Automated Essay Scoring

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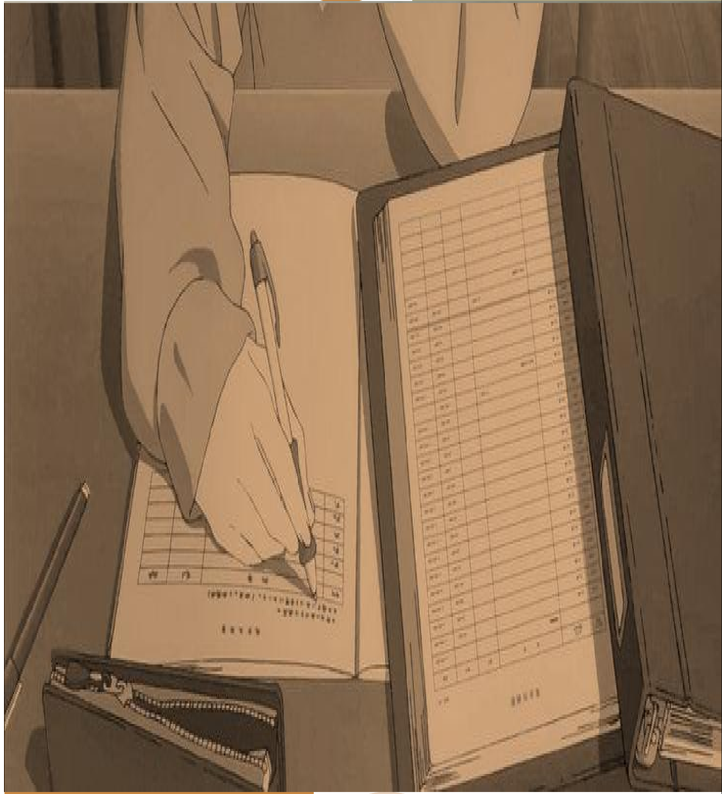

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Introduction

- Essay writing is considered to be one of the best ways to analyze students performance and perfection. They have become a major part of formal education and entry level test in competitive exams.

- Grading automatically is proven effective.

- Our aim is to develop a deep learning technique using K-Means clustering.

- Our project will determine relationship between sentences in the essay and assess the students performance.

Problem Statement

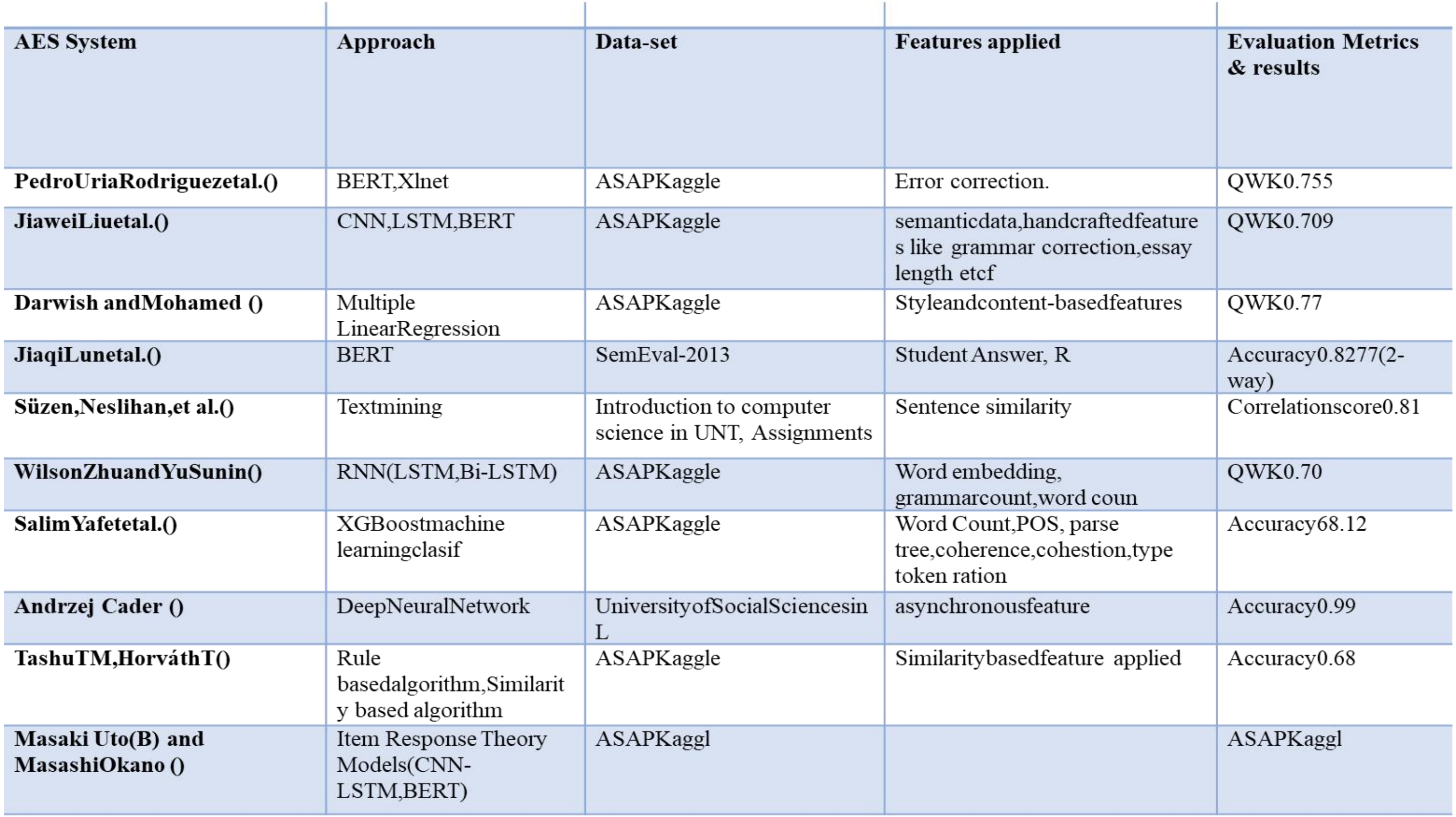
- Essay consists of many paragraphs and evaluating them is a time consuming task.

- The number of participants or applicants is also huge and doing it manually would be a laborious work.

- Moreover, essays are the work piece of writer which help in analysing there ideas and observations. Doing it manually at times may not help evaluator to clearly understand their ideas.

- **Our aim is to build a model that can take an essay as input and automatically predicts the grade/score of that essay.**

Literature Review



AES System	Approach	Data-set	Features applied	Evaluation Metrics & results
PedroUriaRodriguezetal.()	BERT,Xlnet	ASAPKaggle	Error correction.	QWK0.755
JiaweiLiuetal.()	CNN,LSTM,BERT	ASAPKaggle	semanticdata,handcraftedfeatures like grammar correction,essay length etcf	QWK0.709
Darwish andMohamed ()	Multiple LinearRegression	ASAPKaggle	Styleandcontent-basedfeatures	QWK0.77
JiaqiLunetal.()	BERT	SemEval-2013	Student Answer, R	Accuracy0.8277(2-way)
Süzen,Neslihan,et al.()	Textmining	Introduction to computer science in UNT, Assignments	Sentence similarity	Correlationscore0.81
WilsonZhuandYuSunin()	RNN(LSTM,Bi-LSTM)	ASAPKaggle	Word embedding, grammarcount,word coun	QWK0.70
SalimYafetetal.()	XGBoostmachine learningclasif	ASAPKaggle	Word Count,POS, parse tree,coherence,cohestion,type token ration	Accuracy68.12
Andrzej Cader ()	DeepNeuralNetwork	UniversityofSocialSciencesin L	asynchronousfeature	Accuracy0.99
TashuTM,HorváthT()	Rule basedalgorithm,Similarity based algorithm	ASAPKaggle	Similaritybasedfeature applied	Accuracy0.68
Masaki Uto(B) and MasashiOkano ()	Item Response Theory Models(CNN-LSTM,BERT)	ASAPKaggl		ASAPKaggl

Model Used

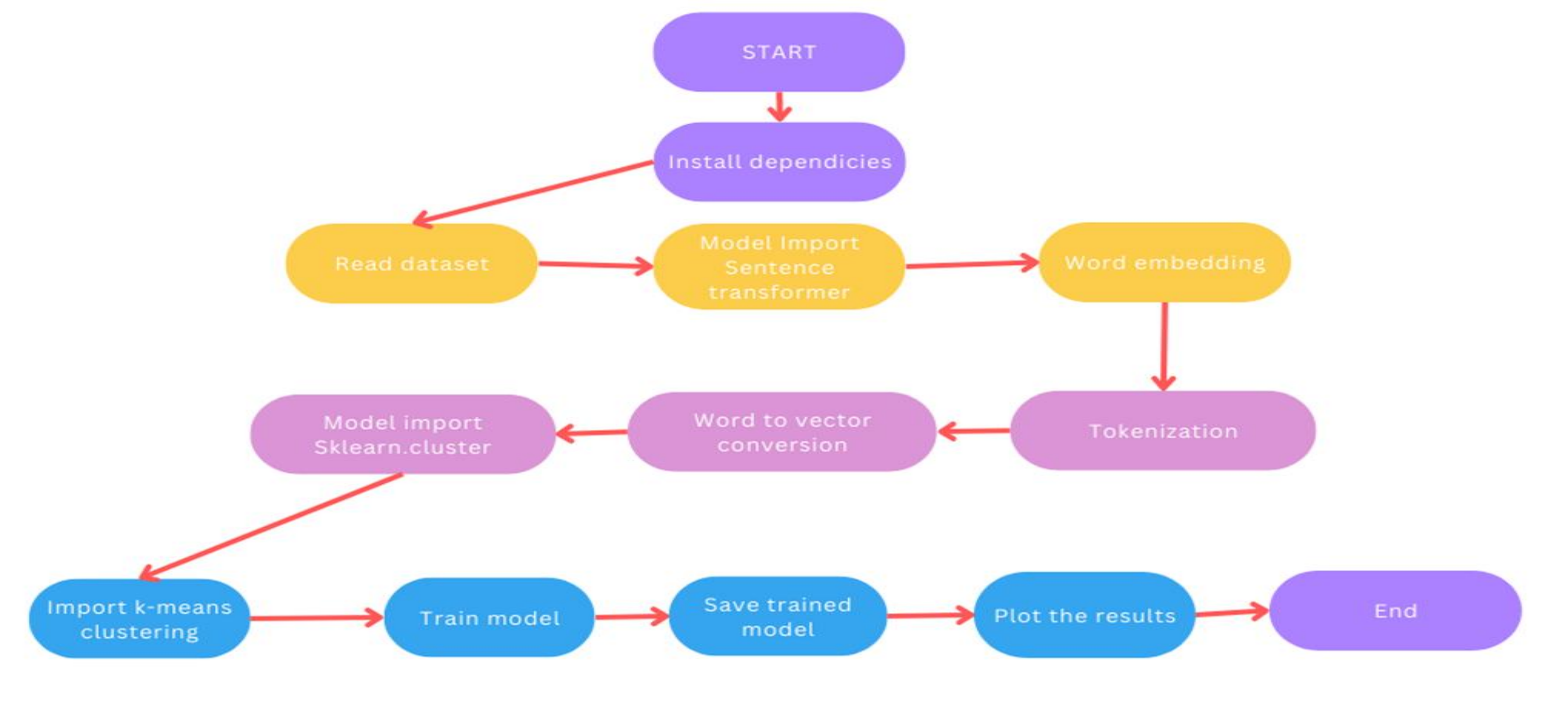
K-Means clustering:

K-means clustering is a method used for clustering analysis, especially in data mining and statistics. It aims to partition a set of observations into a number of clusters (k), resulting in the partitioning of the data into Voronoi cells

Transfer-Learning:

For natural language processing, the transformers architecture is the go-to model for solving different problems, e.g. text classification, machine translation, language modeling, text generation, question answering, etc. Thanks to Huggingface and its ecosystem, transfer learning with transformers has been made very easy to start with.

Flow Chart



START

Install dependicies

Read dataset

Model Import Sentence transformer

Word embedding

Tokenization

Word to vector conversion

Model import Sklearn.cluster

Import k-means clustering

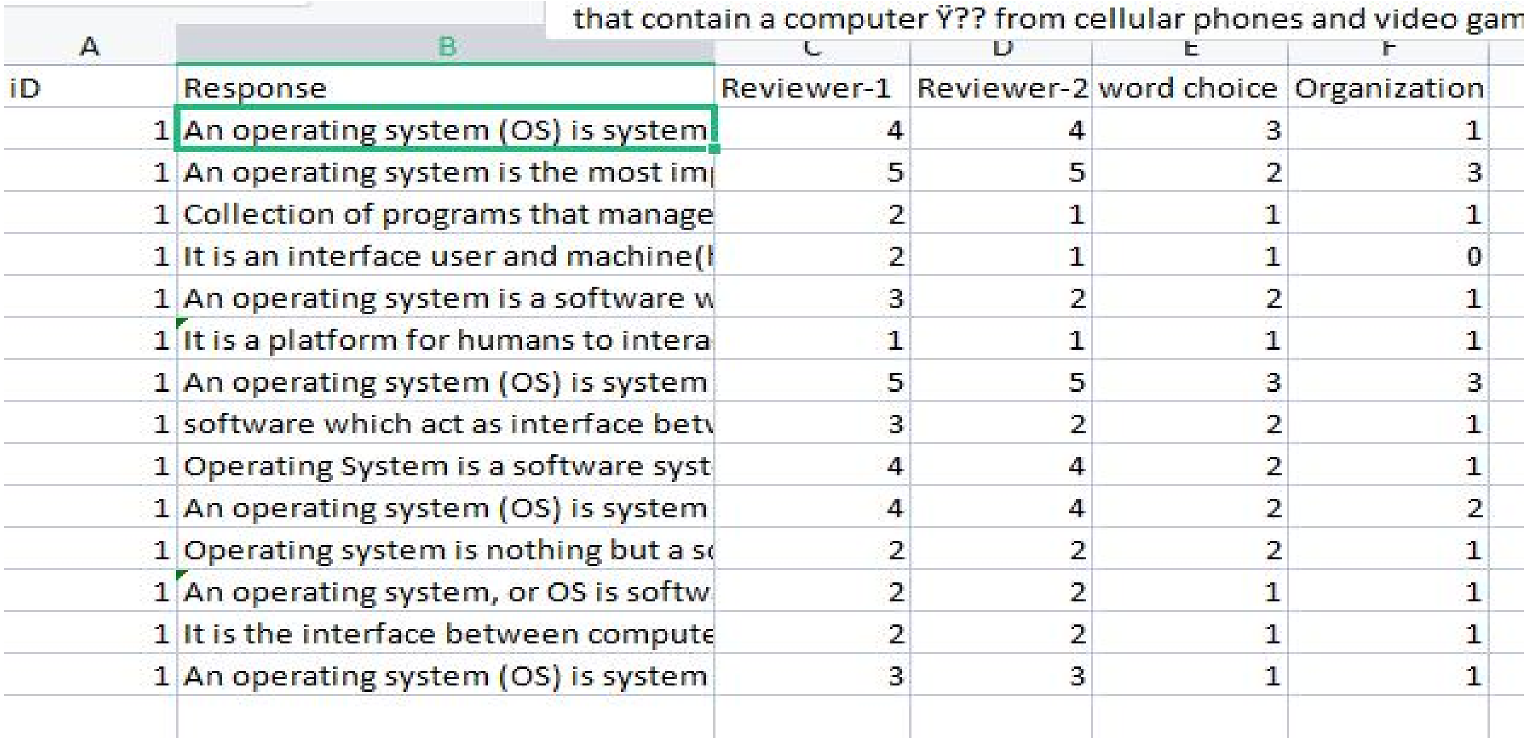
Train model

Save trained model

Plot the results

End

Data Set

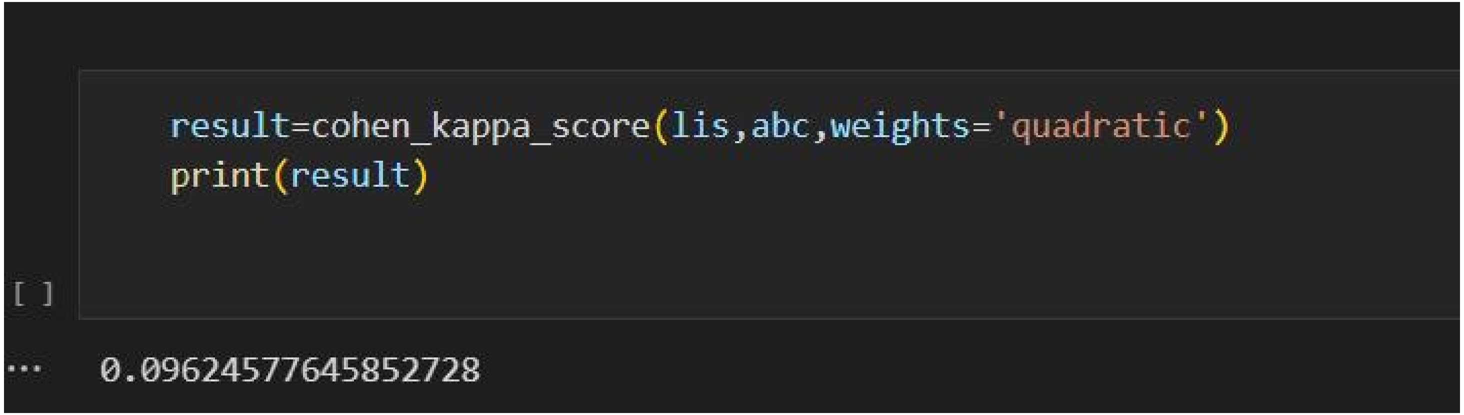


that contain a computer Ÿ?? from cellular phones and video gam

A	B	C	D	E	F
iD	Response	Reviewer-1	Reviewer-2	word choice	Organization
1	An operating system (OS) is system	4	4	3	1
1	An operating system is the most im	5	5	2	3
1	Collection of programs that manage	2	1	1	1
1	It is an interface user and machine(I	2	1	1	0
1	An operating system is a software w	3	2	2	1
1	It is a platform for humans to intera	1	1	1	1
1	An operating system (OS) is system	5	5	3	3
1	software which act as interface betv	3	2	2	1
1	Operating System is a software syst	4	4	2	1
1	An operating system (OS) is system	4	4	2	2
1	Operating system is nothing but a sc	2	2	2	1
1	An operating system, or OS is softw	2	2	1	1
1	It is the interface between compute	2	2	1	1
1	An operating system (OS) is system	3	3	1	1

Consists of 2 dependent features and 3 independent variables

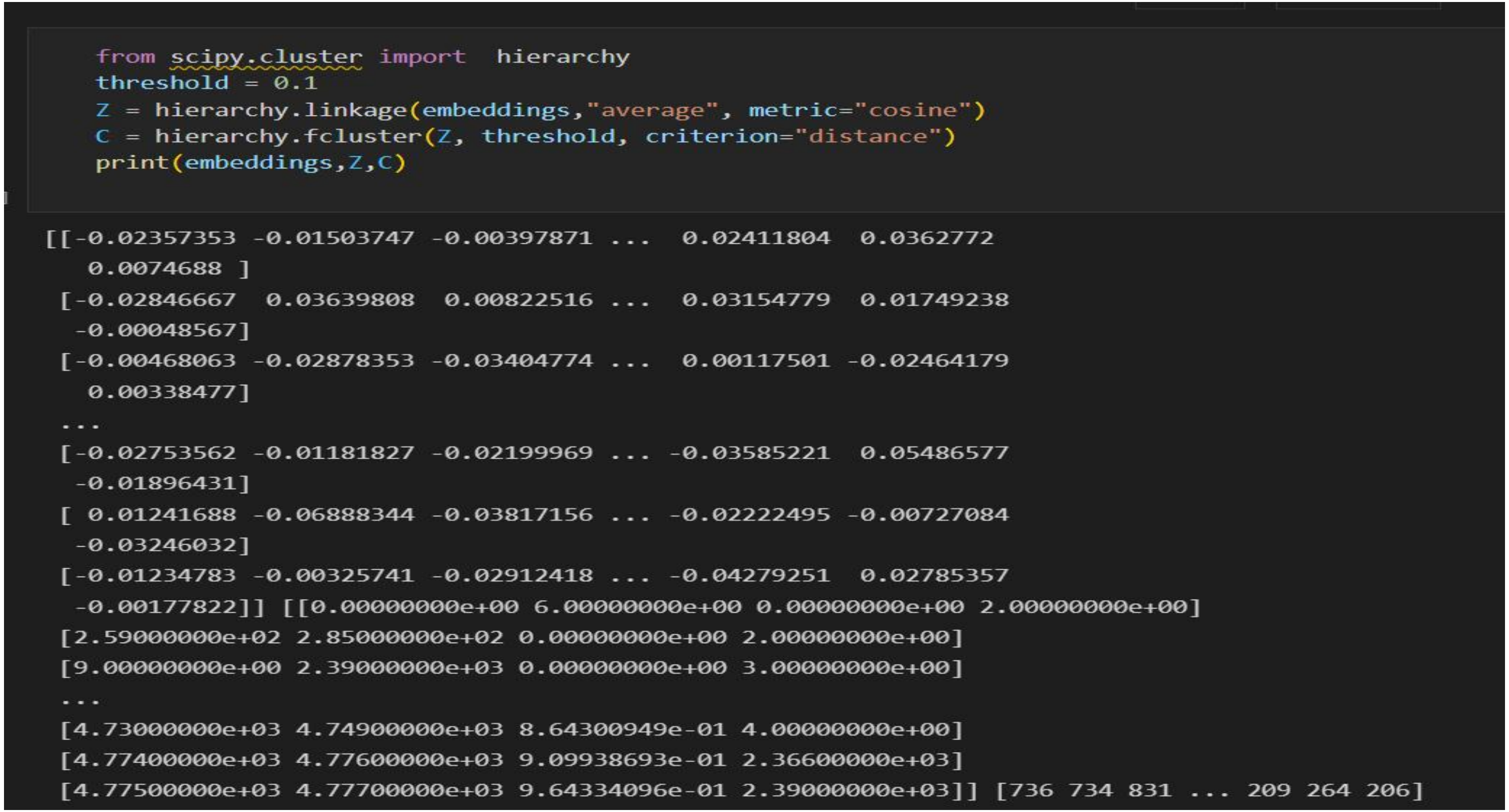
Results



```
result=cohen_kappa_score(lis,abc,weights='quadratic')
print(result)
```

```
0.09624577645852728
```

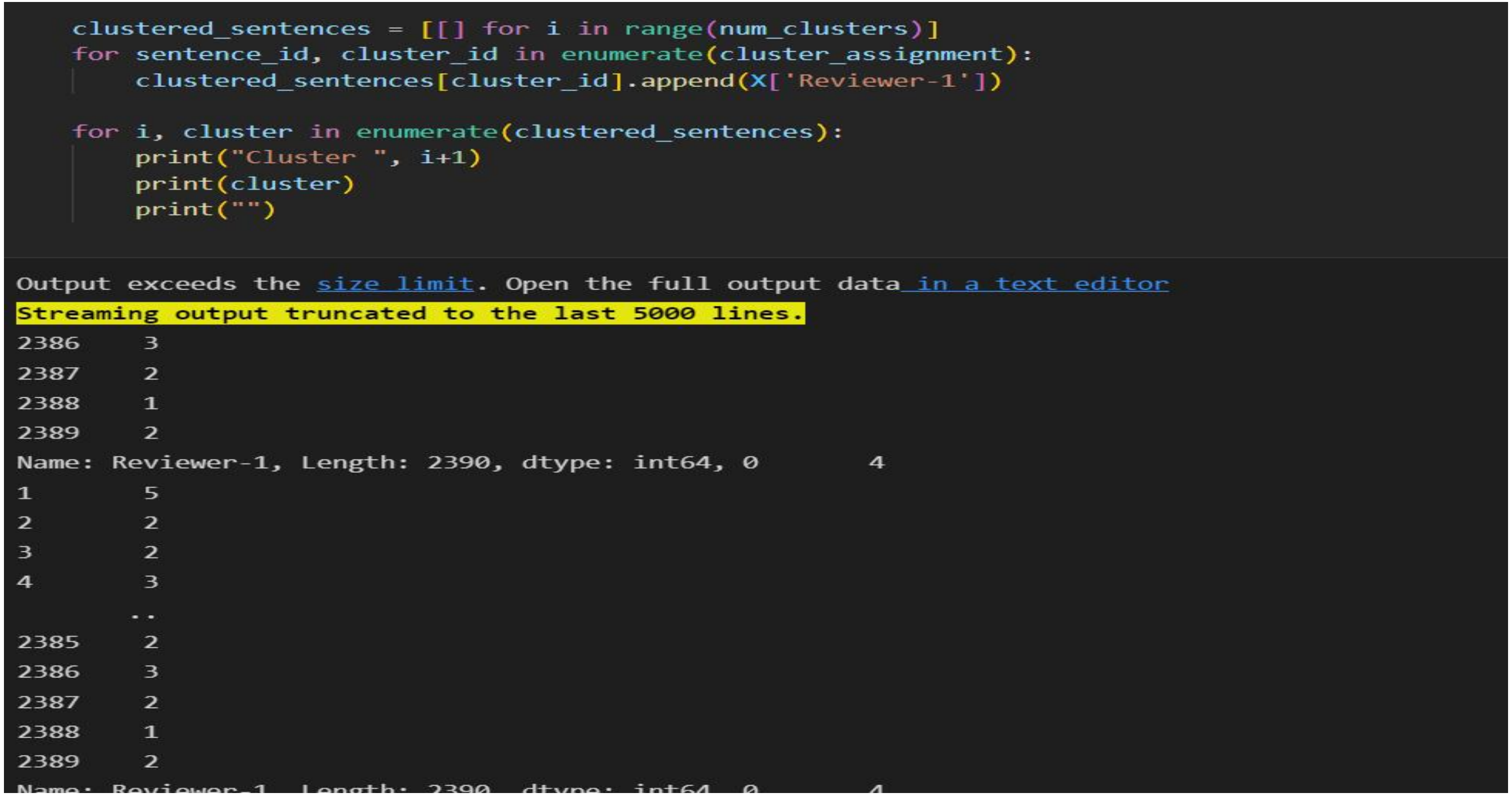
Kappa Score



```
from scipy.cluster import  hierarchy
threshold = 0.1
Z = hierarchy.linkage(embeddings,"average", metric="cosine")
C = hierarchy.fcluster(Z, threshold, criterion="distance")
print(embeddings,Z,C)
```

```
[[-0.02357353 -0.01503747 -0.00397871 ...  0.02411804  0.0362772
   0.0074688 ]
 [-0.02846667  0.03639808  0.00822516 ...  0.03154779  0.01749238
  -0.00048567]
 [-0.00468063 -0.02878353 -0.03404774 ...  0.00117501 -0.02464179
   0.00338477]
 ...
 [-0.02753562 -0.01181827 -0.02199969 ... -0.03585221  0.05486577
  -0.01896431]
 [ 0.01241688 -0.06888344 -0.03817156 ... -0.02222495 -0.00727084
  -0.03246032]
 [-0.01234783 -0.00325741 -0.02912418 ... -0.04279251  0.02785357
  -0.00177822]] [[0.00000000e+00 6.00000000e+00 0.00000000e+00 2.00000000e+00]
 [2.59000000e+02 2.85000000e+02 0.00000000e+00 2.00000000e+00]
 [9.00000000e+00 2.39000000e+03 0.00000000e+00 3.00000000e+00]
 ...
 [4.73000000e+03 4.74900000e+03 8.64300949e-01 4.00000000e+00]
 [4.77400000e+03 4.77600000e+03 9.09938693e-01 2.36600000e+03]
 [4.77500000e+03 4.77700000e+03 9.64334096e-01 2.39000000e+03]] [736 734 831 ... 209 264 206]
```

Embedded essay



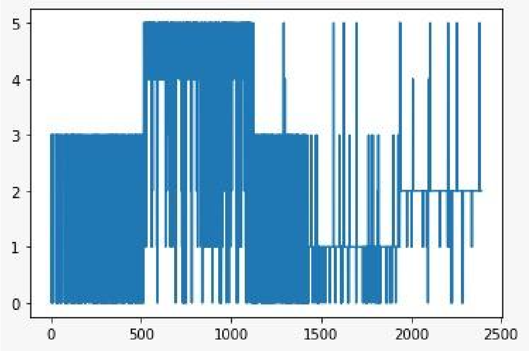
```
    clustered_sentences = [[] for i in range(num_clusters)]
    for sentence_id, cluster_id in enumerate(cluster_assignment):
        clustered_sentences[cluster_id].append(X['Reviewer-1'])

    for i, cluster in enumerate(clustered_sentences):
        print("Cluster ", i+1)
        print(cluster)
        print("")
```

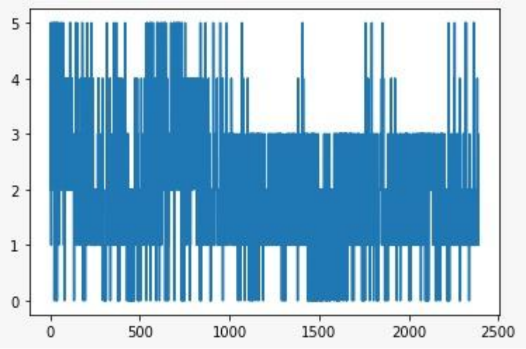
```
Output exceeds the size limit. Open the full output data in a text editor
Streaming output truncated to the last 5000 lines.
2386    3
2387    2
2388    1
2389    2
Name: Reviewer-1, Length: 2390, dtype: int64, 0       4
1       5
2       2
3       2
4       3
       ..
2385    2
2386    3
2387    2
2388    1
2389    2
Name: Reviewer-1, Length: 2390, dtype: int64, 0       4
```

Clustered Data

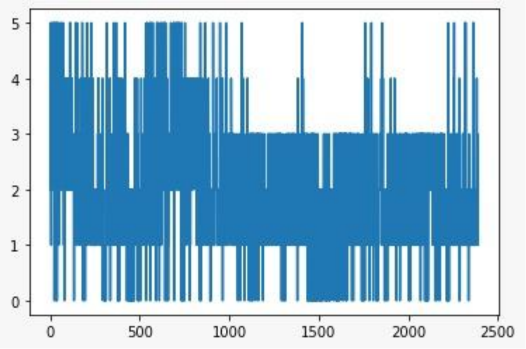
DATA VISULAIZATION WITH RESULTS



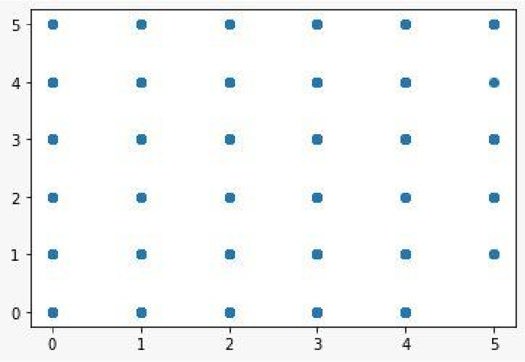
Clusters



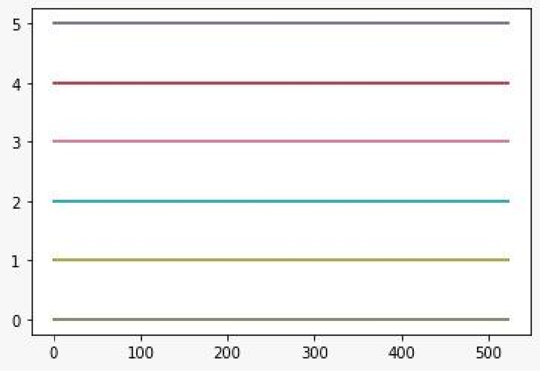
Review 1 plot



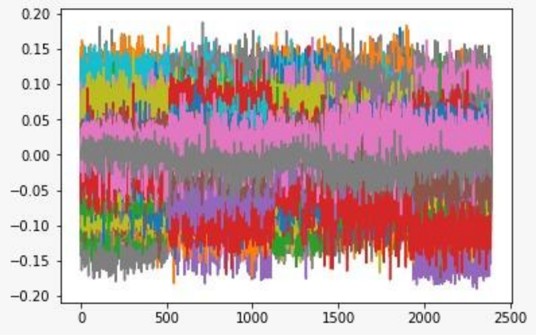
Cluster assignment plot



Scattering of reviewer 1, clusters



Clusters



Graph for embedding

Conclusion

- We have designed a new way of analyzing the essay and scoring them based on clustering.

- This deep learning model helps in understanding the sentences and similarities between them. Hence, it is more useful to create vectors.

- We have designed the model with an aim to help reduce the burden of essay evaluators and make the work automated and productive.

THANK YOU