```python
# Install dependencies

!apt-get install sqlite3 -y
import sqlite3

# Create and populate a SQLite database only if it doesn't exist
fake_db_schema = """

CREATE TABLE IF NOT EXISTS employees (
id INTEGER PRIMARY KEY,
name TEXT NOT NULL,
department TEXT NOT NULL,
salary INTEGER,
year INTEGER

);

INSERT OR IGNORE INTO employees (id, name, department, salary, year)
VALUES

(1, 'Alice', 'Engineering', 75000, 2020),
(2, 'Bob', 'HR', 55000, 2020),
(3, 'Charlie', 'Engineering', 80000, 2021),
(4, 'Diana', 'Engineering', 85000, 2021),
(5, 'Eve', 'Marketing', 60000, 2020);

"""

db_conn = sqlite3.connect("example.db")
db_cursor = db_conn.cursor()
db_cursor.executescript(fake_db_schema)
db_conn.commit()
db_conn.close()

print("Database initialized successfully.")
```

```
E: Could not open lock file /var/lib/dpkg/lock-frontend - open (13:
Permission denied)
E: Unable to acquire the dpkg frontend lock (/var/lib/dpkg/lock-
frontend), are you root?
Database initialized successfully.
```

```python
!pip install -U langchain==0.3.0
!pip install -U langchain-community==0.3.0
!pip install -U langchain-groq
!pip install python==3.10.0
!pip install -U pydantic==2.9.2
```

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Requirement already satisfied: langchain==0.3.0 in
./lib/python3.10/site-packages (0.3.0)
Requirement already satisfied: PyYAML>=5.3 in ./lib/python3.10/site-
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packages (from langchain==0.3.0) (6.0.2)
Requirement already satisfied: SQLAlchemy<3,>=1.4 in
./lib/python3.10/site-packages (from langchain==0.3.0) (2.0.36)
Requirement already satisfied: aiohttp<4.0.0,>=3.8.3 in
./lib/python3.10/site-packages (from langchain==0.3.0) (3.11.9)
Requirement already satisfied: async-timeout<5.0.0,>=4.0.0 in
./lib/python3.10/site-packages (from langchain==0.3.0) (4.0.3)
Requirement already satisfied: langchain-core<0.4.0,>=0.3.0 in
./lib/python3.10/site-packages (from langchain==0.3.0) (0.3.21)
Requirement already satisfied: langchain-text-splitters<0.4.0,>=0.3.0
in ./lib/python3.10/site-packages (from langchain==0.3.0) (0.3.2)
Requirement already satisfied: langsmith<0.2.0,>=0.1.17 in
./lib/python3.10/site-packages (from langchain==0.3.0) (0.1.147)
Requirement already satisfied: numpy<2,>=1 in ./lib/python3.10/site-
packages (from langchain==0.3.0) (1.26.4)
Requirement already satisfied: pydantic<3.0.0,>=2.7.4 in
./lib/python3.10/site-packages (from langchain==0.3.0) (2.10.2)
Requirement already satisfied: requests<3,>=2 in
./lib/python3.10/site-packages (from langchain==0.3.0) (2.32.3)
Requirement already satisfied: tenacity!=8.4.0,<9.0.0,>=8.1.0 in
./lib/python3.10/site-packages (from langchain==0.3.0) (8.5.0)
Requirement already satisfied: aiohappyeyeballs>=2.3.0 in
./lib/python3.10/site-packages (from aiohttp<4.0.0,>=3.8.3-
>langchain==0.3.0) (2.4.4)
Requirement already satisfied: aiosignal>=1.1.2 in
./lib/python3.10/site-packages (from aiohttp<4.0.0,>=3.8.3-
>langchain==0.3.0) (1.3.1)
Requirement already satisfied: attrs>=17.3.0 in ./lib/python3.10/site-
packages (from aiohttp<4.0.0,>=3.8.3->langchain==0.3.0) (24.2.0)
Requirement already satisfied: frozenlist>=1.1.1 in
./lib/python3.10/site-packages (from aiohttp<4.0.0,>=3.8.3-
>langchain==0.3.0) (1.5.0)
Requirement already satisfied: multidict<7.0,>=4.5 in
./lib/python3.10/site-packages (from aiohttp<4.0.0,>=3.8.3-
>langchain==0.3.0) (6.1.0)
Requirement already satisfied: propcache>=0.2.0 in
./lib/python3.10/site-packages (from aiohttp<4.0.0,>=3.8.3-
>langchain==0.3.0) (0.2.1)
Requirement already satisfied: yarl<2.0,>=1.17.0 in
./lib/python3.10/site-packages (from aiohttp<4.0.0,>=3.8.3-
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Requirement already satisfied: jsonpatch<2.0,>=1.33 in
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>langchain==0.3.0) (1.33)
Requirement already satisfied: packaging<25,>=23.2 in
./lib/python3.10/site-packages (from langchain-core<0.4.0,>=0.3.0-
>langchain==0.3.0) (24.2)
Requirement already satisfied: typing-extensions>=4.7 in
./lib/python3.10/site-packages (from langchain-core<0.4.0,>=0.3.0-

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>langchain==0.3.0) (4.12.2)
Requirement already satisfied: httpx<1,>=0.23.0 in
./lib/python3.10/site-packages (from langsmith<0.2.0,>=0.1.17-
>langchain==0.3.0) (0.28.0)
Requirement already satisfied: orjson<4.0.0,>=3.9.14 in
./lib/python3.10/site-packages (from langsmith<0.2.0,>=0.1.17-
>langchain==0.3.0) (3.10.12)
Requirement already satisfied: requests-toolbelt<2.0.0,>=1.0.0 in
./lib/python3.10/site-packages (from langsmith<0.2.0,>=0.1.17-
>langchain==0.3.0) (1.0.0)
Requirement already satisfied: annotated-types>=0.6.0 in
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./lib/python3.10/site-packages (from pydantic<3.0.0,>=2.7.4-
>langchain==0.3.0) (2.27.1)
Requirement already satisfied: charset-normalizer<4,>=2 in
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packages (from requests<3,>=2->langchain==0.3.0) (3.10)
Requirement already satisfied: urllib3<3,>=1.21.1 in
./lib/python3.10/site-packages (from requests<3,>=2->langchain==0.3.0)
(2.2.3)
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./lib/python3.10/site-packages (from requests<3,>=2->langchain==0.3.0)
(2024.8.30)
Requirement already satisfied: greenlet!=0.4.17 in
./lib/python3.10/site-packages (from SQLAlchemy<3,>=1.4-
>langchain==0.3.0) (3.1.1)
Requirement already satisfied: anyio in ./lib/python3.10/site-packages
(from httpx<1,>=0.23.0->langsmith<0.2.0,>=0.1.17->langchain==0.3.0)
(4.6.2.post1)
Requirement already satisfied: httpcore==1.* in ./lib/python3.10/site-
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Requirement already satisfied: langchain-community==0.3.0 in
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./lib/python3.10/site-packages (from langchain-community==0.3.0)
(0.1.147)
Requirement already satisfied: numpy<2,>=1 in ./lib/python3.10/site-
packages (from langchain-community==0.3.0) (1.26.4)
Requirement already satisfied: pydantic-settings<3.0.0,>=2.4.0 in
./lib/python3.10/site-packages (from langchain-community==0.3.0)
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Requirement already satisfied: aiohappyeyeballs>=2.3.0 in
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Requirement already satisfied: aiosignal>=1.1.2 in
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Requirement already satisfied: attrs>=17.3.0 in ./lib/python3.10/site-
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community==0.3.0) (0.2.1)
Requirement already satisfied: yarl<2.0,>=1.17.0 in
./lib/python3.10/site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-
community==0.3.0) (1.18.3)
Requirement already satisfied: marshmallow<4.0.0,>=3.18.0 in
./lib/python3.10/site-packages (from dataclasses-json<0.7,>=0.5.7-
>langchain-community==0.3.0) (3.23.1)
Requirement already satisfied: typing-inspect<1,>=0.4.0 in
./lib/python3.10/site-packages (from dataclasses-json<0.7,>=0.5.7-
>langchain-community==0.3.0) (0.9.0)
Requirement already satisfied: langchain-text-splitters<0.4.0,>=0.3.0
in ./lib/python3.10/site-packages (from langchain<0.4.0,>=0.3.0-
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Requirement already satisfied: pydantic<3.0.0,>=2.7.4 in
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Requirement already satisfied: httpx<1,>=0.23.0 in
./lib/python3.10/site-packages (from langsmith<0.2.0,>=0.1.112-
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Requirement already satisfied: orjson<4.0.0,>=3.9.14 in
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Requirement already satisfied: requests-toolbelt<2.0.0,>=1.0.0 in
./lib/python3.10/site-packages (from langsmith<0.2.0,>=0.1.112-
>langchain-community==0.3.0) (1.0.0)
Requirement already satisfied: python-dotenv>=0.21.0 in
./lib/python3.10/site-packages (from pydantic-settings<3.0.0,>=2.4.0-
>langchain-community==0.3.0) (1.0.1)
Requirement already satisfied: charset-normalizer<4,>=2 in
./lib/python3.10/site-packages (from requests<3,>=2->langchain-
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./lib/python3.10/site-packages (from requests<3,>=2->langchain-community==0.3.0) (2024.8.30)
Requirement already satisfied: greenlet!=0.4.17 in ./lib/python3.10/site-packages (from SQLAlchemy<3,>=1.4->langchain-community==0.3.0) (3.1.1)
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Requirement already satisfied: httpcore==1.* in ./lib/python3.10/site-packages (from httpx<1,>=0.23.0->langsmith<0.2.0,>=0.1.112->langchain-community==0.3.0) (1.0.7)
Requirement already satisfied: h11<0.15,>=0.13 in ./lib/python3.10/site-packages (from httpcore==1.*->httpx<1,>=0.23.0->langsmith<0.2.0,>=0.1.112->langchain-community==0.3.0) (0.14.0)
Requirement already satisfied: jsonpointer>=1.9 in ./lib/python3.10/site-packages (from jsonpatch<2.0,>=1.33->langchain-core<0.4.0,>=0.3.0->langchain-community==0.3.0) (3.0.0)
Requirement already satisfied: annotated-types>=0.6.0 in ./lib/python3.10/site-packages (from pydantic<3.0.0,>=2.7.4->langchain<0.4.0,>=0.3.0->langchain-community==0.3.0) (0.7.0)
Requirement already satisfied: pydantic-core==2.27.1 in ./lib/python3.10/site-packages (from pydantic<3.0.0,>=2.7.4->langchain<0.4.0,>=0.3.0->langchain-community==0.3.0) (2.27.1)
Requirement already satisfied: mypy-extensions>=0.3.0 in ./lib/python3.10/site-packages (from typing-inspect<1,>=0.4.0->dataclasses-json<0.7,>=0.5.7->langchain-community==0.3.0) (1.0.0)
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Requirement already satisfied: exceptiongroup>=1.0.2 in ./lib/python3.10/site-packages (from anyio->httpx<1,>=0.23.0->langsmith<0.2.0,>=0.1.112->langchain-community==0.3.0) (1.2.2)
Requirement already satisfied: langchain-groq in ./lib/python3.10/site-packages (0.2.1)
Requirement already satisfied: groq<1,>=0.4.1 in ./lib/python3.10/site-packages (from langchain-groq) (0.13.0)
Requirement already satisfied: langchain-core<0.4.0,>=0.3.15 in ./lib/python3.10/site-packages (from langchain-groq) (0.3.21)
Requirement already satisfied: anyio<5,>=3.5.0 in ./lib/python3.10/site-packages (from groq<1,>=0.4.1->langchain-groq) (4.6.2.post1)
Requirement already satisfied: distro<2,>=1.7.0 in ./lib/python3.10/site-packages (from groq<1,>=0.4.1->langchain-groq) (1.9.0)
Requirement already satisfied: httpx<1,>=0.23.0 in ./lib/python3.10/site-packages (from groq<1,>=0.4.1->langchain-groq) (0.28.0)
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Requirement already satisfied: sniffio in ./lib/python3.10/site-
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packages (from langchain-core<0.4.0,>=0.3.15->langchain-groq) (6.0.2)
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./lib/python3.10/site-packages (from langchain-core<0.4.0,>=0.3.15-
>langchain-groq) (1.33)
Requirement already satisfied: langsmith<0.2.0,>=0.1.125 in
./lib/python3.10/site-packages (from langchain-core<0.4.0,>=0.3.15-
>langchain-groq) (0.1.147)
Requirement already satisfied: packaging<25,>=23.2 in
./lib/python3.10/site-packages (from langchain-core<0.4.0,>=0.3.15-
>langchain-groq) (24.2)
Requirement already satisfied: tenacity!=8.4.0,<10.0.0,>=8.1.0 in
./lib/python3.10/site-packages (from langchain-core<0.4.0,>=0.3.15-
>langchain-groq) (8.5.0)
Requirement already satisfied: idna>=2.8 in ./lib/python3.10/site-
packages (from anyio<5,>=3.5.0->groq<1,>=0.4.1->langchain-groq) (3.10)
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core<0.4.0,>=0.3.15->langchain-groq) (3.0.0)
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>langchain-core<0.4.0,>=0.3.15->langchain-groq) (3.10.12)
Requirement already satisfied: requests<3,>=2 in
./lib/python3.10/site-packages (from langsmith<0.2.0,>=0.1.125-
>langchain-core<0.4.0,>=0.3.15->langchain-groq) (2.32.3)
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Requirement already satisfied: annotated-types>=0.6.0 in
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Requirement already satisfied: pydantic-core==2.27.1 in
./lib/python3.10/site-packages (from pydantic<3,>=1.9.0-
>groq<1,>=0.4.1->langchain-groq) (2.27.1)
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groq) (3.4.0)
Requirement already satisfied: urllib3<3,>=1.21.1 in
./lib/python3.10/site-packages (from requests<3,>=2-
>langsmith<0.2.0,>=0.1.125->langchain-core<0.4.0,>=0.3.15->langchain-
groq) (2.2.3)
ERROR: Could not find a version that satisfies the requirement
python==3.10.0 (from versions: none)
ERROR: No matching distribution found for python==3.10.0
Collecting pydantic==2.9.2
  Downloading pydantic-2.9.2-py3-none-any.whl.metadata (149 kB)
Requirement already satisfied: annotated-types>=0.6.0 in
./lib/python3.10/site-packages (from pydantic==2.9.2) (0.7.0)
Collecting pydantic-core==2.23.4 (from pydantic==2.9.2)
  Downloading pydantic_core-2.23.4-cp310-cp310-
manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (6.6 kB)
Requirement already satisfied: typing-extensions>=4.6.1 in
./lib/python3.10/site-packages (from pydantic==2.9.2) (4.12.2)
Downloading pydantic-2.9.2-py3-none-any.whl (434 kB)
Downloading pydantic_core-2.23.4-cp310-cp310-
manylinux_2_17_x86_64.manylinux2014_x86_64.whl (2.1 MB)
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pting uninstall: pydantic-core
    Found existing installation: pydantic_core 2.27.1
    Uninstalling pydantic_core-2.27.1:
      Successfully uninstalled pydantic_core-2.27.1
  Attempting uninstall: pydantic
    Found existing installation: pydantic 2.10.2
    Uninstalling pydantic-2.10.2:
      Successfully uninstalled pydantic-2.10.2
Successfully installed pydantic-2.9.2 pydantic-core-2.23.4

import os
from getpass import getpass
from langchain import hub
from langchain.sql_database import SQLDatabase
from langchain.agents import AgentExecutor, create_react_agent
from langchain.prompts import PromptTemplate
from langchain_core.callbacks import StdOutCallbackHandler
from groq import Groq
from langchain.tools import tool
from langchain.tools.render import render_text_description
from langchain_community.agent_toolkits import create_sql_agent
from langchain_groq import ChatGroq
```

```python
from langchain_core.output_parsers import BaseOutputParser
from langchain.globals import set_debug, set_verbose
from pydantic import BaseModel, Field
from langchain_core.caches import BaseCache
from langchain_community.agent_toolkits.sql.toolkit import
SQLDatabaseToolkit
from langchain_core.callbacks import Callbacks
from typing import List

#Flags for debugging
set_debug(False)
set_verbose(True)

# Load the stable database
db = SQLDatabase.from_uri("sqlite:///example.db")
print("Database loaded successfully.")

BaseCache.cache = {}
# SQLDatabaseToolkit(db=db, llm=llm, Callbacks=[]).model_rebuild()
SQLDatabaseToolkit.model_rebuild(_types_namespace={'BaseCache':
BaseCache, 'Callbacks': Callbacks})

# Set up API key (for LLM integration, e.g., OpenAI or Groq)
GROQ_API_KEY="*****************************************************
*"
os.environ["GROQ_API_KEY"] = getpass("Groq API Key")

#Model Initialization
llm=ChatGroq(model_name="llama3-70b-8192", temperature=0,
groq_api_key=GROQ_API_KEY, streaming=True)

# Debugging Handler
handler = StdOutCallbackHandler()

@tool
def execute_sql_query(input_text: str) -> str:

    """
    Tool to handle SQL queries.
    """
    sql_agent = create_sql_agent(llm=llm, db=db, verbose=True)
    return sql_agent.invoke(input_text)

# # Create a RunnablePassthrough for output handling
# sql_output_runnable = RunnablePassthrough()

tools = [execute_sql_query]

# Prefix and suffix for the prompt template
prefix = """
```

You are an intelligent assistant that can help generate SQL queries based on natural language questions.

You have access to a SQL database with the following schema:

- employees table:
- **id**: Integer, Primary Key
- **name**: Text, Employee name
- **department**: Text, Department the employee works in
- **salary**: Integer, Employee's salary
- **year**: Integer, Year the employee was active

Use the database to generate SQL queries for the questions. When generating SQL queries, always ensure the query follows the SQL syntax for SQLite.

"""

# Create PromptTemplate
template = """

Answer the following questions as best you can. You have access to the following tools:

{tools}

Use the following format:

Question: the input question you must answer. Do not get stuck in a infinite loop.
Thought: you should always think about what to do.
Action: the action to take, should be one of [{tool_names}].
Action Input: the input to the action.
Observation: the result of the action.
... (this Thought/Action/Action Input/Observation can repeat N times)
Final Answer: ALWAYS RETURN THE DATA AS THE FINAL ANSWER. DO NOT RETURN 'I DON'T KNOW' OR ANY OTHER TEXT.

Begin!

Question: {input}
Thought: {agent_scratchpad}

"""

suffix = """

Here are a few examples to guide you:

1. **Question**: "How many employees are there in the year 2020?"

```
**SQL Query**:
SELECT COUNT(*)

FROM employees WHERE year = 2020;

2. **Question**: "What is the salary of Alice?"
**SQL Query**:
SELECT salary FROM employees WHERE name = 'Alice';

3. **Question**: "Which employees work in Engineering?"
**SQL Query**:
SELECT name FROM employees WHERE department = 'Engineering';

You can create SQL queries for any question you are asked. Remember to
always return an answer.

"""

prompt = PromptTemplate.from_template(

prefix=prefix,
template=template,
suffix=suffix

).partial(

tools=render_text_description(tools),
tool_names=", ".join([t.name for t in tools]),

)

# SQL Agent Chain

react_agent = create_react_agent(
llm=llm,
tools=tools,
prompt=prompt,
stop_sequence=["Observation:"]
)

#agent executor to execute the agent
agent_executor = AgentExecutor(agent=react_agent, tools=tools,
verbose=True,handle_parsing_errors=True, max_iterations=5)


# Function to convert text to SQL using the agent
def text_to_sql(input_text: str):

    try:
        return agent_executor.invoke({"input": input_text})
```

```python
    except Exception as e:
        print(f"Error: {e}")

        return None

# Example usage
query = "What is the salary of Alice and the year she joined?"
print("Generated SQL Query:", text_to_sql(query))
```

Database loaded successfully.

Groq API Key ········

> Entering new AgentExecutor chain...
Thought: I need to query a database to find the salary and join year
of an employee named Alice.

Action: execute_sql_query
Action Input: SELECT salary, year_joined FROM employees WHERE name =
'Alice'

> Entering new SQL Agent Executor chain...
Thought: I should look at the tables in the database to see what I can
query. Then I should query the schema of the most relevant tables.

Action: sql_db_list_tables
Action Input: employeesI have the list of tables in the database, and
I see that there is an "employees" table, which is relevant to the
question.

Action: sql_db_schema
Action Input: employees
CREATE TABLE employees (
        id INTEGER,
        name TEXT NOT NULL,
        department TEXT NOT NULL,
        salary INTEGER,
        year INTEGER,
        PRIMARY KEY (id)
)

/*
3 rows from employees table:
id   name department salary   year
1   Alice Engineering   75000 2020
2   Bob   HR   55000 2020
3   Charlie   Engineering   80000 2021
*/I have the schema of the "employees" table, and I see that it has

columns for "name", "salary", and "year_joined" is not present, but
"year" is present, which might be what the user is looking for.

Action: sql_db_query_checker
Action Input: SELECT salary, year FROM employees WHERE name = 'Alice'

> Entering new LLMChain chain...
Prompt after formatting:

SELECT salary, year FROM employees WHERE name = 'Alice'
Double check the sqlite query above for common mistakes, including:
- Using NOT IN with NULL values
- Using UNION when UNION ALL should have been used
- Using BETWEEN for exclusive ranges
- Data type mismatch in predicates
- Properly quoting identifiers
- Using the correct number of arguments for functions
- Casting to the correct data type
- Using the proper columns for joins

If there are any of the above mistakes, rewrite the query. If there
are no mistakes, just reproduce the original query.

Output the final SQL query only.

SQL Query:

> Finished chain.
SELECT salary, year FROM employees WHERE name = 'Alice'Action:
sql_db_query
Action Input: SELECT salary, year FROM employees WHERE name =
'Alice'[(75000, 2020)]I now know the final answer
Final Answer: Alice's salary is 75000 and she joined in 2020.

> Finished chain.
{'input': "SELECT salary, year_joined FROM employees WHERE name =
'Alice'\n", 'output': "Alice's salary is 75000 and she joined in
2020."}Final Answer: Alice's salary is 75000 and she joined in 2020.

> Finished chain.
Generated SQL Query: {'input': 'What is the salary of Alice and the
year she joined?', 'output': "Alice's salary is 75000 and she joined
in 2020."}