



Service Quality AI Based System

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Abstract

The concept of smart government has been gaining momentum in recent years, as governments around the world strive to improve service delivery and enhance citizen engagement with technology. Our project has applied the target desired from smart government service quality idea as we have deployed many AI NLP-based techniques as topic classification, sentiment analysis, text generation and information retrieval, these techniques allowed us to analyze reviews, complains and feedbacks of citizens in order to get desired outputs automatically without need of human participating, these outputs includes: the ministry responsible for the review, the sentiment of the citizen posting the review, the specific governmental sector responsible for the problem in the review and the recommended solution for the problem in the review.

We have applied fine tuning for transformer models like MARBERT , Arabert, Arat5, MT5 on our downstream tasks, we have reached **0.96** f1 score in sentiment analysis task, **0.957** f1 score in topic classification task and **7.8** BLEU score in text generation task.

Introduction

The Smart Government Service Quality Project is an innovative initiative aimed at improving the quality of government services through the use of advanced technologies. The project leverages data analytics, artificial intelligence, and other smart technologies to optimize government service delivery processes, reduce bureaucracy, enhance transparency, and increase citizen satisfaction.

Methodology

WE HAVE CREATED THIS PROJECT WITH MANY SCRIPTS, WE USED PYTHON PROGRAMMING LANGUAGE AS IT WAS THE SIMPLEST AND MOST USED LANGUAGE IN THE FIELD OF AI BECAUSE IT IS OPEN SOURCE, EASY LANGUAGE AND HAVE ENORMOUS NUMBER OF PACKAGES AND LIBRARIES THAT ARE VERY USEFUL IN OUR PROJECT FIELD.

ENVIRONMENTS:

LOCALHOST ,GOOGLE COLAB,GOOGLE COLAB PRO ,KAGGLE NOTEBOOKS:SAME AS GOOGLE COLAB WITH ADDITIONALTPU.

PACKAGES & LIBRARIES

PANDAS, MATPLOTLIB, OS, NUMPY, PY TORCH, TRANSFORMERS, SENTENCE PIECE, TQDM, JSON, TENSORFLOW, SCIKITLEARN, NLTK, RE, JOBLIB, SELENIUM, BEAUTIFUL SOUP.

DATASET PREPROCESSING

GLARE DATASET PREPROCESSING, MERGED TOPICS DATA PREPROCESSING, WEB SCRAPPING MODULE, INPUT TEXT PREPROCESSING MODULE.

TOPIC CLASSIFICATION MODULE:

MODELS USED: MARBERT, ARABIC-MARBERT-NEWS-ARTICLE-CLASSIFICATION

DATA PREPARATION: CORPUS COLLECTION, TEXT PREPROCESSING.

KEY PREPROCESSING TECHNIQUES INCLUDE: TEXT

CLEANING, TOKENIZATION, LEMMATIZATION AND STEMMINGFEATURE

EXTRACTION, LABEL ENCODING.

TRAINING PROCEDURE: SPLITTING THE DATASET, MODEL SELECTION ,MODEL

TRAINING, HYPERPARAMETER TUNING.

EVALUATION METRICS: WE USE METRICS SUCH AS MACRO F1 SCORE.

SENTIMENT ANALYSIS MODULE:

MODELS USED: MARBERT MODEL ,ARABERT MODEL.

HERE IS A DESCRIPTION OF THE FUNCTIONS TYPICALLY EMPLOYED IN

ARABERTFORSENTIMENTANALYSIS:

DATAPREPARATION,MODEL

ARCHITECTURE,LOSSFUNCTION,OPTIMIZATIONALGORITHM,TRAININGLOOP,EVALUATIONMETRICS

,HYPERPARAMETER TUNING.

RECOMMENDED SOLUTION GENERATION MODULE:

MODELS USED:GOOGLE\MT5,UBC\NLP ARAT5,AUBMIND\LAB ARAGPT

DATA PREPARATION:

THE PREPROCESSED INPUT TEXT IS TOKENIZED USING THE MODEL'S TOKENIZER, THEN WE EXTRACT THE FEATURE USING THE TRANSFORMER MODEL REPRESENTATION TO BE ABLE TO BE PASSED TO THE ARCHITECTURE OF THE MODEL.

TRAINING PROCEDURE:FINE TUNING, TRAINING LOOP, LOSS FUNCTION, OPTIMIZATION ALGORITHM

EVALUATION METRICS:WE USED BLEU SCORE FOR EVALUATION AS IT IS A METRIC THAT MEASURES THE SIMILARITY BETWEEN A MACHINE-GENERATED TEXT AND ONE OR MORE HUMAN-GENERATED REFERENCE TEXTS.

INFORMATION RETRIEVAL:

TECHNIQUES USED:TF-IDF REPRESENTATION,SENTENCE COSINE SIMILARITY

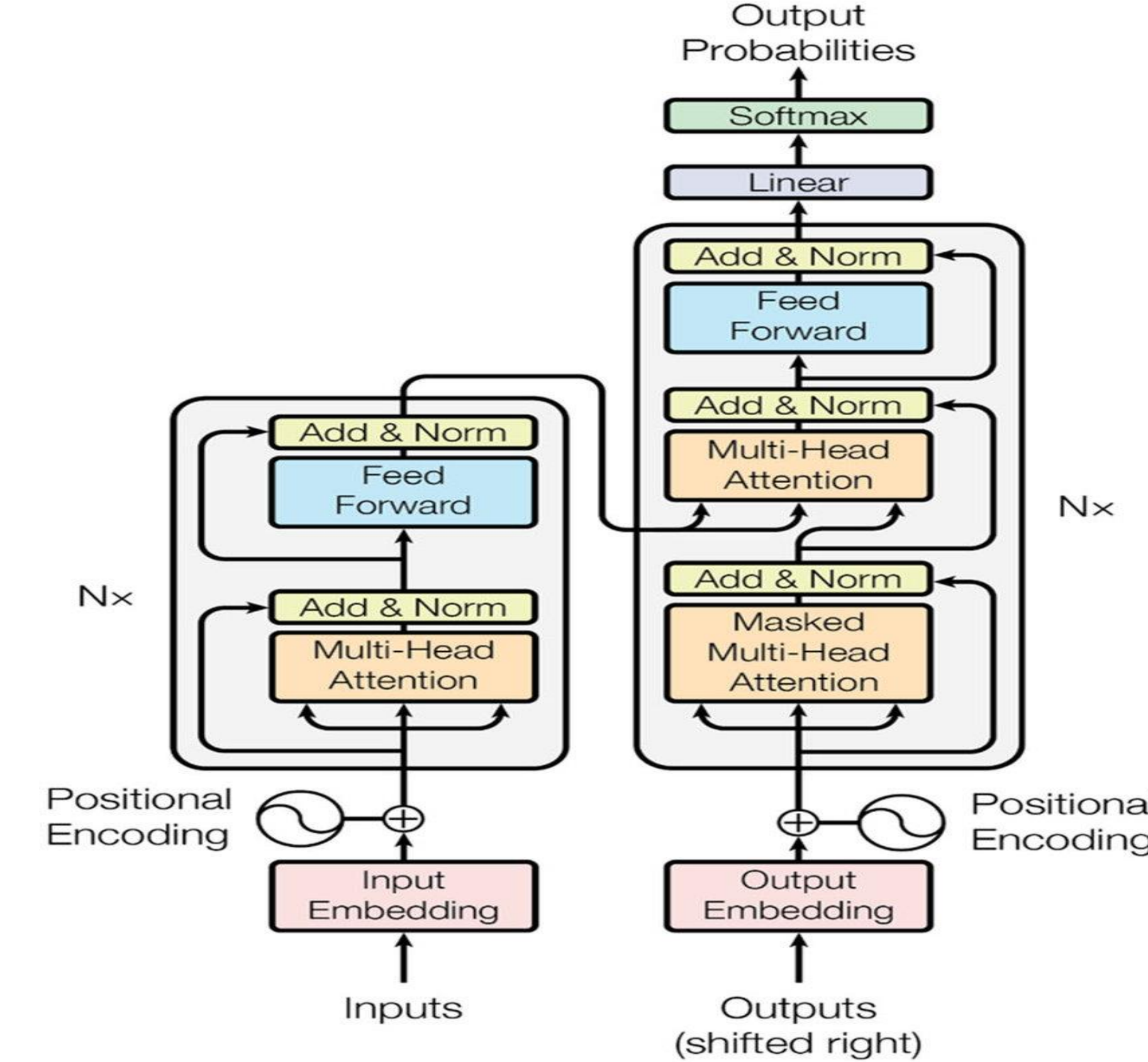
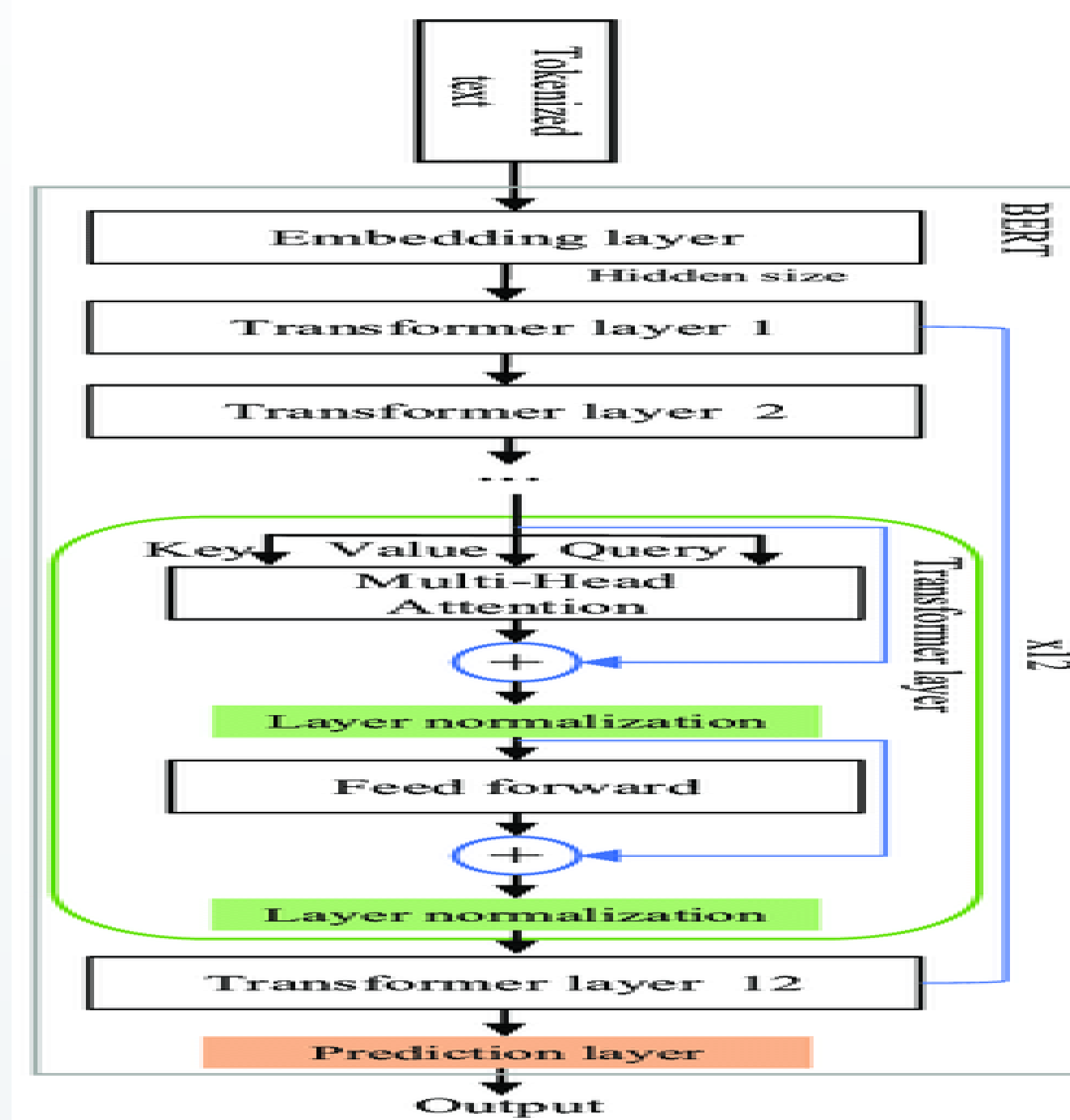
ALGORITHMS:FEATURE EXTRACTION,SIMILARITY CHECK,RANKING.

References

[1]ABDUL-MAGEED, M., ELMADANY, A. AND NAGOUDI, E.M.B., 2020. ARBERT & MARBERT: DEEP BIDIRECTIONAL TRANSFORMERS FOR ARABIC. ARXIV PREPRINT ARXIV:2101.01785.

[2]ANTOUN, W., BALLY, F. AND HAJJ, H., 2020. ARABERT: TRANSFORMER-BASED MODEL FOR ARABIC LANGUAGE UNDERSTANDING. ARXIV PREPRINT ARXIV:2003.00104.

[3]XUE, L., CONSTANT, N., ROBERTS, A., KALE, M., AL-RFOU, R., SIDDHANT, A., BARUA, A. AND RAFFEL, C., 2020. MT5: A MASSIVELY MULTILINGUAL PRE-TRAINED TEXT-TO-TEXT TRANSFORMER. ARXIV PREPRINT ARXIV:2010.11934.



Results

Topic classification:

Expir eme nt No.	Catego ries	Train Data size	Test Data size	Batch Size	Learn ing Rate	Mode l used	Score	Datas et
1	7	80000	20000	32	1e-06	MARB ERT	f1: 0.65	Clare
2	7	80000	20000	32	1e-05	MARB ERT	f1: 73.3	Clare
3	9	104000	26000	32	5e-06	MARB ERT	f1: 0.70	Clare
4	4	80000	20000	32	2e-06	MARB ERT	f1: 0.81	Clare
5	4	80000	20000	32	5e-05 decaye	MARB ERT	f1: 0.835	Clare
6	4	80000	20000	32	5e-05 decaye	MARB ERT	f1: 0.847	Clare
7	7	44400	11000	32	5e-05 decaye	MARB ERT	f1: 0.958	Merge d topics

After large number of experiments using different models, applying different text preprocessing, and applying hyperparameter tuning we concluded that experiment 7 using marbert model and preprocessed Merged topics dataset gives the best f1 score

Sentiment Analysis:

Expir eme nt No.	Catego ries	Train Data size	Test Data size	Batch Size	Learn ing Rate	Mode l used	Score	Datas et
1	2	4000	1000	32	2e-06	MARB ERT	f1: 0.85	Oclar
2	3	160000	40000	32	5e-05	MARB ERT	f1: 0.695	100k revs & glare
3	3	80000	20000	32	5e-05	MARB ERT	f1: 0.70	100k revs
4	2	80000	10000	32	2e-06	MARB ERT	f1: 0.71	glare & 100k revs
5	2	136000	20000	16	2e-05	Araber t	f1: 0.96	100k revs & glare

After large number of experiments using different models, applying different text preprocessing and applying hyperparameter tuning we concluded that experiment 5 using arabert model and preprocessed combination between 100k reviews dataset and glare dataset, gives the best f1 score

Text Generation:

Expir eme nt No.	Catego ries	Train Data size	Test Data size	Batch Size	Learn ing Rate	Mode l used	Score	Datas et
1	-	4000	1000	5	1e-04	Mt5 small	bleu : 0.1154	Clare
2	-	160000	40000	10	5e-04	Arat5	bleu: 7.047	Clare
3	-	80000	20000	13	5e-05	Arat5	bleu: 7.8017	Clare
4	-	60000	10000	8	1e-03	Gpt2 arabic	bleu:	Clare
5	-	150000	15000	8	1e-03	Gpt2 arabic	bleu :	Clare

After large number of experiments using different models, applying different text preprocessing and applying hyperparameter tuning we concluded that experiment 3 using arat5 model and preprocessed glare dataset, gives the best bleu score

Information Retrieval:

Here are some outputs from our algorithm

المشكلة : تلوث الهواء من كثرة الدخاان والثلوثات الكبير
سنرسل هذه الشكوه ال القطاعات الخاصه ب : البيئة
الحل التي يجب ان يتم : تعزيز استخدام الطاقة المتجددة والتكنولوجيا النظيفة

+ Code + Markdown

Conclusion

The Smart Government Service Quality Project is an important initiative aimed at improving the quality of government services By leveraging data analytics, artificial intelligence,this project can help governments to identify and address service delivery bottlenecks, reduce bureaucracy ,enhance transparency, and increase citizen satisfaction. making intraction more efficient, effective, and responsive to the needs of citizens.The project can automatically analyze the text reviews of citizens and get the topic of the review, the sentiment of citizen writing the review, the governmental sector responsible for the review content and recommend solutions for the problems in the review.

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