LLMs and Network Models for Mental Health Insight

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May 2025

Abstract

Mental health challenges, particularly depression and suicidal ideation, are pressing concerns in modern society. Without timely intervention, undiagnosed mental disorders may escalate into severe consequences. The widespread use of online platforms such as social media and mental health forums (e.g., Beyond Blue) presents a unique opportunity to detect early warning signs through user-generated content. This project aims to apply advanced text analytics and machine learning techniques to analyze online textual data for the early identification of depressive symptoms and related mental health conditions. By leveraging large language models (LLMs), natural language processing (NLP), and network analysis, this research will explore multiple avenues: detecting depression and anxiety comorbidity through bridge symptoms, modeling cognitive change patterns from user replies, and identifying anomalous emotional shifts over time. The ultimate goal is to enhance our understanding of online behavioral indicators related to mental health and contribute to public health strategies through improved predictive models and decision-making tools. This hands-on project will strengthen your practical experience in data science, specifically in the domains of NLP, LLM and health analytics.

Rough project outlines:

- **Week 1:** Project topic finalization and goal refinement
- **Weeks 2–6:** Literature review and data acquisition (e.g., social media scraping, Beyond Blue forum data)
- **Weeks 6–7:** Data preprocessing, cleaning, and exploratory data analysis (EDA)
- **Weeks 8–10:** Core analyses: anomaly detection, network modeling, and preliminary LLM-based prediction
- **Weeks 11–12:** Results evaluation, initial findings, and visualizations
- **Weeks 13–18:** Algorithm tuning, research extension (e.g., theory development, temporal analysis, comparison of LLM architectures)
- **Weeks 19–24:** Final analysis, conclusion, and comprehensive report writing

Skill Required:

- Web scrapping especially public forum, social media data, and data wrangling/mining
- Understanding of Network modelling, Unsupervised Machine Learning (ML), Natural language processing, Large Language models,
- Python/R programming

Reference (some recommend readings):

[1]. Xu, Xuhai, et al. "Mental-llm: Leveraging large language models for mental health prediction via online text data." Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies 8.1 (2024): 1-32.

[2]. Kaiser, Tim, et al. "Unraveling the comorbidity of depression and anxiety in a large inpatient sample: Network analysis to examine bridge symptoms." *Depression and anxiety* 38.3 (2021): 307-317.

[3]. Uddin, Md Zia, et al. "Deep learning for prediction of depressive symptoms in a large textual dataset." *Neural Computing and Applications* 34.1 (2022): 721-744.

[4]. Gu, Dongxiao, et al. "An analysis of cognitive change in online mental health communities: a textual data analysis based on post replies of support seekers." *Information Processing & Management* 60.2 (2023): 103192.