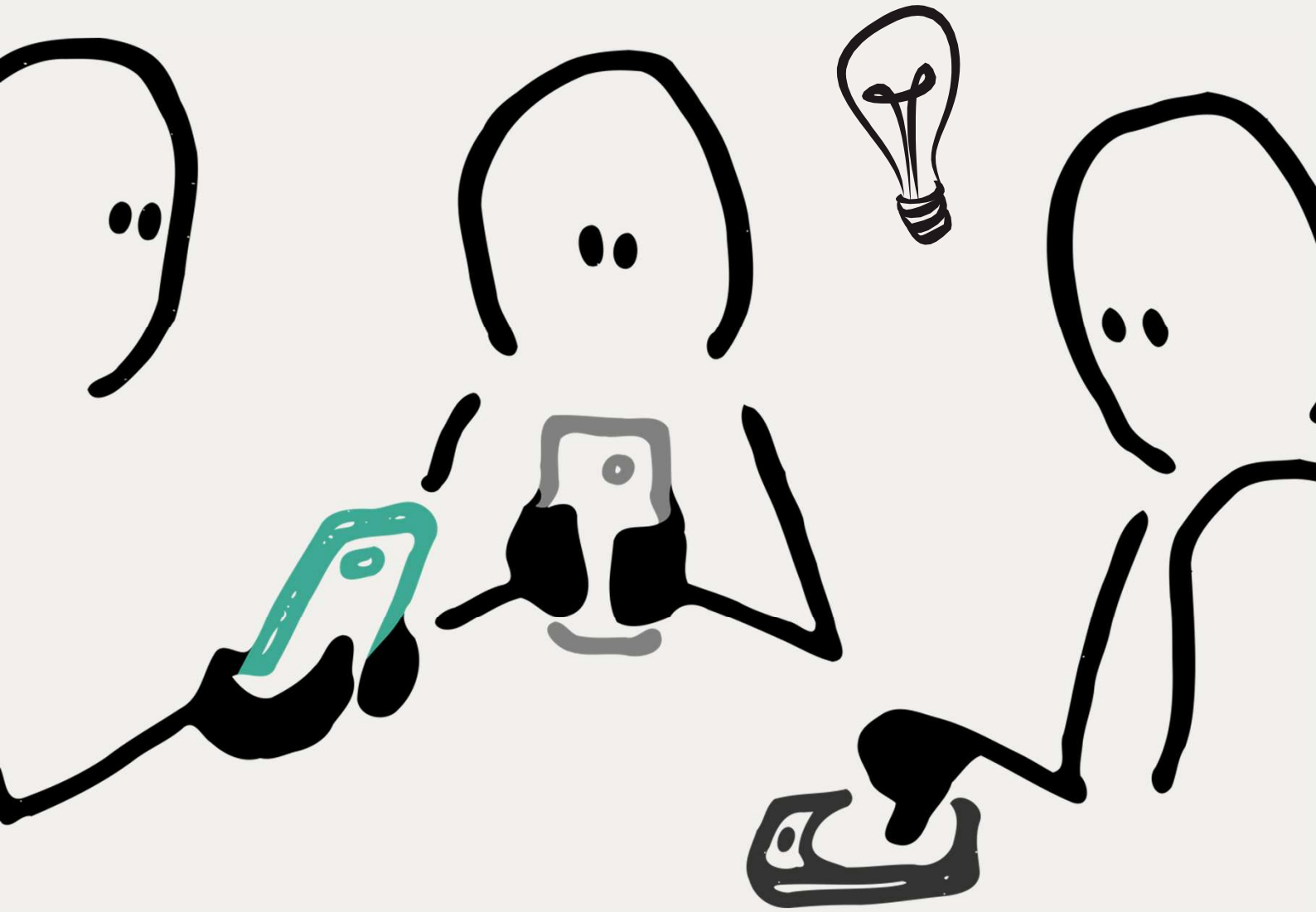

BLESS THIS MESS

FUNDAMENTALS OF DATA SCIENCE

GRUPPO COPIA DI COPIA DI UNTITLED14

DATA SCIENCE A.Y. 2025/2026

ROSAMARIA GRAZIOSI

IRENE DI TIMOTEO

JACOPO CALVANO

THE PROBLEM

Copia di Copia di non modificare di Copia di Copia di Copia di Copia di Copia di ...	me
Copia di Copia di Progetto_pokemon_finale.ipynb	me
Copia di Progetto_pokemon_finale.ipynb	me
Copia di Copia di Copia di Progetto_pokemon_finale.ipynb	me
Copia di Progetto_pokemon_finale.ipynb	me
Copia di non modificare di Copia di Copia di Copia di Copia di Copia di Copia.ipy...	me
lavoro Copia di non modificare di Copia di Copia di Copia di Copia di Copia di Co...	me
Copia di Copia di non modificare di Copia di Copia di Copia di Copia di Copia di ...	me
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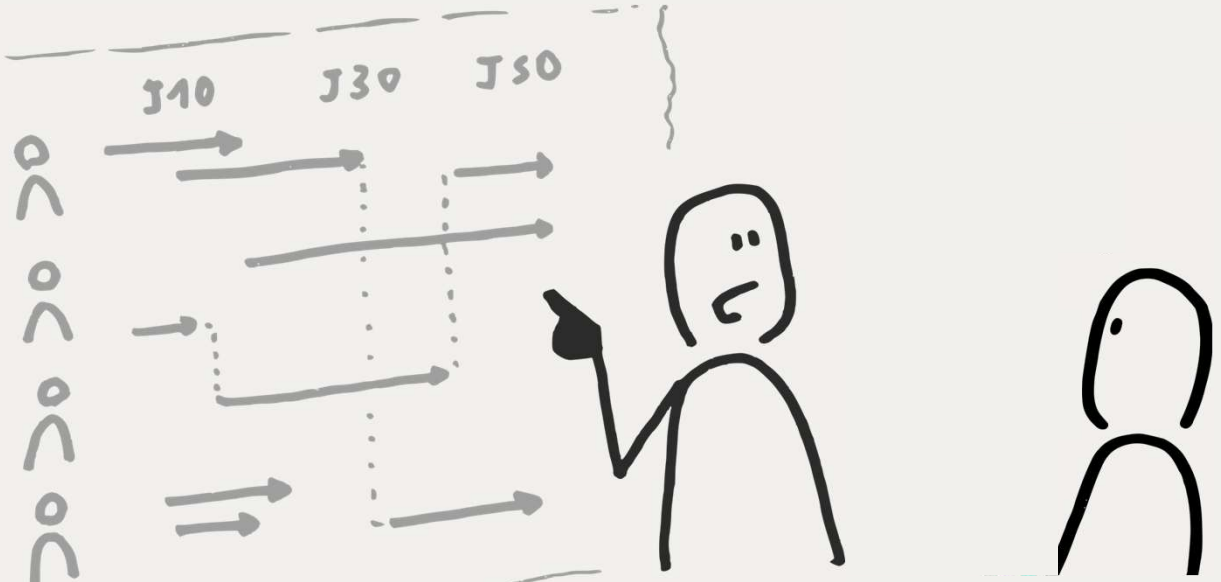


FORMALIZING THE CHALLENGE

Given a folder of files

01 Identify relations between files and reorganize them into semantic subfolders

02 Assign relevant titles to files and folders

03 Obtain information from versions and different files

THE DATASET

50 papers from *ArXiv of* 7 subjects, stripped of the title and abstract + 5 versions of each paper

Start with 350 original files

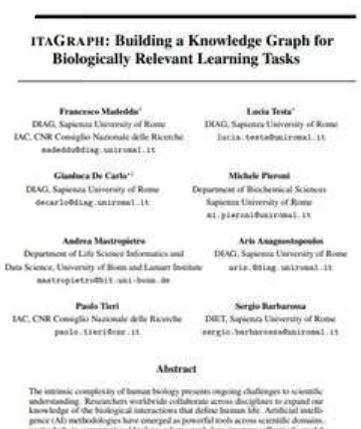
Extract the text, without title and abstract into json file with ids

Create 5 versions by selecting random sections from the originals

End with a single json with 1750 texts and ids


Rademacher and Gaussian Complexities: Risk Bounds and Structural Results

Abstract


ITAGRAPH: Building a Knowledge Graph for Biologically Relevant Learning Tasks

Abstract

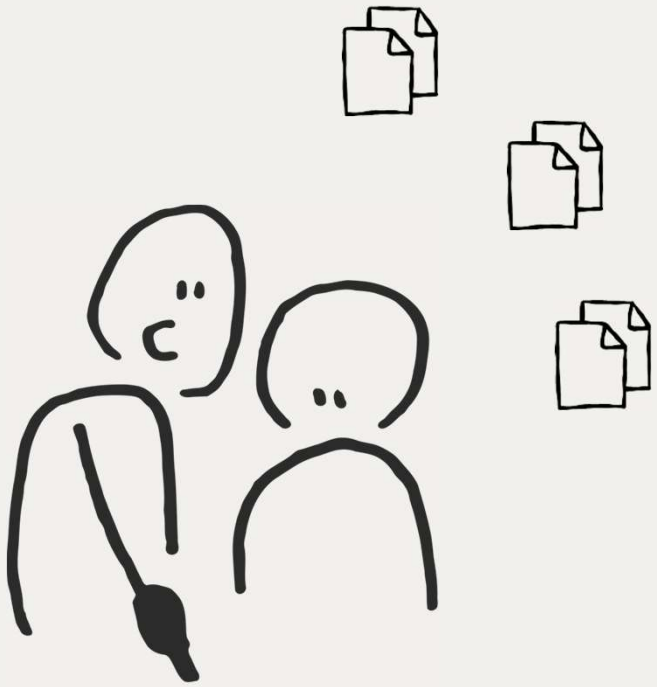

-Bayesian Theorems


Stability and Generalization

Abstract

1. Introduction

THE PIPELINE



Documents embedding

↓

Pretrained Siamese NN

Semantic clustering

↓

Leiden algorithm

Generation of file and folder titles

↓

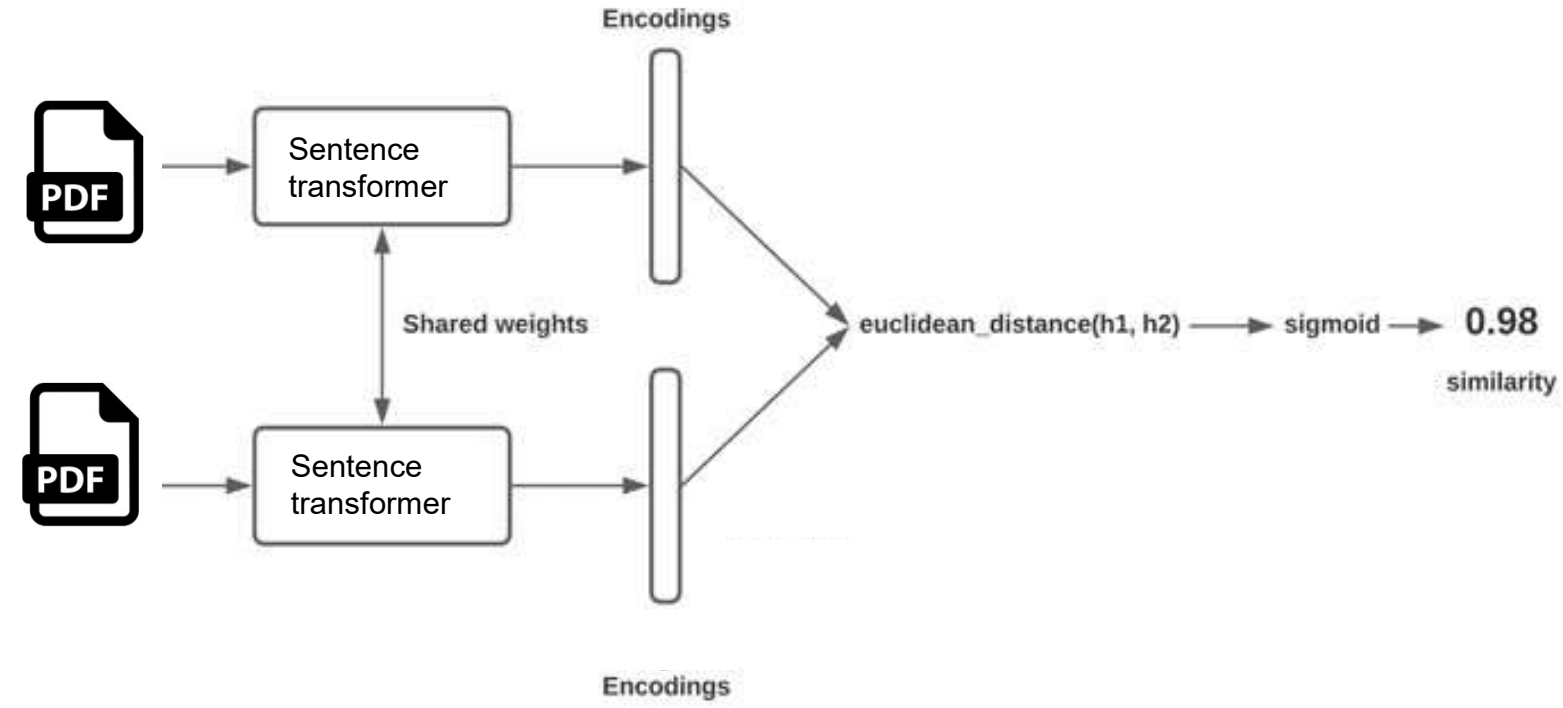
Pretrained LLM

Information retrieval

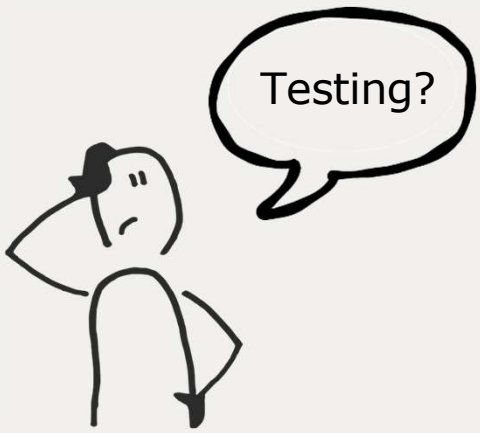
↓

Cosine similarity

DOCUMENTS EMBEDDING

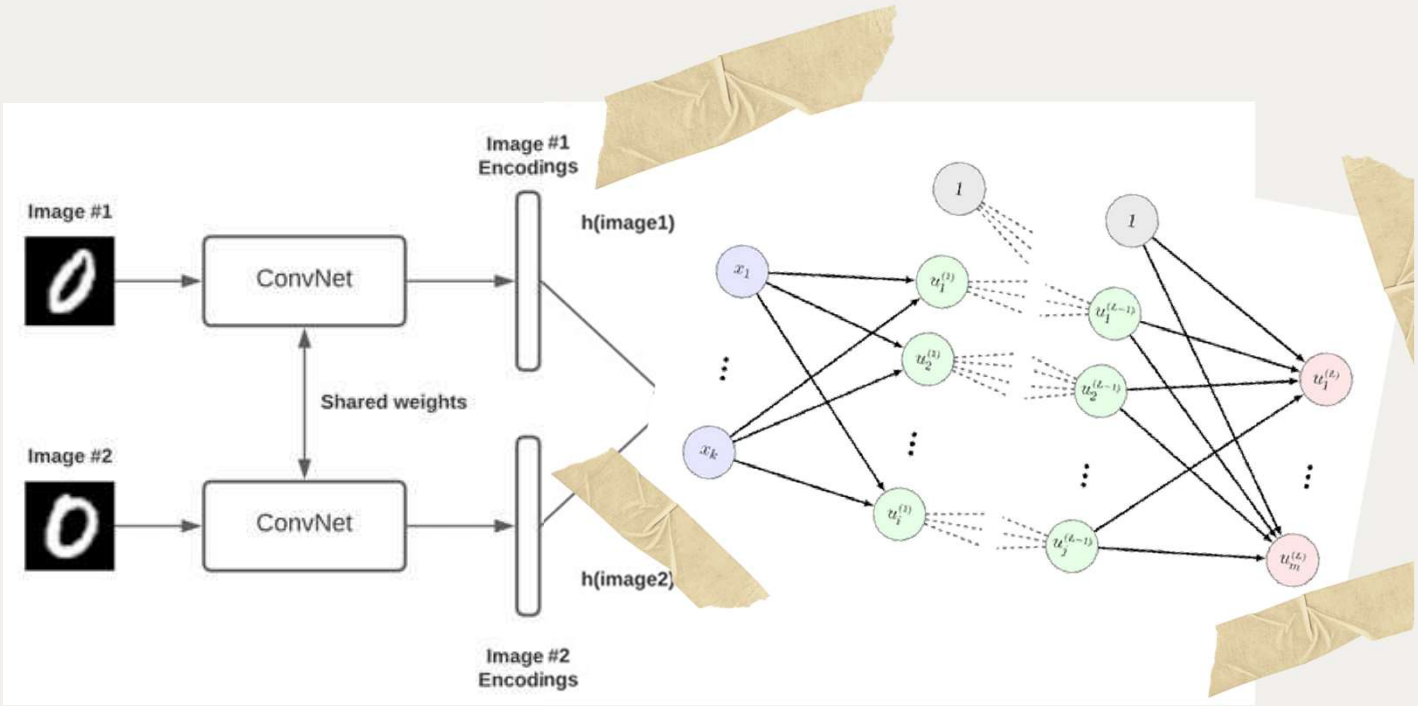


Picture from: https://pyimagesearch.com/2020/11/30/siamese-networks-with-keras-tensorflow-and-deep-learning/



Use Siamese NN's embeddings to encode the relations between pairs of files

DOCUMENTS EMBEDDING

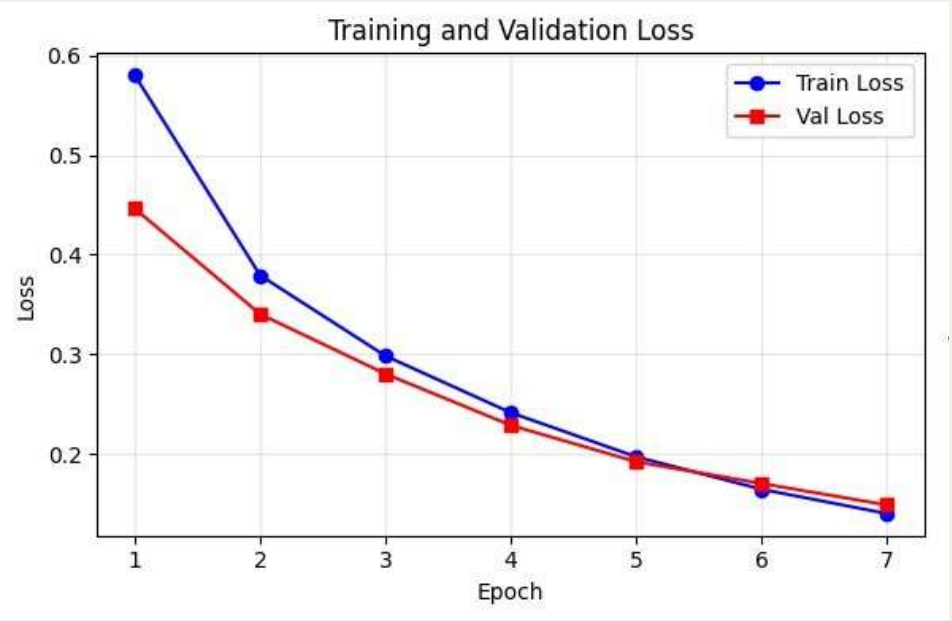


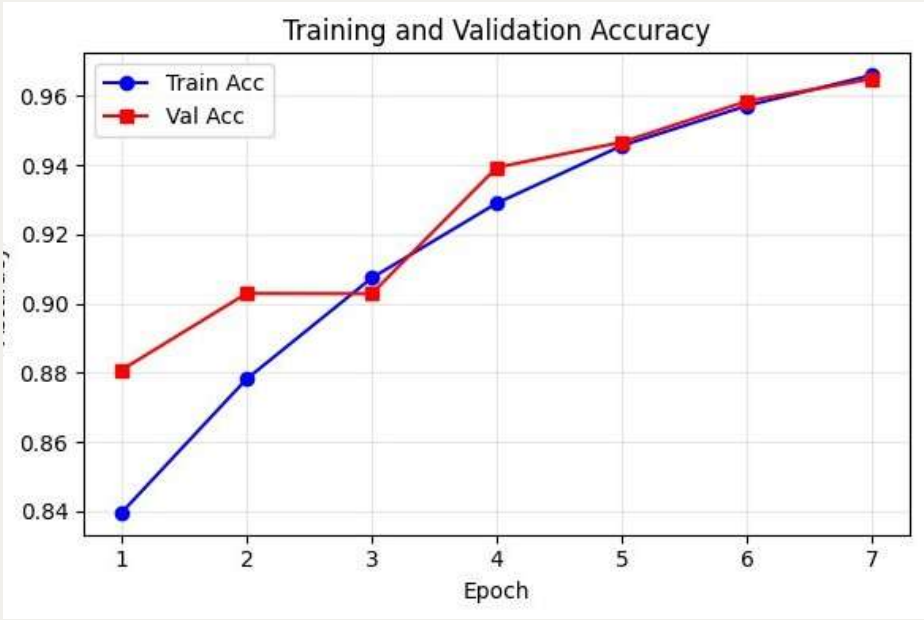
Picture from: https://pyimagesearch.com/2020/11/30/siamese-networks-with-keras-tensorflow-and-deep-learning/

Siamese NN + MLP classifier:

- version
- unrelated
- similiar

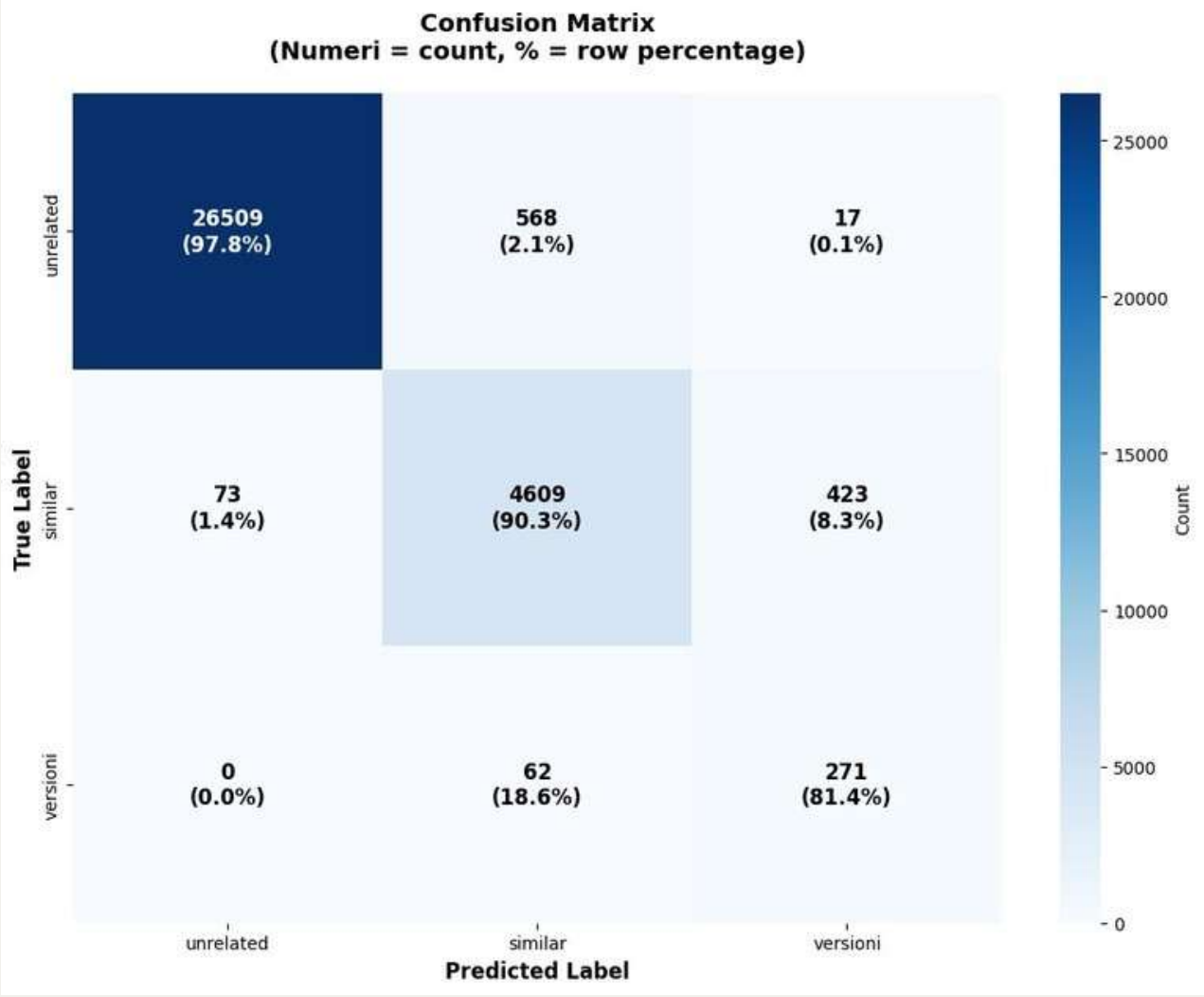
DOCUMENTS EMBEDDING

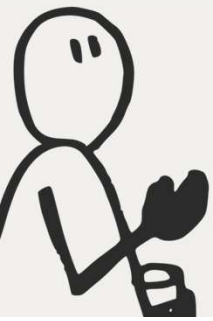




Using the 3 classes as a proxy we can evaluate the siamese embeddings

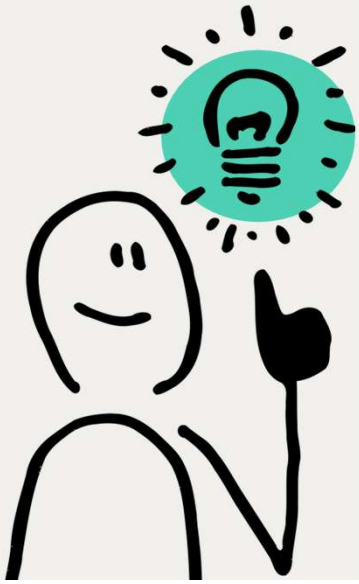
DOCUMENTS EMBEDDING



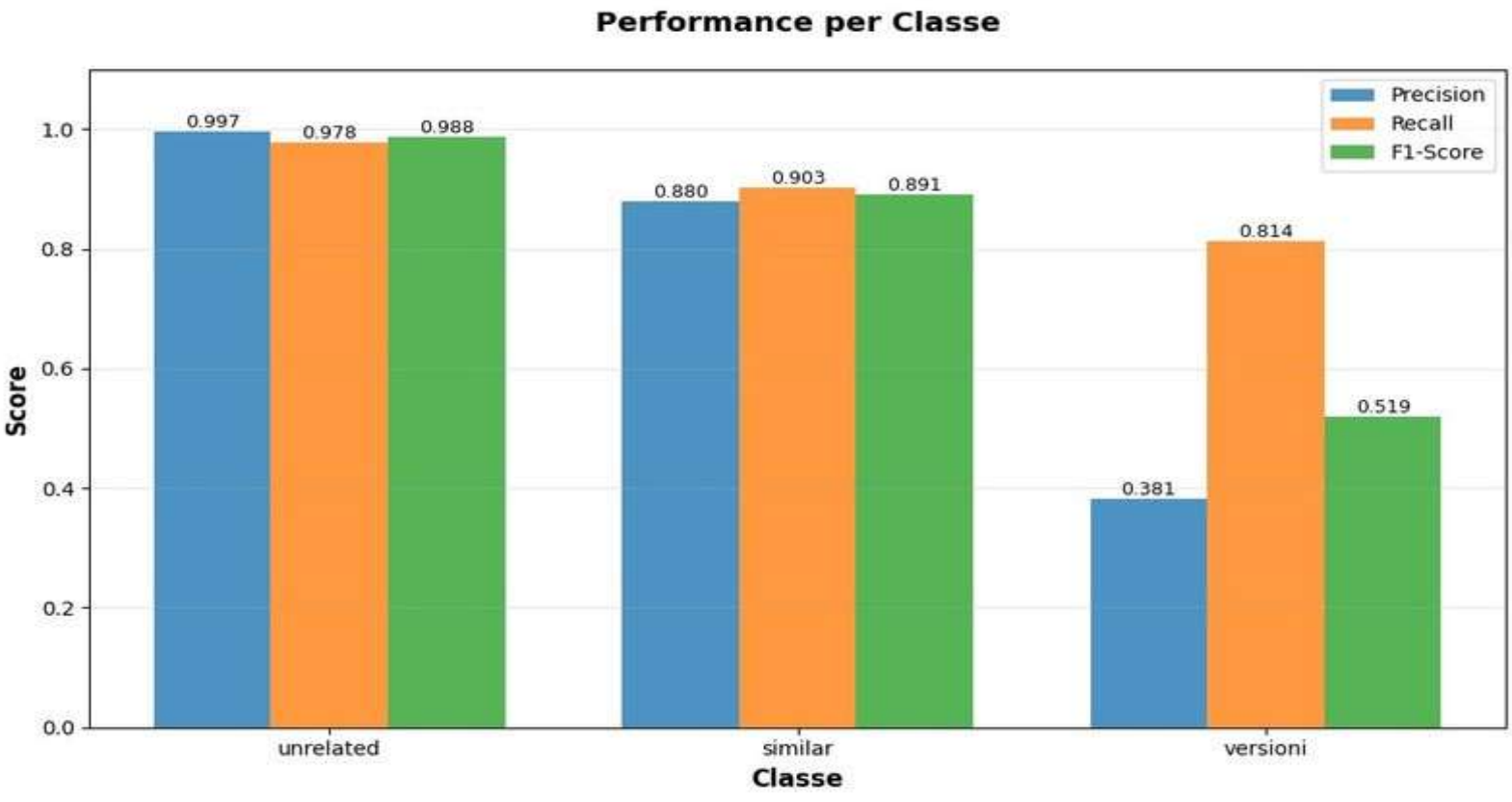


The classes
are unbalanced!

DOCUMENTS EMBEDDING



Precision
Recall
F1-Score

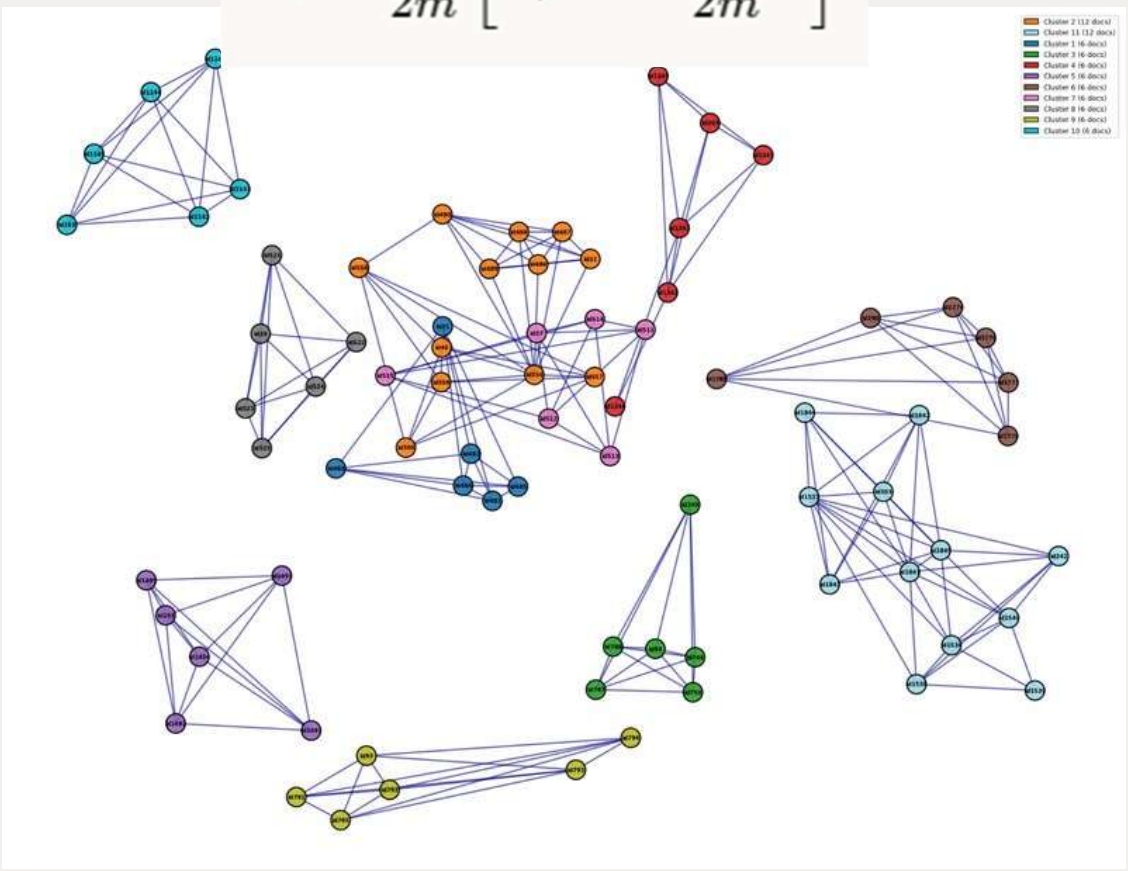


SEMANTIC CLUSTERING

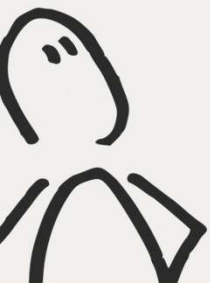
Louvain algorithm

An Heuristic to detect communities in large networks by maxizing modularity. It optimizes modularity greedily and locally using this gain measure

$$\Delta Q = \frac{1}{2m}\left[k_{i,in} - \frac{\Sigma_{tot} \cdot k_i}{2m}\right]$$



Example on
78 documents
11 clusters



SEMANTIC CLUSTERING

Silhouette (cosine)

Mean: 0.6056 ± 0.0787

Range: [0.4389, 0.7961]

Davies–Bouldin

Mean: 1.0423 ± 0.1682

Range: [0.6468, 1.4853]

Conductance

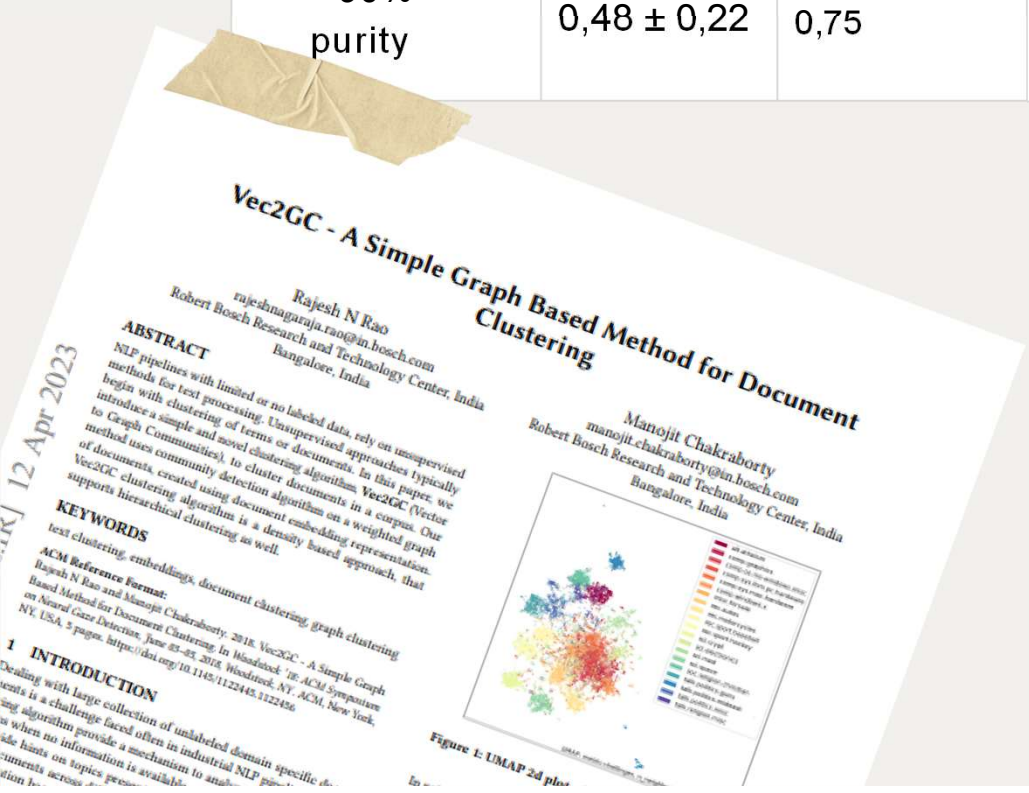
Mean: 0.2075 ± 0.780

Range: [0.0000, 0.4327]

SEMANTIC CLUSTERING

purity

	Our Result #100 folder	Vec2GC DBPedia DS	K-Medoids DBPedia DS
≥ 50% purity	0,93 ± 0,11	0,94	0,80
≥ 70% purity	0,52 ± 0,23	0,88	0,54
≥ 90% purity	0,48 ± 0,22	0,75	0,32



Vec2GC - A Simple Graph Based Method for Document Clustering

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ABSTRACT

NLP pipelines with limited or no labeled data, rely on unsupervised methods for text processing. Unsupervised approaches typically begin with clustering of terms or documents. In this paper, we introduce a simple and novel clustering algorithm, Vec2GC (Vector to Graph Communities), to cluster documents in a corpus. Our method uses community detection algorithm on a weighted graph of documents, created using document embedding representation. Vec2GC clustering algorithm is a density based approach, that supports hierarchical clustering as well.

KEYWORDS

text clustering, embeddings, document clustering, graph clustering

ACM Reference Format:

Rajesh N Rao and Manojit Chakraborty. 2018. Vec2GC - A Simple Graph Based Method for Document Clustering. In Woodstock '18: ACM Symposium on Neural Gaze Detection, June 03–05, 2018, Woodstock, NY. ACM, New York, NY, USA, 5 pages. https://doi.org/10.1145/1122445.1122456

1 INTRODUCTION

Figure 1: UMAP 2d plot

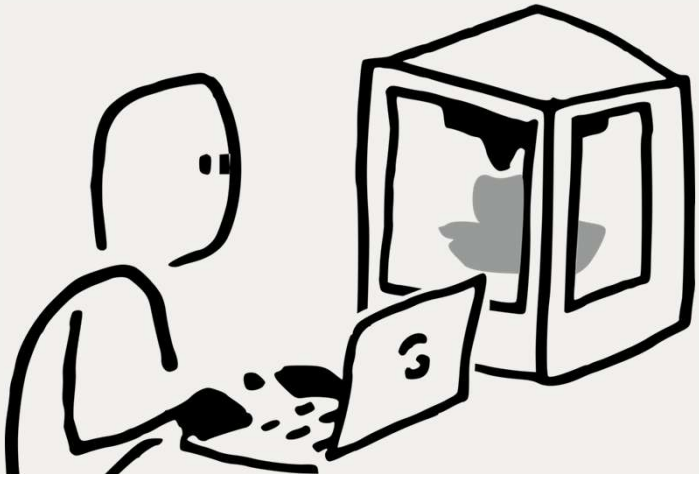
12 Apr 2023

GENERATING TITLES FOR FILES AND FOLDERS

LLM
Qwen

```
    messages = [
        {"role": "system", "content": "Create
concise titles. Output ONLY the title."},

        {"role": "user", "content": f"Create a title
(max 10 words):\n\n{snippet}\n\nTitle:"}
    ]
```



INFORMATION RETRIEVAL

```
ID: id1
Titolo Generato: Microfluidic Platforms for Studying Angiogenesis in iPSC-ECs
Articoli Simili Trovati:
  - Rank 1 (Score: 0.6360) | ID: id1  (COERENZA INTERNA)
  - Rank 2 (Score: 0.6360) | ID: id331
  - Rank 3 (Score: 0.6360) | ID: id335
  - Rank 4 (Score: 0.5455) | ID: id332
  - Rank 5 (Score: 0.5245) | ID: id333
  - Rank 6 (Score: 0.5163) | ID: id334
```

```
Titolo: Modeling iPSC-derived Endothelial Cell Transition in Tumor Angiogenesis using Petri Nets
Articoli Simili Trovati (incluso se stesso):
  - Rank 1 (Score: 0.7636) | ID: id332
  - Rank 2 (Score: 0.7259) | ID: id334
  - Rank 3 (Score: 0.6618) | ID: id331
  - Rank 4 (Score: 0.6618) | ID: id335
  - Rank 5 (Score: 0.6618) | ID: id1  (COERENZA INTERNA)
  - Rank 6 (Score: 0.6486) | ID: id333
```

```
ID: id1
Titolo: Modeling iPSC-derived Endothelial Cell Transition in Tumor Angiogenesis using Petri Nets
Articoli Simili Trovati (Abstract vs. Testo Completo):
  - Rank 1 (Score: 0.8218) | ID: id1  (COERENZA INTERNA)
  - Rank 2 (Score: 0.4943) | ID: id17
  - Rank 3 (Score: 0.4048) | ID: id24
  - Rank 4 (Score: 0.3888) | ID: id212
  - Rank 5 (Score: 0.3509) | ID: id19
  - Rank 6 (Score: 0.3317) | ID: id172
```

Top 6 on 3 different query levels:

generated title

original title

abstract

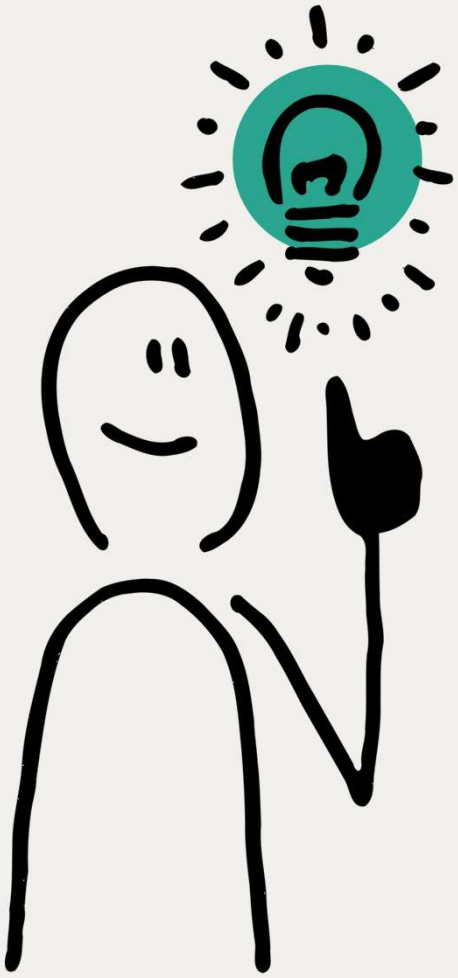
INFORMATION RETRIEVAL

A metric to evaluate the generated titles

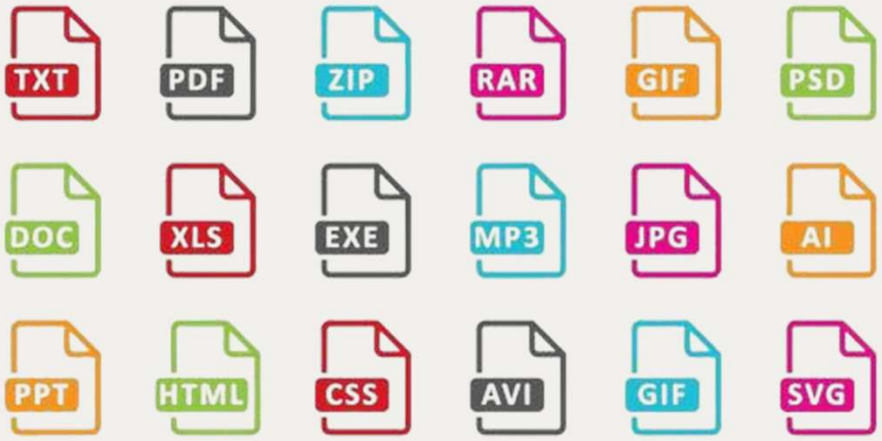
Query	Score	%
Gen. title	3.6672	61.1
Orig. title	3.7449	62.4
Abstract	2.3697	39.5

$$\text{score} = \sum_{d \in D} \mathbf{1}_{\text{correct}(d)} + 0.5 \sum_{d \in D} \mathbf{1}_{\text{similar}(d)}$$

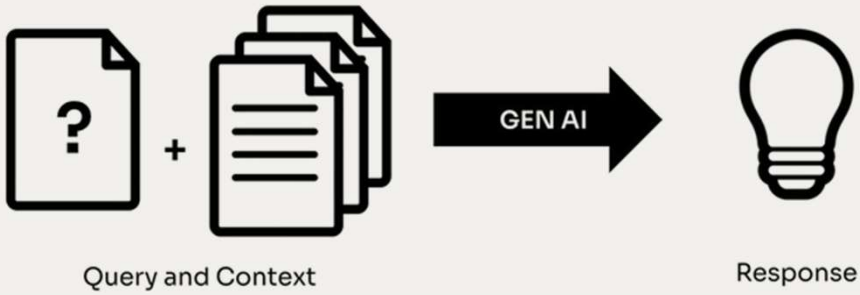
FUTURE



1. extend to other tipe of file



2. RAG



THANK YOU!