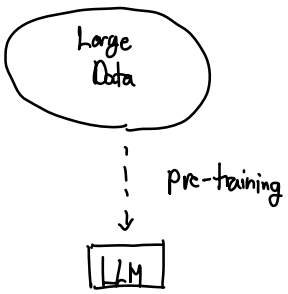
Before RAG (traditional LLM models)



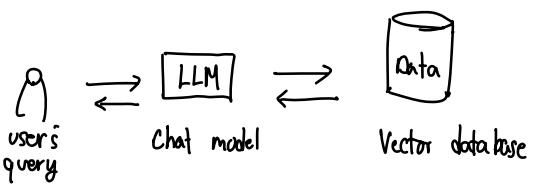
Problems:

② Knowledge cut-off: If user's query required the most recent news where the pre-trained model haven't been exposed to, the model simply didn't know or "hallucinated"

② hallucination: LLMs are "probability machines". They prioize smoothness over accuracy. Without a source to check, they often made up fake facts.

③ Privacy & Business data: inability to teach entire new large sets of data without retraining the entire model.

Solution: **RAG: Retrieval-Augmented Generation**



① Up-to minute accuracy: No need to train the LLM. only upload documents that the LLM needs to reference.

② Citations: tracking sources is possible (seeing if hallucination occurred or not). by referencing a tool online called Langsmith.

③ Cost-effective: Since retraining the model itself is not required, uses much less computational energy cost.

RAG Implementation

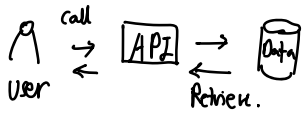
- 3 key words

① API
② Huggingface
③ Langchain

① API : Application Programming Interface

- set of rules and protocols allowing different software applications to communicate, share data, and utilize the functionality.

ex.)



ex.) repo_id = "google/gemma-2-9b-it" ← one of huggingface's free models.

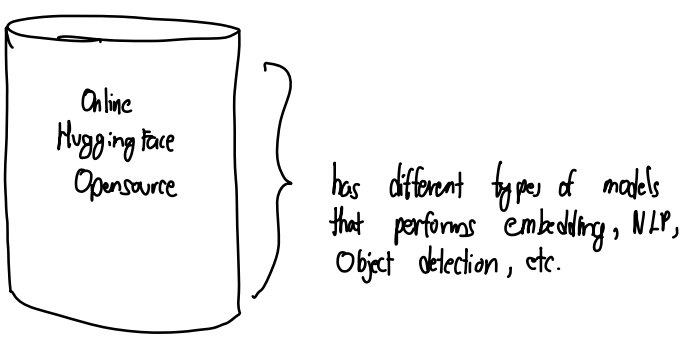
② Huggingface

- Online opensource for pre-trained ML models.

can be used simply for 2 types of model.

① Embedding model
② LLM model.

ex.)



③ Langchain.

- Opensource Framework for the ease of application development.

3 main key highlights about Langchain.

① Abstraction

- Simplifies complex RAG development tasks into few lines of code.

ex.) developing RAG : 1. Upload document
2. Splitting text
3. Embedding to vector
4. Saving to Vector Data Base.

↳ traditionally, this would take many lines of code, but using langchain tools, it makes it much quicker.

② Standardization

- creates a "standard shape" for different AI models.

LLM sources
- Chat GPT
- Groq
- Gemini
- Claude
- ⋮

Standardization →

Chat model
- Chat Anthropic
- Chat Groq
- Chat Google Generative AI.
- ⋮

- Since most LLMs have different endpoints, APIs, changing one model would require many changes in the code.
↳ Langchain allow to change single line of code

③ Chaining

- Most components are designed with input → output structure. and using Langchain can "chain" multiple sources under few/single of code.

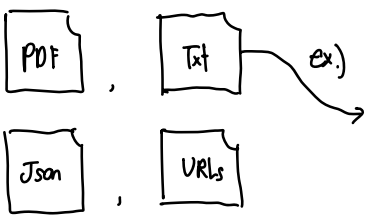
ex.) Prompt | chat_LLM | Str Output Parser()
↑
pipe

Implementation Flow diagram -

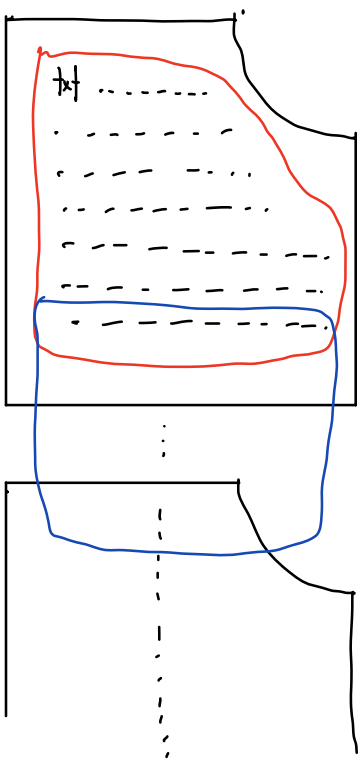
① Indexing.

a.) Upload documents
b.) Split text within the document
c.) Embed each splits
d.) Save to a vector database.

a.) Load.



b.) Split text within document



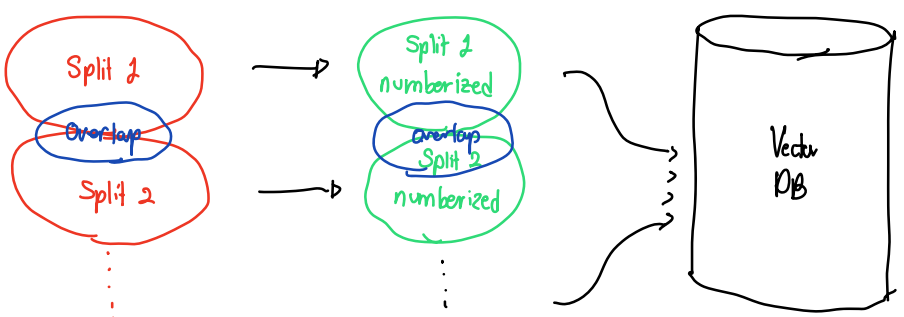
Chunk size = 1000
overlap = 50

- doing so allows consistency check for the LLM.

(can use free LLM from HF)

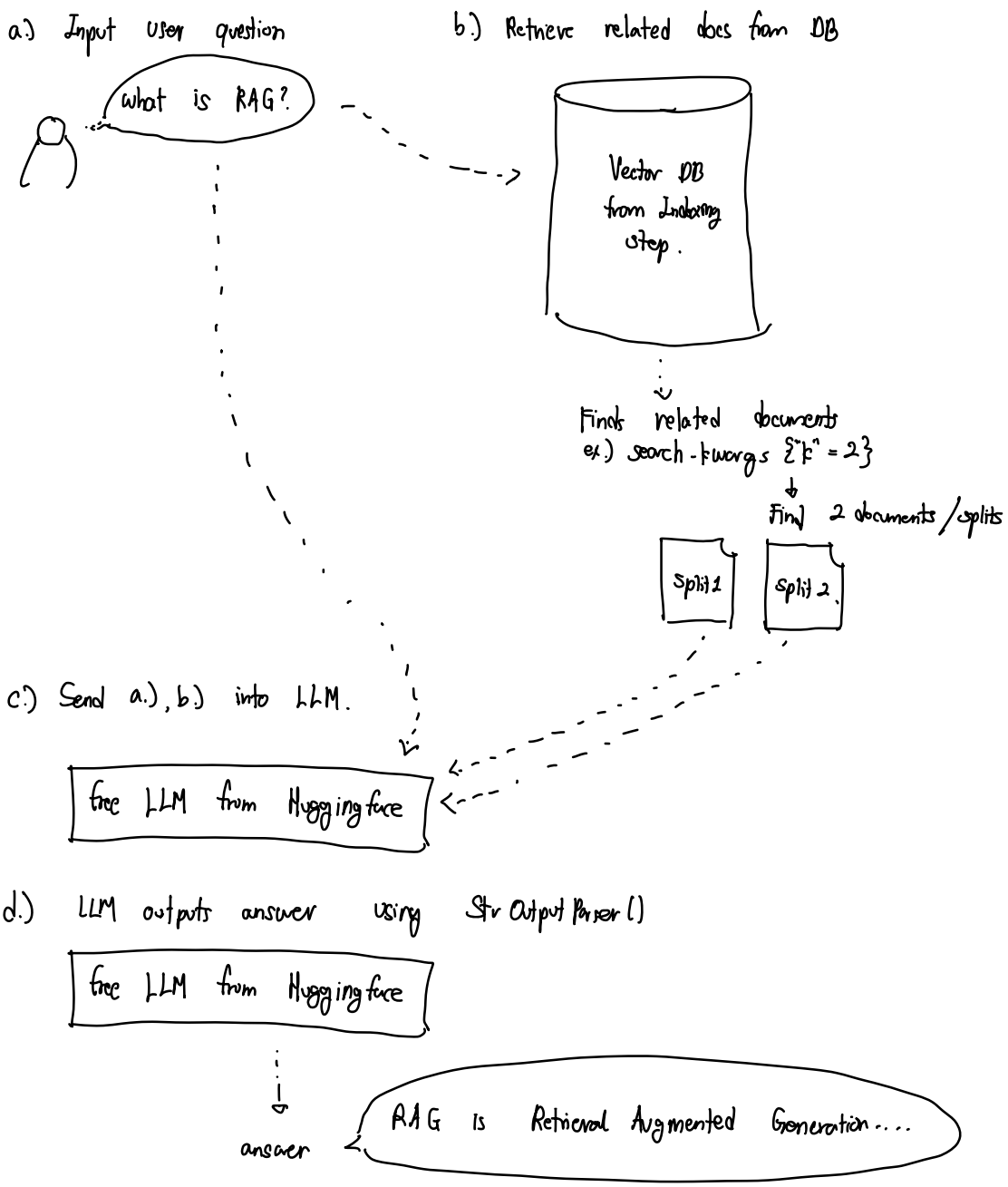
c.) Embed splits.

d.) Store to Vector database



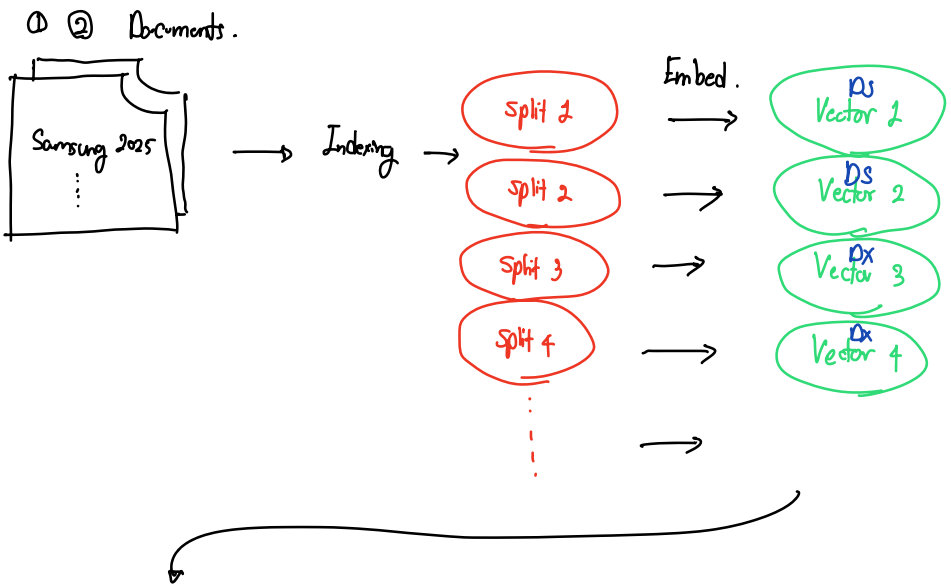
② Query

a.) Input user question
b.) Retrieve from Vector DB
c.) Send step a.), b.) into LLM
d.) LLM outputs answer.

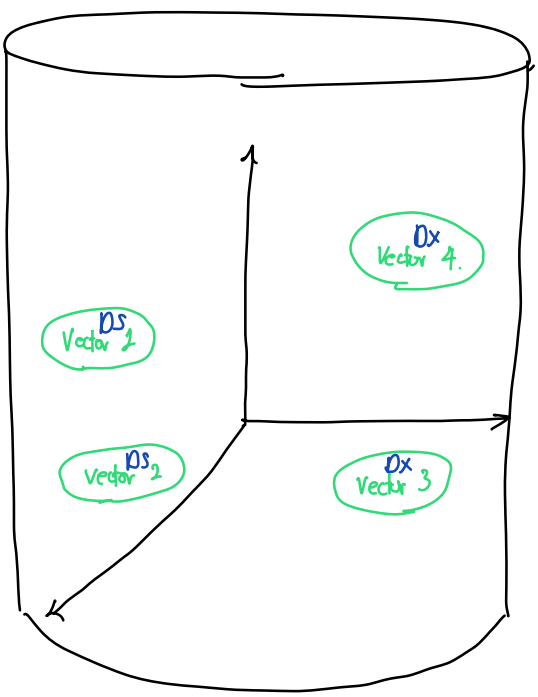


Visualized simple example.

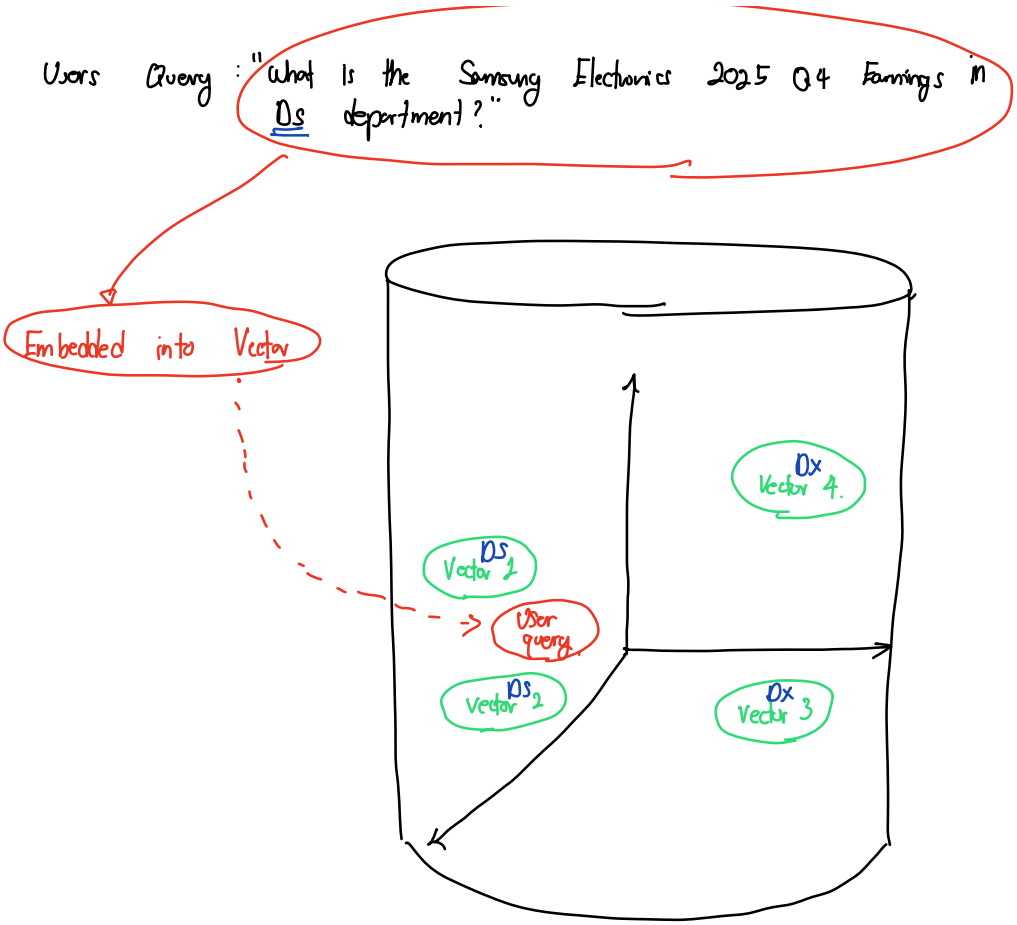
Documents : ① "Samsung 2025 Q4 earnings call PDF"
② "Samsung 2025 Q4 earnings call Presentation"



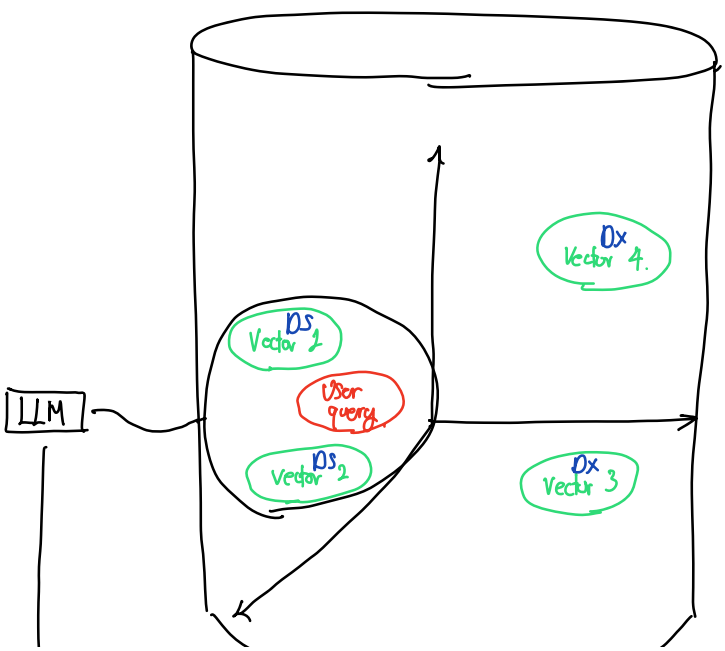
Inside Vector DB

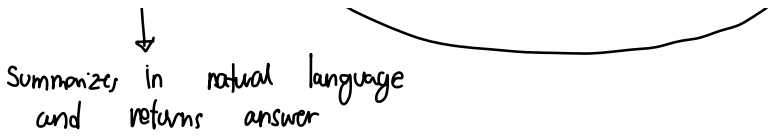


Users Query : "What is the Samsung Electronics 2025 Q4 Earnings in Ds department?"



- LLM Finds the two closest neighbors (splits) with regards to where the user's query is located and fetches them.




Summarizes in natural language
and returns answer