Combining Coherence and Adaptation in Discourse-Oriented Hypermedia Generation

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Abstract. This paper provides a solution to discourse structure adaptation in the process of automatic hypermedia presentation generation. Existing approaches to discourse structure composition are based on the assumption that a user can comprehend relations between the elements in a discourse structure if the overall structure is semantically coherent. This assumption does not, so far, take into account specific user needs. In this paper we show that although discourse structure composition approaches significantly differ, a general model of the composition process can be derived. Within this general model we identify how adaptation can be applied. We formulate the problem of discourse adaptation with regard to the general model and present our proposed solution.

1 Introduction

One of the main goals in semantic-based hypermedia presentation generation research is to provide higher-level conceptual structures that ensure coherent organization of media assets for a particular presentation in the context of a dynamic heterogeneous environment [1, 4, 5, 6]. This goal is achieved by creating discourse structures that are motivated by existing genre theories [2, 7]. It is assumed that a user can comprehend relations between the elements in a discourse structure if the overall structure is semantically coherent. This assumption does not, so far, take into account specific user needs. For example, users with different knowledge in the domain might have different views on what organization of concepts in the discourse structure is more coherent.

To address this problem we propose a flexible adaptation layer that can handle a dynamic discourse composition process and that is independent of this process. Our goal is to provide adaptation to improve coherence in the discourse structure composition process that, on the one hand, preserves coherence of resulting discourse structures and, on the other hand, makes them more appropriate from the perspective of a particular user. Our scope is not in identifying which user features influence discourse structure

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composition. We focus on providing an approach for adapting coherence when such influences have been identified. Influences of the different levels of user knowledge on discourse coherence are used in our discussion as examples.

2 Discourse Composition in Hypermedia Presentation Generation

We describe related work with the goal of identifying a general model of the discourse composition process. Thus, we highlight similarities between the systems in the steps they follow to compose discourse structures.

A discourse structure contains domain concepts that are grouped and ordered to ensure coherence. Domain concepts and relations between them form a metadata structure that provides means for semantically annotating media items from a repository. A metadata structure together with annotated media items form a *semantic framework*. The selection of domain concepts for the discourse structure is done based on (1) relevance of each element in the discourse structure with regard to the complete discourse structure belonging to a certain genre (*global coherence*) and (2) the coherence relationships between a concept and other concepts in the discourse structure (*local coherence*).

In the **Artequakt project** [1] a developer creates templates for biographies of artists. A template consists of queries to the knowledge base. Each query retrieves data about one aspect of an artist's life. The author determines global coherence by selecting domain concepts for queries. S/he specifies local coherence by grouping and ordering queries using constructs that specify the preferred order of query appearances within the template. The *Context* construct allows for a certain level of adaptivity by identifying specific parts of a template available only to users with a necessary level of domain knowledge.

In **DISC** [6], discourse structures are represented by dynamic rule-based templates. A template specifies the main character and the genre and is divided into narrative units, e.g. a narrative unit about the professional life of a person. A narrative unit contains discourse rules that define which domain concepts can play a role of related characters in the discourse structure. For example, for a main character "Rembrandt", "Lastman" can play a role of the related character "teacher". Hence, narrative units determine global coherence of concepts for a discourse structure. In addition, discourse rules specify local coherence by defining what information about the related character can be presented. A dynamic template produces different discourse structures depending on what related characters can be found in the semantic framework.

Samp*Le* [4] uses discourse flow templates as an initial representation of a discourse flow for the genre. A discourse template is an analytical framework for building discourse structures for a particular genre. For example, a newspaper article discourse template consists of the components: *Main Event, Context, History, Comments* [8]. Samp*Le* uses rules to specify the mapping between a discourse template and the semantic framework. These rules help to select domain concepts appropriate for each discourse template component. To create a coherent discourse structure, selected domain concepts are differentiated using coherence rules. Coherence rules take into account a part of the discourse structure which is already composed and a set of concepts that are appropriate for inclusion at the next step.

3 Problem of Discourse Adaptation

The descriptions in the previous section show that existing hypermedia presentation generation approaches create discourse structures following similar steps. They specify a *discourse flow* for a particular genre with human-authored templates (Artequakt) or rule-based templates (DISC, Samp*L*e). Then they identify *relevant domain concepts* based on *global coherence* rules. *Local coherence* rules determine which domain concepts are *selected* to be used within each section of the discourse structure. These steps can be combined into a common model presented in Fig. 1.

The coherence achieved by hypermedia presentation generation approaches can be regarded as ”general” coherence, since specific user features are not taken into account. We argue that discourse structures can be tailored to different users if we adapt decisions taken while evaluating local coherence to specific user needs.

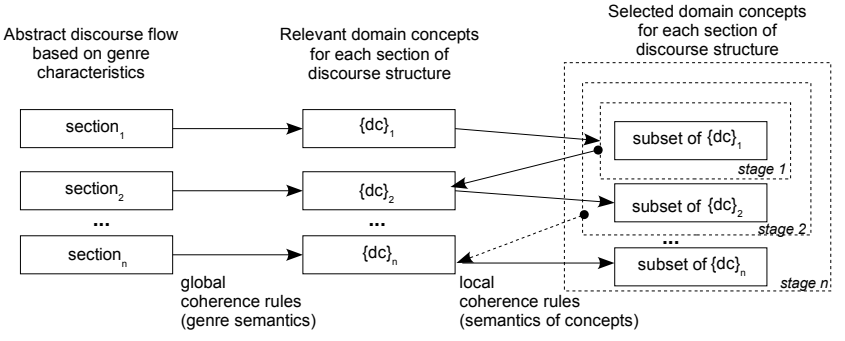

Fig. 1. A general model of the discourse structure composition process

Decisions about global coherence are guided by the notion of genre which represents established communication patterns [3] and is thus applicable among various user groups. Decisions about local coherence are guided by semantic relations between domain concepts. For different users the view on semantic relations between the concepts can vary. A user with little domain knowledge might be unfamiliar with one or more concepts in the discourse structure. The semantic relation between the two unfamiliar concepts will be unclear to the user and s/he might have difficulties in understanding why one concept follows another in the discourse. Thus, users with different domain knowledge have different views on the coherence relations between elements so the notion of local coherence can vary. Hypermedia presentation generation approaches do not take this aspect into account.

Adding adaptation to a discourse structure composition process results in *the problem of enabling modifications in evaluating local coherence between the concepts while preserving global coherence of the obtained discourse structure*.

4 Proposed Solution to Discourse Adaptation

To enable adaptation of local coherence rules we propose a mapping between the existing coherence rules and adaptation rules that we want to integrate in the discourse

composition process. We define adaptation rules on top of the existing coherence rules. This allows specification of adaptation rules at an appropriate level of abstraction so that suggested adaptation strategies are independent from the particular strategies of traversing a semantic framework specified in the coherence rules.

To provide such a mapping we specify a set of common constructs that represent necessary means for both types of rules. As a result, coherence rules and adaptation rules operate with the same set of constructs that have agreed-upon datatypes. For each coherence rule there is a corresponding adaptation rule. An adaptation rule is written using variables as values of the common constructs. The corresponding coherence rule uses the functionality defined in the adaptation rule and instantiates the variables with specific instances found in the semantic framework.

We identify the set of common constructs based on the concepts involved in the evaluation of local coherence in the general model of the discourse composition process (Fig.1):

1. domain concepts that are already selected to represent the elements of the discourse structure - *current structure* (e.g. at the stage 2 of the composition process it is *subset of* $\{dc\}_1$);
2. domain concepts that are appropriate to appear inside a certain element of the discourse structure based on global coherence - *relevant concepts* (e.g. $\{dc\}_2$ at the stage 2);
3. one or more domain concepts that are selected to represent an element of the discourse structure - *selected concepts* (e.g. *subset of* $\{dc\}_2$ at the stage 2).

Coherence rules evaluate the *current structure* and *relevant concepts* and come up with *selected concepts* to be added to the *current structure*. For instance, for the stage *n* of the discourse composition process a coherence rule is defined as follows:

a_Rule(inputs=[currentStructure(subset of $\{dc\}_{n-1}$*), relevantConcepts(*$\{dc\}_n$*)], output=[selectedConcepts(subset of* $\{dc\}_n$*)]).*

5 Conclusions

This paper explores an approach to add adaptivity into the discourse structure composition process used by automatic hypermedia presentation generation systems[1]. In order to evaluate our proposed solution, we implemented it within the Samp*L*e system[2]. We choose Samp*L*e as testing platform since it contains explicitly encoded local coherence rules, as described in Section 2. Explicit coherence rules provide the freedom in applying our approach to the necessary step in the discourse structure composition process, without having to modify other components. We tested the solution on the use case of composing discourse structures for the newspaper article genre. The main direction of our current work is to use a larger number of use cases with various local coherence

[1] The extended version of this paper can be found at http://ftp.cwi.nl/CWIreports/INS/INS-E0601.pdf

[2] The Samp*L*e demo can be found at http://homepages.cwi.nl/∼media/projects/CHIME/demos.html

rules and discourse structures belonging to different genres. These experiments should provide possible extensions to the rule-base. Besides, we aim at investigating whether particular genres have influences on coherence rules and their adaptation. Knowledge about such influences would allow fine-tuning the rules to make them even more suitable for a particular user case.

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References

1. H. Alani, S. Kim, D. E. Millard, M. J. Weal, W. Hall, P. H. Lewis, and N. R. Shadbolt. Automatic Ontology-based Knowledge Extraction from Web Documents. *IEEE Intelligent Systems*, 18(1):14–21, January-February 2003.
2. D. Duff. *Modern Genre Theory*. Pearson Education Limited, Edinburgh Gate, United Kingdom, 2000.
3. T. Erickson. Rhyme and Punishment: The Creation and Enforcement of Conventions in an On-Line Participatory Limerick Genre. In *Proceedings of the 32rd Hawaii International Conference on System Science*. IEEE Computer Society, January 5-8, 1999.
4. K. Falkovych and F. Nack. Composing Discourse based on Genre Semantics. Technical Report INS-E0502, CWI, December 2005.
5. K. Falkovych and F. Nack. Context Aware Guidance for Multimedia Authoring: Harmonizing Domain and Discourse Knowledge. *Multimedia Systems Journal, Special issue on Multimedia System Technologies for Educational Tools, S. Acton, F. Kishino, R. Nakatsu, M. Rauterberg & J. Tang eds.*, 11(3):226–235, 2006.
6. J. Geurts, S. Bocconi, J. van Ossenbruggen, and L. Hardman. Towards Ontology-driven Discourse: From Semantic Graphs to Multimedia Presentations. In *Second International Semantic Web Conference (ISWC2003)*, pages 597–612, Sanibel Island, Florida, USA, October 20-23, 2003.
7. A. Huxley. *Collected Essays*. Harper, New York, 1959.
8. T. A. van Dijk. *Handbook of Qualitative Methods in Mass Communication Research*, chapter The interdisciplinary study of news as discourse, pages 108–120. Routledge, London, 1991.