

Mining Fine-grained Argument Elements

Adam Wyner

Department of Computing Science
University of Aberdeen
Meston Building, Meston Walk
Aberdeen, AB24 3UK, Scotland
azwyner@abdn.ac.uk

Abstract

The paper discusses the architecture and development of an Argument Workbench, which supports an analyst in reconstructing arguments from across textual sources. The workbench takes a semi-automated, interactive approach searching in a corpus for fine-grained argument elements, which are concepts and conceptual patterns in expressions that are associated with argumentation schemes. The expressions can then be extracted from a corpus and reconstituted into instantiated argumentation schemes for and against a given conclusion. Such arguments can then be input to an argument evaluation tool.

1 Introduction

We have large corpora of unstructured textual information such as in consumer websites (Amazon), newspapers (BBC’s “Have Your Say”, or in policy responses to public consultations. The information is *complex, high volume, fragmentary*, and either *linearly* (Amazon or BBC) or *alinearly* (policy responses) presented as a series of comments or statements. Given the lack of structure of the corpora, the cumulative *argumentative* meaning of the texts is obscurely distributed across texts. In order to make coherent sense of the information, the content must be extracted, analysed, and restructured into a form suitable for further formal and automated reasoning (e.g. ASPAR-TIX (Egly et al., 2008) that is grounded in Argumentation Frameworks (Dung, 1995)). There remains a significant *knowledge acquisition bottleneck* (Forsythe and Buchanan, 1993) between the textual source and formal representation.

Argumentation text is rich, multi-dimensional, and fine-grained, consisting of (among others): a range of (explicit and implicit) *discourse relations*

between statements in the corpus, including indicators for conclusions and a premises; speech acts and propositional attitudes; contrasting sentiment terminology; and domain terminology that is represented in the verbs, nouns, and modifiers of sentences. Moreover, linguistic expression is various, given alternative syntactic or lexical forms for related semantic meaning. It is difficult for people to reconstruct argument from text, and even moreso for a computer.

Yet, the presentation of argumentation in text is not a random or arbitrary combination of such elements, but is somewhat structured into reasoning patterns, e.g. defeasible argumentation schemes (Walton, 1996). Furthermore, the scope of linguistic variation is not unlimited, nor unconstrained: diathesis alternations (related syntactic forms) appear in systematic patterns (Levin, 1993); a thesaurus is a finite compendium of lexical semantic relationships (Fellbaum, 1998); discourse relations (Webber et al., 2011) and speech acts (Searle and Vanderveken, 1985) (by and large) signal systematic semantic relations between sentences or between sentences and contexts; and the expressivity of contrast and sentiment is scoped (Horn, 2001; Pang and Lee, 2008). A more open-ended aspect of argumentation in text is domain knowledge that appears as terminology. Yet here too, in a given corpus on a selected topic, discussants demonstrate a high degree of topical coherence, signalling that similar or related conceptual domain models are being deployed. Though argumentation text is complex and coherence is obscured, taken together it is also underlyingly highly organised; after all, people do argue, which is meaningful only where there is some understanding about what is being argued about and how the meaning of their arguments is linguistically conveyed. Without such underlying organisation, we could not successfully reconstruction and evaluate arguments from source materi-

als, which is contrary to what is accomplished in argument analysis.

The paper proposes that the elements and structures of the lexicon, syntax, discourse, argumentation, and domain terminology can be deployed to support the identification and extraction of relevant fine-grained textual passages from across complex, distributed texts. The passages can then be reconstituted into instantiated argumentation schemes. It discusses an argument workbench that takes a semi-automated, interactive approach, using a text mining development environment, to flexibly query for concepts (i.e. semantically annotated) and patterns of concepts within sentences, where the concepts and patterns are associated with argumentation schemes. The concepts and patterns are based on the linguistic and domain information. The results of the queries are extracted from a corpus and interactively reconstituted into instantiated argumentation schemes for and against a given conclusion. Such arguments can then be input to an argument evaluation tool. From such an approach, a “grammar” for arguments can be developed and resources (e.g. gold corpora) provided.

The paper presents a sample use case, elements and structures, tool components, and outputs of queries. Broadly, the approach builds on (Wyner et al., 2013; Wyner et al., 2014; Wyner et al., 2012). The approach is contrasted against statistical/machine learning, high level approaches that specify a grammar, and tasks to annotate single passages of argument.

2 Tool Development and Use

In this section, some of the main elements of the tool and how it is used are briefly outlined.

2.1 Use Case and Materials

The sample use case is based on Amazon consumer reviews about purchasing a camera. Consumer reviews can be construed as presenting arguments concerning a decision about what to buy based on various factors. Consumers argue in such reviews about what features a camera has, the relative advantages, experiences, and sources of misinformation. These are qualitative, linguistically expressed arguments.

2.2 Components of Analysis

The analysis has several subcomponents: a consumer argumentation scheme, discourse indicators, sentiment terminology, and a domain model. The consumer argumentation scheme (CAS) is derived from the value-based practical reasoning argumentation scheme (Atkinson and Bench-Capon, 2007); it represents the arguments for or against buying the consumer item relative to preferences and values. A range of explicit discourse indicators (Webber et al., 2011) are automatically annotated, such as those signalling premise, e.g. *because*, conclusion e.g. *therefore*, or contrast and exception, e.g. *not*, *except*. Sentiment terminology (Nielsen, 2011) is signalled by lexical semantic contrast: *The flash worked poorly* is the semantic negation of *The flash worked flawlessly*, where *poorly* is a negative sentiment and *flawlessly* is a positive sentiment. Contrast indicators can similarly be used. Domain terminology specifies the objects and properties that are relevant to the users. To some extent the terminology can be automatically acquired (term frequency) or manually derived and structured into an ontology, e.g. from consumer report magazines or available ontologies. Given the modular nature of the analysis as well as the tool, auxiliary components can be added such as speech act verbs, propositional attitude verbs, sentence conjunctions to split sentences, etc. Each such component adds a further dimension to the analysis of the corpus.

2.3 Components of the Tool

To recognise the textual elements of Section 2.2, we use the GATE framework (Cunningham et al., 2002) for language engineering applications. It is an open source desktop application written in Java that provides a user interface for professional linguists and text engineers to bring together a wide variety of natural language processing tools in a pipeline and apply them to a set of documents. Our approach to GATE tool development follows (Wyner and Peters, 2011). Once a GATE pipeline has been applied to a corpus, we can view the annotations of a text either *in situ* or extracted using GATE’s ANNIC (ANNotations In Context) corpus indexing and querying tool.

In GATE, the gazetteers associate textual passages in the corpus that match terms on the lists with an annotation. The annotations introduced by gazetteers are used by JAPE rules, creating anno-

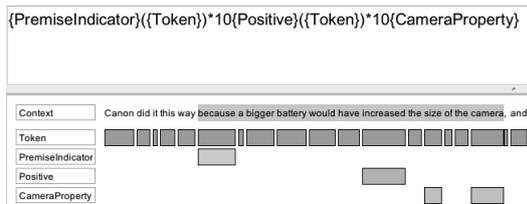


Figure 1: Query and Sample Result

tations that are visible as highlighted text, can be reused to construct higher level annotations, and are easily searchable in ANNIC. Querying for an annotation or a pattern of annotations, we retrieve all the terms with the annotation.

2.4 Output and Queries

The ANNIC tool indexes the annotated text and supports semantic querying. Searching in the corpus for single or complex patterns of annotations returns all those strings that are annotated with pattern along with their context and source document. Complex queries can also be formed. A query and a sample result appear in Figure 1, where the query finds all sequences where the first string is annotated with *PremiseIndicator*, followed some tokens, then a string annotated with *Positive* sentiment, some tokens, and finally ending with a string that is annotated as *CameraProperty*. The search returned a range of candidate structures that can be further scrutinised; the query can be iteratively refined to zero on in other relevant passages. The example can be taken as part of a positive justification for buying the camera. The query language (the language of the annotations) facilitates complex search for any of the annotations in the corpus, enabling exploration of the statements in the corpus.

2.5 Analysis of Arguments and their Evaluation

The objective of the tool is to find specific patterns of terminology in the text that can be used to instantiate the CAS argumentation scheme both for and against purchase of a particular model of camera. We iteratively search the corpus for properties, instantiate the argumentation scheme, and identify attacks. Once we have instantiated arguments in attack relations, we may evaluate the argumentation framework. Our focus in this paper is the identification of arguments and attacks from the source material rather than evaluation. It is important to emphasise that we provide an analyst's

support tool, so some degree of judgement is required.

From the results of queries on the corpus, we have identified the following premises bearing on *image quality*, where we paraphrase the source and infer the values from context. Agents are also left implicit, assuming that a single agent does not make contradictory statements. The premises instantiate the CAS in a positive form, where *A1* is an argument for buying the camera; similarly, we can identify statements and instantiated argumentation schemes against buying the camera.

- A1. P1: The pictures are perfectly exposed.
- P2: The pictures are well-focused.
- V1: These properties promote image quality.
- C1: Therefore, you (the reader) should by the Canon SX220.

Searching in the corpus we can find statements contrary to the premises in A1, constituting an attack on A1. To defeat these attacks and maintain A1, we would have to search further in the corpus for contraries to the attacks. Searching for such statements and counterstatements is facilitated by the query tool.

3 Discussion

The paper presents an outline of an implemented, semi-automatic, interactive rule-based text analytic tool to support analysts in identifying fine-grained, relevant textual passages that can be reconstructed into argumentation schemes and attacks. As such, it is not evaluated with respect to *recall* and *precision* (Mitkof, 2003) in comparison to a gold standard, but in comparison to user facilitation (i.e. analysts qualitative evaluation of using the tool or not), a work that remains to be done. The tool is an advance over graphically-based argument extraction tools that rely on the analysts' unstructured, implicit, non-operationalised knowledge of discourse indicators and content (van Gelder, 2007; Rowe and Reed, 2008; Liddo and Shum, 2010; Bex et al., 2014). There are logic programming approaches that automatically annotate argumentative texts: (Pallotta and Delmonte, 2011) classify statements according to rhetorical roles using full sentence parsing and semantic translation; (Saint-Dizier, 2012) provides a rule-oriented approach to process specific, highly structured argumentative texts. (Moens et

al., 2007) manually annotates legal texts then constructs a grammar that is tailored to automatically annotated the passages. Such rule-oriented approaches do not use argumentation schemes or domain models; they do not straightforwardly provide for complex annotation querying; and they are stand-alone tools that are not integrated with other NLP tools.

The interactive, incremental, semi-automatic approach taken here is in contrast to statistical/machine learning approaches. Such approaches rely on prior creation of *gold standard corpora* that are annotated manually and adjudicated (considering interannotator agreement). The gold standard corpora are then used to induce a model that (if successful) annotates corpora comparably well to the human annotation. For example, where sentences in a corpora are annotated as premise or conclusion, the model ought also to annotate the sentences similarly; in effect, what a person uses to classify a sentence as premise or conclusion can be acquired by the computer. Statistical approaches yield a probability that some element is classified one way or the other; the *justification*, such as found in a rule-based system, for the classification cannot be given. Moreover, refinement of results in statistical approaches rely on enlarging the training data. Importantly, the rule-based approach outlined here could be used to support the creation of gold standard corpora on which statistical models can be trained. Finally, we are not aware of statistical models that support the extraction of the fine-grained information that appears to be required for extracting argument elements.

We should emphasize an important aspect of this tool in relation to the intended use on corpora. The tool is designed to apply to reconstruct or construct arguments that are identified in *complex, high volume, fragmentary, and alinearly* presented comments or statements. This is in contrast to many approaches that, by and large, follow the structure of arguments within a particular (large and complex) document, e.g. the BBC's Moral Maze (Bex et al., 2014), manuals (Saint-Dizier, 2012), and legal texts (Moens et al., 2007). In addition, the main focus of our tool is not just the premise-claim relationship, but rich conceptual patterns that indicate the content of expressions and are essential in instantiating argumentation schemes.

The development of the tool can proceed modularly, adding argumentation schemes, developing more articulated domain models, disambiguating discourse indicators (Webber et al., 2011), introducing auxiliary linguistic indicators such as other verb classes, and other parts of speech that distinguish sentence components. The tool will be applied to more extensive corpora and have output that is associated with argument graphing tools. More elaborate query patterns could be executed to derive more specific results. In general, the openness and flexibility of the tool provide a platform for future, detailed solutions to a range of argumentation related issues.

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