stored text. SCISOR also provides the user with a hot window for the latest takeover information and other windows for more general information regarding specific takeovers.

Both of these systems use the knowledge-base approach for retrieving information. But these systems are not designed for use with a GDSS; they mainly concentrate on organizing and retrieving information presented in unformatted texts. The prototype described in this paper makes use of some of the characteristics of both systems to make it suitable for a Group Decision Support System. Also, as the basic function of the knowledge base presented here is to provide information support for a GDSS, it differs from SCISOR and RUBRIC in that it uses formatted textual information.

Knowledge-Based Information Retrieval in a GDSS

The main goals of integrating knowledge-based retrieval with a GDSS are 1) to help users more readily obtain information on their own (efficiency) and 2) to provide more accurate information to the group to aid in decision making (effectiveness). The design of the knowledge-based information retrieval agent was driven by these two goals.

The Design

The design of the information retrieval system is based partly on the rule-based approach of RUBRIC and the bottom-up, top-down approaches of SCISOR. Bottom-up analysis starts with a parse of the query, identifying linguistic structures and mapping these structures into a conceptual, rule-based framework. The top-down approach starts with conceptual expectations and tries to fulfill these expectations from the key information present in the query. The prototype supports queries presented in the form of English questions (entered as a comment with the GDSS brainstorming soft-
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