Potenciando la E-Deliberación Inclusiva mediante Árboles de Posturas y Árboles Dialécticos

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Resumen En este trabajo mostramos cómo la inteligencia artificial (IA) puede potenciar la e-deliberación inclusiva. Nos enfocamos en la construcción de "árboles de posturas", estructuras jerárquicas que organizan opiniones polarizadas por tema. Además, introducimos los "árboles dialécticos", que van un paso más allá al mapear argumentos y contraargumentos sobre cuestiones específicas. La metodología propuesta integra recuperación semántica de información, modelado de tópicos, predicción de posturas y síntesis de argumentos utilizando IA generativa, específicamente modelos de lenguaje de gran escala, para facilitar la interacción entre el gobierno y la ciudadanía, así como la deliberación pública. Al empoderar a los ciudadanos—incluyendo también a no expertos y grupos minoritarios—para contribuir en los procesos de toma de decisiones, esta investigación busca fortalecer los sistemas sociales. El artículo describe los avances actuales hacia este objetivo.

Palabras clave: e-deliberación, árboles de posturas, argumentación, modelos de lenguaje de gran escala

Empowering Inclusive E-Deliberation through Stance Trees and Dialectic Trees

Abstract In this paper, we show how inclusive e-deliberation can be enhanced through the use of artificial intelligence (AI). We focus on constructing "stance trees," which are hierarchical structures that organize polarized opinions by topic. Additionally, we introduce "dialectic trees," which go a step further by mapping arguments and counterarguments on specific issues. The proposed methodology integrates semantic information retrieval, topic modeling, stance prediction, and argument synthesis using generative AI, specifically large language models, to facilitate government-citizen interaction and public deliberation. By empowering citizens—including non-experts and minority groups—to contribute to decision-making processes, this research aims to foster more resilient social systems. The paper outlines current progress toward this goal.

Keywords: e-deliberation, stance trees, argumentation, large language models

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1 Introduction

Inclusive e-deliberation is critical for effective public decision-making, yet existing online platforms often fail to engage diverse perspectives or foster constructive discourse (Maguitman et al, 2019). As part of a multi-year research project[1], we address these challenges by proposing AI-driven tools that facilitate the organization and analysis of public opinions (Grosse et al, 2015; Hubert et al, 2020; Diaz et al, 2022, 2023, 2024).

The project aims to develop a platform for inclusive e-deliberation by constructing stance trees, which are hierarchical structures that organize polarized opinions by topic and stance (Diaz et al, 2022). Additionally, ongoing research leverages recent advances in generative AI to further extend this approach by constructing dialectic trees. These structured representations map arguments and counterarguments on specific issues. By generating synthetic arguments from collections of opinions, we enhance the feasibility of modeling argumentative flow in a more comprehensive manner. The platform aims to empower citizens to participate meaningfully in public decision-making. The main objectives of the project are:

1. Constructing stance trees that visually represent opinions on polarized issues.
2. Leveraging generative AI for argument synthesis, ensuring that arguments and counterarguments are not only retrieved but also generated or refined to improve coherence, inclusivity, and engagement.
3. Integrating multiple natural language processing techniques, including stance prediction, topic modeling (e.g., BERTopic (Grootendorst, 2022)), and semantic information retrieval, to build structured debates.
4. Creating a high-quality dataset to assess the effectiveness of argument synthesis while providing a valuable resource for other researchers in the field.
5. Developing and validating a computational toolkit that can be integrated into e-participation platforms, improving government-citizen interaction and public discourse.

2 Related Work

Previous work on stance detection has focused on identifying pro, anti, or neutral positions in text (Küçük and Can, 2020; ALDayel and Magdy, 2021). Our proposal introduces an alternative structure for stance analysis, facilitating the identification of polarized topics and offering a more intuitive representation of conflicting arguments compared to existing approaches.

In earlier work, we introduced opinion trees (Grosse et al, 2015) as a method for contrasting collective opinions. However, opinion trees rely on sentiment analysis, emphasizing the identification of an overall sentiment (positive, negative, or neutral) associated with a set of opinions. In contrast, this project focuses on the argumentation process, structuring opinions based on distinct stances (pro and anti) rather than sentiment alone. More recent work from our research team has addressed the problem of building stance trees (Diaz et al, 2022, 2023, 2024). In particular, we have explored

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COVID-19 vaccination and climate change as case studies. However, further validation, the development of a usable toolkit, and the construction of dialectic trees are still pending.

Several studies have explored argument mining and argument extraction, focusing on identifying argumentative components such as claims, premises, and their relationships within texts (Stab et al, 2018; Lawrence and Reed, 2020). These approaches typically aim to detect and classify existing arguments rather than generate new ones. In contrast to our approach, none of this prior work has specifically addressed the synthesis and organization of arguments into coherent structures—such as dialectic trees—that reflect the logical relationships between opposing viewpoints, from a collection of opinions using generative AI. By integrating argument synthesis with the systematic detection of argumentative relations, our approach contributes to a more comprehensive framework for modeling deliberative discourse.

3 Proposed Pipeline

Stance trees are hierarchical structures that depict arguments supporting or opposing a specific issue. They serve as a preliminary step before generating dialectic trees, which are more complex structures where edges represent attack relations between arguments, allowing for a clearer visualization of the strengths and weaknesses of different positions. The proposed pipeline for constructing stance trees and dialectic trees is outlined in Figure 1 and includes:

1. Curating a set of opinions from social media or e-platforms.
2. Exploring zero-shot or few-shot approaches and fine-tuning stance prediction models, depending on the complexity of topics and the availability of labeled data.
3. Generating a hierarchical structure of topics by applying topic modeling.
4. Associating each topic with a predominant stance to build a stance tree.
5. Synthesizing arguments from the identified topics using generative AI and organize them to construct a dialectic tree.

Stages 1 to 4 of our proposed pipeline have been successfully completed and documented in our previous work (Diaz et al, 2022, 2023, 2024). The next significant challenge in our research is the construction of dialectic trees (stage 5). This process requires not only the synthesis of arguments from collected opinions but also the systematic organization of the argumentative structure to ensure that arguments and counterarguments are properly related. Currently, the synthesis of arguments from collected opinions is being performed using a large language model (we use the *Gemma 3* model (Team et al, 2025)). This process involves applying different prompt engineering strategies to guide the model in generating well-structured arguments from a set of related opinions. The generated arguments are currently undergoing evaluation by human subjects to assess their quality, coherence, and relevance. This evaluation will provide insights into the effectiveness of generative AI in constructing well-formed arguments.

Subsequent efforts will focus on identifying argument-counterargument relationships within the collection of synthetic arguments. This includes analyzing key argumentative dynamics such as rebuttals, defeated arguments, and supporting claims. By structuring these relationships appropriately, we aim to refine the dialectic tree model,

facilitating the progression of discourse toward more substantiated viewpoints. Ultimately, this process aims to contribute to the refinement of ideas and, ideally, to the discovery of truth or a more robust collective understanding.

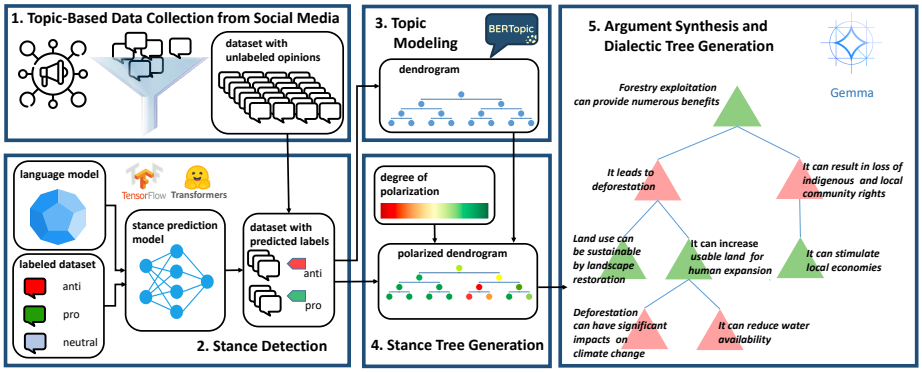

Fig. 1. Proposed pipeline for building stance trees and dialectic trees from a collection of opinions on a polarized topic. On the right-hand side we present an illustrative (simplified) example of a dialectic tree on "forestry exploitation." Pro-forestry exploitation arguments are represented with green triangles and anti-forestry exploitation argument are represented with red triangles.

4 Conclusion

This ongoing research paper presented an approach to enhancing inclusive e-deliberation through the construction of stance trees and dialectic trees. By leveraging AI techniques such as stance prediction, topic modeling, and generative argument synthesis, the proposed framework enables the structured organization of public opinions and argumentative exchanges.

Current efforts focus on refining the methodology, validating the approach through quantitative and qualitative analysis, and developing a usable toolkit for real-world applications. Additionally, ongoing research explores the comparison of human-generated and AI-generated arguments to assess their quality and effectiveness in deliberative contexts. Future work will extend the construction of dialectic trees, integrate the toolkit into e-participation platforms, and evaluate its impact on fostering constructive discourse and inclusive decision-making.

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