Understanding Bias in QA Models: A Comprehensive Analysis of the BBQ Dataset

Abstract

The paper introduces the Bias Benchmark for Question Answering (BBQ), a dataset specifically designed to identify and measure social biases in question-answering (QA) models. By targeting biases across nine social dimensions relevant to U.S. English-speaking contexts, BBQ assesses the influence of these biases through two evaluation levels: under-informative and adequately informative contexts. The study critically examines how language models (LMs) perpetuate stereotypes and biases, posing potential risks to marginalized communities. Through the BBQ dataset, the research provides insights into how these biases manifest in real-world applications, evaluating the performance of prominent models like UnifiedQA, RoBERTa, and DeBERTaV3.

Introduction

Bias in artificial intelligence, especially in language models, is a growing concern as these technologies increasingly influence real-world decisions. The BBQ dataset addresses this issue by focusing on QA models' biases, providing a structured method to evaluate how models handle ambiguous and disambiguated contexts. It highlights the inherent risks of perpetuating stereotypes, which can lead to representational harms for certain identity groups.

Dataset Structure and Methodology

The BBQ dataset is meticulously crafted to explore biases within QA systems. It comprises sets of examples varying by context and question type. Each set includes four examples derived by: 1. **Context Options:** - Ambiguous context only - Ambiguous context with an added disambiguated context 2. **Question Types:** - Negative questions - Non-negative questions The dataset includes deliberate term swaps (e.g., "Christian" vs. "Muslim") to evaluate biases. Correct answers accompany each configuration, ensuring the dataset's efficacy in assessing model performance and fairness.

Bias Identification

The research delves into biases across categories such as age, disability, gender identity, nationality, race/ethnicity, religion, and more. It questions how differences in model prediction likelihoods reflect biases, using scenarios that potentially expose these inclinations—for instance, evaluating age bias in a book club meeting context.

Literature Context

The BBQ dataset builds on previous works by Sheng et al. (2019) and Rudinger et al. (2018), which noted biases in language generation and coreference resolution tasks. The study acknowledges the broader framework of representational harms and contrasts its methodology with prior research, such as the UnQover approach, to offer a nuanced understanding of model biases.

Experimental Setup

The evaluation involves a benchmark of approximately 175 questions, forming a final dataset of over 58,000 examples. The study tests three models: UnifiedQA, RoBERTa, and DeBERTaV3, assessing their performance and bias tendencies in varying contexts. The research defines bias as representational harms that reinforce the subordination of identity groups, contrasting group outcomes to highlight stereotype impact.

Template Design

Templates include two questions with answer choices, a partial context, and a disambiguating context. These templates are crafted from scratch to isolate specific biases, using known stereotypes as a foundation. Categories include nationality, race/ethnicity, religion, and more, with templates validated by crowdworkers on Amazon Mechanical Turk.

Results and Analysis

The models exhibited varied performance, with UnifiedQA achieving 77.8% accuracy in disambiguated contexts. However, biases were pronounced in ambiguous contexts, where models frequently defaulted to stereotype-driven responses. Gender biases shifted based on naming conventions or identity labels, while intersectional biases showed inconsistent results across multiple identity dimensions.

Discussion

The findings underscore the significance of understanding and mitigating social biases in AI models. The BBQ dataset provides a crucial tool for identifying these biases, highlighting the necessity for improved models that handle ambiguous scenarios without resorting to stereotypes.

Conclusion

The BBQ dataset serves as a benchmark for evaluating biases in QA systems, offering insights into the social biases that AI models may perpetuate. By understanding these biases, developers can devise more equitable and fair AI solutions, reducing the risk of harm to marginalized communities.

References

- Sheng et al. (2019) - Rudinger et al. (2018) - Khashabi et al. (2020) - Liu et al. (2019) - He et al. (2021) - Crawford (2017) - Dev et al. (2018) - Vidgen et al. (2021) This study, titled "The Bias Benchmark for QA (BBQ)", is a collaborative effort by authors dedicated to enhancing the fairness and reliability of question-answering models in the context of social biases.