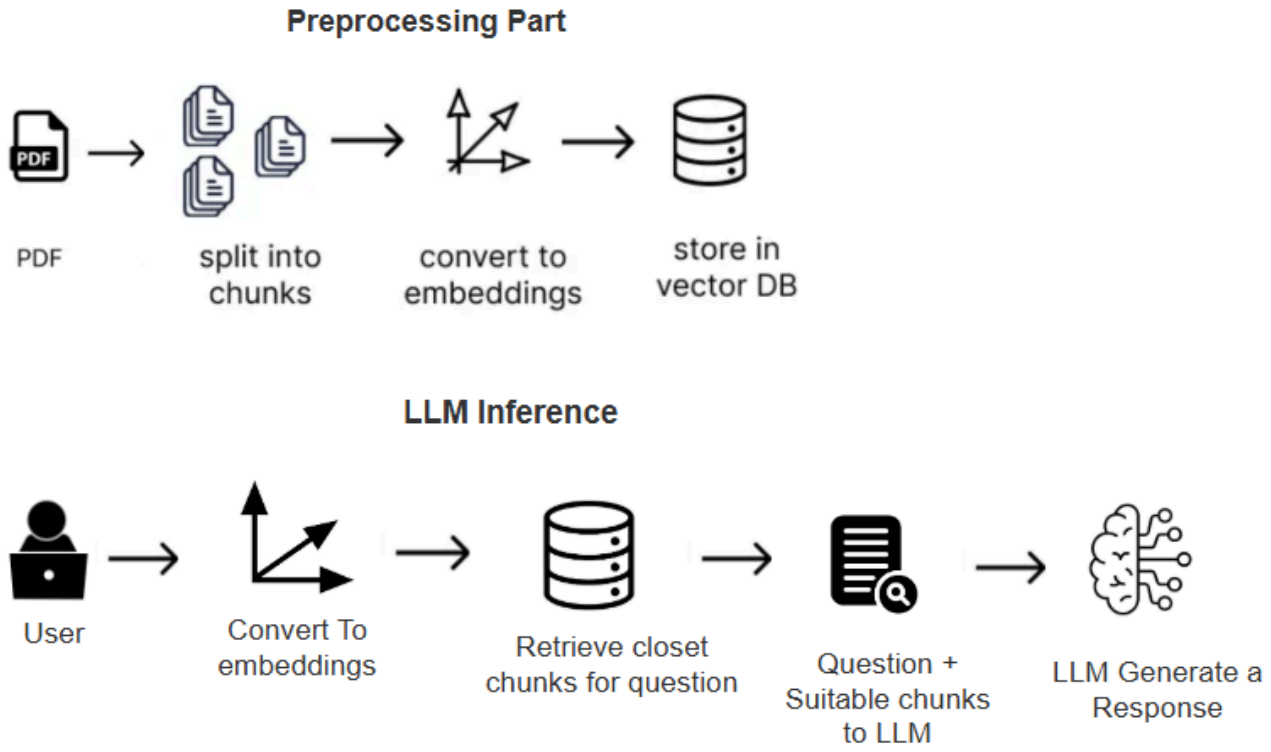
Basic RAG

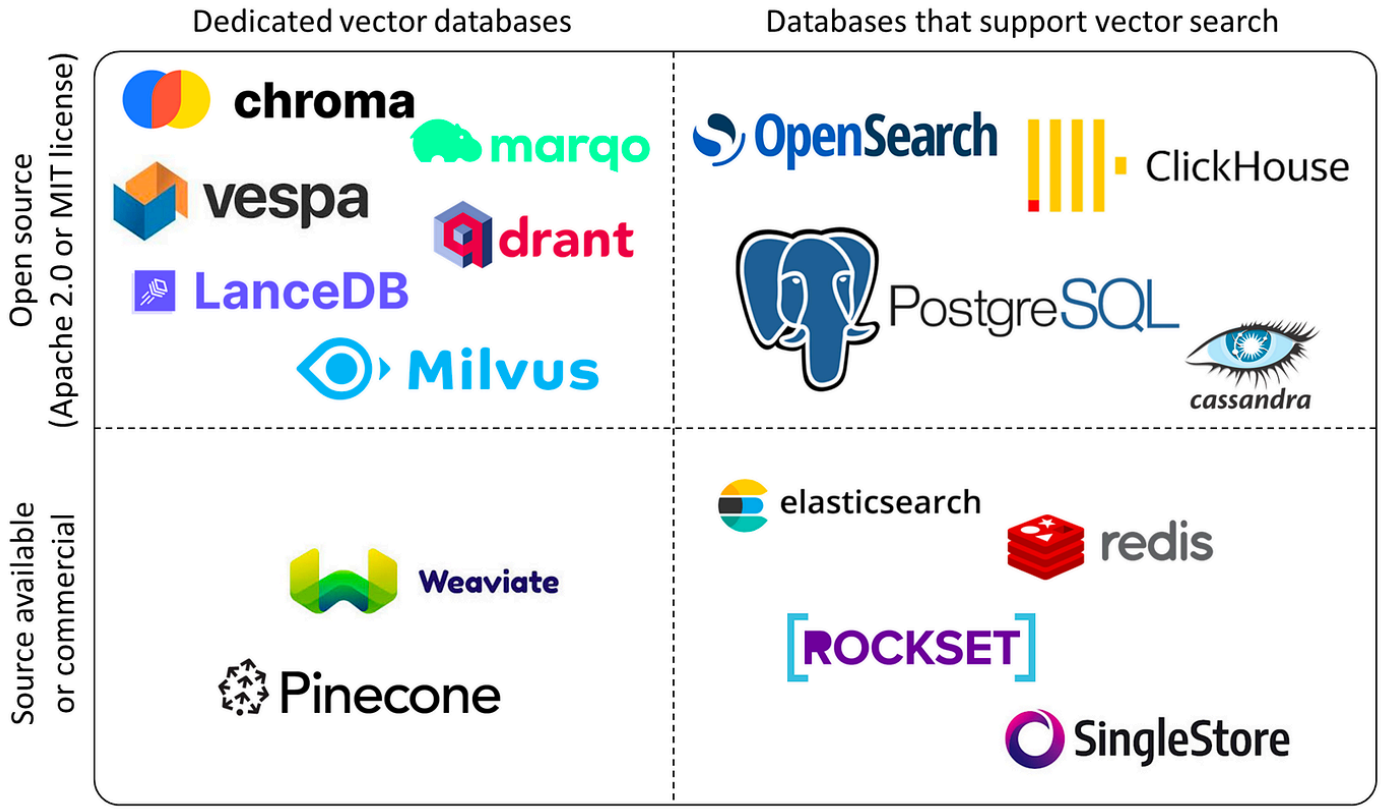


Problems in system

1. When separting to fixed token chunks, it loses the relavent infomration ex: 1 paragraph 250 word and 2nd paragraph 300 words, if we set chunk size to fixed we are unable to capture meaning

!!! Numerical data representation will be inaccurate in above approach !!

Vector Databases



- FAISS only vector search algorithm not as a vector database functionalities
- Vector - Mathematical way of representing words

Embedding

A meaningful vector representation

- Max tokens
- Dimension

embedding for 5 tokens and 100 tokens are dimensions are same - compressing lot of info

Indexing Technqiues

1. LSH - Locality-Sensitive Hashing
2. HNSW - Hierarchical Navigable Small World

3. IVF - Inverted File Index

Used to organize the embedding vectors

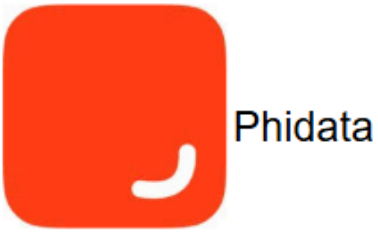
Retrival algorithms

1. ANN
2. KNN - Top K
3. Hybrid Search

LLM AI Agents frameworks

- CrewAI -- Agents, Crew, Process, Tasks

** Pydantic is used for data validation ex: name : str = "Manith" **



DSPY (declarative self improving python)

- Not LLM prompting, programtically prompting

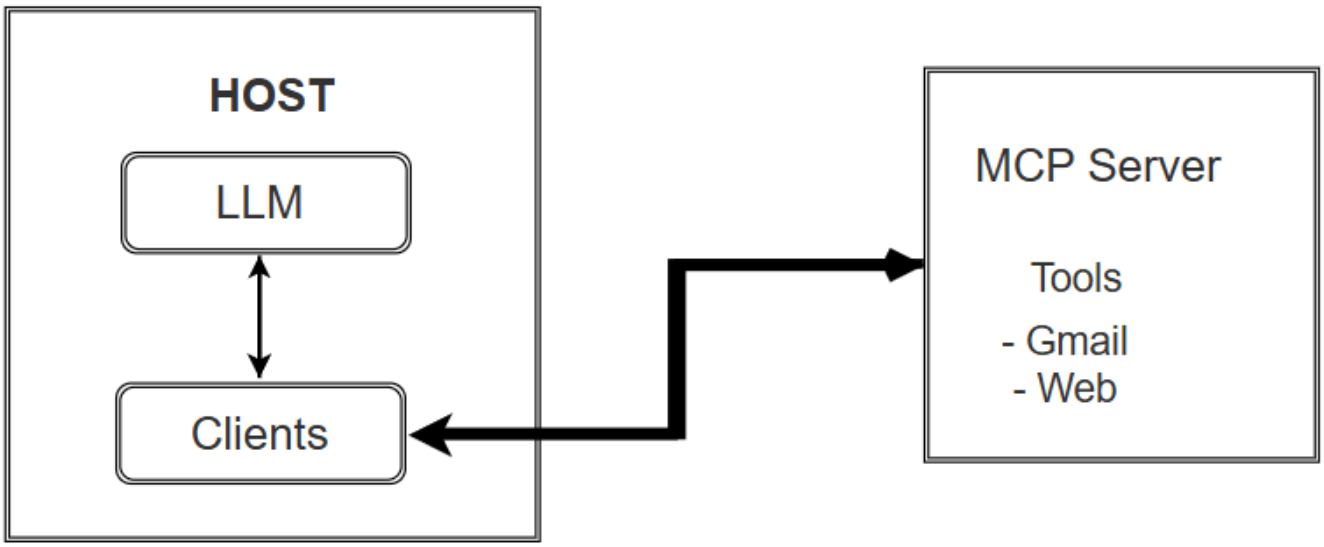
DSPy

Programming—not prompting—Language Models

MCP (Model Context Protocol)

- Anthropic (ClaudeAI) for common protocol

Components in MCP Server



Data Prepraration

- OCR (Optical Character Recognition)
- ColPali - Vision LLM : Can capture the text in the images : multimodels

Custom Embedding Model

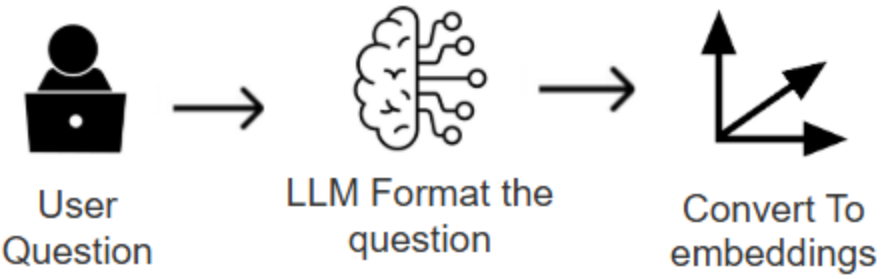
Advance RAG Methods

Problems in Simple Approach

When separting to fixed token chunks, it loses the relavent infomration ex: 1 paragraph 250 word and 2nd paragraph 300 words, if we set chunk size to fixed we are unable to capture meaning Numerical data representation will be wrong

Tip for RAG

Before searching relavent vectors need to format user Question for better Retrival from vector database



Different Way for RAG

CAG (Cache Augmented Generation)

RAG - Loads only the relavent information to the LLM

CAG - It loads whole data into model - now LLMs have large context windows

GraphRAG

High Accuracy but need to do multiple LLM calls, this makes it slow

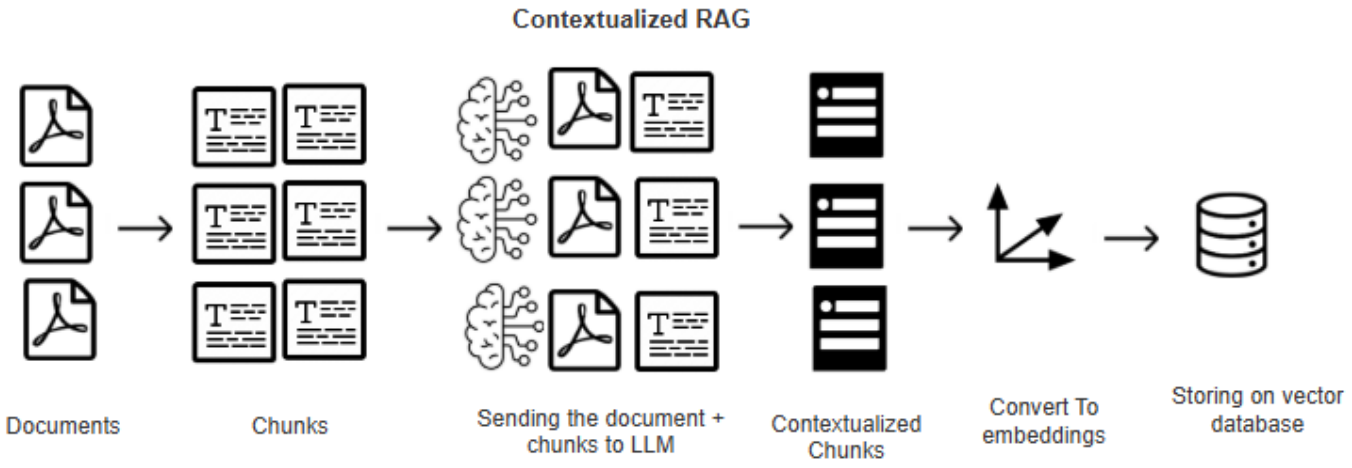
- Microsoft Graph Rag - Requires a API key Ollama is not supproted yet
- neo4j

LightRAG

- Much more effective than GraphRAG

Optimized Ways to do RAG

Contextual Retrieval



Late Chunking

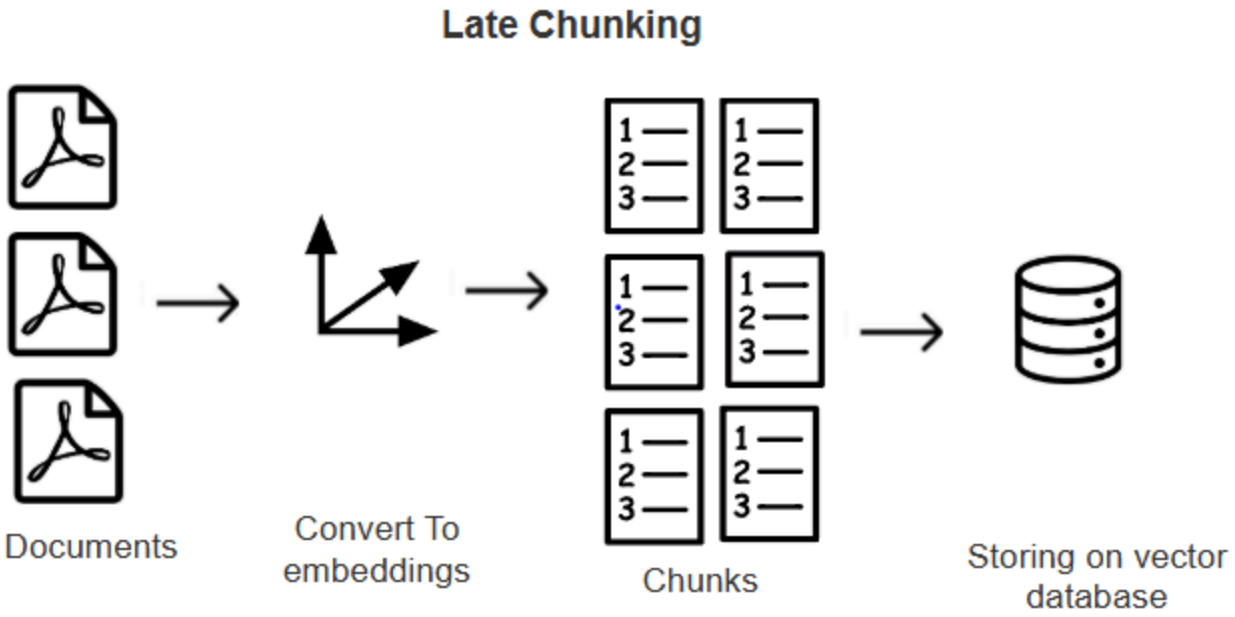


Image To Text conversion in RAG

OCR (Optical Character Recognition)

ColPali

Vision LLM : Can capture the text in the images : multimodels

KAG (Knowledge Augmented Graph)

It built on OpenSPG engine solve RAG and GraphRAG limitation

LLM AI Agents frameworks

- CrewAI :: Agents, Crew, Process, Tasks
- PydanticAI

** Pydantic is used for data validation ex: name : str = "Manith"

- Phidata
- Autogen

- LlamaIndex
- LangGraph

DSPY (declarative self improving python)

- Not LLM prompting, programtically prompting

RAPTOR (Retrival Abstractive Processing Tree Organized Retrieval)

RAPTOR is RAG framework RAG - Relies on chunks RAPTOR - Bottom up approach -> Clustering and summarizing chunks

ColBERT (Contextualized Late Interaction over BERT)

- Efficent than traditional RAG

** Research papers are available for above every method with comparision and evaluations

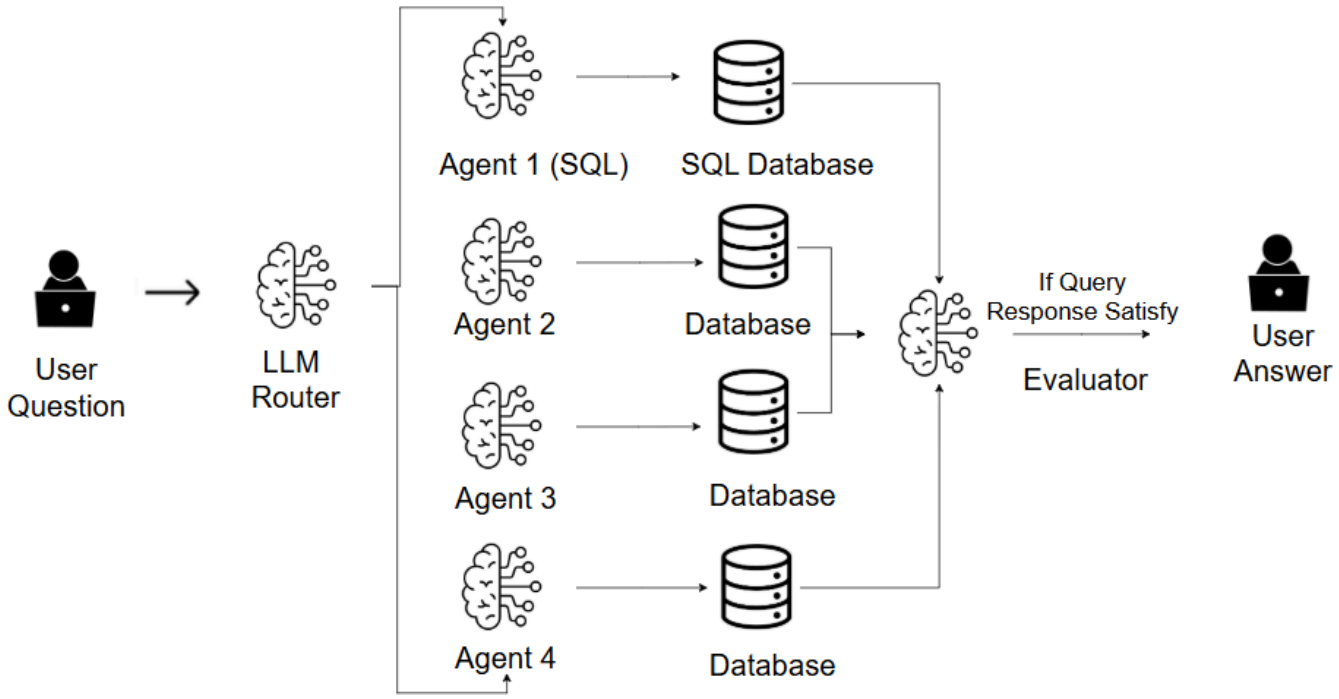
Evaluating RAG systems

RAGAS (Retrieval Augmented Generation Assessment)

Metrics

- Faithfulness
- Context Recall
- Answer relavency

LLM Router



** Subject to changes in future **