Unit 10 - Research Proposal Presentation - Transcript:

[1]

Hello and welcome to this research proposal presentation on the efficient implementation of advanced machine learning techniques for context-rich sentiment analysis. My name is Ben Zapka. I will hold this presentation as part of the University of Essex Online's module Research Methods and Professional Practice, Unit 10.

[2]

Ashbaugh and Zhang (2024), as well as Sakhdiah et al. (2024) define sentiment analysis as a natural language processing technique used to categorise texts based on the emotional tone. Texts are typically classified as positive, negative, or neutral. The used models include several machine and deep learning techniques.

Sentiment analysis is of great interest for academic studies. This is the case due to its application to various domains and businesses. Barunaha, Prakash, and Naresh (2023) argue that by tracking customer sentiment over time, businesses inform their real-time reputation management and strategic decision making. Other studies stress additional use cases for sentiment analysis in business context. Malik et al. (2022) and Schmidt et al (2022) stress the importance of sentiment analysis in, for example, public opinion sensing, political discourse, and health care, where it aids in understanding public perceptions and improving service delivery. Additionally, Wörner et al. (2022) show how sentiment analysis can be used to guide product development by tracking customers' perceptions and wishes. Myint, Lo and Zhang (2024) add the use case of crisis management, where knowledge about public perceptions can be a valuable tool for policy makers.

Contributing to the discipline, several advancements have been made recently. Especially advanced machine learning models like transformers were able to significantly improve the classification precision, as shown by Semary et al. (2023) as well as Ashbaugh and Zhang (2024). Large datasets can be handled more efficiently by machine learning algorithms, as shown by Kaur et al. (2021) and Brandao et al. (2025), which is important to, for example, handle massive social media traffic. Beyond textual data, sentiment is often conveyed through audio and visual cues. Devi and Indira (2024) as well as Cai et al. (2025) stress how using multimodal sentiment analysis enables a more holistic analysis of sentiment, resulting in better performing models. Furthermore, Liu et al. (2019) and He et al. (2021) showed that tailoring models to specific domains, capturing unique linguistic features and sentiment expressions pertinent to particular industries or contexts, enhances the relevance and precision of sentiment analysis applications across various fields.

However, even after all these helpful recent contributions, some challenges persist that make further research in this area necessary. Tan et al. (2023) and Kumar, Dikshit, and Albuquerque (2021) present the challenge that machine learning models often struggle to accurately interpret sarcasm and irony, leading to potential misclassifications. Also, capturing the context of each expressed sentiment is important. Here, Hu, Pan, and Wang (2024), Du, Li, and Luo (2021), as well as Punetha and Jain (2024) stress that models need to account for factors such as cultural nuances, domain-specific jargon, and evolving language use to avoid misinterpretation. The model performance is also significantly impacted by the quality of training data. Noisy, unbalanced, or biased datasets can lead to screwed results, highlighting the need for meticulous data curation and preprocessing, as argued by Plisiecki et al. (2025) and Wang et al. (2019). Furthermore, Miah et al. (2024) and Krasitskii et al. (2024) stress that extending sentiment analysis to multiple languages and across different domains requires models to generalise effectively, which is often hindered by linguistic diversity and varying contextual meanings.

[3]

Our gaps in the literature inspire the following research question: “How can advanced machine learning techniques, particularly transformer-based models, improve the accuracy, contextual understanding, and domain adaptability of sentiment analysis systems?”

[4]

Following the works of both Kutzias et al. (2023) and Chiesa and Sikder (2024) who both present structures for data science projects and the research question I defined on the previous slide, I here present the aim and the objectives of my research. The aim is to implement and evaluate transformer-based machine learning models for improving sentiment analysis performance within a multi-domain context.

To achieve this aim, several objectives have been set that need to be fulfilled. First, I conduct a comprehensive review of recent literature on machine learning and sentiment analysis, deriving the best-suited machine learning methods for the task. In this step, I also conceptualise benchmarks with which I can then compare the performance of my trained transformer-based model to ensure a valid comparison on the same datasets and domains.

Next, I develop a sentiment analysis system based on transformer-based models, fine-tuned for one domain. In the next step, I then implement streamlined domain adaptation techniques to enhance the performance across at least two different domains. For example, I could use the Twitter dataset by Kazanova (2013) and the IMDB dataset by Kurmi (2019) to ensure for two different domains general conversation on Twitter and movie reviews on IMDB.

Next, I then need to benchmark models performance against one classical machine learning model and one deep learning model following the approaches by Rostami et al. (2023) and Semary et al. (2023) and ensuring robust evaluation.

Finally, I complete the evaluation and analysis and deliver a deployable sentiment analysis pipeline along with a formal report.

[5]

Some existing literature on the identified research problems now informs the approach of the proposed study. Sentiment analysis continues to face challenges in dealing with nuanced language such as irony and sarcasm as shown by Helal et al. (2024) and Bagate and Suguna (2022). Van Hee et al. (2018) and their work brought up the idea of fine-tuning transformer-based models on irony-labeled datasets to investigate their effectiveness in detecting ironic statements. Additionally, Grover and

Banati (2022) incorporated contextual and pragmatic cues like emojis in their approach, providing additional context and this way further improving irony detection.

I also aim at addressing the problem of insufficient context awareness leading to bias in sentiment analysis systems. Here, transformer-based models like BERT by Devlin et al. (2019) and its successors RoBERTa by Liu et al. (2019)and DeBERTa by He et al. (2021) look promising in improving generalisability across domains. Moreover, the study will also explore integrating domain adaptation techniques to enhance performance on underrepresented or specialised datasets where Rostami et al. (2023) and Badr, Wanas and Fayek (2024) showed promising progress. Recent studies for example by Anwar et al. (2024) as well as Bandaranayake and Usoof (2025) have demonstrated that fine-tuning transformer models on domain-specific data can significantly improve their performance in capturing nuanced sentiments. Additionally, integrating multimodal information into classification models has shown promise in enhancing sentiment analysis systems' ability to detect more nuanced variations including also irony and sarcasm thereby improving overall accuracy. Examples for studies on this topic are the works by Devi and Indira (2024), Cai et al. (2025) and Ahamad and Mishra (2025). Relating to these identified research problems, the proposed study contributes to the evolving field of sentiment analysis.

Overall, the chosen research approach is agile and experimental, facilitating the rapid implementation of models and iterative testing as defined by Reiff and Schlegel (2022) and Tettey et al. (2025). Within this research design, the literature review aims at informing the model choices based on work that has already been carried out for this topic and the already known findings. This is best practice also for quantitative studies like this one as stressed by Luft et al. (2022) and Schmidt-Goecks et al. (2021).

In line with the definitions by SAGE (2021) and the University of Liverpool Academic Skills (n. d.), the study focuses on secondary numerical and labelled data, again stressing its quantitative nature. Datasets from distinct domains, for example general conversation and movie reviews, are chosen in line with the design by Ijaz et al. (2024) and Rostami et al. (2023). In line with these two references, this is connected with transfer learning design.

In the model development phase, the proposed fine-tuning of pre-trained transformers is a computationally intensive and experimental research process as shown by Liu et al. (2019) and He et al. (2021). The use of transfer learning, domain adaptation and training optimisation techniques like early stopping or mixed precision as used in this study falls under the category of empirical AI research as defined by Fan, Luyi and Pengcheng (2022). The model development also aligns with design-oriented research as defined by Thuan et al. (2023), since the output of the research are models as constructed artifacts.

The benchmarking phase compares the newly created models against established baselines, in this case classical machine learning and deep learning models. This is a best practice control comparison strategy in experimental design as applied by Willmington et al. (2022) as well as Ashbaugh and Zhang (2024).

As evaluation metrics in line with comparable classification tasks as the works by Ashbaugh and Zhang (2024) and Devi and Indira (2024), I choose to report and analyse accuracy, precision, recall and F1 scores as quantitative indicators of model performance. Their use implies the “positivist epistemological stance” as applied by Hicks et al. (2022), as well as Mkansi and Mkalipi (2023), which follows the idea that better models can be measured numerically.

[6]

Also in the events of secondary research and with solely anonymised datasets like in this study, researchers must implement robust data handling protocols to prevent unauthorised access of sensitive information. Due to Khalid, Ahmed and Kim (2023) as well as Sung, Cha and Park (2021) this should include adhering to data protection regulations and employing techniques such as data masking and differential privacy to prevent access and re-identification of anonymised data. Regarding bias, following the approach of Mitchell et al. (2019), I explore potential biases in model outputs like for example overfitting to dominant sentiments and document them to enhance transparency. Focusing on fine-tuning pre-trained models and only optimising for two domains, as done by Rostami et al. (2023) and Arefyev, Kharchev and Shelmanov (2021), it is ensured that even in a tight timeline, all presented aims and objectives are fulfilled. Inspired by the work of Hakimi et al. (2024) and Nama, Pattanayak and Meka (2023), cloud-based GPU services, in this case Google Colab Pro, are used to enable an efficient model training without suffering from performance issues due to hardware limitations. Additionally, in line with Cheong (2024) and Habiba et al. (2024), I will document the methodologies, data sources and decision-making processes involved in model development to provide clear explanations of how the model arrives at specific conclusions and enable stakeholders to understand and critically assess the system's output. Finally, following the approaches by Karoo and Chitte (2023) as well as Sanei, Cheng and Adams (2021), I evaluate the potential impact of the sentiment analysis system and establish mechanisms to address any unintended consequences that may arise.

[7]

We now take into consideration the proposed timeline for this project, which is based on a seven-month period that the University of Essex Online defined in 2024 for the Master of Science in Data Science (University of Essex Online, 2024). The first month is for the research proposal and the remaining six months are for the study itself. The structure is then based on Kutzias et al. (2023) and Chiesa and Sikder (2024), who propose a structure for data science projects.

I will start with a focused literature review to select datasets and finalise the research plan. This will then also inform the later stages of the project. In month two, I will then pre-process the datasets and already implement the rather easy, classic machine learning and deep learning models as baselines. In the third month, I will then develop the fine-tuned transformer model on primary domain data. In the fourth month, I will then conduct the domain adaptation and fine-tuning on secondary domain data. After that, the comprehensive model evaluation and comparative performance analysis will take place and finally, in the sixth month, I will finalise all artifacts, complete the formal research report, and review and submit the thesis.

[8]

Still referencing Kudzias et al. (2023) and Chiesa and Sikder (2024), the artifacts that are created here are a sentiment analysis pipeline with a fine-tuned transformer model that works across two domains, a comparative performance report benchmarking against two different machine learning and deep learning models, a formal research report summarising the methodology, experiments and key findings found, and a Jupyter Notebook or even a lightweight Python package enabling reuse.

[9]

I now end by showing you the references, which you can also directly access in PowerPoint.

[10]

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[11]

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[12]

This ends the presentation. Thank you for your attention.

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