# Getting Started with LangChain

Lucas Soares

**21-02-2024**

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  - **Presentation Block**
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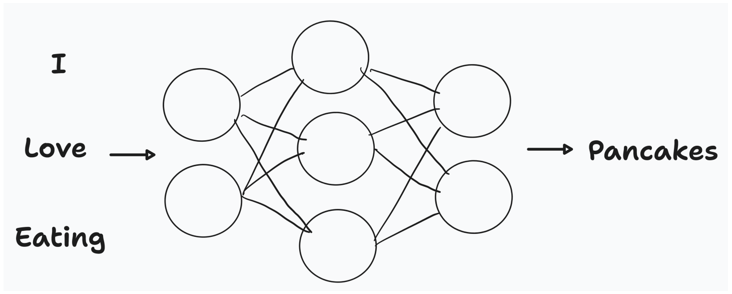
- Repeat

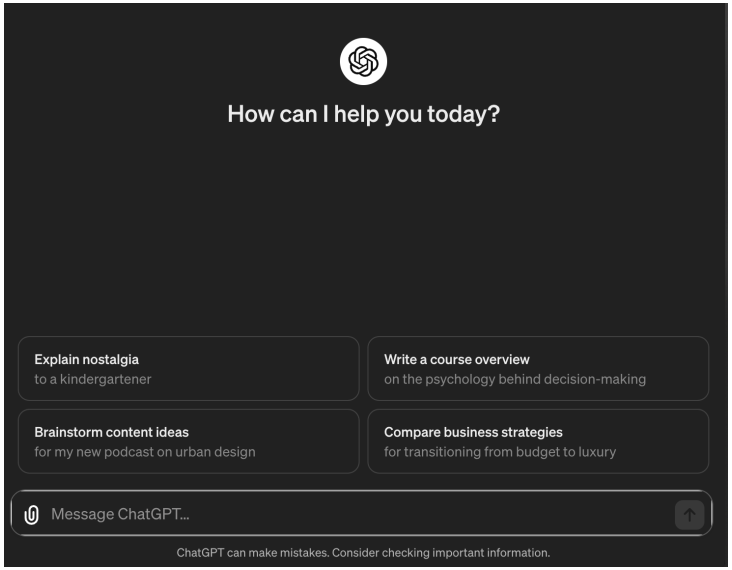
## Large Language Models

Large Language Models Predict the Next Word



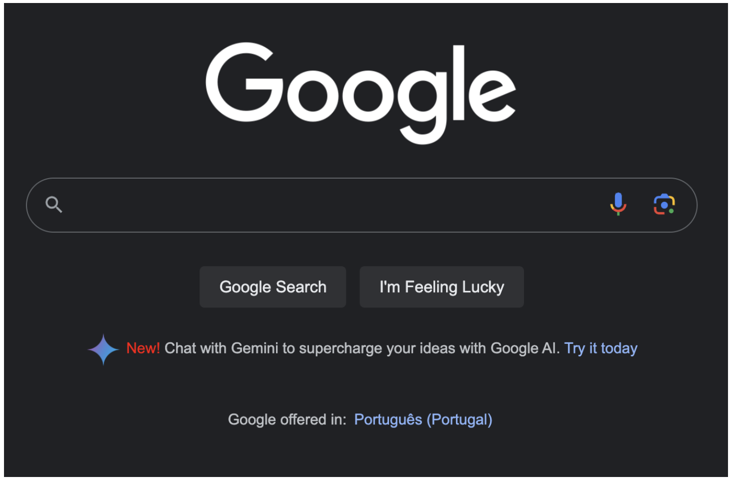
## Applications of Large Language Models

- Conversational ChatBots


How can I help you today?
Explain nostalgia
to a kindergartener
Write a course overview
on the psychology behind decision-making
Brainstorm content ideas
for my new podcast on urban design
Compare business strategies
for transitioning from budget to luxury
Message ChatGPT...
ChatGPT can make mistakes. Consider checking important information.

## Applications of Large Language Models

- Search Engines

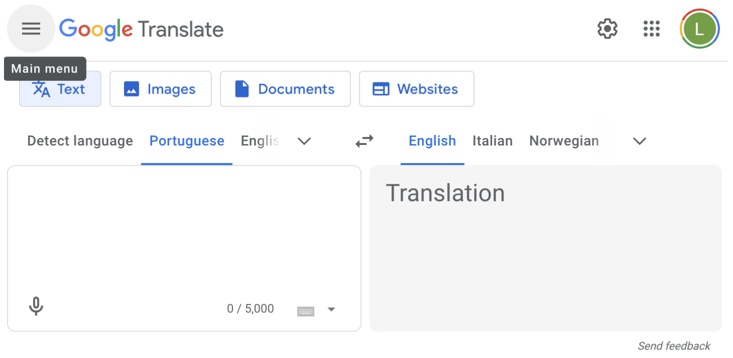


New! Chat with Gemini to supercharge your ideas with Google AI. Try it today

Google offered in: Português (Portugal)

## Applications of Large Language Models

- Translation



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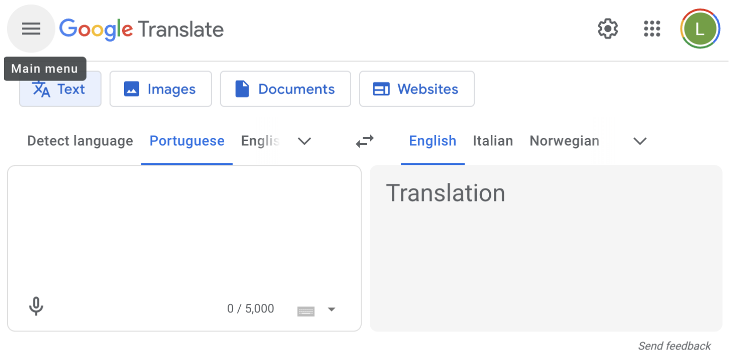

- And so much more from Q&A over PDFs to personalized tutoring.

## 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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- Abstractions over the LLM APIs like the ChatGPT API

```python
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)
```

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- 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'
```

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

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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

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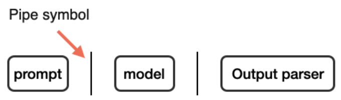
- LCEL is a powerful, declarative language designed to streamline the composition of complex chains in the LangChain framework.
- Pipe syntax



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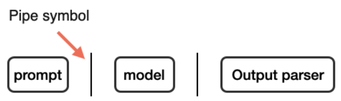

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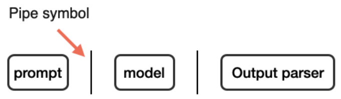

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- Allows you to build complex chain pipelines with a simple standard interface

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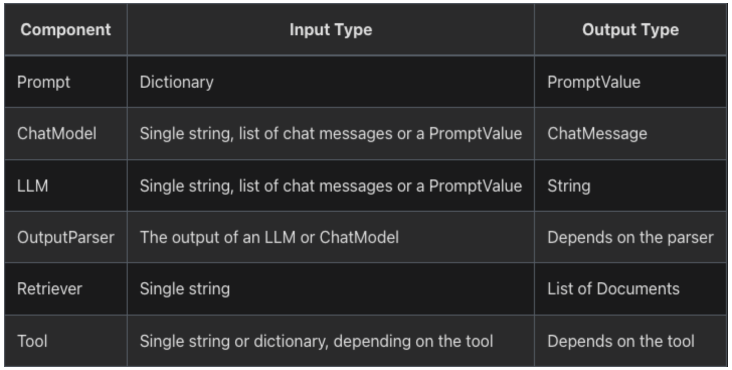
- The standard interface includes `stream`, `invoke`, and `batch` methods. Async methods are also available
- The input type and output type vary by component:



| 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**

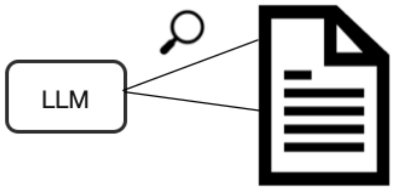
```
Create a simple chain for summarization of content.

Your chain should:

- A prompt template with one or more variables
- A model like ChatGPT or other (you can use local models if you'd like, I recommend `ChatOllama` for that!)
- Optional: use output parsing or just fetch the string output at the end!
```

## Break 5 minutes

## LangChain for Chat Over Documents



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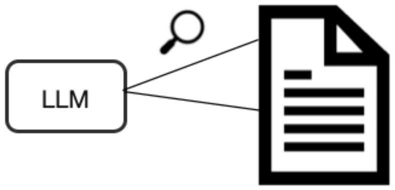

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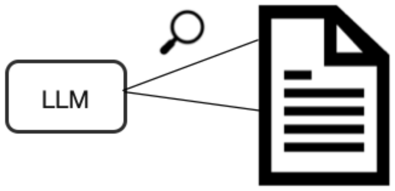

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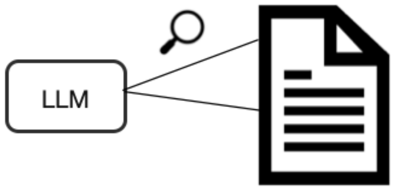

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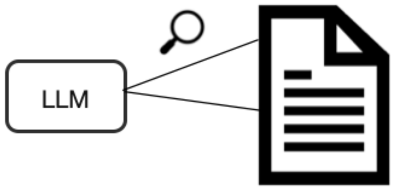

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- Quick Answer is **Embeddings**!

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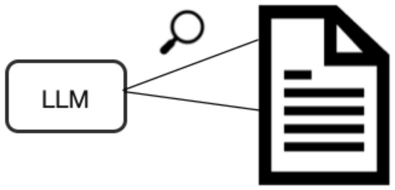
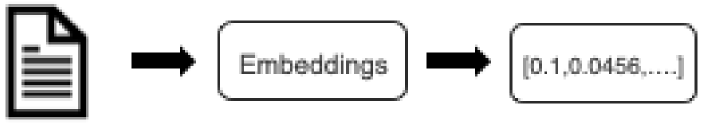


- Embeddings are vectorized representations of text



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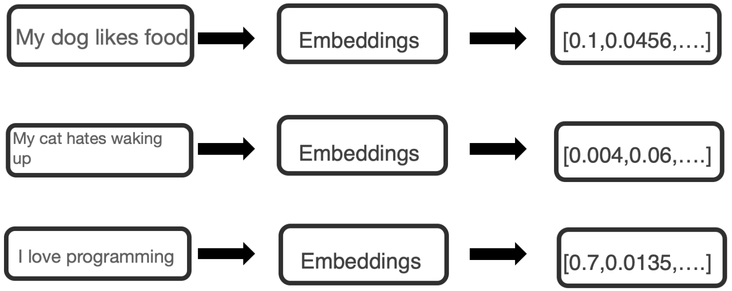

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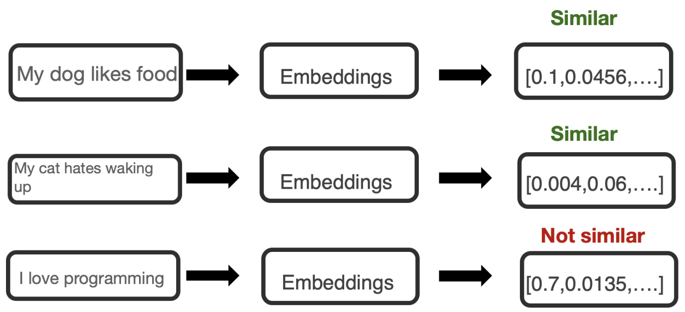

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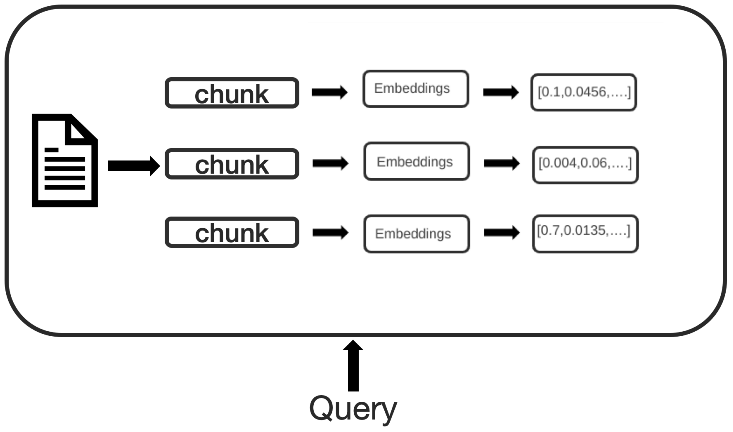

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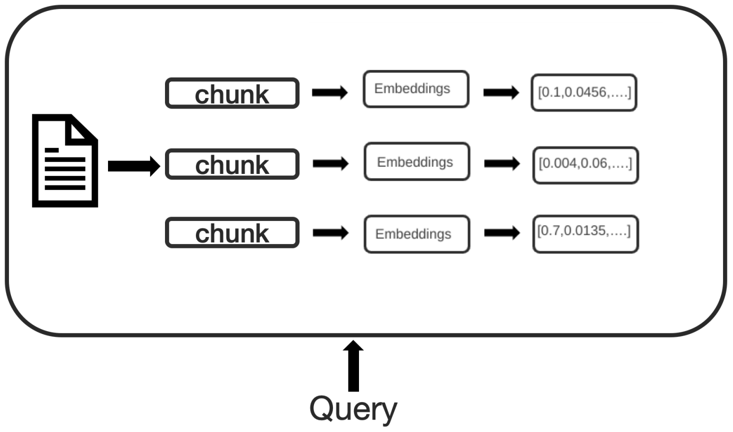

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- How to build RAG systems with LangChain?

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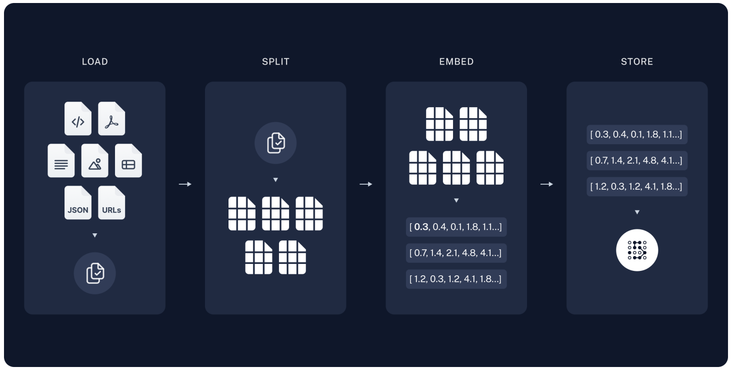

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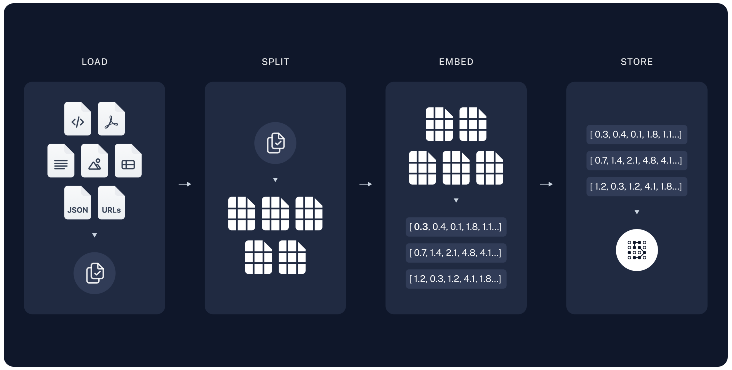

- Load

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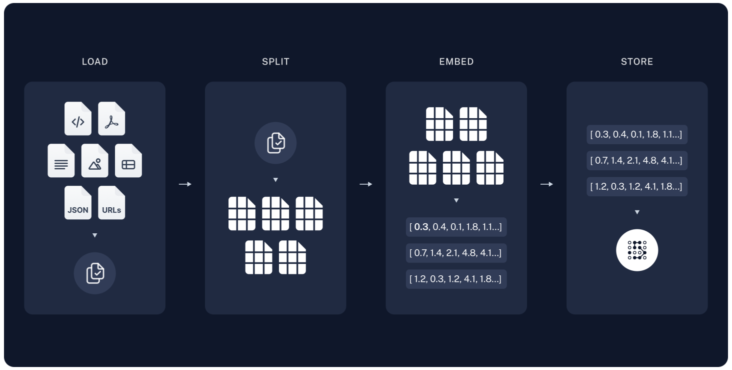

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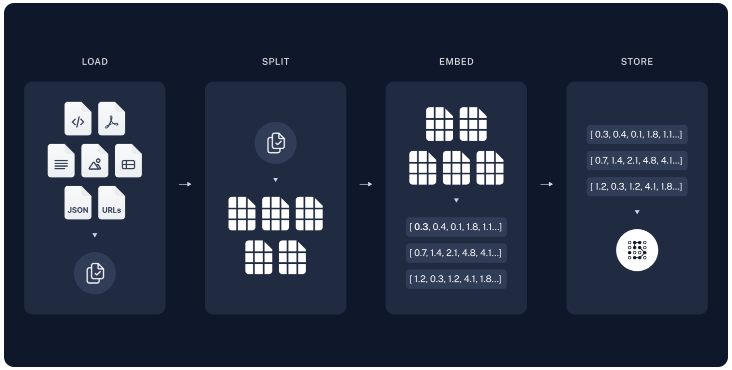

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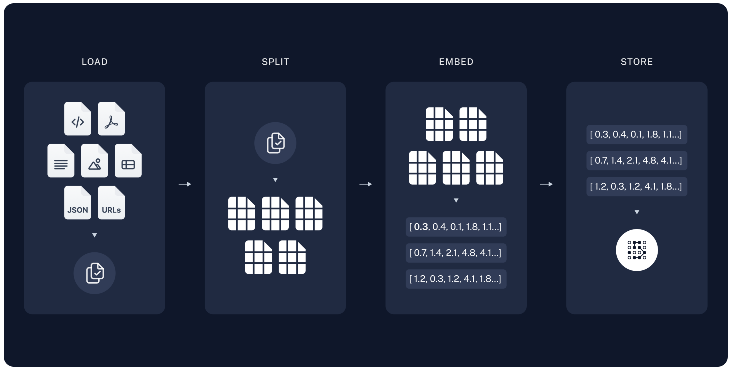

- Load
- Split
- Embed
- Store

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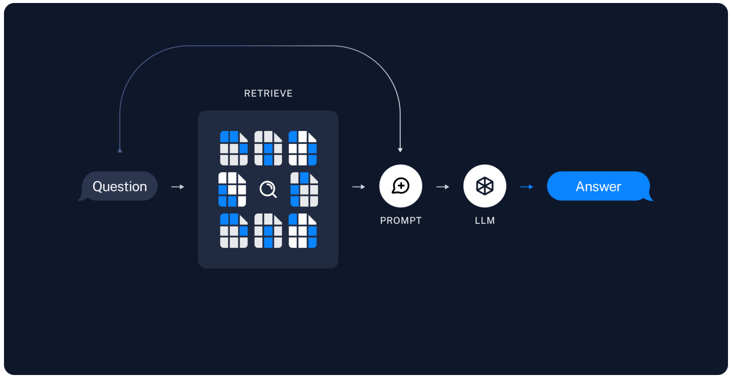

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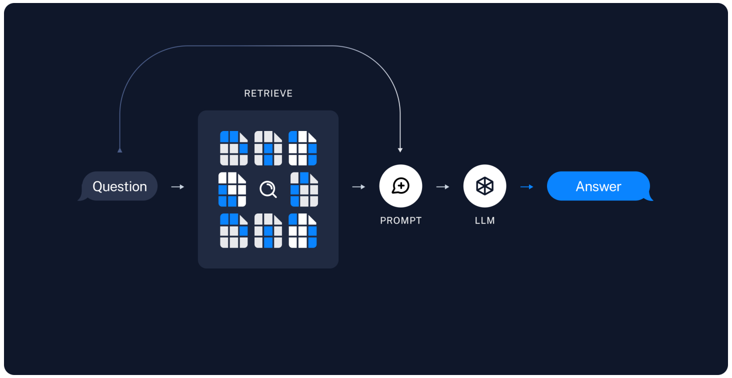

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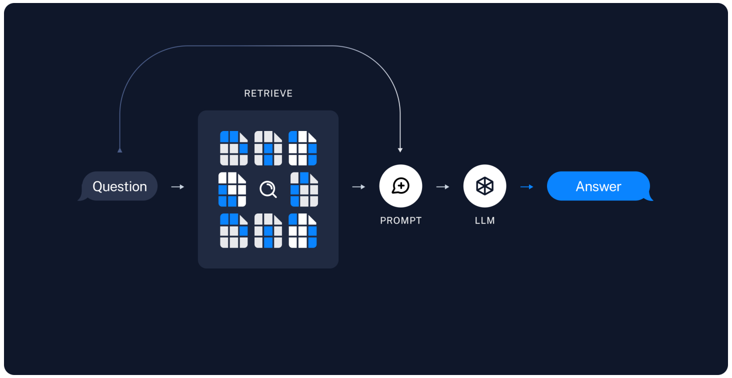

- Retrieval Piepeline
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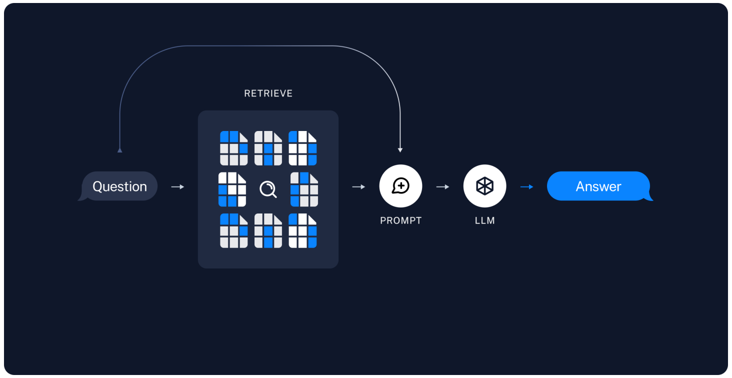

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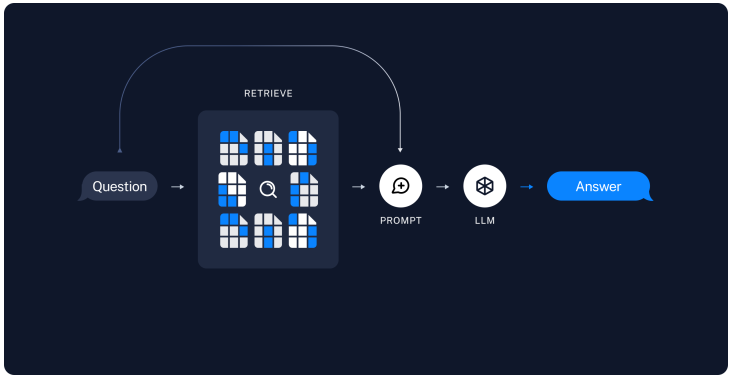

- Retrieval Piepeline
    - Input Question
    - Retrieve Relevant Documents
    - LLM uses the prompt question + retrieved data to produce a final answer

## 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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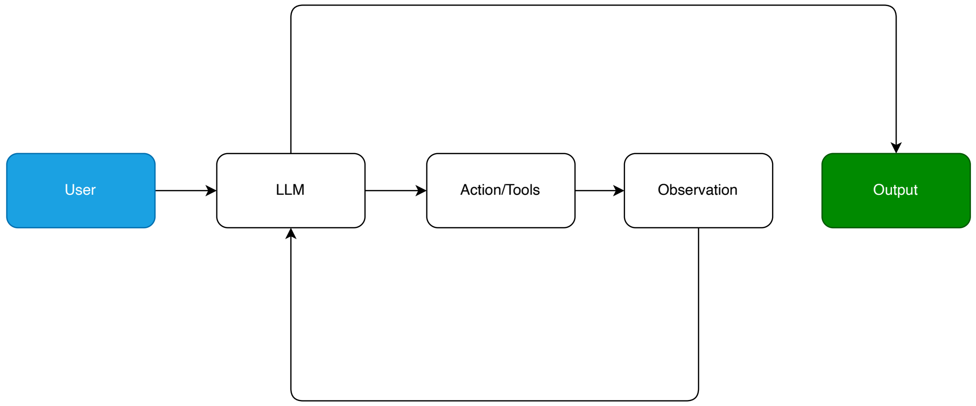

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- **Agent**: Chain responsible for deciding the next step, powered by a language model.

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    observation = run(next_action)
    next_action = agent.get_action(..., next_action, observation)
return next_action
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  - Handling cases where the tool errors
  - Handling cases where the agent produces output that cannot be parsed into a tool invocation

## AgentExecutor

- The agent executor is the runtime for an agent.
- It calls the agent, executes the actions it chooses, passes the action outputs back to the agent, and repeats.
- 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)
return next_action
```

- 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

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    - Function to run.
- Important for building a working agent.

## Langchain Toolkits

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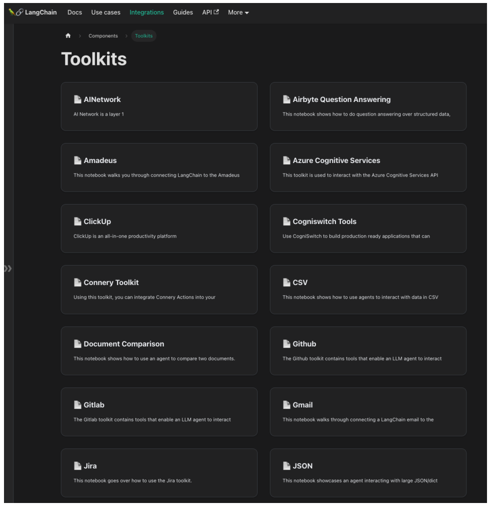
- LangChain provides a wide set of toolkits.
- Groups of 3-5 tools for specific objectives.
- Example: GitHub toolkit for interacting with GitHub.



Toolkits

**AINetwork**
AI Network is a layer 1

**Airbyte Question Answering**
This notebook shows how to do question answering over structured data,

**Amadeus**
This notebook walks you through connecting LangChain to the Amadeus

**Azure Cognitive Services**
This toolkit is used to interact with the Azure Cognitive Services API

**ClickUp**
ClickUp is an all-in-one productivity platform

**Cogniswitch Tools**
Use CogniSwitch to build production ready applications that can

**Connery Toolkit**
Using this toolkit, you can integrate Connery Actions into your

**CSV**
This notebook shows how to use agents to interact with data in CSV

**Document Comparison**
This notebook shows how to use an agent to compare two documents.

**Github**
The Github toolkit contains tools that enable an LLM agent to interact

**Gitlab**
The Gitlab toolkit contains tools that enable an LLM agent to interact

**Gmail**
This notebook walks through connecting a LangChain email to the

**Jira**
This notebook goes over how to use the Jira toolkit.

**JSON**
This notebook showcases an agent interacting with large JSON/dict

## 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 deadlines.
  table format = task | date
  ```

## Break 5 minutes

## LangServe Super Quick Intro

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## Notebook Demo - Deployment with LangServe

## Final Q&A & Summary

- **LangServe** helps developers deploy LangChain runnables and chains as a REST API.
- It is integrated with FastAPI and uses pydantic for data validation.

## References

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- ReACT Paper