Georgia State University

EVALUATING TRANSFORMER ARCHITECTURES FOR HEALTHCARE INSIGHTS

Empowering Healthcare Decisions

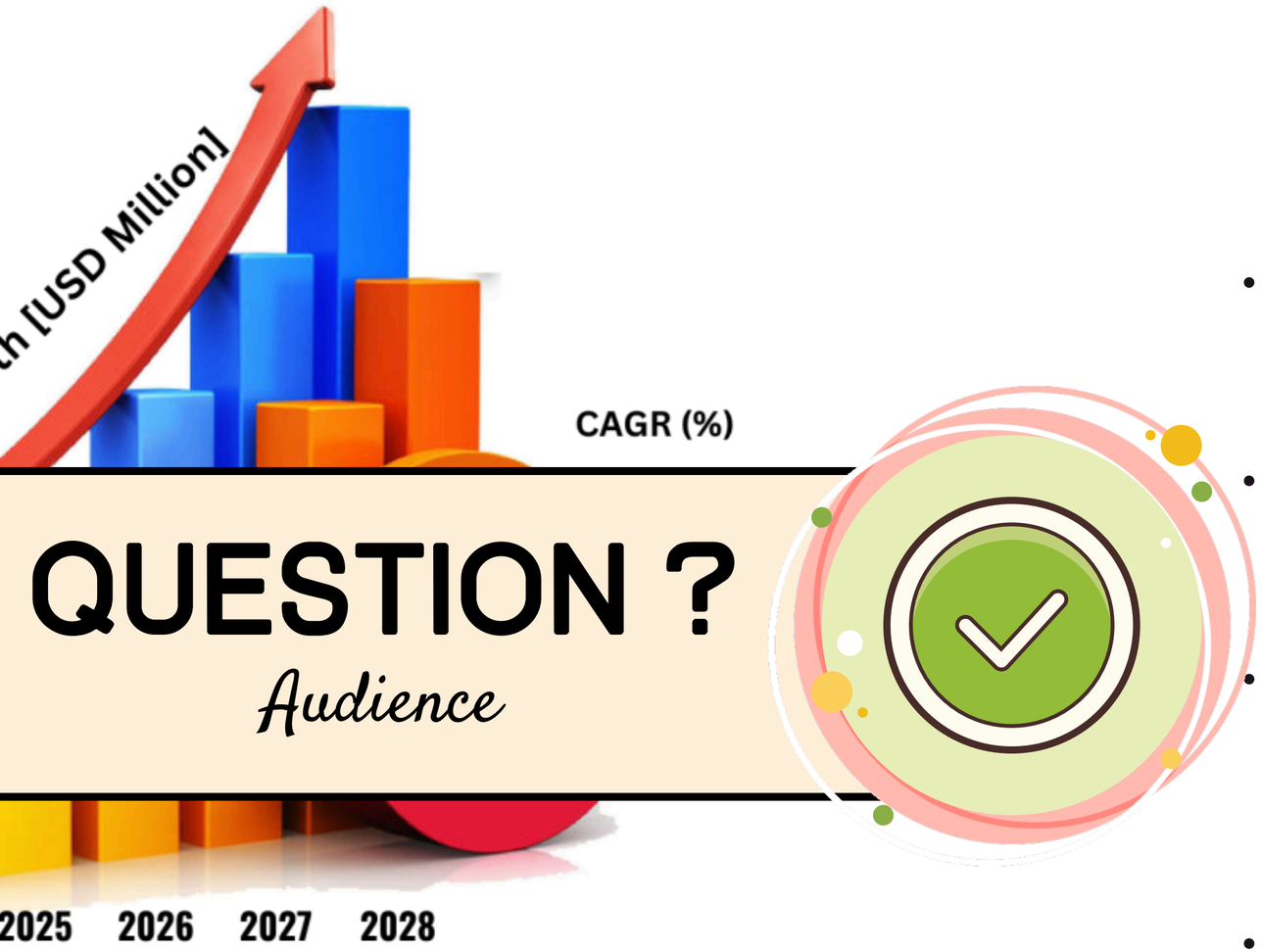
Presented By

Rani Chowdary Mandepudi

Sai Shravanth Gelli

AGENDA

"Unlocking Patient Insights: Beyond the Prescription"



DO YOU BROWSE INTERNET FOR CHECKING MEDICATION ????

Background of the Study

- **Invaluable Insights**: Customer reviews shape satisfaction and effectiveness across sectors.
- **Healthcare's New Frontier**: Patient feedback illuminates treatment outcomes and satisfaction.
- **Deep Dive into Experiences**: Analyzing reviews reveals patient perspectives on healthcare effectiveness.
- **Patient Voices Lead the Way**: Understanding experiences and treatment effectiveness through their eyes.

Problem Statement

- In the realm of healthcare, accurately diagnosing and treating various medical conditions remains a significant challenge.
- Online recommender systems are being used increasingly often for hospitals, medical professionals, and drugs.
- Today, the great majority of consumers look online before asking their doctors for prescription suggestions for a range of health conditions. The medical suggestion system can be valuable when pandemics, floods, or cyclones hit.
- Traditional diagnostic methods can be enhanced by incorporating insights directly from patients' experiences.

“A drug recommendation system during medical emergencies is a lifeline, ensuring patient safety with optimal medication choices.” - Researchers

OBJECTIVE OF THE PROPOSED SOLUTION

To explore the transformative impact of online recommender systems in healthcare, focusing on their increasing application within hospitals and among medical professionals for drug recommendations.

According to a survey, 55% of those with Internet access use it to search for health-related information.

Literature Review

01

NLP Based Topic Modeling for Healthcare: Analyzing Patient Reviews to Improve Quality of Care and Access to Services

Emphasizes the utility of topic modeling as a powerful tool for healthcare improvement, underscoring the importance of utilizing patient reviews as an essential source of valuable data in health care analytics

02

Case Studies on the Use of NLP to Assess the Effectiveness and Safety of Health Technologies: A Scoping Review

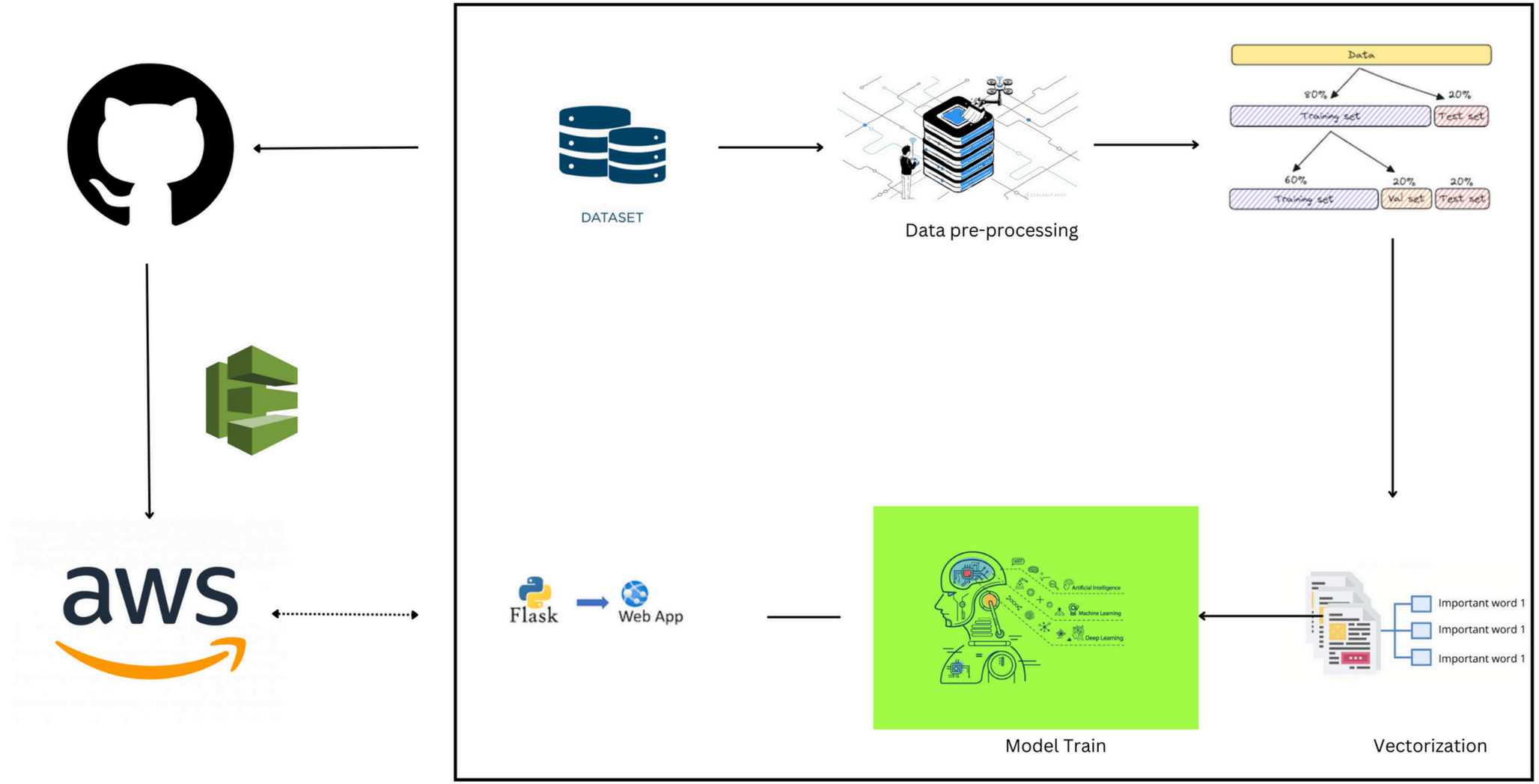
Among the 1,776 unique citations identified, 12 studies that described the use of NLP methods to evaluate public opinion on or experiences with the use of health technologies.

03

Analyzing Customer Sentiment in Drug Reviews Using Natural Language Processing

Patients' experiences and feedback are pivotal in shaping medication choices and improving healthcare services

Proposed Solution



Dataset

UCI Machine Learning Repository

Instances: 215063

Missing Values: No

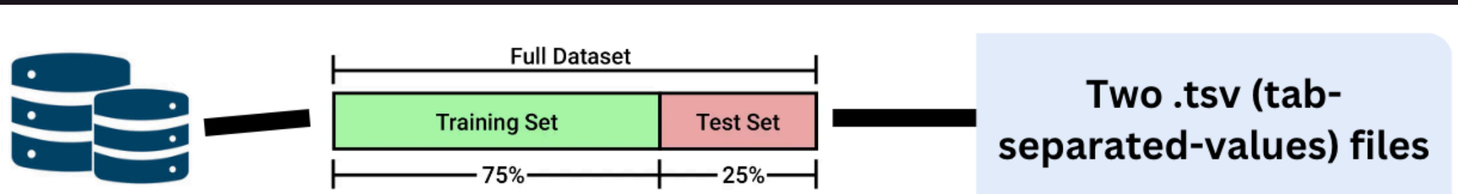
Information: Patient reviews on specific drugs along with related condition, 10 star patient rating

Variables Information

- drugName (categorical): name of drug
- condition (categorical): name of condition
- review (text): patient review
- rating (numerical): 10 star patient rating

date (date): date of review entry

- usefulCount (numerical): number of users who found review useful



METHODOLOGY

TRADITIONAL MODELS

-Navie Bayes
-Passive Aggressive Classifier

TRANSFORMER BASED MODELS

-DistilBert
-XLNet

Research Analysis

- Used to deal with text data
- Rely on recurrance
- Can’t be parallized
- LSTM tend to remember a bit longer, take long to train

RNN & LSTM

- Which rely on attention mechanism to remember
- Dont have any reccurance
- Faster
- Parallized

TRANSFORMERS

- Capacity to learn specific tasks - in a language
- Pre - training model & Fine-tuning model to a specific task
- Bert only contains Encoders

BERT

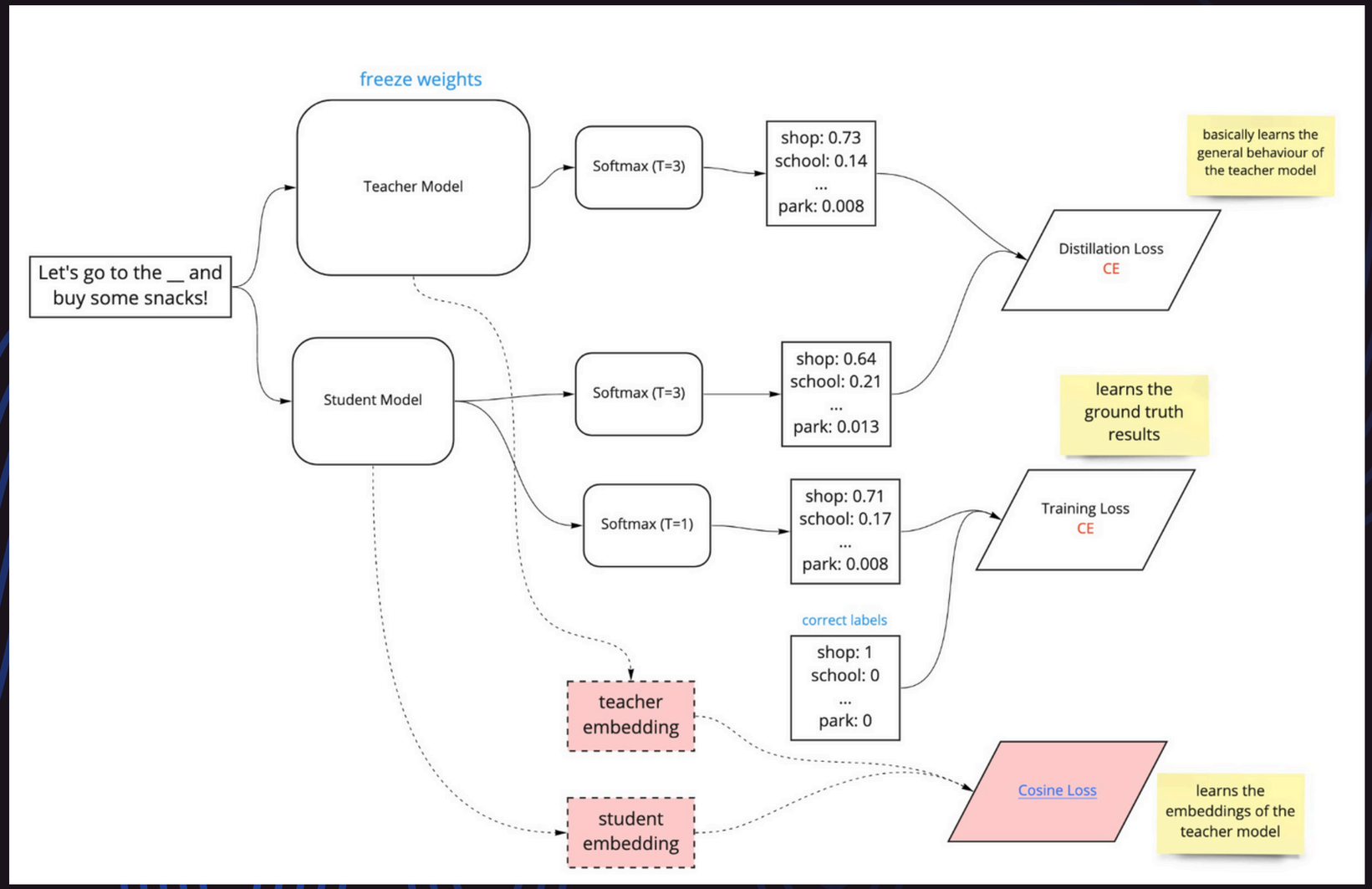
Why Transformer Based Model ?

- Contextual Understanding
- Handling of Sequential Data
- Pre-training on Large Datasets
- Fewer Data Requirements for Fine-tuning
- Flexibility and Adaptability
- Parallel Processing

They also come with higher computational costs due to their complexity

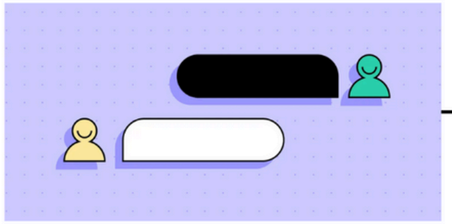
DistilBert Architecture

Preparing a Student Bert using pre-trained Teacher-Bert following Knowledge Distillation

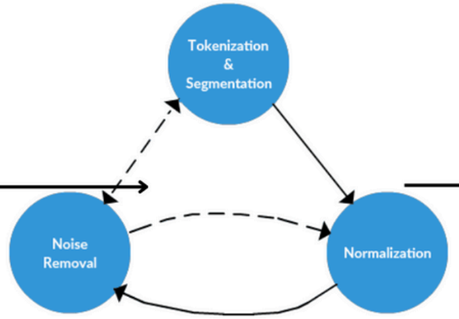


- 60% faster
- 40% smaller in size
- With many optimiztions, results produced were ~97% of Bert

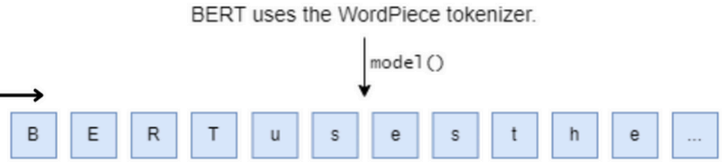
Model Architecture



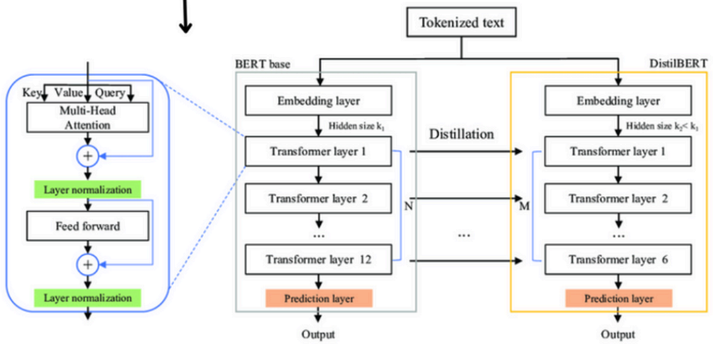
User Input



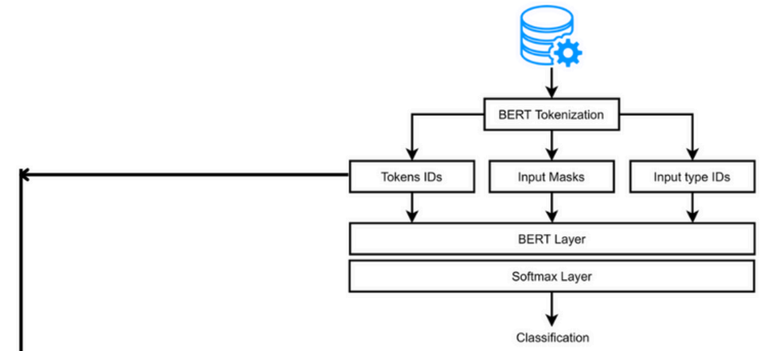
Data Pre-processing



Vectorization



DistiBert



Fine - tuning

Condition Prediction

classification head

BERT

Q&A head

BERT

Limitations

Auto Regressive

Considering Ordering

Only Words that come before hand considered

Auto Encoding

Bert can use whole sequence

No Ordering

“Taj Mahal is in Delhi”
“RedFort is in Delhi”

Future Scope - XLNET Model

XLNET combines best of both of these approaches

$$\mathcal{J}_{\text{BERT}} = \log p(\text{New} \mid \text{is a city}) + \log p(\text{York} \mid \text{is a city}),$$

$$\mathcal{J}_{\text{XLNet}} = \log p(\text{New} \mid \text{is a city}) + \log p(\text{York} \mid \text{New}, \text{is a city}).$$

Both models provide activation at t=1

Evaluation Metrics

01

Accuracy

dataset is balanced with respect to the various drug classes, accuracy will give you a quick understanding of how often your model is correct across all predictions

02

F1 Score

The F1 score is the harmonic mean of precision and recall, providing a single metric to assess balance between them. It's particularly useful when you have an imbalanced dataset

03

Confusion Matrix

Provides a detailed breakdown of predictions across actual classes, showing true positives, false positives, true negatives, and false negatives. This can help in understanding the types of errors the model is making.

how to evaluate my model?

CHALLENGES -XLNET

Computational Resources

XLNet's architecture is more complex than DistilBERT's, requiring more memory and computational power for both training and inference.

Resource Intensity

This can be a significant hurdle if limited by hardware capabilities

Training Time

XLNet typically takes longer to train due to its larger size and more sophisticated training mechanism (permutation-based language modeling). This may not be ideal for projects with tight development timelines

Overfitting Risk

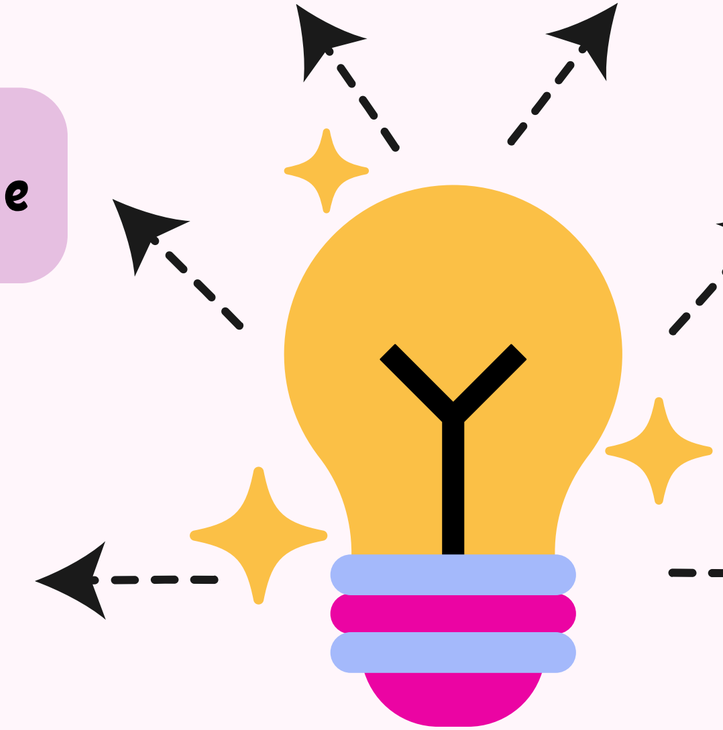
Due to its capacity and complexity, XLNet may be more prone to overfitting on smaller datasets compared to DistilBERT.

Model Complexity

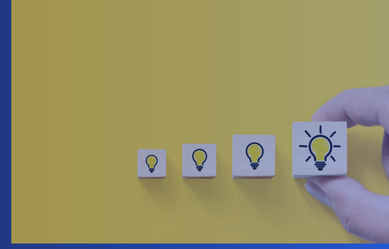
XLNet's complexity makes it harder to interpret and debug compared to DistilBERT

Deployment Challenges

The larger size of XLNet may also pose challenges for deployment, particularly in environments with strict latency or memory constraints, like mobile or web applications.



Conclusion



-Our project embarked on the ambitious path of harnessing the power of state-of-the-art NLP models to revolutionize the way we extract valuable insights from patient reviews for drug prediction. By carefully selecting and fine-tuning DistilBERT, we develop a system that not only accurately identifies medical conditions mentioned in textual feedback but also recommends the most suitable medications. This model stands as a testament to the potential of AI to augment and assist in the field of healthcare.

-As we look to the future, we envision further refining our system, exploring additional models like XLNet for comparative analysis, and expanding our dataset to cover a broader spectrum of medical conditions and treatments. With continued improvement and validation, we anticipate our work contributing to more personalized and responsive patient care, ultimately enhancing the well-being of individuals around the globe.

Proposed Timeline

Week 1

Data Pre Processing
& Vectorization

Week 2

Model Development

Week 3

Model Testing
& Fine-tuning

Week 4

Model Deployment
& Report

References

[1] B. Bhukya, M. Sheshikala and B. Bhukya, "NLP Based Topic Modeling for Healthcare: Analyzing Patient Reviews to Improve Quality of Care and Access to Services," 2023 International Conference on Emerging Techniques in Computational Intelligence (ICETCI), Hyderabad, India, 2023, pp. 7-12, doi: 10.1109/ICETCI58599.2023.10330957.

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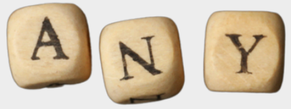
[4] S. K H, C. Gnanaprakasam, M. Swarna, R. Geetha and N. V. Krishnamoorthy, "A Novel Design of Deep Learning Assisted Drug Recommendation Model using Sentimental Inspection," 2023 International Conference on Advances in Computing, Communication and Applied Informatics (ACCAI), Chennai, India, 2023, pp. 1-6, doi: 10.1109/ACCAI58221.2023.10199209.

THANK YOU



https://github.com/ranimandepudi