

# ProgDS-2025 Exercise – 9: Text Encoding and Clustering Metrics

## Concepts covered:

1. Text encoding
2. Clustering metrics

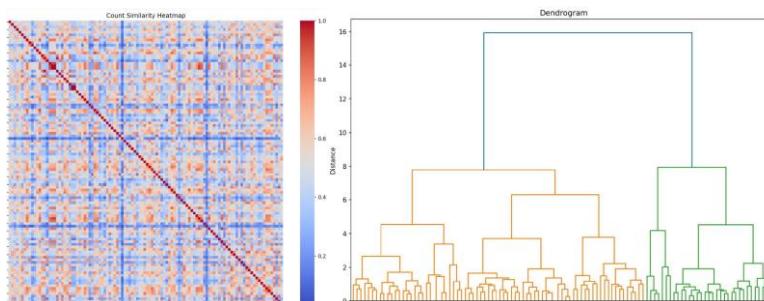
## Goals of this exercise:

- To create vector representations of words and documents
- To use the vector representations to group the documents into clusters
- To use metrics like Silhouette Score and Davies-Bouldin Index to decide the optimum cluster count
- To save and analyze clusters, and make conclusions.

Data file to be used: **Session-Summary-all-2025-S1.csv**

Process the data file as suggested in the following steps:

1. Read the data into a dataframe. Treat each row (submission) as a **document**
2. With each document:
  - a. Combine the **Topic** and **YourAnalysis** columns to create a unified text column
  - b. Remove all special characters (use Python library **re**)
  - c. Remove **stop words** and **lemmatize** the text (use Python library **nltk**). Understand what is lemmatization, and its importance in text processing.
  - d. Store the pre-processed text into a new column in the dataframe
3. Create **vector representations of each document** based on the following methods, and store them in the dataframe:
  - a. Count vectorization (use **CountVectorizer** from **sklearn**)
  - b. TFIDF vectorization (use **TFIDFVectorizer** from **sklearn**)
  - c. Word2vec vectorization (use **Word2vec** from **genism**)
  - d. Save the dataframe into a spreadsheet and review all the created data
4. Using **each** of the above vectorization methods carry out the following:
  - a. Calculate pair-wise cosine distance between the documents and visualize (image below) / analyze the results.
  - b. Calculate pair-wise Euclidean distance between the documents and visualize / analyze the results.
  - c. Perform PCA analysis.
  - d. Create PCA based 2D visualization and its analysis
  - e. Create 2D t-SNE based visualization and its analysis
  - f. Using 2D t-SNE coordinates:
    - i. Use Hierarchical Clustering (with complete linkage) to cluster the documents to create 3 to 15 clusters and calculate Silhouette Score and Davies-Bouldin Index values in each case.
    - ii. Create line plots of these metrics and decide the most optimum cluster count.
    - iii. Based on this final count create colour-coded dendrogram (see image below)
    - iv. Against each document record it's cluster number and save the data into a spreadsheet (see below)
    - v. Analyze the clusters and record your observations.
  - g. Using the vector representation itself (ie. without PCA and without t-SNE) cluster the documents, as outlined above, and analyze the results.



Sno	Timestamp	Topic	YourAnalysis	Questions	Comment	Total_Characters	Total_Words	After-Pre-Processing	TF-IDF	word2vec	TFIDF_cluster	Word2vec_cluster
0	2025/10/2	Trade-offs between lazy and eager				1799	240	tradeoff lazy eager exec [0. 0. [-5.78479]	0. 0. [-5.78479]	2	1	
1	2025/10/2	Resilient D resilient data distribution:resilier				893	138	resilient data distribut [0. 0. [-0.059034]	2	1		
2	2025/10/2	Aadhaar D Aadhaar data management:the e				985	137	aadhaar data manager [0.508049] [-7.84462]	1	3		
3	2025/10/2	Resilient D resilient distributed dataset:a res				1326	215	resilient distributed dat [0. 0. [-8.85856]	2	1		
4	2025/10/2	Data stora Data storage in large storage sys				2110	336	data storage large stor [0. 0. [-0.06682]	2	1		
5	2025/10/2	How aadhar stores fingerprint an				1330	191	aadhar store fingerpri [0.114719] [-6.53610]	1	3		
6	2025/10/2	Resilient D resilient distributed datasets: i				1289	194	resilient distributed dat [0. 0. [-0.07884]	2	1		
7	2025/10/2	Distributet distributed data processing with				1893	282	distributed data proces [0. 0. [-0.08628]	2	1		
8	2025/10/2	Analysis or analysis on spark in cloud compu				1531	246	analysis spark cloud co [0. 0. [-7.75401]	2	1		

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