Stack Overflow in the Age of AI
Sentiment, User Engagement, Language Trends

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INTRODUCTION

ABSTRACT

This project analyzes how AI tools have influenced Stack Overflow activity. We examined trends in AI-related questions, posting frequency, and user sentiment, over time and across programming language levels. Results show a significant post-ChatGPT rise in AI-related content, a sharper decline in posting rates, and inconclusive sentiment differences between language types.

BACKGROUND

Stack Overflow is a popular Q&A platform for programmers, widely used to seek help and share knowledge. However, the rise of generative AI tools presents an alternative source of answers. This project examines whether AI adoption is reshaping user engagement in the platform.

HYPOTHESES

✧ Users express more negative sentiment in questions about low-level languages.

✧ AI-related question volume has significantly increased since ChatGPT's release.

✧ Stack Overflow question volume has decreased post-AI, with sentiment becoming more positive.

OBJECTIVES

✧ Measure sentiment across different programming language levels.

✧ Quantify changes in AI-related questions over time.

✧ Analyze changes in question frequency post-ChatGPT.

RESEARCH

DATA COLLECTION

We combined four Kaggle datasets, including Stack Overflow questions, programming language popularity, and GitHub issue counts. We then filtered for relevance and time range to answer each hypothesis. AI-related content was identified with keyword matching, and sentiment was scored using a pre-trained DistilBERT model. Questions were grouped by language level.

METHODOLOGY

✧ **Sentiment Analysis:** Used DistilBERT for sentiment score; compared low- vs. high-level language posts with an independent t-test.

✧ **AI Trends:** Identified AI-related posts via keyword matching; measured pre- vs. post-ChatGPT frequency with a chi-squared test.

✧ **Usage Trends:** Analyzed monthly post volume trends using linear regression and t-tests.
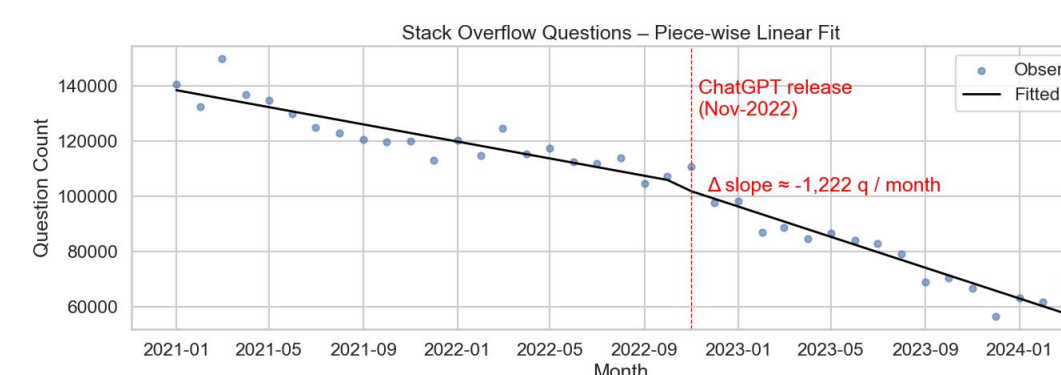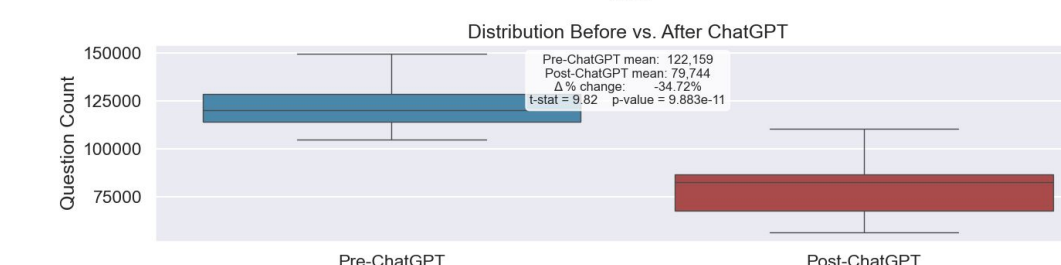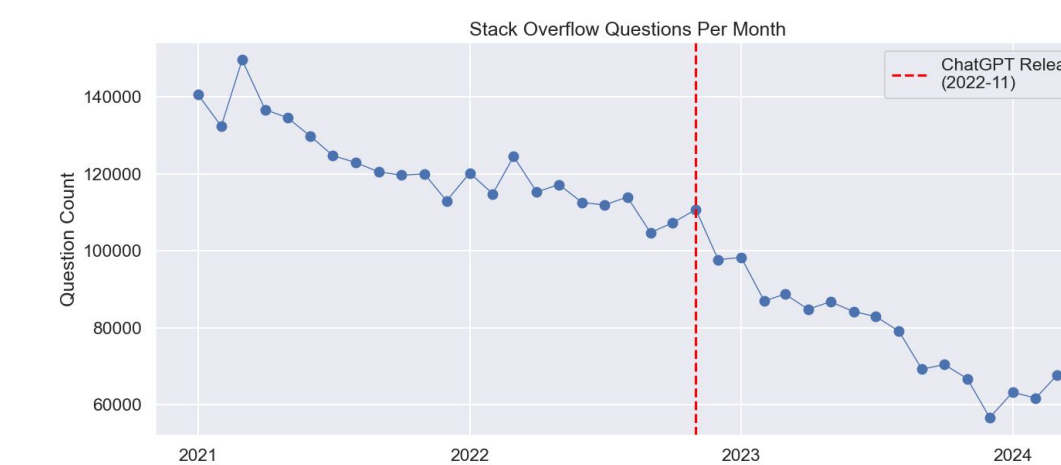
RESULTS

Our sentiment scores showed no significant difference by language level ($p = 0.55$), likely due to text classification model mismatch.
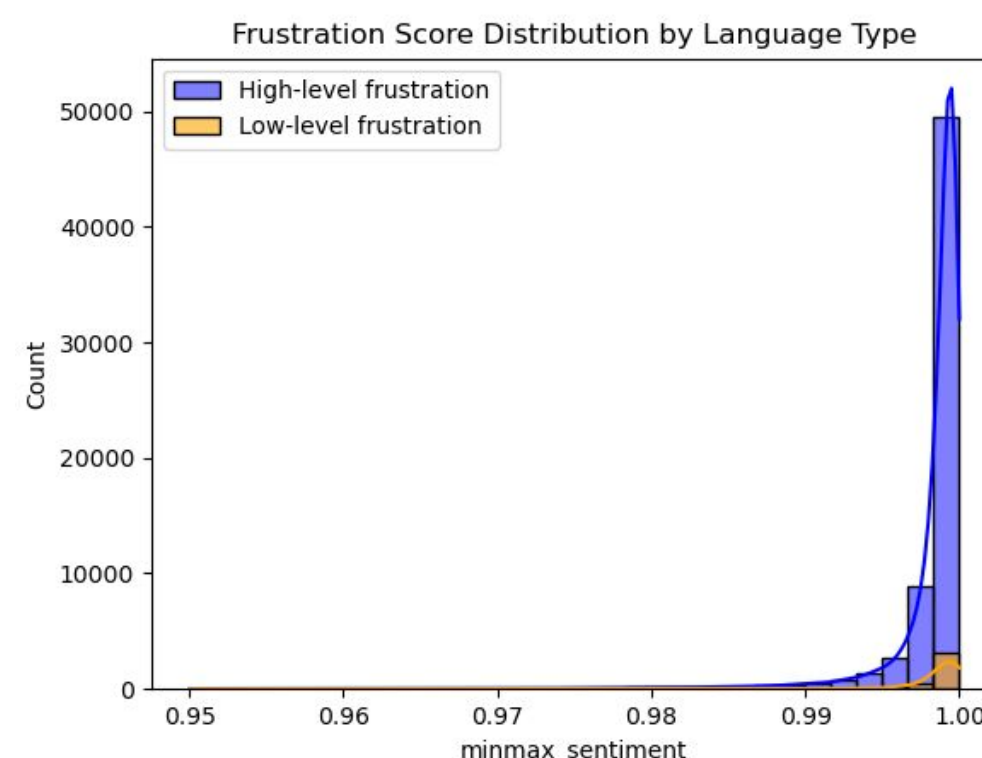
AI-related posts increased 11.6% post-ChatGPT ($p < 0.001$).
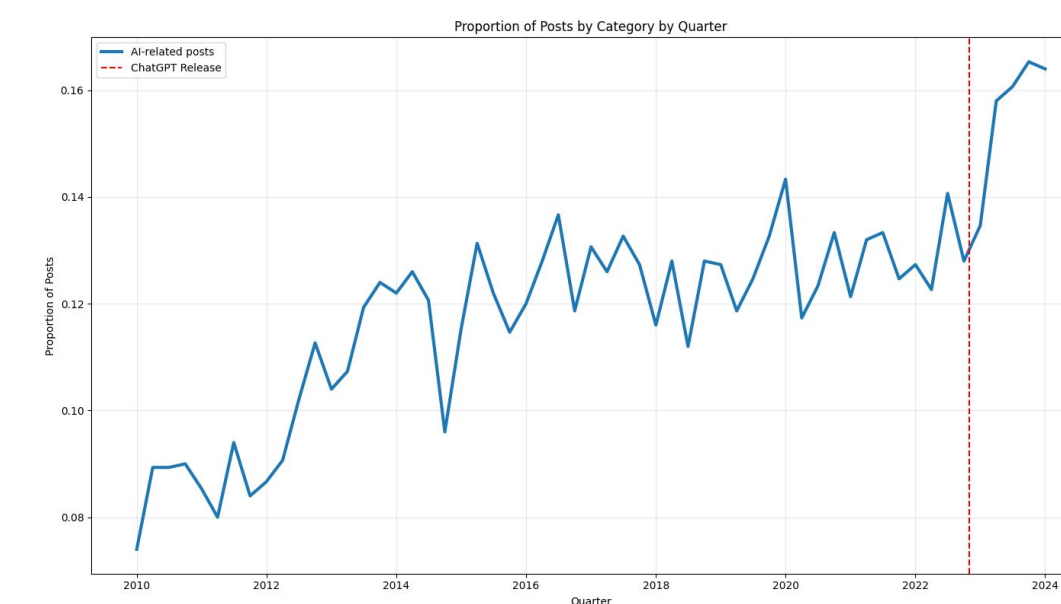
Overall question volume declined more steeply after ChatGPT's release.

CONCLUSION

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ChatGPT's release corresponds with an increase in AI-related questions and a sharper decline in Stack Overflow activity.

The future of online technical Q&A may increasingly shift toward conversational AI tools.

RECOMMENDATIONS

✧ Use sentiment analysis models trained on technical data (e.g., Stack Overflow posts).

✧ Replace keyword matching with NLP-based classifiers for AI post detection.

✧ Enhance reliability of post tags for labeling language types and AI relatedness of posts using ML models.
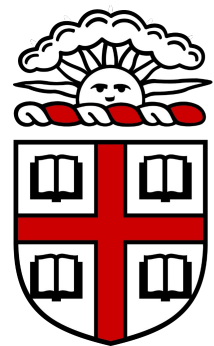
DISCUSSION

Our findings suggest AI tools are reshaping developer habits, reducing reliance on traditional platforms. However, analysis is limited by imperfect sentiment modeling and keyword-based classification. Future improvements could include fine-tuned classifiers for both sentiment and topic detection.

ACKNOWLEDGEMENTS

Frustration Score Distribution by Language Type

Stack Overflow Questions Per Month

Distribution Before vs. After ChatGPT

Proportion of Posts by Category by Quarter

Stack Overflow Questions – Piece-wise Linear Fit