Getting Started with LangChain

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21-02-2024

Quick 'Interactivity Notes'

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  - **Optional Exercise** During Q&A (for those that don't have questions and want to try something out)

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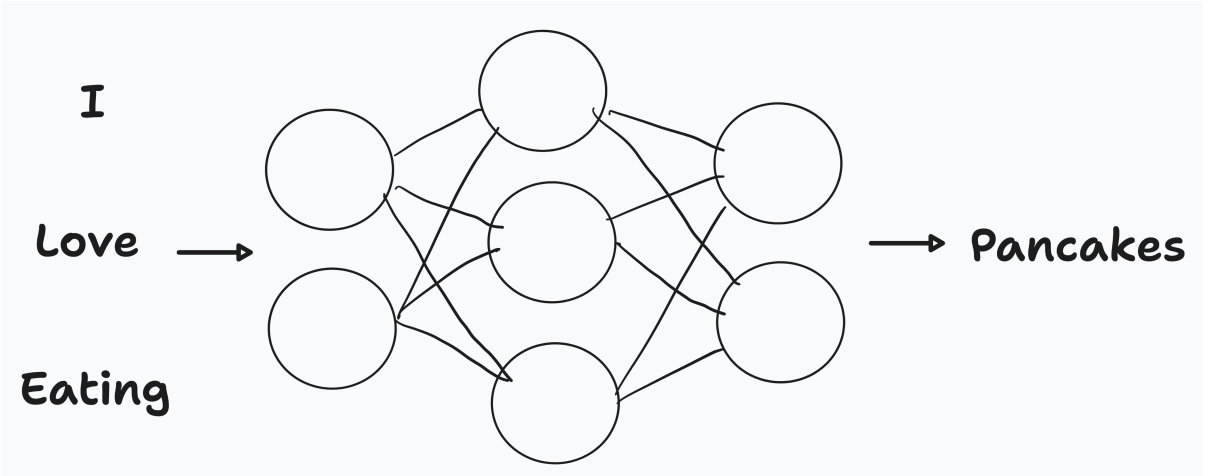
  - **Presentation Block**
  - **Notebook Demo**
  - **Quick Q&A + Summary**
  - **Optional Exercise** During Q&A (for those that don't have questions and want to try something out)
- Repeat

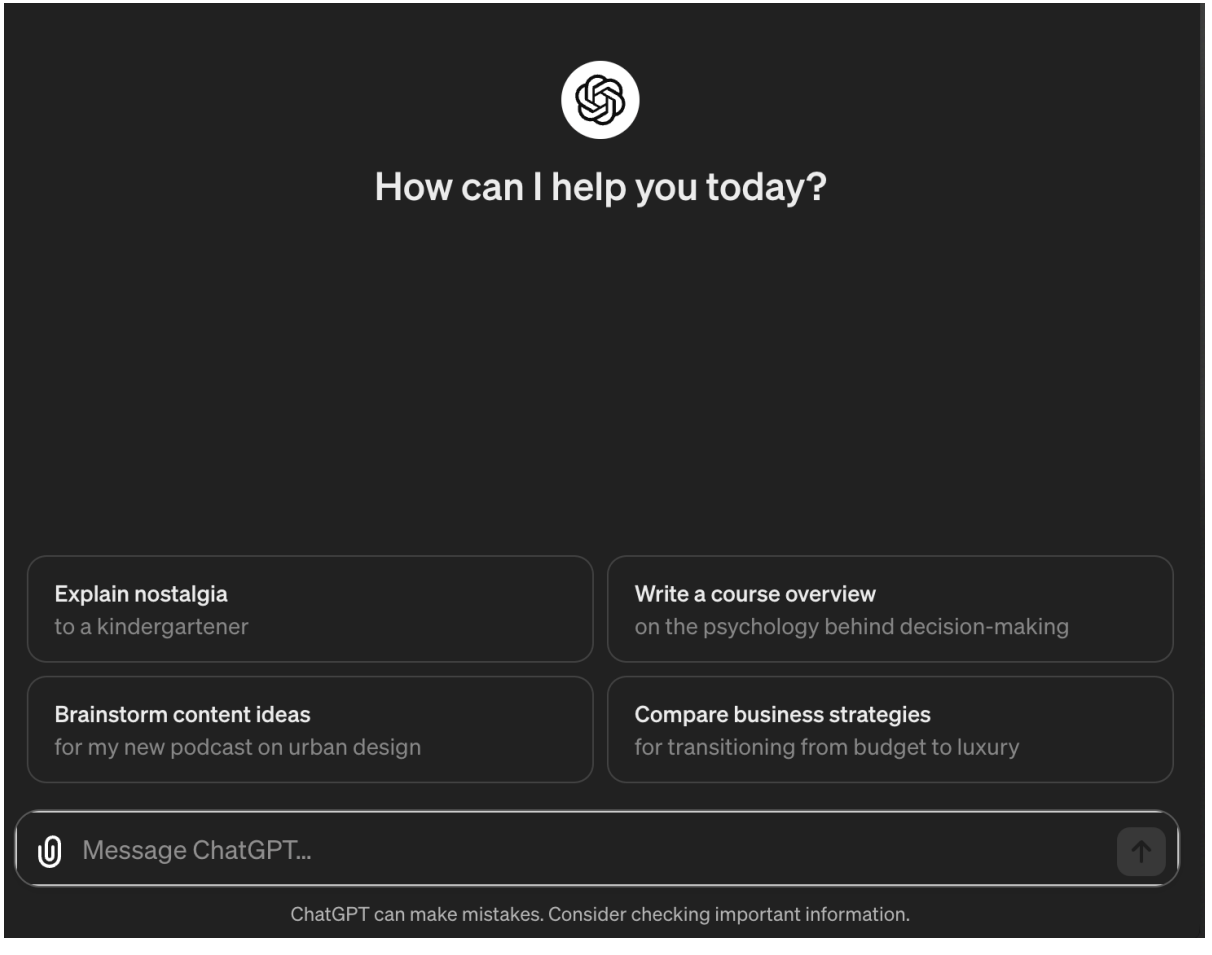
Large Language Models

Large Language Models Predict the Next Word



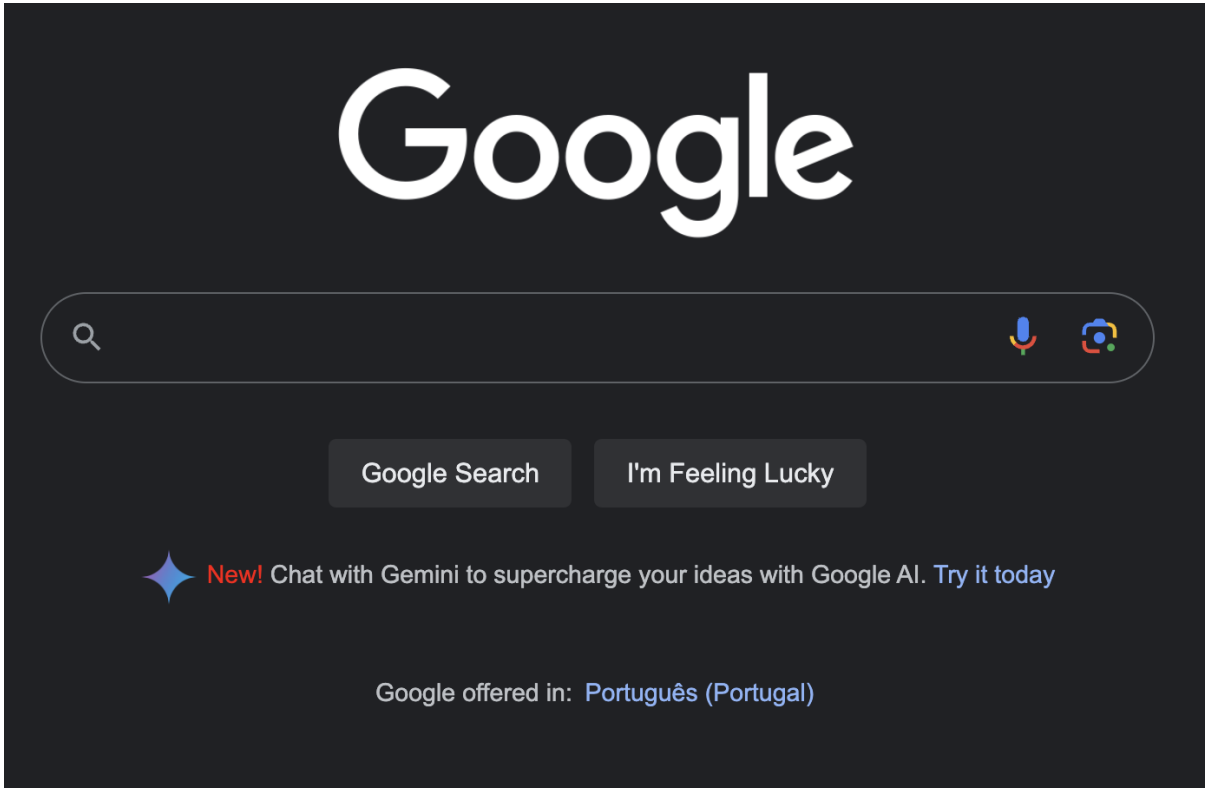
Applications of Large Language Models

- Conversational ChatBots



Applications of Large Language Models

- Search Engines



Applications of Large Language Models

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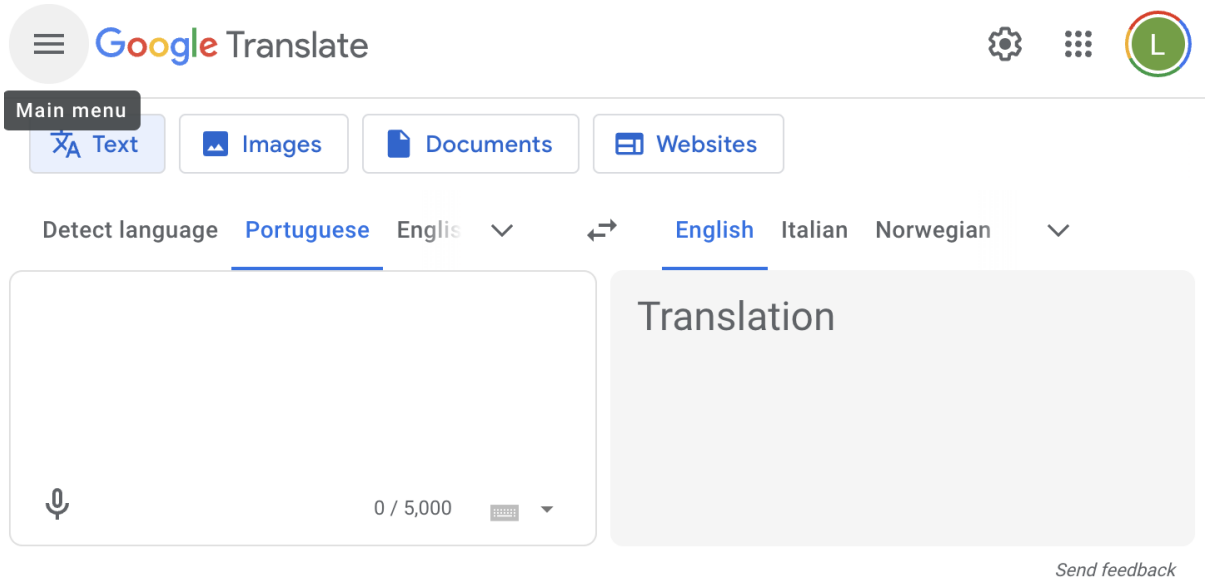

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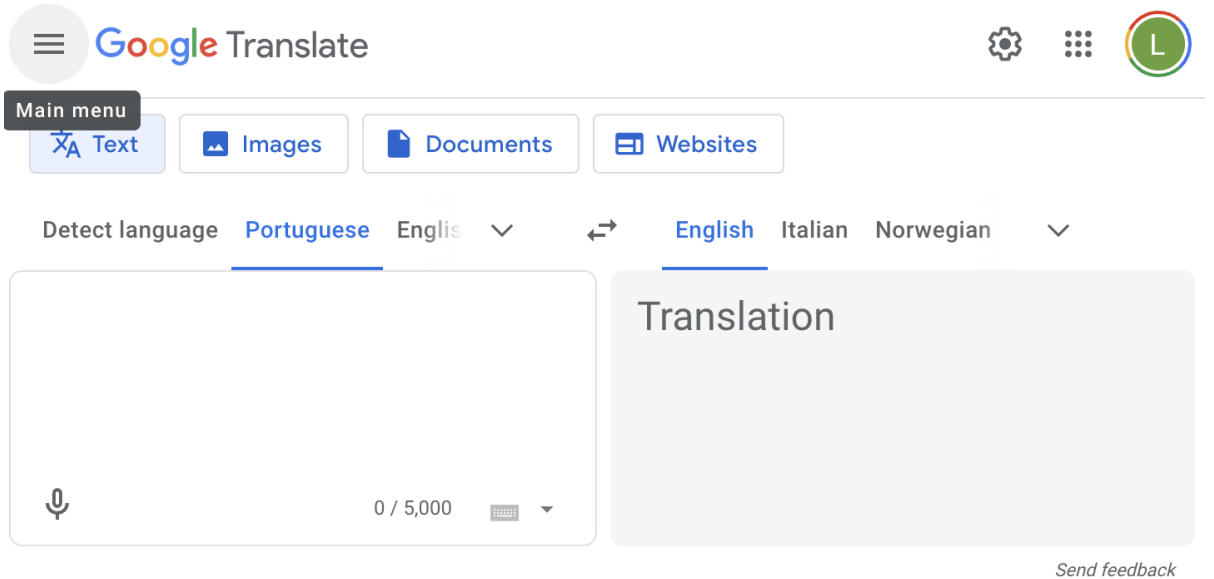

- And so much more from Q&A over PDFs to personalized tutoring.

What is Langchain?

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- **LangChain is a framework that facilitates creation of LLM-based applications**
- **Main features**:
  - components
  - off-the-shelf-chains
- Meaning: LangChain gives you building blocks for building interesting and powerful LLM applications

LangChain Components

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Models

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Models

- Abstractions over the LLM APIs like the ChatGPT API

LangChain Components

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```
from langchain_openai import ChatOpenAI

chat_model = ChatOpenAI(model="gpt-3.5-turbo-0125")

output = chat_model.invoke("I am teaching a live-training\
  about LLMs!")

print(output.content)
```

LangChain Components

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Prompt Templates

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- Abstractions over standard prompts to LLMs

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Prompt Templates

- Abstractions over standard prompts to LLMs

```
from langchain_core.prompts import ChatPromptTemplate

prompt = ChatPromptTemplate.from_template(
  """Show me 5 examples of this concept: {concept}"""
  )

prompt.format(concept="animal")

# Output
# 'Human: Show me 5 examples of this concept: animal'
```

LangChain Components

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Output Parsers

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- Translates raw output from LLM to a workable format

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```
from langchain_core.output_parsers import StrOutputParser
output_parser = StrOutputParser()
```

Chains in LangChain

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Chain = Model + Prompt + Output Parser

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```
llm = ChatOpenAI(model="gpt-3.5-turbo-0125")
prompt = ChatPromptTemplate.from_template("""
Write 5 concepts that are fundamental to learn about {topic}.
                                          """)
chain = prompt | llm | output_parser
chain.invoke({"topic": "Artificial Neural Networks"})
```

LCEL - LangChain Expression Language

Composing Chains with LCEL

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LCEL - LangChain Expression Language

Composing Chains with LCEL

- LCEL is a powerful, declarative language designed to streamline the composition of complex chains in the LangChain framework.
- Pipe syntax


```
chain = prompt | llm | output_parser
```

- Allows you to build complex chain pipelines with a simple standard interface

LCEL - Runnables

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- The input type and output type vary by component:

Component	Input Type	Output Type
Prompt	Dictionary	PromptValue
ChatModel	Single string, list of chat messages or a PromptValue	ChatMessage
LLM	Single string, list of chat messages or a PromptValue	String
OutputParser	The output of an LLM or ChatModel	Depends on the parser
Retriever	Single string	List of Documents
Tool	Single string or dictionary, depending on the tool	Depends on the tool

Notebook Demo - Intro to LangChain

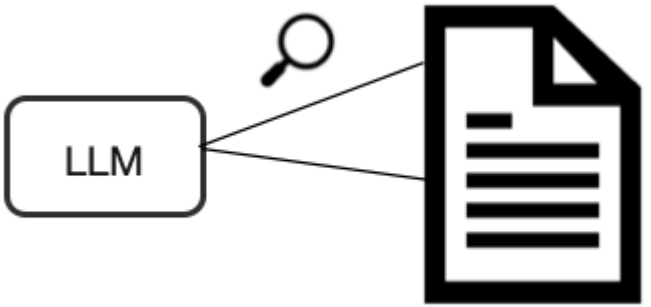
Q&A & Summary

- **LLMs can predict the next word in a sequence**. ("I Like eating...? ;P ")
- **LangChain framework:** eases the creation of LLM-based applications, featuring chains and the following basic components:
  - **Models**: Abstractions over LLM APIs (e.g ChatGPT).
  - **Prompt Templates**: Abstractions over prompts (makes them dynamic).
  - **Output Parsers**: Converts LLM outputs into usable formats (e.g string, json).
- **Chains** are the building blocks in LangChain, composed of Models, Prompt Templates, and Output Parsers.
- **LCEL** is a declarative language that users the Unix pipe symbol to build complex chain pipelines with a simple standard interface.
- **Optional Exercise During Q&A**

  ```
  Create a simple chain for summarization of content.
  ```

Break 5 minutes

LangChain for Chat Over Documents



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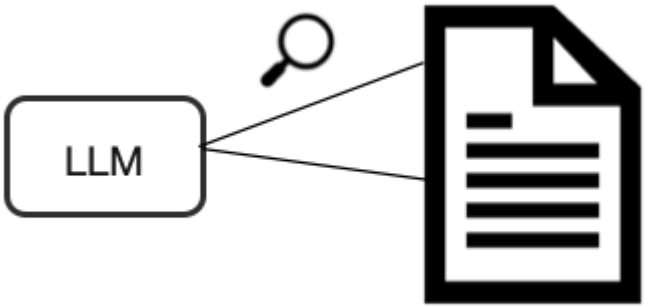

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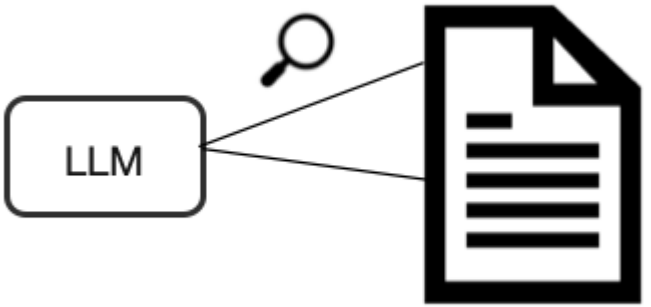

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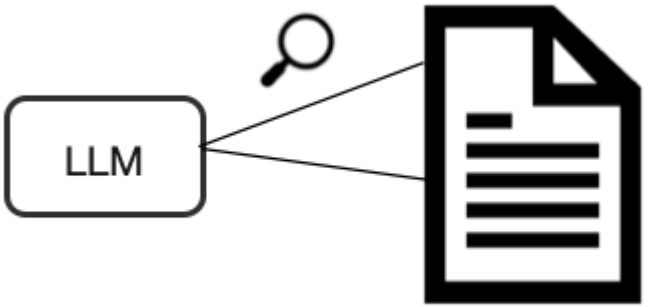

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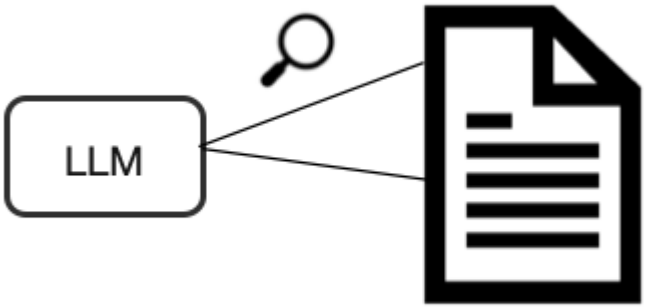

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- How do we get around the context length limitations of LLMs?
- Quick Answer is **Embeddings**!

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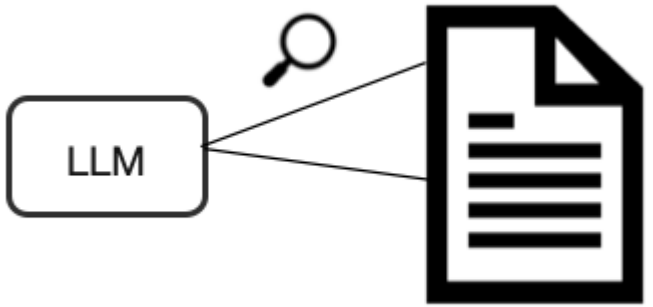
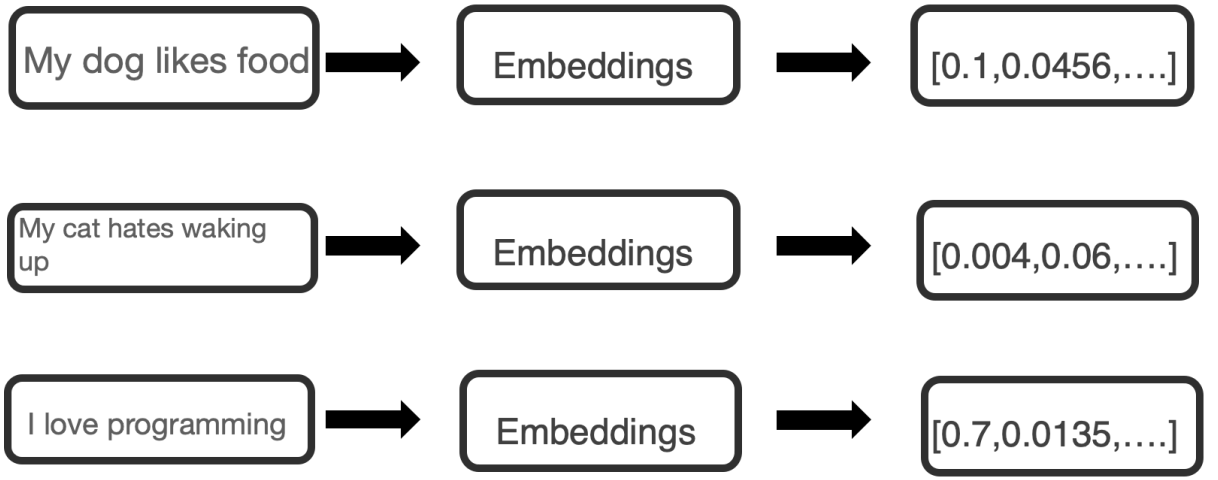


- Embeddings are vectorized representations of text

LangChain for Chat Over Documents



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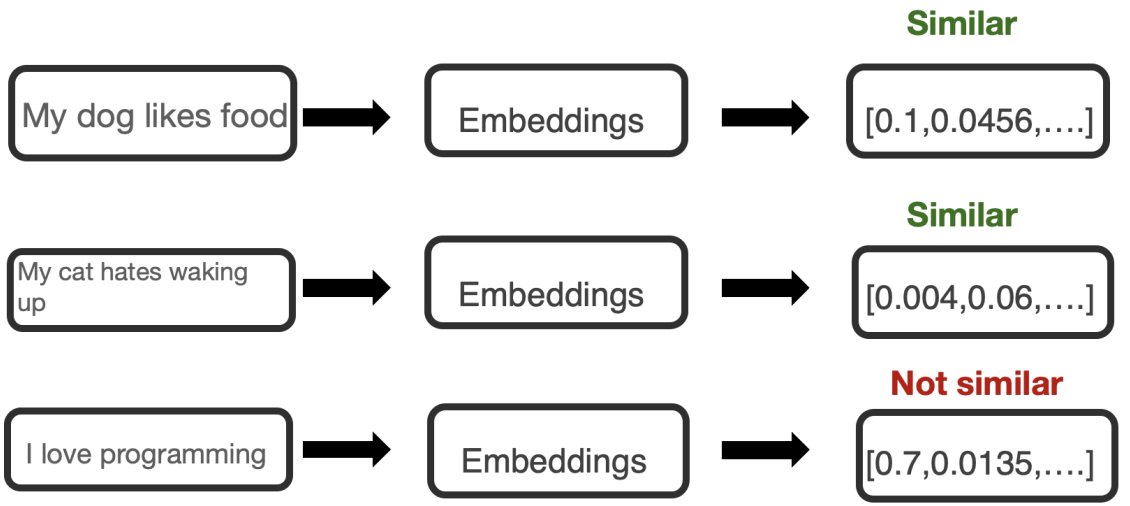
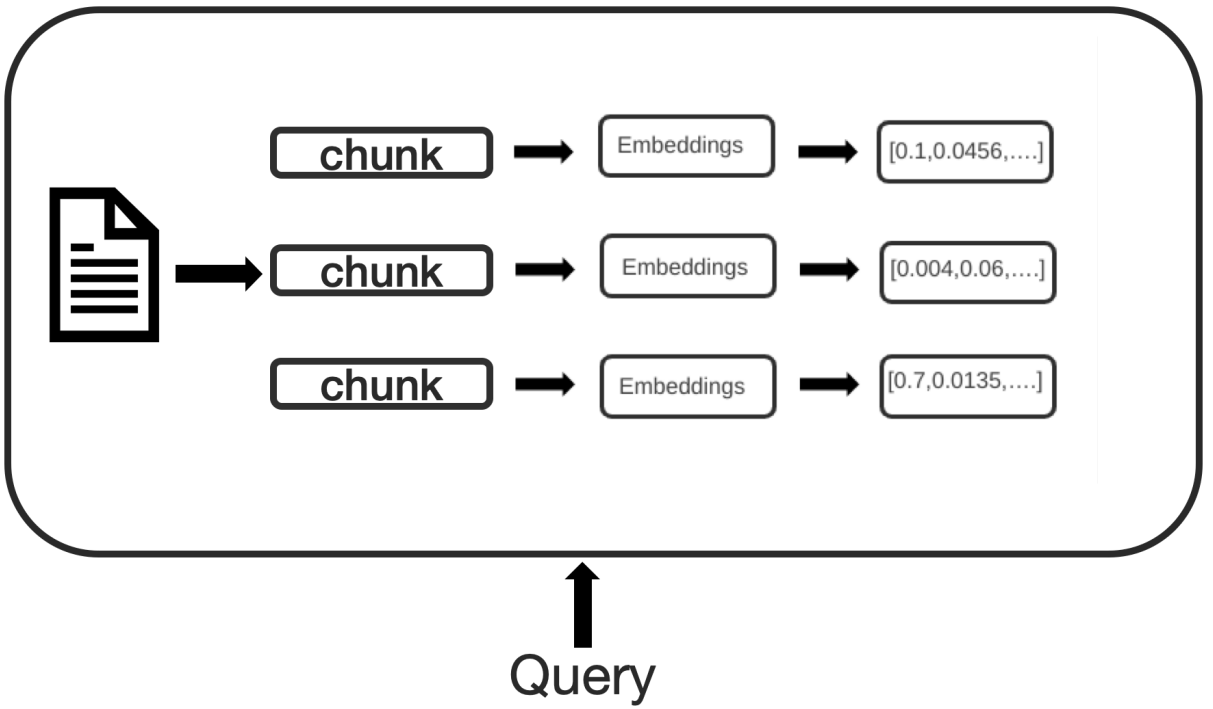


- Embeddings capture content and meaning

LangChain for Chat Over Documents



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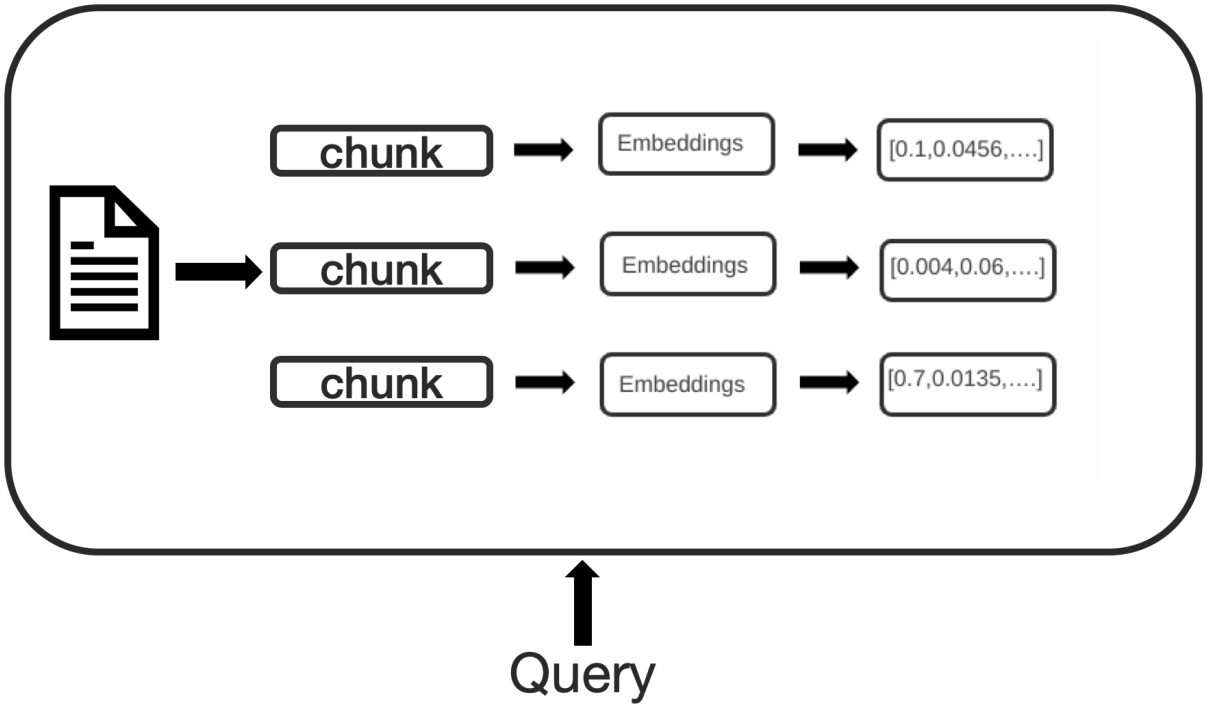

- Embeddings capture content and meaning
- Vector DBs
- How to build RAG systems with LangChain?

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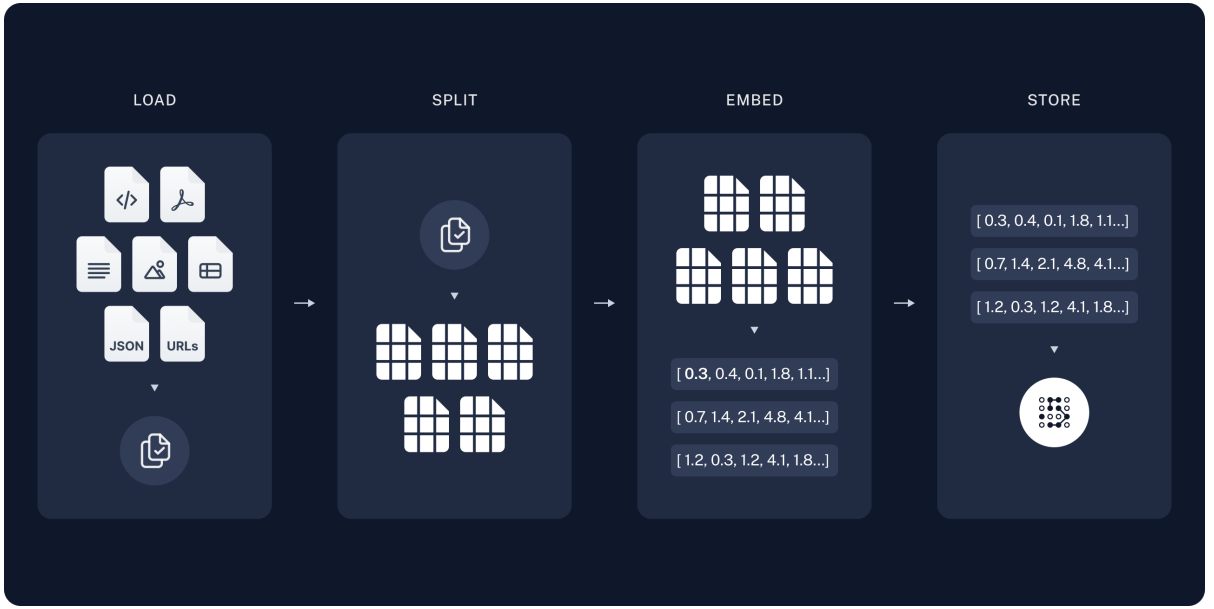

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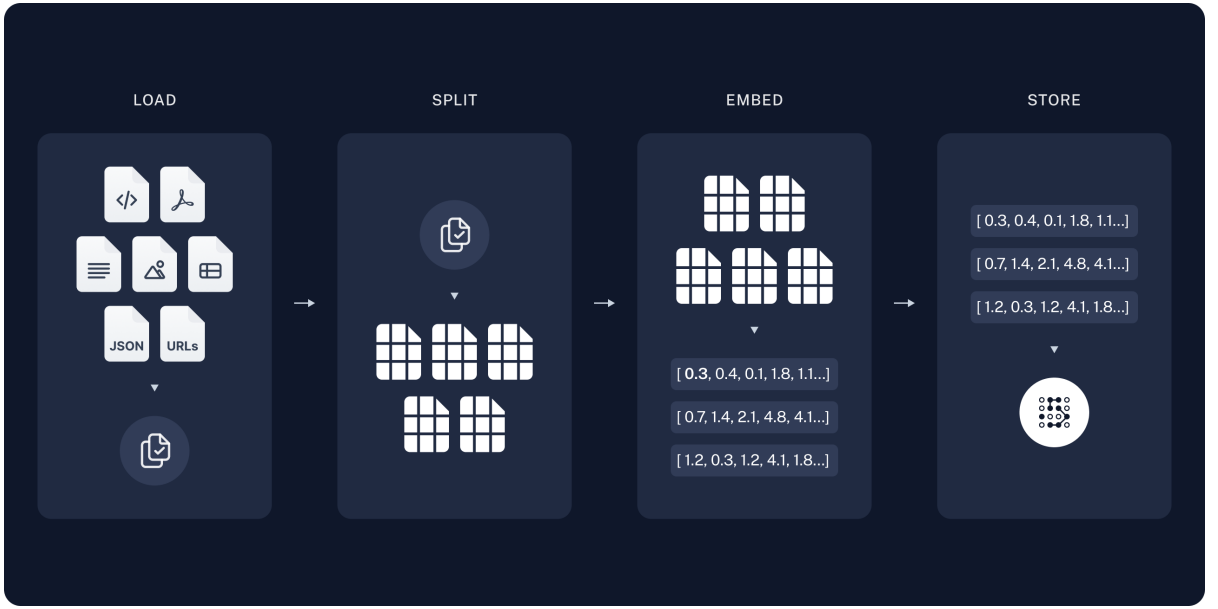
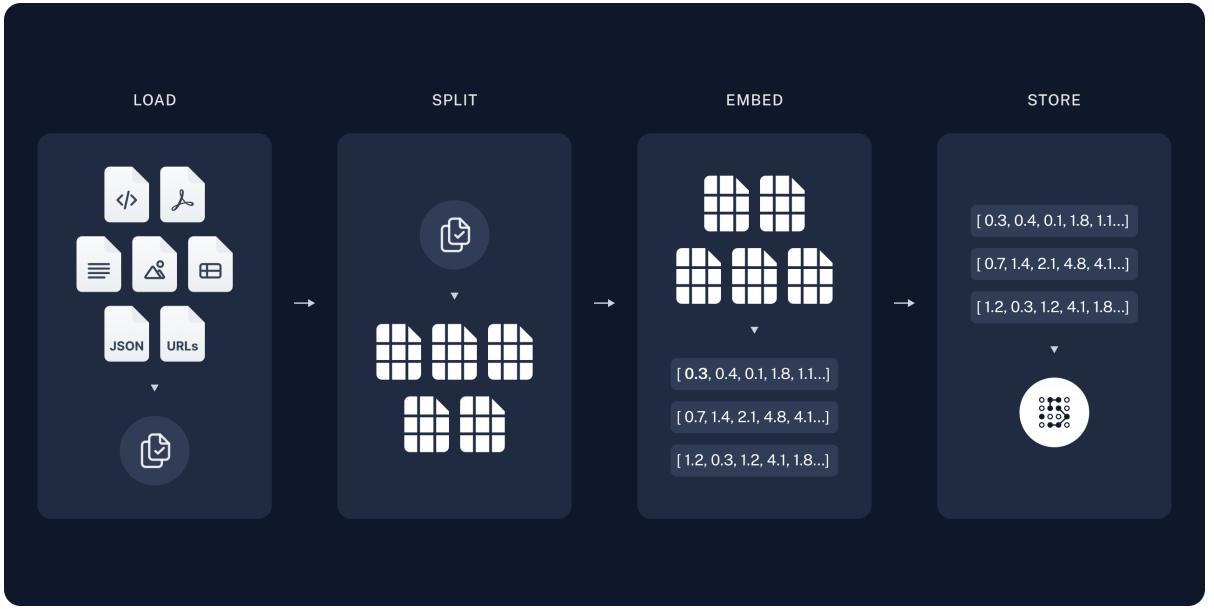


- Load

LangChain for Chat Over Documents



- Load
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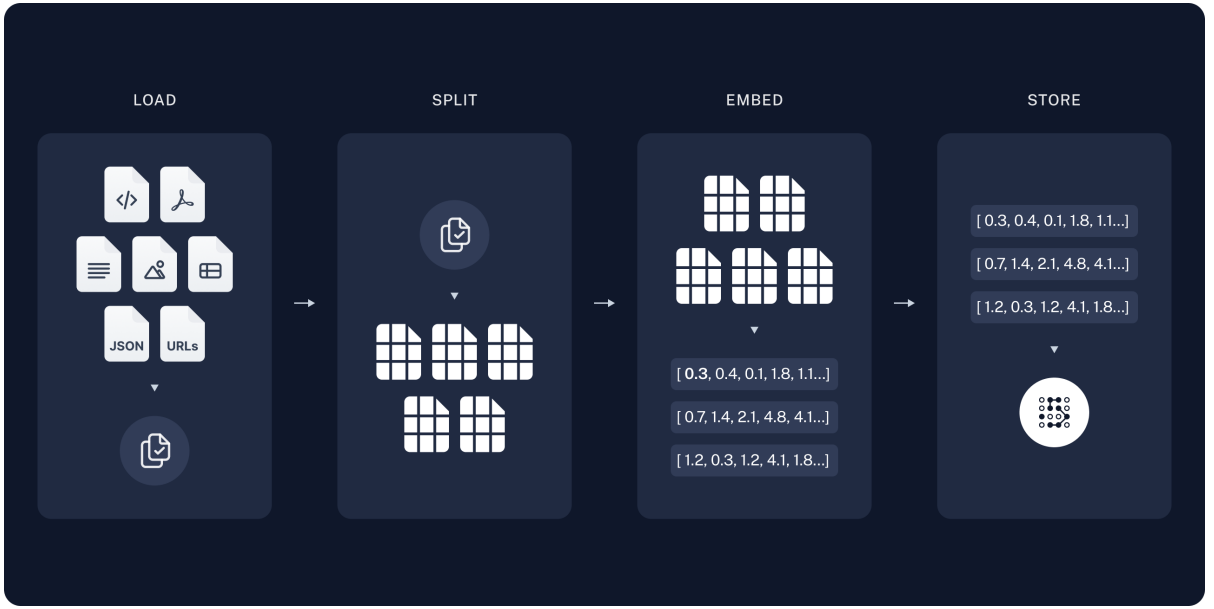

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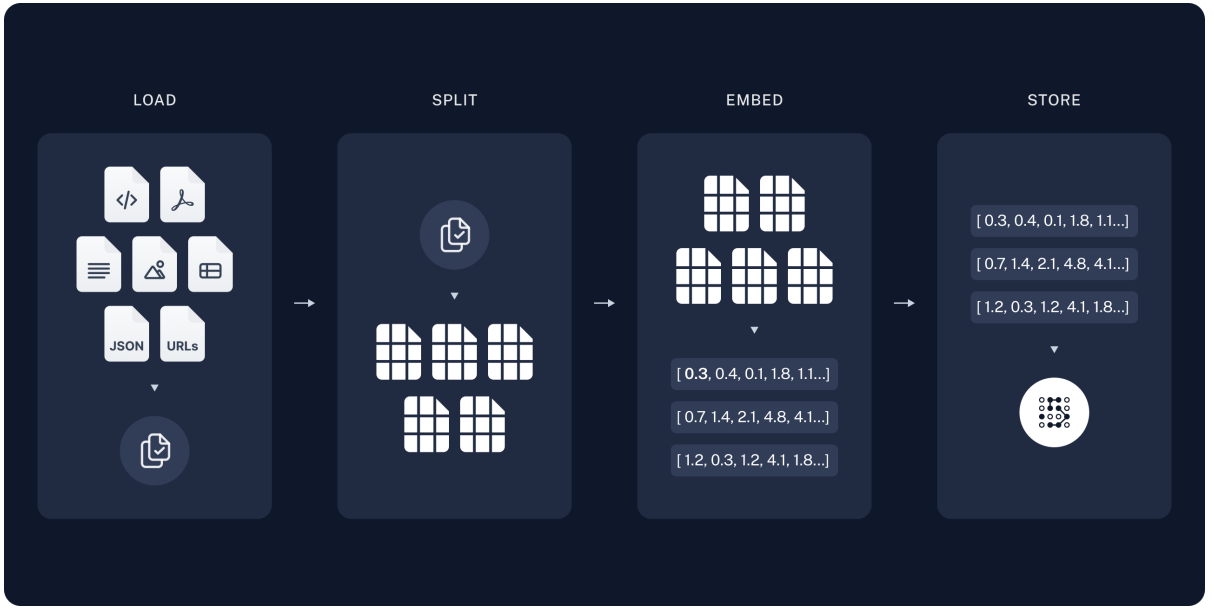

- Load
- Split
- Embed
- Store

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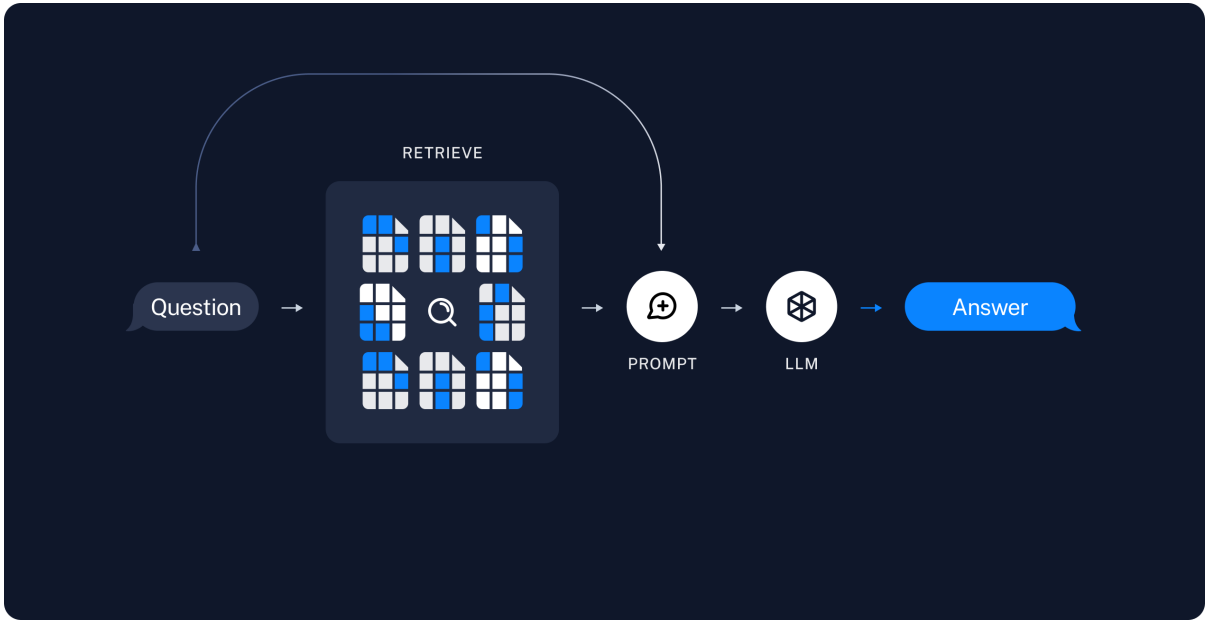

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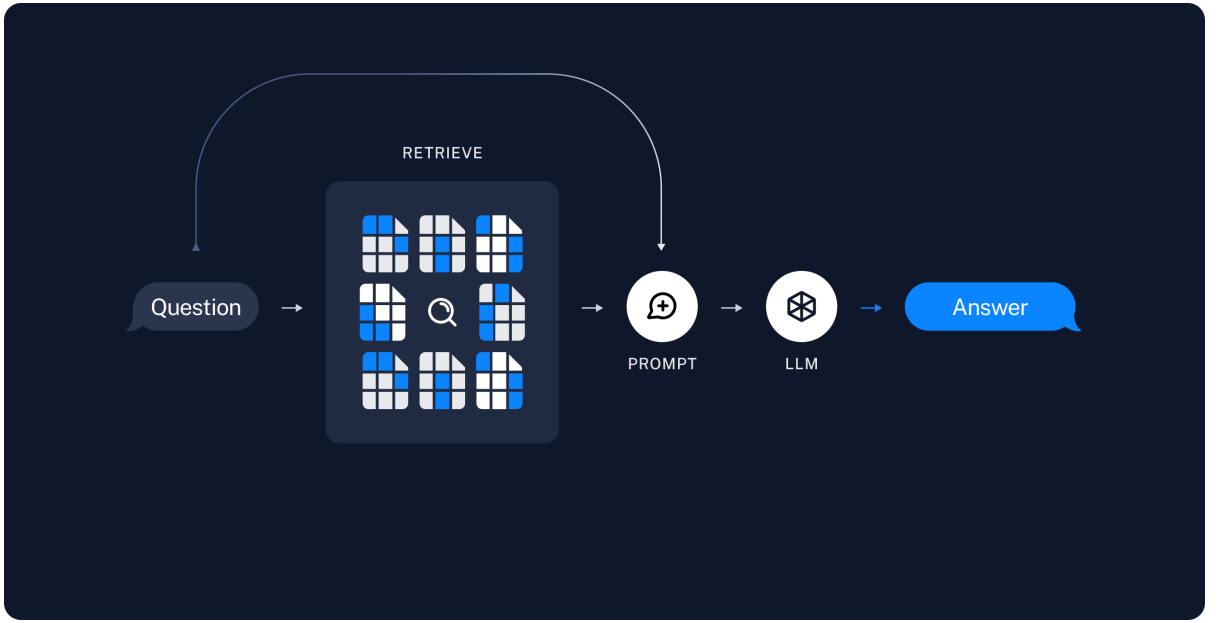

- Retrieval Piepeline

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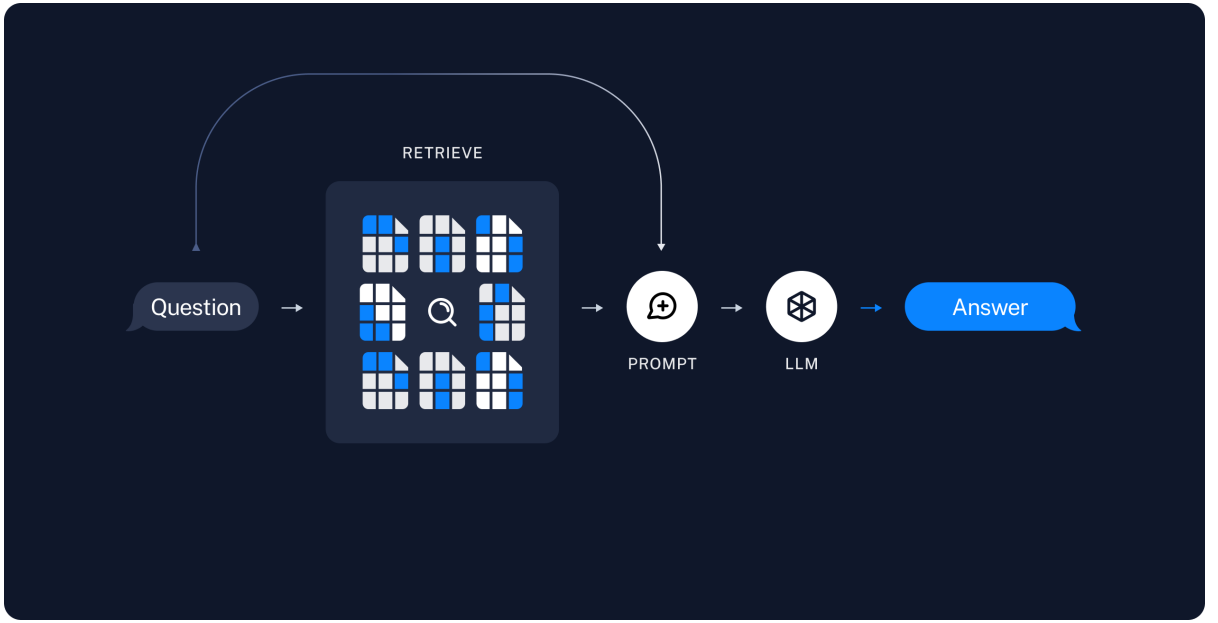
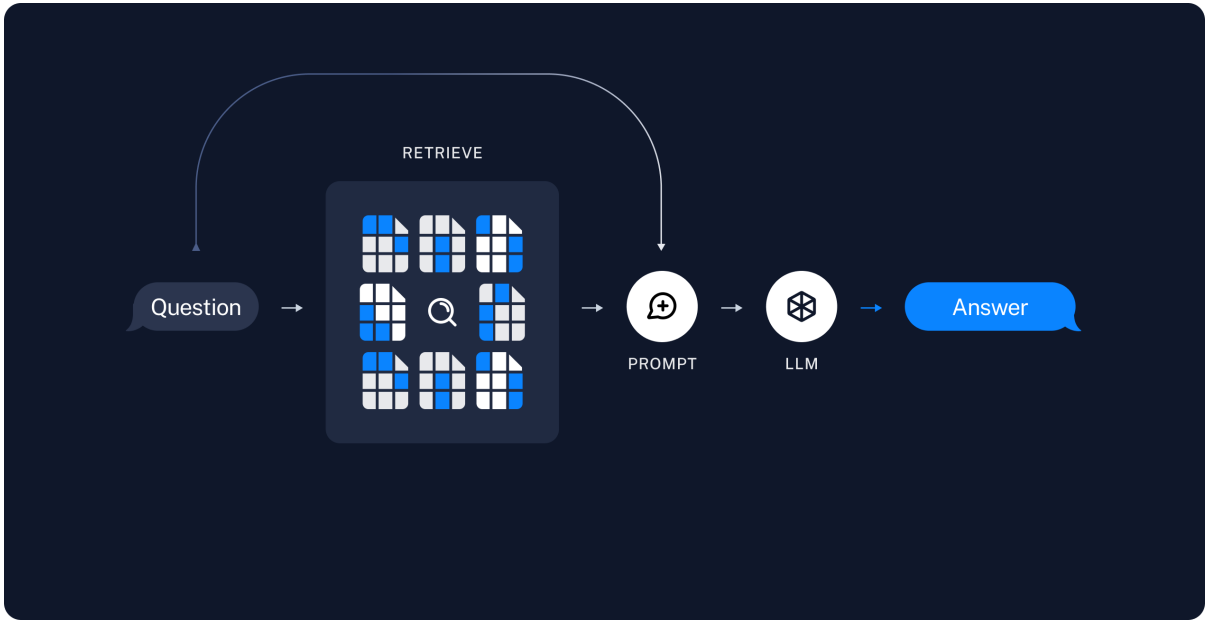


- Retrieval Piepeline
  - Input Question

LangChain for Chat Over Documents



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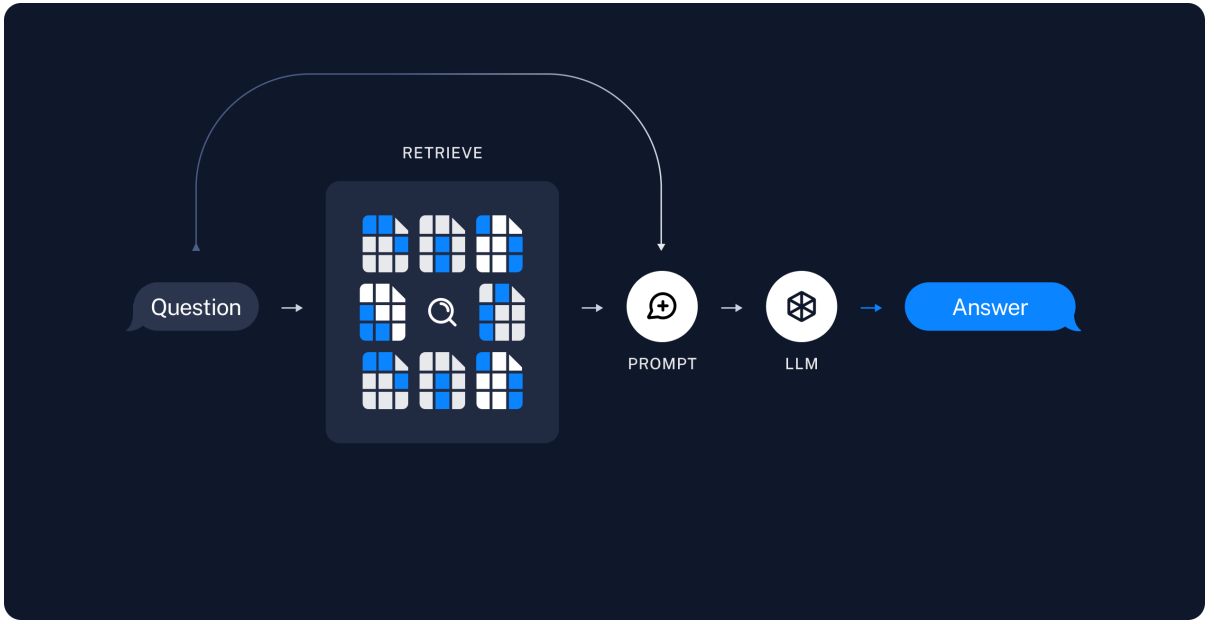

- Retrieval Piepeline
  - Input Question
  - Retrieve Relevant Documents
  - LLM uses the prompt question + retrieved data to produce a final answer

LangChain for Chat Over Documents

- Sample Code

```
from langchain import hub
from langchain_community.vectorstores import Chroma
from langchain_openai import ChatOpenAI, OpenAIEmbeddings
from langchain.document_loaders import PyPDFLoader
from langchain.chains import RetrievalQA

pdf_path = "path-to-pdf.pdf"
loader = PyPDFLoader(pdf_path) # LOAD
pdf_docs = loader.load_and_split() # SPLIT
embeddings = OpenAIEmbeddings() # EMBED
vectordb = Chroma.from_documents(pdf_docs, embedding=embeddings) # STORE
retriever = vectordb.as_retriever()
llm = ChatOpenAI(model="gpt-3.5-turbo-0125")
pdf_qa = RetrievalQA.from_llm(llm=llm, retriever=retriever) # RETRIEVE
pdf_qa.invoke("What is this paper about?") # ANSWER
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Notebook Demo - Q&A with LangChain

Q&A & Summary

- **RAG** = **R**etrieval **A**ugmented **G**eneration
- **RAG** is about connecting LLMs to documents like PDFs, Text files, HTML, etc.
- **Embeddings** are vectorized representations of text that capture content and meaning.
- **Vector DBs** are used to store and retrieve embeddings.
- **RAG** systems with LangChain are built using a pipeline that includes loading, splitting, embedding, and storing documents.
- **Optional Exercise During Q&A**

```
Create a simple RAG system with LangChain that can answer questions about pdfs or csvs.
```

Break 5 minutes

Building Agents with LangChain

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The Agent Loop

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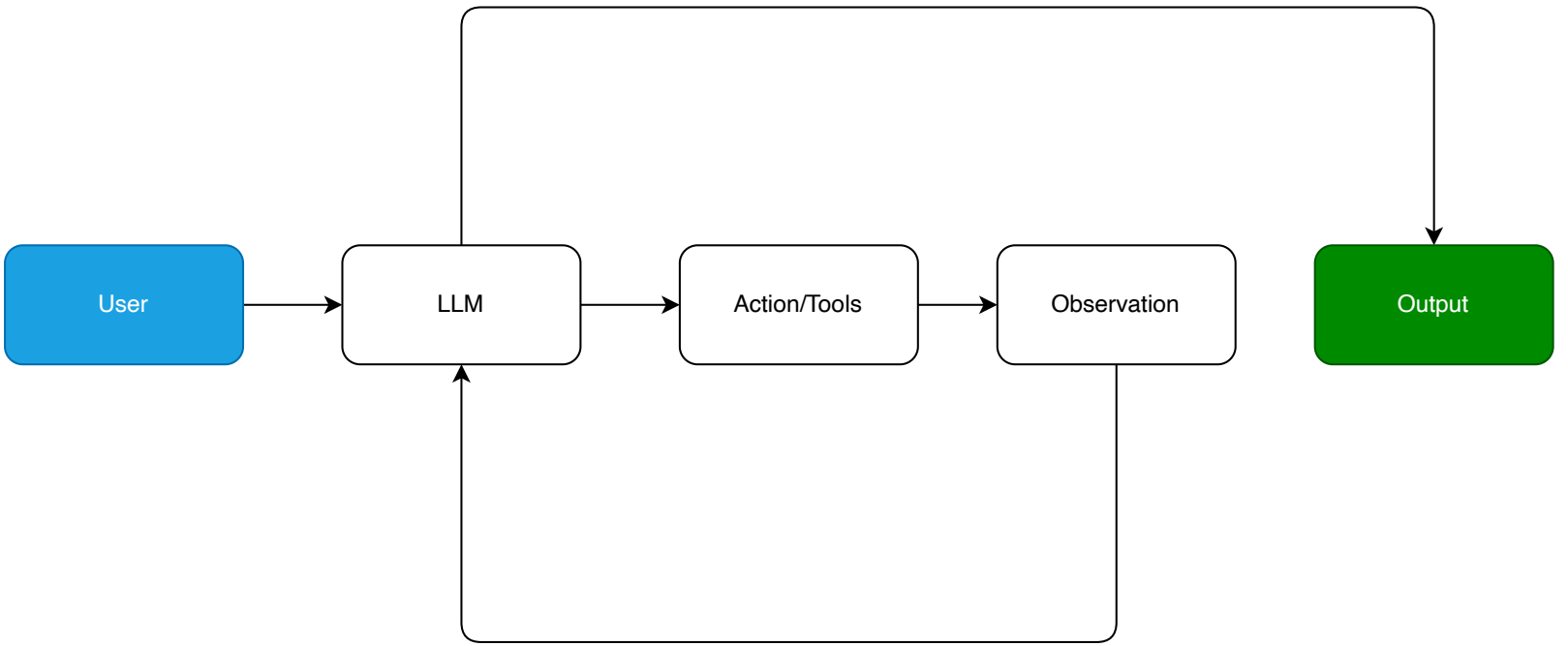
The Agent Loop



Key LangChain Components for Agents

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- **Intermediate Steps**: Previous actions and outputs for the current agent run.

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- LangChain provides many abstractions for ease of use
- **AgentAction**: Represents the action an agent should take.
- **AgentFinish**: Represents the final result to return to the user.
- **Intermediate Steps**: Previous actions and outputs for the current agent run.
- **Agent**: Chain responsible for deciding the next step, powered by a language model.

Agent Inputs and Outputs

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Agent Outputs

- Next actions or final response (AgentActions or AgentFinish).
- Handled by the output parser.

AgentExecutor

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- In pseudocode, this looks roughly like:

```
next_action = agent.get_action(...)
while next_action != AgentFinish:
    observation = run(next_action)
    next_action = agent.get_action(..., next_action, observation)
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- Runtime handles things like:
  - Handling cases where the agent selects a non-existent tool
  - Handling cases where the tool errors
  - Handling cases where the agent produces output that cannot be parsed into a tool invocation
  - Logging and observability at all levels (agent decisions, tool calls) to stdout and/or to LangSmith.

Tools in LangChain

Tools in LangChain

- Functions that an agent can call.

Tools in LangChain

- Functions that an agent can call.
- Consists of:

Tools in LangChain

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- Important for building a working agent.

Langchain Toolkits

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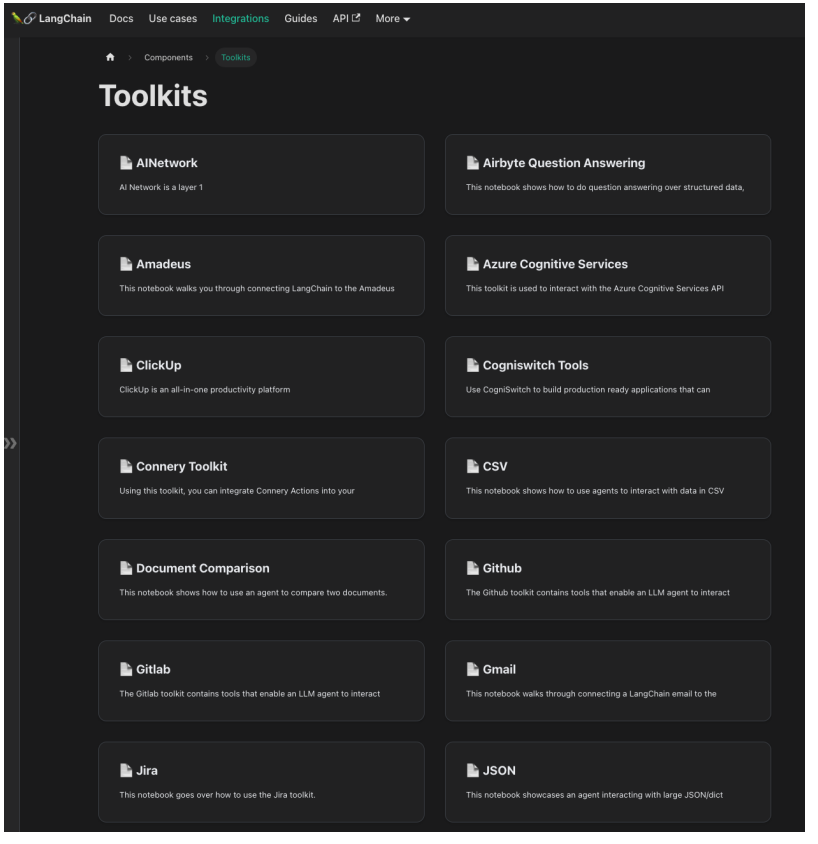
- LangChain provides a wide set of toolkits.
- Groups of 3-5 tools for specific objectives.
- Example: GitHub toolkit for interacting with GitHub.



Let's Build Agents!

Notebook Demo - Building LLM Agents with LangChain; Github Agent; Research Assistant

Q&A & Summary

- **LangChain** provides abstractions for building agents, including AgentAction, AgentFinish, and Agent.
- **AgentExecutor** is the runtime for an agent, handling agent decisions, tool calls, and observability.
- **Tools** in LangChain are functions that an agent can call, consisting of an input schema and a function to run.
- **LangChain** provides a wide set of toolkits, groups of 3-5 tools for specific objectives, an example is GitHub toolkit for interacting with GitHub.
- **Optional Exercise During Q&A**

```
Create a simple agent that can create a schedule for you given a table of tasks and deac
table format = task | date
```

Break 5 minutes

LangServe Super Quick Intro

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Final Q&A & Summary

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References

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- GPT-Engineer
- BabyAGI
- Karpathy on Agents
- ReACT Paper