

Identification of Argumentation Acts in Conversations

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Abstract. Argumentation mining, the subject of this paper, is a new research area that moves between natural language processing, argumentation theory and information retrieval. The aim of argumentation mining is to automatically detect the argumentation of a document and its structure.

Key words: natural language processing, machine learning, argumentation, statistical learning

1 Introduction

1.1 History of Argumentation Theory

Argumentation has its roots in Ancient Greece, where the art of rhetoric developed first. Aristotle defines the rhetorician as someone who is always able to see what is persuasive. Correspondingly, rhetoric is defined as the ability to see what is possibly persuasive in every given case. Argumentation theorists have searched for the requirements that make an argument correct, by some appropriate standard of proof, by examining the errors of reasoning we make when we try to use arguments. These errors have been called fallacies. Until the 1950s, the approach of argumentation was based on rhetoric and logic.

In 1895, George Pierce Baker writes *The Principles of Argumentation* giving the following definition: "Argumentation is the art of producing in the mind of someone else a belief in the ideas which the speaker or writer wishes the hearer or reader to accept" In the United States debating and argumentation became an important subject on universities and colleges. In the 1960s and 1970s Perelman and Toulmin were the two of the most influential writers on argumentation. Perelman tried to find a description of techniques of argumentation used by people to obtain the approval of others for their opinions. Perelman called this 'new rhetoric'. Toulmin developed his theory (starting in 1950s) in order to explain how argumentation occurs in the natural process of an everyday argument. He called his theory 'the uses of argument'.

Hamblin took, as well, a radical approach to argumentation. Considering the fact that deductive logic did not seem to be enough, Hamblin proposed a new

concept for describing arguments: he considered it not just as an arbitrarily designated set of propositions, but as a move one party makes in a dialog to offer premises that may be acceptable to another party who doubts the conclusion of the argument. Hamblin and Perelmans work announced a new field of study: informal logic. Nowadays, research in informal logic increasingly incorporates the approaches to argumentation found in cognate disciplines and fields like Speech Communication, Rhetoric, Linguistics, Artificial Intelligence, Cognitive Psychology and Computational Modeling. Looked at from this perspective, informal logic as a discipline is an integral part of a much broader multi-disciplinary attempt to develop an “argumentation theory” that can account for informal reasoning.

1.2 Argumentation in Computer Science

With regards to computer science, the study of argumentation is crucial in many artificial intelligence and natural language research problems.

For example, in the field of Multi Agent Systems (MAS) reasoning agents need to communicate with each other and apply argumentation-based reasoning mechanisms to resolve the conflicts arising from their different views of goals, beliefs, and actions. Another example are question answering systems, which deal with finding the correct response to questions like “Why was this decision taken?” and therefore integrate the analysis of argumentation as a crucial part of identifying the answer to the questions as well as the pros and cons that make up the answer.

The field of computer-supported collaborative learning (CSCL) has, in particular, been interested in argumentation and how students can benefit from it (Stegmann et al. 2007 - *Facilitating argumentative knowledge construction with computer-supported collaboration scripts*). So-called “collaborative argumentation” is viewed as a key way in which students can learn critical thinking, elaboration, and reasoning. Therefore, it is a crucial point to understand the characteristics and models of argumentation.

Argumentation mining, the subject we are trying to approach, is a new research area that moves between natural language processing, argumentation theory and information retrieval. The aim of argumentation mining is to automatically detect the argumentation of a document and its structure.

Some relevant work in this area has been done by R.M. Palau and M-F Moens in *Argumentation mining: the detection, classification and structure of arguments in text*. In the paper they analyze the main research questions when dealing with argumentation mining and the different methods they have studied and developed in order to successfully confront the challenges of argumentation mining in legal texts. A more structured approach is taken by Safia ABBAS , Hajime SAWAMURA in *ALES: An Innovative Argument Learning Environment*. The environment uses different mining techniques to manage a highly structured arguments repository.

Overall, the task of argument extraction from free text is a new and difficult research area, one that will hopefully see a lot of activity in the near future,

because the results that can be obtained will be of great use in many related fields of natural language processing.

2 Argumentation Concepts Overview

A nice overview on argumentation tasks and concepts was given by Douglas Walton in his research reports. The next sections are inspired by his work.

2.1 Main problems

There are four tasks undertaken by argumentation:

- identification which means finding the premises and conclusion of arguments in a text and fitting that argument in an argumentation scheme;
- analysis which involves the identification of implicit premises or conclusion of arguments (such an argument is called an enthymeme);
- evaluation where the strength of an argument must be determined using a general criteria;
- invention which means constructing new arguments that can be used to prove some conclusion

2.2 Argument definition

An argument is a set of statements (propositions), made up of three parts, a conclusion, a set of premises, and an inference from the premises to the conclusion. An argument can be supported by other arguments, or it can be attacked by other arguments, and by raising critical questions about it.

The definition of ‘argument’ relied on so far could be called a minimal inferential definition, and the method of argument diagramming shown so far fits this minimal definition. The boxes represent propositions and the arrows represent inferences from some propositions to others.

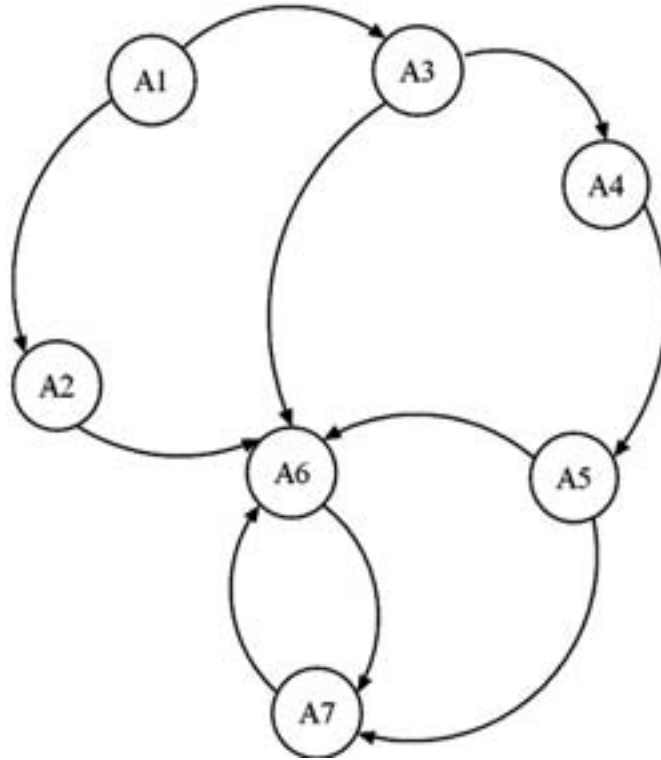
The general approach or methodology of argumentation can be described as distinctively different from the traditional approach based on deductive logic. The traditional approach concentrated on a single inference, where the premises and conclusion are designated in advance, and applied formal models like propositional calculus and quantification theory determine whether the conclusion conclusively follows from the premises. This approach is often called monological.

In contrast, the argumentation approach is called dialogical (or dialectical) in that it looks at two sides of an argument, the pro and the contra. According to this approach, the method of evaluation is to examine how the strongest arguments for and against a particular proposition at issue interact with each other, and in particular how each argument is subject to probing critical questioning that reveals doubts about it. By this dialog process of pitting the one argument against the other, the weaknesses in each argument are revealed, and it is shown which of the two arguments is the stronger.

2.3 Argument Attack and Refutation

There are several ways to attack an argument and the easiest way is to ask an appropriate critical question that raises doubt about the acceptability of the argument. When this happens, the argument temporarily defaults until the proponent can respond appropriately to the critical question. Another way to attack an argument is to question one of the premises. A third way to attack an argument is to put forward counter-argument that opposes the original argument, meaning that the conclusion of the opposing argument is the opposite (negation) of the conclusion of the original argument.

A simple way to represent a sequence of argumentation is using a directed graph:



2.4 Argumentation Schemes

Some of the most common schemes are: argument from witness testimony, argument from expert opinion, argument from popular opinion, argument from example, argument from analogy, practical reasoning (from goal to action), argument from verbal classification, argument from sign, argument from sunk costs, argument from appearance, argument from ignorance, argument from cause to effect, abductive reasoning, argument from consequences, argument from alternatives,

argument from pity, argument from commitment, ad hominem argument, argument from bias, slippery slope argument, and argument from precedent. Each scheme has a set of critical questions matching the scheme and such a set represents standard ways of critically probing into an argument to find aspects of it that are open criticism.

2.5 Types of dialog

There are six types of dialogs:

Persuasion generated by a **Conflict of Opinions** in which each party tries to **Persuade Other Party** in order to **Resolve or Clarify Issue**

Inquiry generated by the **Need to Have Proof** in which each party tries to **Find and Verify Evidence** in order to **Prove (Disprove) the Hypothesis**

Negotiation generated by a **Conflict of Interests** in which each party tries to **Get What He Most Wants** in order to reach a **Reasonable Settlement Both Can Live With**

Information-Seeking catalyzed by the **Need of Information** in which each party **Acquires or Gives Information** in order to **Exchange Information**

Deliberation generated by a **Deliberation Dilemma or Practical Choice** that is needed in which the participants try to **Co-ordinate Goals and Actions** in order to **Decide on Best Available Course of Action**

Eristic generated by a **Personal Conflict** in which each party tries to **Verbally Hit Out at Opponent** in order to **Reveal Deeper Basis of Conflict**.

On our project we will probably focus on inquiry dialogs.

3 NLP Aspects Overview

As stated in the last section the goal of project becomes that of identifying the arguments and the relations that exist between them in a given text. As such, our task can be modeled as a classification problem.

As presented previously, there exist a number of models for both the intrinsic structure of a model, as well as for the relations that can hold between them. The above sections gave a classification of the different types of dialog and argumentation schemes. What is interesting to notice is that each type of dialog supports some argumentation schemes better than others. Thus, having chosen one specific type of dialog, the most relevant argumentation schemes pertaining to that dialog model will be chosen as structure guidelines for our arguments. In addition, a Toulmin (S. E. Toulmin. *The Uses of Argument*) based alternative representation of an argument will be considered.

3.1 Main problems

Having laid out this model, we are faced with the following challenges of Argumentation Mining:

- Detect all the arguments in a free text (classification problem)
- Determine argument limits (segmentation problem)
- Determine arguments type (complex)
- Detect argumentation structure (complex)

The Corpus that will be used to for solving the above problems is the one provided by *Araucaria* (<http://www.arg.dundee.ac.uk/projects/araucariadb/search.php>), which, albeit being not very large, has the advantage of giving annotated argument examples.

In the work by R.M. Palau and M-F Moens: *Argumentation mining: the detection, classification and structure of arguments in text* some solutions to this problems are proposed, some of which we consider to be very useful for our project. For the problem of argument detection statistical classifiers are employed. In particular, good results can be obtained by using the *maximum entropy model* and *multinomial naive Bayes* classifier which learns a model of the joint probability of an element x and its label y , $p(x, y)$, and makes its predictions by using Bayes rule to calculate $p(y|x)$ and then selects the most likely label y .

For the problem of determining argument limits (grouping of argumentative statements into their corresponding argument) we consider computing the semantic distance between different argumentative units (sentences) and group sentences in one argument if they discuss content that is semantically related. Like in the work of Palau and Moens, we assume that the relatedness of two sentences is a function of the relatedness of their words. We want to employ an ontology based semantic relatedness measure, where the relatedness of words depends on their semantic distances in a lexico-semantic resource such as WordNet.

In the determination of argument types, we also consider the use of statistical classifiers. The problem here is that while a classification of argumentative statements into premises and conclusions is possible (as shown by Palau and Moens by use of a SVM), the task of determining a specific scheme for an argument is much more challenging. In particular, we have to rely on some domain ontology in order to be able to find semantic features that will allow us to classify the arguments as belonging to a certain scheme. Extensive use of other NLP tools such as POS taggers will also be made in order to enrich the possible set of features used for classification.

Lastly, the problem of determining the argumentation structure, that is, of relations existing between the arguments, will have to take all the results obtained by the previous steps into consideration. The employed algorithm will make the assumption that the discourse follows the rules of the chosen dialog type and that arguments used within it belong to the appropriate argumentation schemes.