



Research Document

Data Challenge - Critical Text Analysis Tool

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Contents

Research Questions.....	3
Main question.....	3
Sub-questions.....	3
Methods.....	4
Results.....	6
1. Which points are there to analyse a text based on?.....	6
Text Analysis.....	6
Logical Fallacies.....	6
Journalism Ethics.....	7
2. What should the interface of the product look like?.....	9
3. How could that interface be built, and which frameworks should be used?.....	11
4. How can the system be built?.....	13
5. What models already exist that can be extended?.....	13
6. Which data can be used/already exists?.....	13
7. What should the scope be limited to?.....	15
Conclusions and Recommendations.....	16
References.....	17


Research Questions

Main question

What can be implemented as a Proof of Concept for a critical text analysis tool?

Elaboration on the word critical in current context

“Critical” here as described in the third definition in the Britannica Dictionary:

critical /ˈkrɪtɪkəl/  *adjective*

Britannica Dictionary definition of CRITICAL

3 : using or involving careful judgment about the good and bad parts of something

- The program presents a *critical* analysis of the government's strategies.
- She has a talent for *critical* thinking.
- We need to look at these proposed changes **with a critical eye** before we accept them.











(*Critical Definition & Meaning*, n.d.)





Critical text analysis will be further outlined in the results of sub-question 1.

Sub-questions

1. Which points are there to analyse a text based on?
2. What should the interface of the product look like?
3. How could that interface be built, and which frameworks should be used?
4. How can the system be built?
5. What models already exist that can be extended?
6. Which data can be used/already exists?
7. What should the scope be limited to?

Methods

Sub-Question	Method	Type	Application/Reasoning
1	Literature Study		Research critical text analysis and common argumentative pitfalls.
	Brainstorm		Think of structures and look up the phenomenon, its terms, and explanation
2	Problem Analysis		Analysing which inputs and outputs the system would require
	Prototyping		Creating wireframes
3	Explore user requirements		See the problem from a user's point of view and establish requirements based on that
	Available product analysis		Check whether there are similar tools that can be used as an example and how they were built
	Requirements prioritization		Prioritise requirements using MoSCoW method (<i>MoSCoW Method</i> , n.d.)
4	Problem Analysis		What are the system's tasks and with which technologies can they be solved.
	Brainstorm		Which approaches have we used before, what can we come up with and look into?
	Literature Study		Research possible approaches to draw conclusions.

5	Available product analysis		Check which models there are.
	Literature Study		Read up on the found models.
6	Available product analysis		Check which datasets there are. Which datasets have models found in sub-question 5 been trained on?
	Literature Study		Read up on the available datasets.

Results

1. Which points are there to analyse a text based on?

Critical Text Analysis

Critical text analysis is part of the process of evaluating and interpreting texts with the requirement of a comprehensive and objective approach. This process involves a detailed examination to assess the effectiveness of a text and understand how elements contribute to its overall impact. Important steps of critical text analysis include critical reading to identify the author's thesis and main arguments, summarizing the text to capture its core ideas, and considering the author's background and evidence. It's crucial to question the author's viewpoint, assess the quality of their arguments, and evaluate the strengths and weaknesses of their claims. Comparison of the text to similar works places it within a broader context. A more thorough understanding of the text can be achieved through this methodology which leads to biases being more easily spotted and the validity of arguments can be assessed. Critical text analysis is a valuable skill allowing readers to engage with texts more meaningfully and thoughtfully.

Logical Fallacies

Logical fallacies represent types of reasoning that are flawed or misleading, setting them apart from subjective claims or those refutable by factual evidence. A position is deemed a logical fallacy if it contains inherent logical errors or deceptive elements. There are several types of logical fallacies, a few of the most common ones are:

1. **Ad Hominem:** Attacking the character or personal traits of the person making the argument, rather than the argument itself.
Example: *"Morgan can't be trusted to advise on health issues because she smokes."*
2. **Straw Man:** Misrepresenting or exaggerating an opponent's argument to make it easier to attack.
Example: *"He says we should improve public education, but I don't understand why he hates private schools so much."*
3. **Red Herring:** Introducing an irrelevant topic to divert attention from the issue.
Example: *"We can't worry about the environment when there are so many people unemployed."*
4. **Appeal to Ignorance:** Claiming a proposition is true because it has not been proven false, or vice versa.
Example: *"There's no evidence that ghosts don't exist, so they must be real."*
5. **False Dilemma (False Dichotomy):** Presenting two options as the only possibilities, when more exist.
Example: *"You're either with us or against us."*

6. **Slippery Slope:** Suggesting that a small first step will inevitably lead to a chain of related (negative) events.
Example: *"If we allow students to redo this test, they'll expect to retake every test, leading to rampant grade inflation."*
7. **Circular Argument:** Restating the argument rather than actually proving it.
Example: *"God exists because the Bible says so, and the Bible is the word of God."*
8. **Hasty Generalization:** Drawing a general conclusion from a small or unrepresentative sample.
Example: *"My grandfather smoked his whole life and lived until 90, so smoking can't be that bad."*
9. **Bandwagon Fallacy:** Assuming something is true or right because it is popular.
Example: *"Everyone I know is buying this stock, so it must be a good investment."*
10. **Appeal to Authority:** Using the opinion of an authority figure, or the concept of authority, as evidence for an argument's validity.
Example: *"This medication must be safe; a famous actor endorsed it."*

There are several reasons why people fall for logical fallacies:

1. Cognitive biases: are mental shortcuts that our brains use to simplify information processing. They often lead us to make quick judgments based on incomplete or skewed data.
2. Emotional reasoning: emotions can influence someone's thinking process.
3. Social and cultural influences: people may be inclined to accept fallacious arguments when these align with the prevailing social norms or cultural beliefs, driven by a tendency to adhere to the perspectives and values prevalent within their social circle or broader society.
4. Lack of knowledge or critical thinking skills: without adequate knowledge of a subject or strong critical thinking skills, it's easier to accept fallacious arguments as they might seem plausible on the surface.
5. Heuristic processing: this involves using simple and efficient rules (heuristics) to make decisions quickly. While heuristics can be helpful, they can also lead to errors in judgment, including the acceptance of logical fallacies.
6. Overload of information: in the face of overwhelming information, particularly in our fast-paced, media-saturated world, people may rely on simplified forms of reasoning, making them more susceptible to fallacious arguments.

How to avoid falling for logical fallacies:

Awareness and building an understanding of these patterns is the first step to prevent falling for logical fallacies. It can also be a basis for examining one's own communication and argumentation to refrain from using these patterns.

Journalism Ethics

Organisations like The Society of Professional Journalists (SPJ) (*SPJ Code of Ethics*, 2014) and The Associated Press (AP) (Associated Press, n.d.) describe journalism ethics as the foundation of trustworthy and responsible reporting. The pillars of these ethics can be summarised as truthfulness, accuracy, fairness, and integrity in journalism. The SPJ's Code of Ethics call for the free exchange of accurate, fair, and thorough information. Journalists should act with integrity, including verifying facts, seeking out multiple sources, and avoiding conflicts of interest to maintain objectivity and impartiality. The AP's standards emphasize the importance of reporting news accurately and honestly, safeguarding stories from biases and inaccuracies. Both organisations require their employees/members to adhere to an extensive set of guidelines and by that upholding their principles in the organisations context.

A key aspect of journalism ethics is the protection of sources, as highlighted by the Ethical Journalism Network (EJN) (Amez, n.d.) and the Online News Association (ONA) (Online News Association, n.d.). To provide transparency, journalists must ensure the reliability of their sources and disclose source motivations and conditions for providing information, particularly in sensitive or conflict situations.

These principles collectively form a code of conduct that guides journalists in serving the public interest and thereby upholding an essential basis to justice and democracy.

While there is questions or doubts that can arise on the basis of a single article, resulting standards cannot simply be checked without cross referencing and thus taking external information into consideration.

2. What should the interface of the product look like?

Inputs to the system should be made through a simple, user-friendly form. The design should include intuitive input actions/controls.

- Submit an input text, which could be a textarea to copy/paste the text into, an upload for PDF/docx/txt files, or a link to a text on a website (-> start with copy/paste for simplicity)
- Select (multiple) categories to analyse the text for (logical fallacies, journalistic standards, possible critical questions to ask)
- Submit text -> text field transforms to / extracted text displayed as 'solid text' on background -> loading animation

Outputs of the system should be visualised through colour highlighting per selected category

- Display legend connecting each colour to a category
- In the solid text highlight the text pieces recognised as belonging to a category by the system in the respective colour
- When hovering over the highlighted section, make an explanation appear for why the section is recognised as belonging to the category and/or how it would be done correctly.

Wireframes:

Here are two options of how the input interface might look like. The explanation should be simple and minimal, a large text area to paste the text in, a button to submit the inputs to the system, with the difference that the selection of categories to be analysed could be a dropdown menu for selection or checkboxes.

Critical Text Analysis Tool

Lorem ipsum dolor sit amet, consectetur adipiscing elit.

This wireframe shows a large rectangular text input area. Below the input area is a horizontal bar containing a dropdown menu on the left, indicated by a small downward arrow, and a 'Submit' button on the right.

Critical Text Analysis Tool

Lorem ipsum dolor sit amet, consectetur adipiscing elit.

This wireframe shows a large rectangular text input area. Below the input area is a horizontal bar containing six checkboxes, each followed by the word 'Lorem', arranged in two rows of three. A 'Submit' button is located on the right side of the bar.

On click of the submit button the text solidifies on its background, the chosen categories to analyse the text on are each given a colour which can be seen in a legend above the text. Within the text the sections belonging to the categories are highlighted in the respective colours. When hovering over one of these sections an explanation appears in the sidebar.

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3. How could that interface be built, and which frameworks should be used?

To assess which frameworks would be suitable, firstly the requirements for the interface need to be assessed. These requirements, for now, apply to a proof of concept that we want to provide as a result of the data challenge. In the following table, the MoSCoW method is used to prioritise features.

Requirement Description	MUST	SHOULD	COULD	WOULD
GUI visual interface for the user	X			
API Send text through requests from frontend to backend to be processed and return response		X		
AI Integration (Python) Easily integrate Python-based script	X			
User identification (accounts) - Authorisation - Authentication				X
Tutorial instructions on how to use the tool			X	
Highlighting of identified sections	X			
Explanation for why section is highlighted		X		

An interface could be created with a Streamlit or similar application. Alternatively, a full-stack single page application could be built.

Comparison using Streamlit vs building Full-Stack app

For Streamlit, quick initial setup, faster development. Prepared components can be used and customised, so those do not need to be come up with and defined. Easily usable without extensive knowledge of software development, easily deployable.

A full-stack application including an API and a frontend is more customisable to own needs. More freedom than Streamlit, almost anything is possible. It may be easier to create outputs exactly as envisioned instead of trying to fit things into the framework of what a tool like Streamlit provides.

In the case of building a full-stack single page application a choice for frameworks needs to be made. The choice could be made between FastAPI, Flask, or Django (easily usable with AI models since all are Python-based) as a backend and React, Vue, or Angular as a frontend.

FastAPI vs Flask vs Django

Django

A larger framework, with more rigid structures, requires more learning, more suited to larger applications.

Flask

Is lightweight and more suitable for smaller use cases like the current one.

FastAPI

Is lightweight, can be easily learned and set up, is quick to learn and set up, made for AI integration, and has easy-to-follow available documentation and tutorials. On top of that, I have some experience with it. More flexibility and scalability than Flask and Django.

4. How can the system be built?

The basis for the system is natural language processing (NLP). In the light of checking a text for logical fallacies, a relatively simple system could suffice that gets trained to recognise the given structure. In the case of checking for applied journalism ethics or failure to do so, a broader system is required that has access to text external knowledge and can do cross referencing, here is where pretrained large language models (LLM) are required.

Possible Approaches

The following table compares different possible approaches to creating the system in various points concerning the development and potential of the system.

	Langchain & LLM	Extend Model	Build own model
Detecting Logical Fallacies	Already reliably possible with e.g. GPT-4	Depends on pretrained base model	Possible with suitable dataset
Checking for applied journalistic standards	Possible with e.g. GPT-4 (but how well does it perform?)	Depends on pretrained base model	Would not be possible, broad and relatively up to date knowledge required
Possibilities for extension	Easily add to the chain, multitude of possibilities	Depends on pretrained base model	New data must be found for each addition and retrained
Development speed	Relatively quick*	Difficult to estimate, no experience	Tedious because of data sourcing, preparation, etc
Explaining conclusions	May be more difficult or only possible through questions and responses to/from the LLM	If pretrained model's layers are accessible can look into it easily	Easily explainable since own approach and no restrictions of looking into it

*Although we have both worked with the technology before, bottlenecks would be our inexperience with its concepts which would make the process slower than for experienced experts. However, it is still expected to be by far faster than using the other approaches

Conclusions

Using langchain and choosing a LLM that has broader information allows for more complex analysis of the text which is one of the main aims of this project. It also opens lots of

opportunities in extendability of the tool. It makes the system reliant on a external system that is not completely transparent.

Extending on a pretrained model needs to be explored more to draw a conclusion.

Building an own model from scratch that is capable of the intended features seems flat out impossible with our resources, time, and current knowledge but would be the most transparent.

5. What models already exist that can be extended?

Many models could be used (*Top BERT Alternatives in 2023*, n.d.), a few are the OpenAI model (like GPT-3) or BERT (Google) for text analysis. The models can be fine-tuned or extended to detect logical fallacies.

Some models and their advantages/disadvantages:

GPT-3

Advantages: are that it is easy to use and does not require as much fine-tuning compared to other models. It is flexible in use since it can do text translation, question-answering, and more.

Disadvantages: it requires usage fees, and API keys are not free, so it can become expensive over time.

BERT (*Bidirectional Encoder Representations from Transformers*)

Advantages: pre-trained on a large corpus, which saves time. It allows it to understand the context of the words based on all surroundings, this can help with giving more accurate interpretations of meaning.

Disadvantages: can be fine-tuned, but requires NLP expertise and understanding.

RoBERTa (*A Robustly Optimized BERT Pretraining Approach*)

Advantages: trained on a much larger dataset (trained on a dataset of 160 GB, for BERT this is 16 GB). It uses a more effective training procedure.

Disadvantages: training the model can be prohibitive and have a large carbon footprint.

6. Which data can be used/already exists?

Public datasets (e.g., Kaggle) or other open-source platforms containing annotated texts. Academic papers could be used. We could scrape data to collect data from specific websites if needed. We could also collect our data, collected through e.g. interviews or surveys.

The following datasets are used to train on the RoBERTa model. These datasets could be useful for this project as well.

BOOK CORPUS and English Wikipedia dataset: also used for training BERT architecture, this data contains 16GB of text. The dataset combines fiction from Book Corpus with a wide range of topics covered in Wikipedia. Book corpus is no longer available in its original form, but e.g. Project Gutenberg could be used (offers a large collection of free e-books).

CC-NEWS. This data contains 63 million English news articles crawled between September 2016 and February 2019. The size of this dataset is 76 GB after filtering, so it may require significant computation resources. The data can be accessed on [Common Crawl](#).

OPENWEBTEXT: This dataset contains web content extracted from the URLs shared on Reddit with at least 3 upvotes. The size of this dataset is 38 GB. It is not officially hosted but can be found on [GitHub](#) or [Skylion007/openwebtext · Datasets at Hugging Face](#).

STORIES (or CC-Stories): This dataset contains a subset of Common Crawl data filtered to match the story-like style of Winograd NLP task. This dataset contains 31 GB of text. It is used for common sense reasoning and language modeling. The dataset was constructed by aggregating documents from the CommonCrawl dataset that has the most overlapping n-grams with the questions in commonsense reasoning tasks. The top 1.0% of the highest-ranked documents is chosen as the new training corpus.

Datasets on logical fallacies:

<https://www.logical-fallacy.com/articles/dataset-review/>

<https://huggingface.co/datasets?search=fallacies>

Conclusions and Recommendations

IDEAS:

We will try working with a few models and see which one(s) works best in our case.

Look at

- LIME for XAI (for explanations)
- Experiment: Which logical fallacies / listed types of categories can LLMs recognise?
 - Benchmarking of different models

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