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Computer Mediated Analysis of Asynchronous Discussion Forums

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Abstract: In order to perform a multi-aspect analysis of the progress and results of discussions, an instructor must obtain various information from asynchronous discussion forums. An instructor spends a lot of time and effort to perform this work. However, often this does not lead to desired results. A computer-mediated approach to provision of instructor with various information from asynchronous discussion forums is being suggested. This approach adapts information extraction from forums to information requirements of an instructor. The approach assumes sequential performance of the following major functions: presentation of instructor's information demand in a simplified format; building of forum's structure in accordance with information demand of the instructor; reduction of forum's structure by means of the most suitable algorithm; presentation of forum's extracts to the instructor. The approach is based on adaptation of forum structure to the changes in instructor's demands. It means that building of forum structure of a certain granularity level and the choice of a structure reduction algorithm are performed according to an information demand of the instructor. As a result, each extract corresponds to an instructor's information demand. Fragments of an extract can be taken out from one or several forums and can be presented on several granularity levels. The results of information extraction depend on changes in instructor information demands. The proposed approach is a constructive basis for development of an intelligent tool for adaptive extraction of information.

Keywords: Analysis of Discussion Forums, Adaptive Extraction of Information

Introduction

MORE AND MORE university and college faculty members are developing fully online courses instead of using the traditional in class teaching method. Online instruction and learning enable instructors to administer their online courses and students to learn the content of these courses from anywhere at any time. The communication between instructor and students as well as the communication among students themselves can be done through different computer-mediated communication (CMC) tools (Konijn, Utz, Martin, Barnes, 2008; Masakazu, Shuichiro, 2009). These tools are divided into two types: synchronous and asynchronous (Branon, Essex, 2001; Solomon, Whitman, Woszczynski, Hoganson, Mattord, editors, 2008).

The most widely used asynchronous tool for the purpose of increasing interaction and collaboration among participants in an online course is the discussion forum. Asynchronous discussion forums are extensively used in distance learning (Dringus, Ellis, 2005) for establishing discussions focused on the content of the online course and for providing high level interaction in various dimensions, including student-to-student, student-to-teacher, and teacher-to-student interaction (Dringus & Ellis, 2004; Moore, 1989). They allow for active

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learning, since students can create knowledge by working together on the materials of the online course and participating in on-going discussions focused on course content.

In online course, an instructor must perform a multiple aspect content analysis (Bali, Ramadan, 2007) and evaluation of the progress and results of discussions (Marra, More, Klimczak, 2004). In order to do this, the instructor must form various information extracts from forums. This is complicated work because on one hand, a large number of forum participants leads to high volume of discussion information (Andresen, 2009) and on the other hand, instructor's information demands (IIDs) are changeable.

In order to overcome these difficulties, an approach providing adaptive information extraction from forums is required (Turmo, Ageno, Catala, 2006). Such approach should ensure adaptive provision of instructor with various extracts of information from forums in response to changes in instructor's information demands.

Related Research

There are two approaches to adaptive information extraction: expert-driven information extraction and user-driven information extraction.

Expert-driven information extraction (Kushmeric, Bernd, 2003; Turmo, Ageno, Catala, 2006) is based on using a learning system and domain experts that train the system according to their own opinions. Information offered to an instructor in such systems is bound by the goals, information preferences, and the information of experts. As a result, such methods are not flexible and adaptation to instructor's information demands is not available.

User-driven information extraction (Anders, 2003; Ciravegna, 2001) applies various learning techniques, but mostly they assume the formation of learning patterns by an instructor. The use of data mining methods for evaluation asynchronous discussions forums has been proposed in work (Romero, Ventura, 2007). Yet, these methods are too complex for implementation. Moreover, an active role of the instructor in user-driven information extraction is an obstacle for fast development and fast changes of his information demands.

All above-mentioned approaches do not allow flexible provision of the instructor with various forum extracts of different granularity levels during fast changes in instructor's information demands. The granularity levels may correspond to words, sentences, phrases, paragraphs. It is assumed that the changes of IIDs cause frequent switches from one kind of extract to another according to required granularity level of the forum. IIDs are defined in this paper as instructor wishes to receive various extracts from the forum. We assume that an extract is an aggregate of interrelated forum fragments presented on a single or multiple granularity levels.

To overcome the above-mentioned drawbacks, we suggest an approach to provision of instructors with a variety of extracts from forums.

Description of the Approach

The goal of the approach is to minimize the gap among instructor's information demands, forum content, and the forum extract supplied to the instructor.

This approach provides for adaptation of forum's structuring and structure reduction according to the changes of instructor's information demands. Such adaptation is expressed in terms of:

1. Construction of forum's structures
2. Choice and implementation of algorithms of forming the forum extracts.

A forum structure is constructed as a result of forming interrelations between the forum fragments in response to instructor's information demands. According to the above-mentioned, the forum fragments may be presented on a single or various levels of forum granularity. A forum extract is formed as a result of reduction of forum's structure. Reduction of the forum's structure is building a forum's sub structure corresponding to a specific IID. This is done by a suitable algorithm. Consequently**,** required forum extract is a set of interrelated forum fragments selected from the forum.

The proposed approach to adaptive information extraction from forums realizes sequential performance of the following major stages:

- Representation of the instructor's information demand
- Construction of forum's structure corresponding to the instructor's information demand
- Building of the forum extract and its presentation to an instructor.

Representation of Instructor's Information Demand

Information demands are expressed by an instructor as wishes to receive various forum extracts.

The suggested simplified model **F** for representation of the instructor's information demand is**:**

$$\mathbf{F = < G, S >}, \qquad (1)$$

where,

G - the granularity level of instructor's information demand
S - the subject of instructor's information demand.

The granularity level defines the type of forum fragments used to build an information extract. The first (lowest) granularity level is the level of forum's words next types:

- a noun or a noun group
- a pair of related nouns/noun groups presented in one sentence
- a verb or a verb group

The next granularity level is the level of sentences. The paragraph level of a forum is chosen for the third level and so on. For example, a statement of a forum participant is a type of forum fragment of the fourth level. It contains several paragraphs.

The subject of IID is a type of the desired forum extract. The subject could be represented as follows:

- a combination of certain nouns/noun groups(phrases) required by a instructor from the forum
- a secondary theme relative to a certain nouns/noun groups, and expressed by a set of sentences that contain these nouns/noun groups
- a forum content relative to the minor theme, which is expressed by set of paragraphs

- the main theme of the forum

A change of instructor's information demand is expressed as the change of component values of the format (1).

An obtained forum extract corresponds to an instructor's information demand.

After representation of instructor's information demand according to the model (1) identification of this demand is realized. Identification consists of setting a correspondence between the set of values of format (1) and entrance parameters of the processes of building of forum structure and its reduction.

Construction of Forum Structure Corresponding to Instructor's Information Demand

A forum structure is constructed based on the certain instructor's information demand. The information demand is represented according to model (1). The forum structure has the following parameters:

- The forum fragments
- Significance of a forum fragment for instructor
- Connections between forum fragments
- Types and strengths of the connections.

The forum fragment included in the forum structure is selected from fragments of a certain granularity level of the forum.

Significance of a forum fragment for instructor is a dynamic evaluation. Significance of forum fragments from different granularity levels is determined sequentially in the following way. Significance of a word fragment is determined from the point of view of a present IID and its connection with other words in the forum. For example: significance of the word A in the subject of the demand is maximal. Significance of words B, C, D is less because they are directly connected to the word A i.e. allocated in the same sentence. Significance of words connected with the words B, C, D is even less, etc. Significance of a sentence is calculated based on significances of words. Significance of a paragraph is calculated based on significances of sentences and so on.

There are the following possible types of connections among forum fragments: content, structural, associational, timely, ordinal, taxonomic, referential, etc.

For example, the type of connection between the two forum paragraphs is content; connection strength is the number of identical words (nouns) in paragraphs. If there are no such nouns in paragraphs, then there will be no content connection between them.

The formation of the forum structure corresponding to the specific IID implies:

1. The choice of the aggregate of forum fragments of a certain granularity level
2. Calculation of significance of the chosen forum fragments for instructor
3. Fixation of the connections of certain types among the forum fragments
4. Determination of connection strengths.

The process of construction of forum structure is synchronized with the changes of IIDs. Such synchronization provides adaptability of the forum structure.

The construction of a new forum structure of a different granularity level is caused by IID of another level in comparison with the previous IID.

Building of the Forum Extract and its Presentation to an Instructor

The forum extract is built as a result of reduction of the forum structure. Reduction of the forum's structure consists in building a forum's sub structure corresponding to a specific instructor's information demand.

Reduction of the forum structure is preceded by:

- Formation of nomenclature of forum structure reduction algorithms
- Determination of the correspondence between the algorithms and the subjects of instructor's information demands (that is for every subject of IID a suitable reduction algorithm is set).

1. Selection of an algorithm corresponding to the subject of a specific IID from the list of reduction algorithms
2. Reduction of the forum structure by means of the chosen algorithm
3. Receiving of the forum extract in the form of a reduced forum structure.

Presentation of the forum extract to the instructor is a result of the substitution of formal parameters of the reduced forum structure for the real fragments of the forum.

Conclusions

The proposed approach to information extraction from forums provides adaptation of forum structuring and forum structure reduction to the changes of instructor's information demands.

A new forum structure is constructed for each forum granularity level according to instructor's information demand. It decreases significantly the time of reaction to instructor's information demands. This is an important advantage in comparison with the approach that involves the initial construction of a generalized forum structure and its subsequent adaptation to a specific instructor's information demand.

Development of the approach in the near future will enable performance of the following functions:

- Prediction of changes in instructor's information demands
- Provision of forum extracts to instructor as a result of automatic generation of modifications of instructor's information demands

The approach is a constructive basis for development of an intelligent tool for adaptive extraction of information. It will provide on-line response to instructor's information demands by means of flexible and dynamic reactions.

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