From Theoretical Texts to Concept Maps. An Annotation Approach for a Distant Reading of Argumentative Text Structures.

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Introduction

Seen from a content-independent view point, all theoretical texts, as they are used in scientific contexts, (at least intentionally) serve to introduce concepts, define them and connect them with other concepts. We argue that all these texts consist of parts that can be subsumed under three categories, namely theses, arguments and notions. By assigning the segments of a theoretical text to these categories, a formalized structure can be extracted that provides the basis for the establishment of a concept map, which describes the relation and the distances between concepts in and across texts (figure 1).

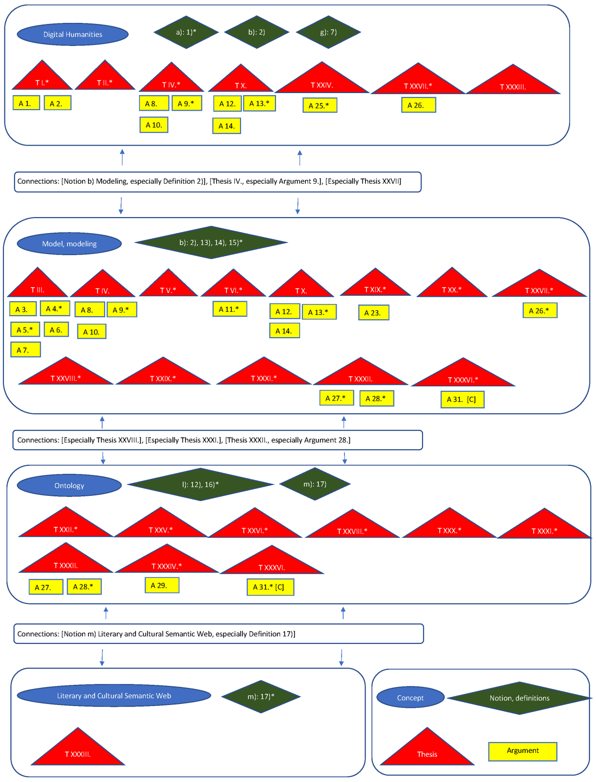

Figure 1: Concept Map for "Digital literary and cultural studies: the state of the art and perspectives" by Fabio Ciotti [Initial concept: "Digital Humanities" / Destination concept: "Literary and Cultural Semantic Web"]

We assume that such a structure-abstracting view is particularly suitable for the application of distance reading methods (Moretti 2013), since the extraction of the categories can provide an overview over large corpora of theoretical texts in respect to their conceptual relationship. This overview can be achieved by the classification of the text segments with machine learning algorithms, based on annotation schemes that also help to assess the validity of such a categorization approach (Pustejovsky /Stubbs 2012; Gius/ Jacke 2017). In our paper, we want to outline the theoretical foundation of our conceptualization and report on attempts to establish an annotation workflow that provides training material for automated classification.

Theoretical Outline

The criteria for rigorous definitions apply to all types of definitions. Rigorous definitions must comply with the principle of eliminability and the principle of conservativeness, exposed by Belnap (1993). The principle of eliminability proposes that a definition must *explain all the meaning of a word*, while the principle of conservativeness must *only explain the meaning of a word*. This also means that definitions are autonomous, they do not refer to external information for their explanation. Explaining all the meaning of a word means that one must cover all the meanings of a word in all possible contexts, and the defined word is interchangeable with the whole definition.

The principle of conservativeness, explaining only the meaning of a word, means that when defining a term, one must not give hidden assertions that lead away from the meaning of that word.

By breaking these rules, one may have theses and arguments, the other components of theories. If we break the criterion of eliminability, the rule according to which every concept present in the body of a definition text fragment is interchangeable with a singular defined concept, we have a text fragment where all concepts are necessary to deliver meaning. This text fragment is a thesis.

The only thing common to theses and definitions is their autonomy. Given that we know each concept composing the theses and definitions, the respective theses and definitions are comprehensible without resorting to any external information.

Arguments, the third category of text fragments, are used for supporting or attacking other text fragments. They are like theses in the way that they also need all the composing concepts to deliver meaning, but they are not autonomous. They need access to the text fragment they support or attack for the reader to comprehend and receive their meaning. Theses and arguments are like algorithms; they employ the entities, defined in the notions – as sets of definitions, to deliver meaning.

The criterion of conservativeness is broken by the nature of theses and arguments. Theses and arguments are not concerned with defining an entity, they are overt assertions about a research topic.

Annotation workflow

To assess the applicability of this theoretically developed categorization on empirical data and to provide the foundation for a computational distant reading with the help of machine learning classifiers, we established a workflow that follows the principles of collaborative annotations and their iterative refinement (Bögel et. al. 2015, Pagel et. al. 2020, Reiter 2020): First, we converted the concept into applicable annotation guidelines and established a decision tree to support annotator’s decisions (figure 2). [1]

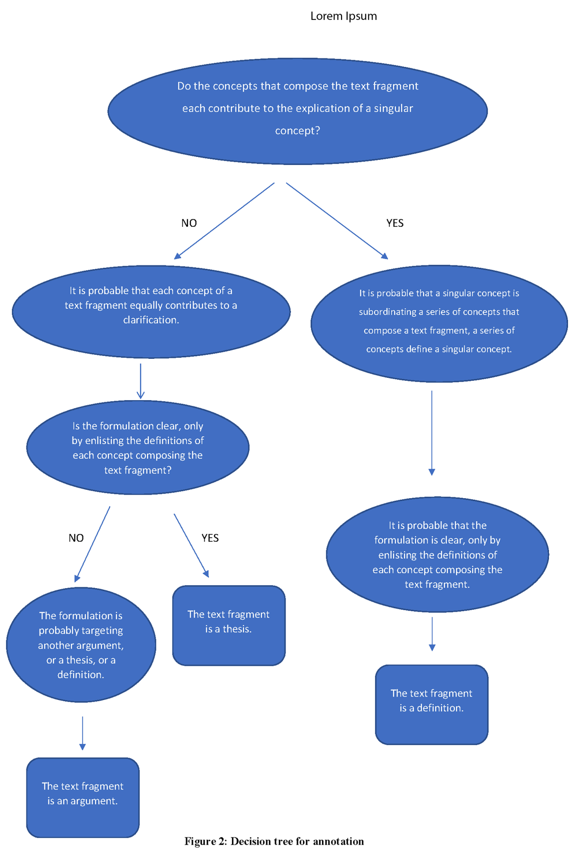

Figure 2: Decision tree for annotation

We then assembled a test corpus of theoretical texts, which we derived from the domain of the Digital Humanities, thus keeping the text base consistent for our first attempts (figure 3).

Test corpus
Artstein, Ron (2017). Inter-annotator Agreement. In: Ide, N., Pustejovsky, J. (eds.) Handbook of Linguistic Annotation. Springer, Dordrecht, S. 297-313.
Ciotti, Fabio (2014). Digital Literary and Cultural Studies. State of the Art and Perspectives. In: Between 4,8, https://doi.org/10.13125/2039-6597/1392
Da, Nan Z. (2019). The Computational Case against Computational Literary Studies. In: Critical Inquiry 43,3, S. 601-639.
Dobson, James E. (2015). Can An Algorithm Be Disturbed?: Machine Learning, Intrinsic Criticism, and the Digital Humanities. In: College Literature 42, S. 543-564.
Evans, Michael S. (2014). A Computational Approach to Qualitative Analysis in Large Textual Datasets. In: PLoS ONE 9,2, https://doi.org/10.1371/journal.pone.0087908
Ganascia, Jean-Gabriel (2015). The Logic of the Big Data Turn in Digital Literary Studies. In: Frontiers in Digital Humanities 2,7. https://doi: 10.3389/fdigh.2015.00007
Gorr, M., Timmons, M. (1989). Subjective truth, objective truth, and moral indifference. Philosophical Studies 55, S. 111–116. https://doi.org/10.1007/BF00372725
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Piper, Andrew (2016). There Will Be Numbers. In: Cultural Analytics May 23, 2016. DOI: 10.22148/16.006
Romele, Alberto, Severo, Marta, Furia, Paolo (2020). Digital hermeneutics: from interpreting with machines to interpretational machines. In: Ai & Society 35, S. 73-86. https://doi.org/10.1007/s00146-018-0856-2
Thaller, Manfred (2012). Controversies around the digital humanities: an agenda. In: Historical Social Research, 37,3, S. 7-23.
Tomasin, Lorenzo (2018). Why digital philology does not exist. Nine and a half theses for philology in the era of digital liquidity. In. Proceedings Textual Philology facing Liquid Modernity

Figure 3: Overview of the corpus

We then assigned four different annotators with the task to annotate the texts according to the guidelines with the help of the tool CATMA (Gius et. al. 2022). In iterative circles we refined the annotation guidelines and calculated inter-annotator agreement (Artstein 2017) to assess, how accurately the categories can be distinguished by human annotators. After achieving a satisfying amount of agreement, we continued to annotate texts for providing more training data and established a gold standard.

Results

For assessing inter-annotator agreement, we used Cohen's Kappa as a measure for the pairwise agreement of the annotators (Cohen 1960). [2]

Text and Annotators	Cohen's Kappa
Artstein A1 & A2	0,59
Artstein Average	0,59
Ganascia A1 & A2	0,66
Ganascia A1 & A3	0,50
Ganascia A1 & A4	0,37
Ganascia A2 & A3	0,71
Ganascia A2 & A4	0,57
Ganascia A3 & A4	0,36
Ganascia Average	0,53
Gorr-Timmons A1 & A2	0,45
Gorr-Timmons A1 & A4	0,41
Gorr-Timmons A2 & A4	0,57
Gorr-Timmons Average	0,48
Hammond A1 & A2	0,33
Hammond Average	0,33

Figure 4: Inter-annotator agreement for four test texts

Figure 4 shows the results for four texts that have been annotated by two to four annotators. On average, we achieve a moderate agreement for three texts, while in one case only fair agreement is reached. However, the annotation guidelines seem to be defined clearly enough to perform further annotations.

Figure 5: Distribution of segments (left) and tokens (right) according to categories

As a first approximation towards distant reading the corpus, figure 5 shows the distribution of the categories over the corpus either by segments or by tokens. As can be seen, the distribution is quite balanced: Regarding segments, the *argument*-category takes up almost half of all cases. However, the *argument*-segments only consist of about the same amount of text as the *notion*-segments. Tokens of the *thesis*-category are rarer, but still make up about a quarter of the total text.

Future Work

To complete our workflow, we plan to annotate more training data in the future and to apply machine learning classifiers and assess their performance according to different features (since the three categories seem to be characterized by syntactic formulas, we expect an n-gram-based approach to lead to best results). We will then automatically classify large amounts of texts to provide a basis for the extraction of concept maps that will serve as a searchable knowledge base of the relationships of concepts in and across different domains.

Notes

1. As can be seen, our categorization differs from similar argument mining tasks (Lawrence/Reed 2019) in that larger sections are considered.
2. We calculated the Kappa values with the code provided by the Gitma-project (Vauth et. al. 2022).

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