Analyzing an Argumentative Discourse Structure for Supporting Argumentation

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1 Introduction

Supporting consensus building through argumentative debate is socially important because misunderstanding speaker's intention or emotional conflict sometimes occur among stakeholders. To develop a system for facilitating debate [1, 6, 7], creation of argumentative corpus and analysis of argumentative discourse is needed for finding the *appropriate* structure of argumentative discourse. However, no works have been performed for finding what kind of *appropriate* pattern leads to consensus. We define argumentative discourse structure as *appropriate* if it tends to lead to *agreement*. We focus on argumentative corpus analysis and assume that *appropriate* structure of argumentative discourse can be detected with help of specific *agreement-oriented* sequences of rhetorical relations that connect related elements in discourse. We create a small argumentative corpus and use a set of Rhetorical Structure Theory relations [2] to annotate it. To verify our assumption we calculate priori and posteriori probability of rhetorical relations pairs in our argumentative corpus.

2 Designing tag set

Argumentative corpus we create consists of web discussions, where participants express their ideas and aim to reach agreement on certain topics. So, we use Rhetorical Structure Theory (RST) relations to annotate our corpus and then try to detect the *appropriateness* of argumentative discourse structure through specific *agreement-oriented* sequences of rhetorical relations that hold within argumentative discourse.

RST is a method of describing text structure through a set of rhetorical relations that hold between text spans. It, as well, has been applied for conversation analysis [3, 4]. For our study we selected a small tag set of rhetorical relations that we think would reflect the structure of argumentative discourse. During the annotation process we found that few additional relations should be introduced for our purpose. These are the relations that give clearer understanding of participant's intention. For example, relation tag *Req_evidence* could indicate that some *Evidence* for previous statement is needed and not *Offence* or *Background*.

3 Data analysis

The data we selected for our small argumentative corpus are taken from Wikipedia, free encyclopedia Talk pages[1][2]. The purpose of Wikipedia talk page is to provide space for editors to discuss changes to the associated article or project page. For convenience we selected English language pages. We gathered a corpus containing 693 comments with the total number of participants 197 people. We annotated our data with the tag set of 15 relations we define as *argumentation-specific* presented in Table 1. We, as well, used other 6 relations posed by the original RST [2], and by [5] and by [3]. As a result, our corpus includes 627 relations that connect participants' comments. The most frequent relations are listed in Table 2. Basing on frequency results, we can assume that rhetorical relations *Explanation_Argumentative, Evidence, Suggestion, Req_evidence* will prevail in the type of argumentative discourse we analyzed.

Table 1: Argumentation-specific tag set of rhetorical relations

Level	Sublevel	Tag Name
Requirement		Req_evidence
		Req_detail
		Req_yes/no
Response	Answer	Affirmation
		Negation
	Argumentation	Evidence
		Explanation_argumentative
		Example
		Background
	Consensus	Agreement
		Disagreement
Action request		Request_to_do
		Suggestion
Politeness		Gratitude
		Apology

To investigate the relationship between *consensus building* notion and *appropriateness* of discourse structure and to verify our assumption that there exist specific *agreement-oriented* sequences of rhetorical relations within argumentative discourse, we firstly count frequencies of bigram of rhetorical relation (r_1, r_2), where let r_1 be a preceding relation and r_2 be a succeeding relation that follows r_1.

Table 2: Frequent rhetorical relation

Relation	Frequency	Percentage
Explanation_argumentative	115	18%
Agreement	108	17%
Disagreement	94	15%
Evidence	67	11%
Suggestion	49	7.8%
Justification	33	5.3%
Req_evidence	26	4.2%
Other rhetorical relations	104	17%
Total	**627**	**100%**

After that we calculate priori $P(r_2|r_1)$ and posteriori $P(r_1|r_2)$ probabilities for relations bigrams, which are respectively defined as

[1] http://en.wikipedia.org/wiki/Talk:Moldova
[2] http://en.wikipedia.org/wiki/Talk:United_States/Archive

$$P(r_2 \mid r_1) = \frac{C(r_1, r_2)}{C(r_1)}, \quad \textbf{(1)} \qquad P(r_1 \mid r_2) = \frac{C(r_1, r_2)}{C(r_2)}, \quad \textbf{(2)}$$

where $C(r)$ and $C(r_1,r_2)$ denote frequencies of a rhetorical relation r and relation bigram (r_1,r_2), respectively. These calculations allow us to see which rhetorical relations precede *Agreement* and *Disagreement* relations. Tables 3 and 4 show some results for agreement and disagreement pairs. Order of relation r_1 is sorted by $P(r_1|r_2=$ Agreement), the posteriori probability of r_1 when r_2=Agreement, because this probability can be regarded as a contribution of r_1 for building consensus.

Table 3: Priori and posteriori probability for agreement pairs

Relation r_1	$P(r_2$=Agreement$\|r_1)$		$P(r_1\|r_2$= Agreement)	
Evidence	0.24	(16 /67)	0.15	(16/108)
Agreement	0.15	(16 /108)	0.15	(16/108)
Disagreement	0.14	(13/94)	0.12	(13/108)
Explanation_ Argumentative	0.10	(12 /115)	0.11	(12/108)
Suggestion	0.22	(11/49)	0.10	(11/108)

Table 4: Priori and posteriori probability for disagreement pairs

Relation r_1	$P(r_2$=Disagreement| $r_1)$		$P(r_1\|r_2$=Disagreement)	
Evidence	0.21	(14 /67)	0.15	(14/94)
Agreement	0.037	(4/108)	0.043	(4/94)
Disagreement	0.10	(9/94)	0.10	(9/94)
Explanation_ Argumentative	0.043	(5/115)	0.10	(5/94)
Suggestion	0.60	(27/49)	0.30	(27/94)

4 Discussion

Creation of argumentative corpus and analysis of *appropriate* argumentative discourse structure that leads to common agreement is crucial for developing argumentation support systems that assist users in consensus building process. We assume that the *appropriateness* of the discourse structure can be detected through specific *agreement-oriented* rhetorical relations sequences that hold within the discourse. We first annotate a small argumentative corpus with a tag set of rhetorical relations we define as *argumentation-specific*. Then we calculate priori and posteriori probabilities for the rhetorical relations bigrams. The results are sorted by the posteriori probability of *preceding* relation when the *following* relation is *Agreement*, because it can be regarded as a contribution of preceding rhetorical relation for consensus building.

Results presented in Tables 3 and 4 show that, most often, *Agreement* relation is preceded by E*vidence* relation. Such result would be expected, since *Evidence* might be regarded as well measured argumentation support. On the other hand, *Disagreement – Agreement* pair is quite frequently met in our corpus. Explanation for this phenomenon would be the discussion process itself, namely the problem of related comments within a discussion. When, for example, a participant expresses his *disagreement* not directly to the topic statement within discussion but instead *agrees* with other participant's *disagreement* statement.

An interesting case represents position of S*uggestion* relation that is frequently followed by both *Agreement* and *Disagreement* rhetorical relations. Still, our results show that *Suggestion-Disagreement* pair prevails in argumentative discourse. This might be explained by so called *emotional conflict* that occurs in a discussion. *Suggestion* often involves requirement for changing hearer's existent belief and sometimes, for participants, it is a difficult problem.

Clear understanding of utterance's intention is also very important. When, for example, E*vidence* is required but B*ackground* or *Example* is provided as a response, the information might be insufficient. Probably, that is why, E*xample - Agreement* or *Background – Agreement* pairs are rarely met in our corpus.

5 Related works

A number of works has been performed in the domain of conversation analysis using RST relations [3, 4], as well as in the domain of Computer Support Argumentation [1, 6]. We focus on finding appropriate patterns that lead to consensus in argumentative discourse. The concept will be basic for the facilitation function of our argumentation support system.

6 Conclusion

The analysis results show that *Evidence* relation tends to precede *Agreement* most frequently. To properly determine the *appropriateness* of argumentative discourse structure we need to examine longer sequences of rhetorical relations that hold within the discourse, which requires considerable increase of the analysis data amount. We also think that participants' ID and relationship between participants should be considered in the analysis because these are important factors for facilitating consensus. For further corpus analysis, we will use the data obtained with help of the computer argumentation support system we are developing [7]. The analysis results, on their turn will be used to improve the facilitation function of the system.

References

[1] Reed, C., Rowe, G.: Araucaria: Software for Argument Analysis, Diagramming and Representation. (2004)
[2] Taboada, M., Mann, W., C.: Applications of Rhetorical Structure Theory, (2005)
[3] Daradoumis, T.: Towards a Representation of the Rhetorical structure of Interrupted Exchanges, Trends in Natural Language Generation: An Artificial Intelligence Perspective (1996)
[4] Stent, A.: Rhetorical structure in dialog. Proceedings of INLG'2000, (2000)
[5] Carlson, L., Marcu, D., Okurowski, M. E.: Building a Discourse-Tagged Corpus in the Framework o Rhetorical Structure Theory. Current Directions in Discourse and Dialogue, (2003)
[6] Verheij, B.: Artificial Argument Assistants for Defeasible Argumentation, Elsevier B.V, (2001)
[7] Takasaki, J., Zidrasco, T., et al.: Designing appropriateness rules by considering opposition and question for discussion support system. IPSJ2010, 4V-4, (2010).