

Cognitive relations for argumentative texts

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Abstract. In the English accreditation exams, skills are assessed in three types of texts; expository, narrative and argumentative. Expository text seek to find hierarchical relationships between concepts and components. Narrative texts aim to identify the ability to discriminate events in time. The third type of document is argumentative that possess complex inferential relationships. These require skills of the student to relate more complex elements and thus produce answers from establishing mental models with inferential routes, which allow discarding distractors.

In this proposal, the characteristics that possess argumentative texts are showed considering the cognitive relations between facts, pieces of evidence, opinions that are present in debates.

Also, the construction of inference routes is defined with the representation of knowledge to generate answers. With the schemes, it is required to apply a degree confidence function to the type of element of the text considering that facts and pieces of evidence have a higher level of confidence than an opinion. With these results, an evaluation can be generated to discard distractors when there is neither evidence nor facts that support the opinion or belief of the writer.

Keywords: inference route, argumentation, opinion, fact, evidence, degree of confidence

1 Introduction

Readers of texts in different languages than their native one have two challenges: first, the readers have to translate to their native language, and then to map the structure from the vocabulary that they know of the foreign language [7]. In the Test of English as a Foreign Language (TOEFL), in particular, the reading comprehension section, to answer the questions. The reader builds a model of knowledge representation, which requires applying inferential processes to understand the meaning of the text [7].

Reading requires the development of a complex cognitive system that supports the processing of information at different levels, whether conscious or unconscious. A good reader is one who can construct an integrated mental representation of the text, which is also coherent and accurate [3].

For this reason, it is crucial to pose models of knowledge representation of the passages of the reading comprehension section, with their corresponding questions and answers. The purpose is to establish the meaning of the argumentative text according to the context. Although first-order logic allows us to model assertions or predicates, it is also essential to establish a passages context model, so situation calculus is a useful

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tool to do so. Another crucial aspect of favoring this knowledge representation is the identification of the semantic and cognitive relations present in the passages.

So, depending on the type of passage, the inferences can be produced that help establishes strategies to respond appropriately to the questions of the reading comprehension section of the TOEFL. In this work the argumentative passages will be revised.

Efforts have been made to improve understanding through tips, strategies, identification of rules, and practices. But in most cases does not take into account the context that is a fundamental element in the mental representation used by the brain to generate inferences and build an inference route of related concepts. In this work is intended to show the knowledge representation of TOEFL argumentative texts considering to model the context of situation calculus as well as identify the cognitive relations present in the these texts to facilitate the selection of answers in questions.

The content of this paper is divided as follows: section 2 shows a theoretical framework of cognitive models of reading comprehension. Section 3 the argumentation theory, the situation calculus, and their relation to the modeling of predicates considering the context are presented. In section 4, an representation knowledge is given. In section 5, an example is given of how a passage is converted to a knowledge base according to cognitive relations and situation calculus. A knowledge representation of the passage is proposed in section 6. Finally, the conclusions and future work are presented in section 7.

2 Related Work

Reading comprehension is the process of simultaneously extracting and constructing meaning. As Johnson[6] mentions in 2006, to understand instructions in reasoning experiments, students need to understand the concepts of premise, conclusion, and implication to make a correct deduction.

This process include to decipher how letters create words, to accurately and efficiently translate them to sounds (extract meaning from text), to formulate a representation of the information that is being presented, which inevitably requires the elaboration of new definitions; and to integrate the previous knowledge with the old (construction of meaning) [10]. This last objective is the one that has proven most interesting both to psychologists through the generation of cognitive models, and to computer scientists who have sought mechanisms to explain or emulate the thought processes with the help of artificial intelligence and natural language processing.

The precursors of these mental models were Van Dijk and Kintsch[3] in 1978 with their article in the journal *Psychological Review*, which explained in detail the cognitive processing of a university text of social psychology. In this work, they sought to understand how the text read is remembered. Also, it is postulated that when reading a text, one works with three levels of mental representation: the surface code, the base text, and the situational model.

Two key concepts in this recall process were the 'macrostructure' and the 'superstructure', which were proposed in that investigation. This theory assumed that textual processing is done in cycles, due to the limited capacity of short-term memory after decoding the code and that a representation of the text (base text) in the memory was

gradually built up in this way. This base text not only consists of a connected sequence of 'propositions', but also establishes a hierarchical structure of 'macro propositions', which correspond to the most critical and least essential themes of the text deduced (inferred) by the reader[3].

The base text, then, results from sequences of propositions that are made coherent by the 'repetition of arguments'. The macrostructures, on the other hand, can be defined as higher-order propositions that include underlying propositions. In other words, macropropositions are constructed with the micropropositions of a document and are a summary or different abstract structure underlying a text, so they must be inferred from it. Thus the micro and macropropositions form a 'macrostructure', that is, a semantic structure that defines the overall meaning of a text.

However, these structures must associate with a context associated with the reader's experience. Thus, a situational model is formed, which is a cognitive model of the situation reflected in the text that contains inferred material [3].

Also in 1995, the 3CAPS model was proposed by Goldman, Varma and Cote[5], which provides interactions between text processing, a priori knowledge, and strategic reading processes.

Later Kintsch [4], proposed the Construction-Integration Model considering the networks of nodes and links between them, mapping these relationships to a coherence matrix.

Even though several cognitive models have been proposed, the Kintsch and Van Dijk model [4] has interrelated elements that fuse cognitive psychology and predicate logic for support in the process of reading comprehension, which is interesting from nonmonotonic reasoning point-of-view.

This work proposes a knowledge representation based on the importance of the situational model, taking advantage of the benefits of cognitive relations and the situation calculus to approach the construction of inferences closer to the creation of mental representations over argumentative texts.

3 Preliminaries

In this section, the theory that will support the argumentative passages representation is mentioned.

An argumentative text is one that aims to support an idea, refute it, or persuade the reader to take the position of the writer of the text, through a series of structured and coherent arguments that expose that point or points of view. In order to argue an idea, it is necessary to present it, which means that the argumentative text combines both the exposition and the argumentation [14].

Initially, the benefits of the calculation of situations to model contexts are described, which in the case of TOEFL texts are required, in addition to generating queries on predicates, which favors the modeling of inferences. Subsequently, the proposed representation is described as an inference tool that allows establishing rules to associate the correct answers to specific questions, these in the case of the argumentative texts depend mainly on the cognitive relations of these, so they are mentioned in the last subsection.

3.1 Argumentation Theory

Argumentation always consists of a constellation of expressed thought contents, called propositions, advanced in defense of the standpoint at issue. Such propositions can be of various kinds and various degrees of complexity. The most uncomplicated propositions make a connection between a subject (someone or something talked about) and a predicate (a property that is assigned to the subject)[1].

Argumentative discourse aimed at resolving a difference of opinion in a reasonable way has both a normative, critical dimension and a descriptive, empirical dimension, and in argumentation theory, both dimensions need to be taken into account.

Scholars of argumentation are often drawn to studying argumentation by their practical interest in improving the quality of argumentative discourse where this is called. To give substance to this challenging combination, they need to carry out a comprehensive research program that ensures that argumentative discourse will not only be examined descriptively as a specimen of verbal communication and interaction but also measured against normative standards of reasonableness [1].

In this theory, there are terms such as belief, opinion, moreover, an attitude which usually refers to related concepts that are in relevant ways Different from a standpoint. These are concepts that suit the purposes of scholars who approach their object of study from a different angle than argumentation theory [1].

Deborah Schiffrin (1990) [1], describes opinions as statements in which an individual, subjective and evaluative position is presented concerning an existing, possible or desirable state of affair.

On the other hand, a body of evidence is a warrant in case that evidence consists of reports of observations which support some universally generalized condition [2].

The evidence has a relation with the facts, for example, this definition from a text on legal evidence: A presumption may be defined to be an inference required by the rule of law drawn as to the existence of one fact from the existence of some other established basic facts [2].

As Secor has pointed out [2], for the rhetorician, facts depend on a system of verification (1998, paragraph 6). He believes this epitomizes the rhetorical understanding of fact. If there is agreement about how a claim is verified, if it is agreed that specific evidence would establish that claim and such evidence is produced, then the claim is a fact.

Hence an argument could o could not be required for every premise accepted. Although some premises may be argued for in the context of a given argument, moreover, some premises have been or may be argued for on other occasions, ultimately if a person accepts any statements at all, this person must accept some statements without argument [1].

4 Cognitive Relations Representation in Argumentative Text

This work proposes four elements in the TOEFL argumentative texts as cognitive relations considering the argumentation theory As the first element, the facts are proposed considering the true elements. As a second element are the opinions that may have a

positive or negative direction concerning an argument, and these will require evidence in order to be sustained. Pieces of evidence are the observable elements that are going to accredit opinions with a certain degree of confidence. The last element would be the evaluation that will allow satisfying a conclusion or a correct answer in the case of the texts if the adequate inference route is found that leads to that justification.

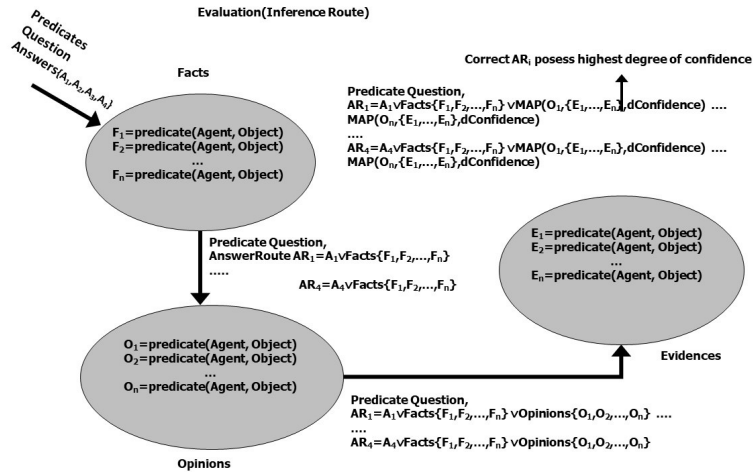


Fig. 1. Evaluation Route Process

In the case of argumentative texts, a structure of representation is proposed, as shown in Figure 1. Consider that the reader needs to analyze the facts, look for evidence of opinions; in order to evaluate the truth value of the judgments made by the author.

In the Figure 1 can be observed that in order to generate this inference route, it is required to place the reader in a specific context. This route will be done using the facts that, being elements that are previously identified with true value, the structure will be based in order to have the context in order to be able to assert in that context the elements that give evidence to find the route or to discard the incorrect routes.

The inference route is generated with this process: initially, the questions coming from the passage become predicates and are introduced in the node of the graph that corresponds to facts, the resulting output is the inference route that has the question in predicate format and the answers with the set of facts with which it is related. Then this route enter in the node of opinions and the generated output is a new route for each answer with all the opinions related to the answer are associated. Finally this new structure leaves and enters to the evidence node where according to the amount of evidence found for the opinions, the answer will have a degree of confidence, so an operator called a map would be required to establish a pair (opinion, evidence) that

gives it a degree of confidence to establish which answer is the correct and in the case of discarded answers, this process establishes the elements by which they were discarded.

Topic: Art

The beginnings of modern dance were happening before Isadora Duncan, but she was the first person to bring the new dance to general audiences and see it accepted and acclaimed.

Her search for a natural movement form sent her to nature. She believed movement should be as natural as the swaying of the trees and the rolling waves of the sea, and should be in harmony with the movements of the Earth. Her great contributions are in three areas.

According to the passage, what did nature represent to Isadora Duncan?
(A) Something to conquer (B) A model for movement
(C) A place to find peace (D) A symbol of disorder

Fig. 2. Example of Argumentative Passage, source text: Chuvanan University source [12]

5 TOEFL Passage Knowledge Representation

Three main reading skills are tested in TOEFL reading comprehension section[14]:

- First, this section evaluates the ability to detect explicit facts and infer implicit facts in the passage. An effective strategy is to make a "road map" of the passage right away so that you can find the answers more efficiently. Certain skills, such as skimming and scanning, will help you more efficiently establish this map.
- Second, It measures the coreference about certain pronouns, like "its" or "their", refers to in specific parts of the text.
- Finally, this proof generate the capacity of create inference from certain information.

In the reading passages [13], questions often ask what a word could be replaced by or what a word means. The context of the word in the sentence and the whole text will provide clues to its meaning. In this section, there are five or six passages that have 400-500 words. Each passage is followed by eight to twelve questions. In some TOEFL questions, however, the context is not reliable for figuring out the meaning of the words. In this case, your knowledge of synonyms, word forms, Latin and Greek roots, prefixes, and suffixes, will help to answer the questions about word meanings. A typical document of TOEFL is the argumentative text, that aims to support an idea, refute it, or persuade the reader to take the position of the writer of the text.

5.1 Argumentative Passage Example

Figure 2 shows an example of an argumentative text paragraph on the subject of art, available on the website of University of Chuvanan [12]. The structure of the passage is as follows: In the first paragraph, the main topic is introduced, while in the subsequent sections, the argumentations are described with the facts, opinions, and pieces of evidence.

The cognitive relations of this passage are the following:

- Modern dance was one of the ways some of these people sought to free their creative spirit (evidence) item She believed movement should be as natural as the swaying of the trees (opinion)
- Duncan danced, ballet was the only type of dance performed in concert (evidence)
- Duncan performed dance by using all her body in the freest possible way(act)
- These were replaced with flowing Grecian tunics, bare feet, and unbound hair(evidence).
- She believed in the natural body being allowed to move freely, and her dress displayed this ideal(opinion).
- She was one of the pioneers who broke tradition so others might be able to develop the art (fact)
- She discarded corset, ballet shoes. and stiff costumes(fact).
- Beethoven and Wagner, which was not the usual custom(fact).

6 Knowledge representation over argumentative text

Figure 3 shows how is the process of the generation of the inference route comes to the question concerning the nature that represents Isadora Duncan. Previously the facts, the opinions, and the pieces of evidence are identified between manual labeling. The process begins with the recopilation of facts. After the routes arrive at the opinions node and new predicates are generated, the operator union is applied for these sets. Finally the new route arrives at the pieces of evidence node, and in this case, the author indicates that good modern dance generates a free creative spirit, this is related as output with the degree of confidence true because the concepts are related. On the other hand, the other answers, how to conquer something is false because the terms are not related. Thus the correct answer is near to the movement.

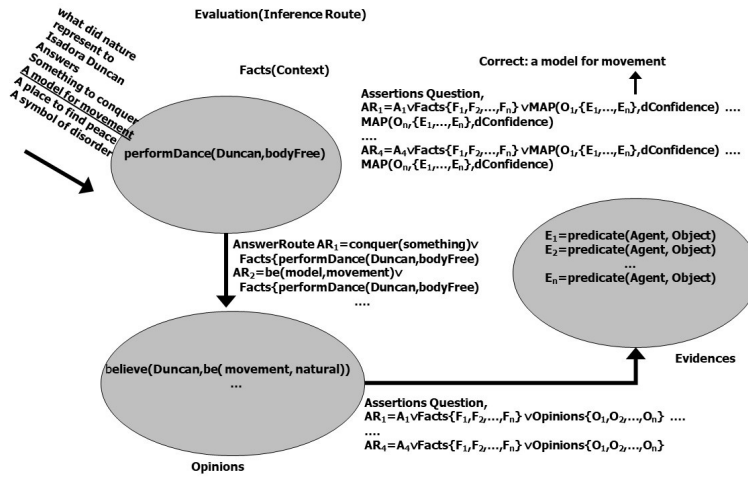


Fig. 3. Example of Inference Route

7 Conclusions

Although reading comprehension is a complex process, designing representation models that allow the identification of terms, semantic relationships, entailments, and context-related assertions will favor the generation of inferences to design query-answer systems to improve the achievement in the reading comprehension sections of TOEFL exams.

The assertions generated from the calculation of situations provide intuitive expressiveness to associate the cognitive relations to a context, so this representation will favor to identify properties and enrich inferential processes.

Kinstch and Van Dijk's model, emphasize the situational model as an element dependent on the reader's experience, with the description of the contexts generated from the calculation of situations, it is possible to create a representation closer to the reader's experience. Thus strategies can be elaborated to improve the process of reading comprehension.

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