Supporting Argument Strength by Integrating Semantic Multimedia Feature Detection with Emerging Argument Extraction

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Abstract. In this paper, we present a hybrid and interdisciplinary approach for the calculation of argument strength, based on the coupling of two existing frameworks - the emerging Argument Recognition (eAR) framework of: (1) the emerging Named Entity Recognition Information Retrieval System (eNER-IRS) for textual medical articles, and (2) the Generic Multimedia Analysis Framework (GMAF) for semantic extraction of visual Multimedia features. We focus on combining textual and visual features to increase the capability of both frameworks and facilitate applications with a higher level of confidence in argumentation.

Keywords: argumentation, argument strength, emerging argument recognition, semantic annotation, reasoning, inferencing

1 Introduction

Factual knowledge, that influences diagnosis in medical applications, is highly relevant. One project is *Recommendation Rationalisation (RecomRatio)* [8][4][3] which aims to support medical argumentation based on textual evidence.

Until now, factual diagnosis argumentation knowledge has been mostly based on textual information [19][16][20][1][17][18]. However, particularly in medical applications, visual argumentative evidence can contribute many additional features to diagnosis [6][5][23][22][10][12][12][14]. This paper proposes an approach to combine textual and visual evidence features by utilizing a multimedia feature processing framework called GMAF [26][27][28][29][25][24][31]. Thus, we plan to increase the strength of arguments by applying textual and visual evidence into an argument strength calculation process.

2 Conceptual Modeling Approach

In our conceptual modeling, we attach the emerging Argument Recognition (eAR) framework and Visual Feature Detection (e.g. of mammograms) as plugins to the Generic Multimedia Analysis Framework (GMAF). Here, an Explainable Semantic Multimedia Feature Graph (ESMMFG) is constructed, which integrates features of these argumentation evidence sources into a single, semantic graph, to which querying, reasoning, and inferencing can be applied. The ESMMFG is exported as an explainable Phrase-Structure-Tree, serving as the basis for argument strength calculation, from which a corresponding argumentation tree can be derived. Figure 1 shows an architectural overview based on the conceptual building blocks of the frameworks.

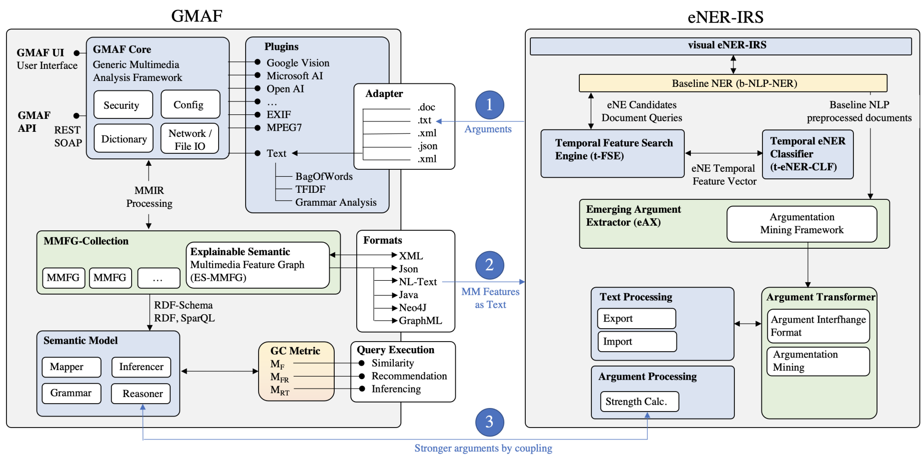

Fig. 1. Overview of the conceptual Integration Scenario

As an exemplary use case, we choose the processing of medical information in the area of breast cancer diagnosis and prevention. In this case, the eAR framework will transfer emerging Argument Entities from medical documents to GMAF. These will be enriched with visual multimedia features detected from mammograms in the GMAF. There, an ESMMFG is constructed, which can be represented by an explainable Phrase-Structure-Tree. This can be exported as a natural language text, which then enables the construction of an argument tree in eAR by applying argument strength calculations based on both textual and visual features. Thus, emerging features, e.g., from historical images of the same patient, can also be considered in eAR.

3 Argument Strength Calculation

Arguments that contain emerging Named Entities are highly relevant for medical research [15]. The resulting emerging Argument Entities are more likely relevant to an argumentation, because they contain and describe new research knowledge represented by emerging Named Entities (eNEs) which makes them more useful than other arguments [15]. Therefore, the strength of an argument is directly impacted and increased by emerging Named Entities.

For calculating the argument strength of the resulting emerging Argument Entities, we chose the term frequency-inverse document frequency (TFIDF) algorithm as one candidate among others. TFIDF is typically employed to calculate the importance of terms within a collection of documents. In our approach, the collection of documents is represented by the set of emerging Argument Entities identified by the eAR framework and the textual phrase representation of semantic multimedia features from medical documents of the GMAF.

This means, that each textual or multimedia feature is explained in textual phrase form, which can be regarded as an emerging Named Entity. Hence, if the TFIDF algorithm is applied to such collections, it can directly calculate the importance of emerging Named Entities and - as these represent emerging Argument Entities - directly contributes to the strength of such arguments. Each emerging Argument Entity (eAE) has one or more textual phrase sentences where each sentence is considered a document. The set of all documents is the entirety of all eAE phrases wherein each emerging Named Entities represents a textual feature.

For the definition of this modified TFIDF algorithm, we calculate the term frequency tf as the number of emerging Named Entities t_{eNE} in each emerging Argument Entity document d in logarithmic scale. The inverse document frequency idf is defined as the logarithmic number of occurrences of the eNEs t_{eNE} in the set D of all eAE documents d. The strength calculation str of an argument then is:

$$str(t_{eNE}, d, D) = tf(t_{eNE}, d) * idf(t_{eNE}, D) \tag{1}$$

where:

$$tf(t_{eNE}, d) = \log(1 + f_{t_{eNE},d}) \tag{2}$$

$$idf(t_{eNE}, D) = \log(\frac{|D|}{|\{d \in D : t_{eNE} \in d\}|}) \tag{3}$$

This modified term frequency-inverse document frequency (TFIDF) algorithm thus can be applied to calculate the strength of eAE arguments for the textual representation of semantic multimedia features and provides a direct integration of the GMAF and eAR frameworks.

4 Discussion and Conclusion

The integration of GMAF and eAR in the area of medical diagnosis promises to provide a significant benefit for the calculation of argument strength and its representation in a corresponding argumentation tree. By integrating textual named entities and multimedia features on a semantic level, inferencing and reasoning can be employed to contribute stronger arguments. Hence, we will present during the workshop both systems and relevant state-of-the-art techniques, including our approach for increasing the argumentation strength. Based on our argument strength calculation, we will derive an argumentation tree that is built upon the calculated features.

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