Using Retrieval Augmented Generation and Knowledge Graphs to Understand Climate Obstruction

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*Abstract*—Climate change is one of the most serious crises the human race has ever faced. However, unlike previous crises such as the destruction of the ozone layer, the world has not come together to address the issue. At times this has been blamed on poor science communication. However, social scientists have realized that in reality the primary problem is that large corporations with vested interests in fossil fuels have orchestrated a campaign of disinformation and obfuscation which social scientists have labelled Climate Obstruction. This project is an attempt to collect the various resources (e.g., papers, databases, news articles) about Climate Obstruction into a knowledge graph using a Large Language Model as the user interface via a Retrieval Augmented Generation architecture. At a minimum, such a system provides a tool for researchers to have all the data in one location accessible via a natural language user interface. A long term goal is to use the rigor and logical foundation of the knowledge graph defined on a logical model using the Web Ontology Language (OWL) to rigorously define climate obstruction models that can be tested against data. I.e., to make the social science behind the analysis of Climate Obstruction a truly rigorous science. The current system is a proof of concept prototype. It provides useful functionality, but the team has not yet acquired the funding required to host the system on the Internet. All that is lacking, however, is the funding. The system utilizes resources such as the AllegroGraph graph database, the Open AI API, and the streamlet.io user interface that are supported in hosted environments such as Amazon Web Services and Microsoft Azure. The system runs as an Internet system already, all that is needed are some basic resources to support hosting the system.

Keywords — climate obstruction, Retrieval Augmented Generation (RAG), knowledge graph, Web Ontology Language (OWL), Large Language Model (LLM)

# Introduction

Climate change is one of the most serious crises the human race has ever faced. However, unlike previous crises such as the destruction of the ozone layer, the world has not come together to address the issue. At times this has been blamed on poor science communication [1] [2]. However, social scientists have realized that in reality the primary problem is that large corporations with vested interests in fossil fuels have orchestrated a campaign of disinformation and obfuscation which social scientists have labelled Climate Obstruction [3].

The goal of this research is to develop a Neurosymbolic (NS) model [4],[5] of the theory defined in [3]. An NS model combines two different techniques to represent meaning. The Web Ontology Language (OWL) utilizes symbolic representation and logic. LLMs model language using embeddings in a huge vector space created by the probabilistic analysis of terabytes of text.

There are several reasons such a model and knowledge graph can benefit researchers. In the short term, it serves as one central portal to find documents related to climate obstruction that can be queried and used to develop arguments, charts, etc. using a LLM. That is the primary goal of this project.

The longer term goal is to provide an example of a new way to approach the social sciences. We are creating another form of the model described in [3]. A model that should eventually be able to make falsifiable predictions. The Description Logic of the Web Ontology Language (OWL) provides a formal model of the Climate Obstruction model. Such a model has many benefits over a model only defined with words. An OWL model is a mathematical model just as any model in science. We can use the reasoner to prove that there are no logical errors in the model and to infer additional data based on the logical axioms.

In addition, the ability of an LLM to model meaning of text as vector space offers a completely different type of analysis using statistical probabilities which work better for much real natural language than any formal model.

As an example, the book defines a process model for the flow of various forms of influence. By creating a formal model we can analyze data and see if we can recognize the kind of patterns of influence flow.

# Methodology

## Retrieval Augmented Generation (RAG)

Retrieval Augmented Generation (RAG) is an architecture that allows the system to utilize the semantic embedding and NLP understanding and generation of an LLM while using a curated corpus of documents as the knowledge-base rather than the default neural network of the LLM [6], [7]. The advantage of a RAG architecture is that for a specific domain, it addresses the two most significant issues with LLMs: black-box reasoning and hallucinations. A standard LLM does not know what it knows. It is not the case that understanding the reasoning of an LLM is simply difficult, it is as of 2025 an unsolved problem [8], [9]. This lack of explicit knowledge representation is the cause for both hallucinations and black-box reasoning. Black-box reasoning results because although an LLM can find sources to support its conclusion, those sources are post-hoc rationalizations. As demonstrated by [8], the specific cells and values that resulted in an LLM response are simply not accessible. This is also the cause for hallucinations. A standard LLM has no way to evaluate how strong a response is because it does not have access to the knowledge that was used to generate the response and hence has no way to evaluate whether that knowledge was a good match for the question. The RAG architecture solves both of these problems by substituting a curated corpus of documents for the domain knowledge of the LLM. Of course, as with any architectural decision there is a trade-off. An LLM has an incredible breadth of knowledge. A RAG system is much more narrow and typically focused on a fairly narrow domain such as customer support for a specific product or a specific sub-domain of medicine such as dental materials [10].

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##### Acknowledgment

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