# ASSIGNMENT 2:
# SALES RECOMMENDATION AGENT

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MSDS 442: AI Agent Design & Development

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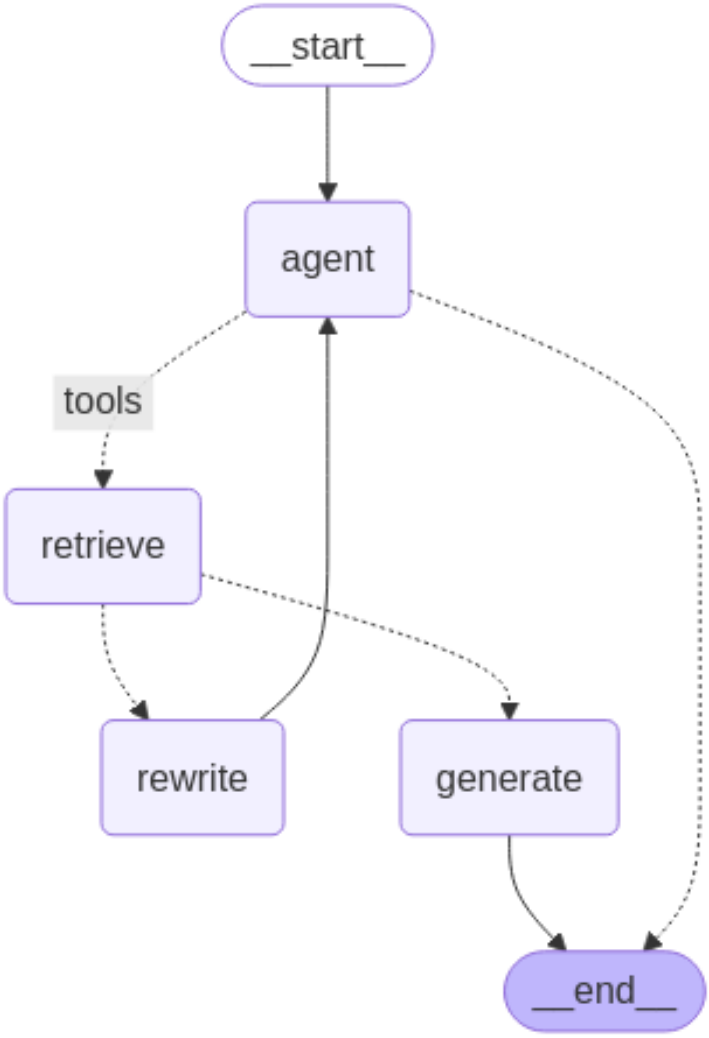
## Requirement 1: Graph the Agent with LangChain/LangGraph

The construction of the agent and accompanying graph begins in cell 2 (see appendix). The actual assembly of the graph occurs in cell 5. However, some of the components, such as the retriever **ToolNode** and **AgentState** class, are built above. Following the logic in cell 5 we first instantiate an empty graph:

```
workflow = StateGraph(AgentState)
```

The `workflow` object has `add_node` and `add_edge` methods that allow us to assemble the components created in cells 2-6. The output is displayed graphically in cell 6 (reproduced below.)

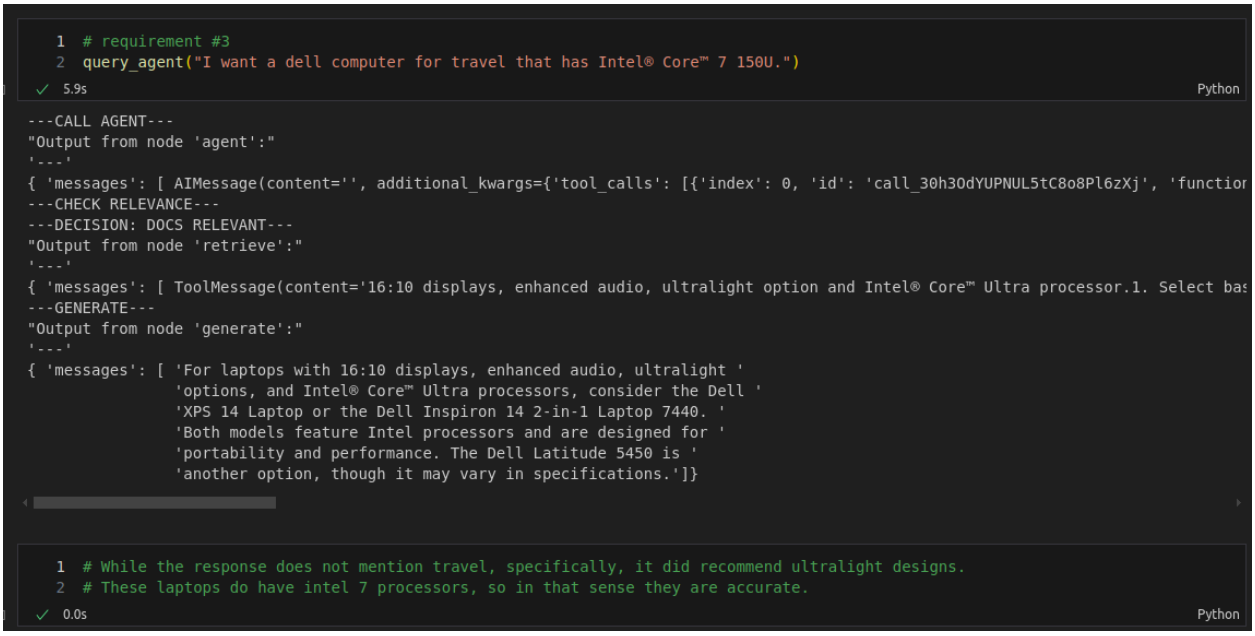


## Requirement 2: Load the Dell web pages

Loading the web pages occurs in in cell 2. A list of URLs are defined and based to the **WebBaseLoader**. The **RecursiveCharacterTextSplitter** chunks the documents into workable pieces. The result is a list of LangChain documents that each have a portion of each site. The documents are embedded and stored in the ChromaDB vector store.

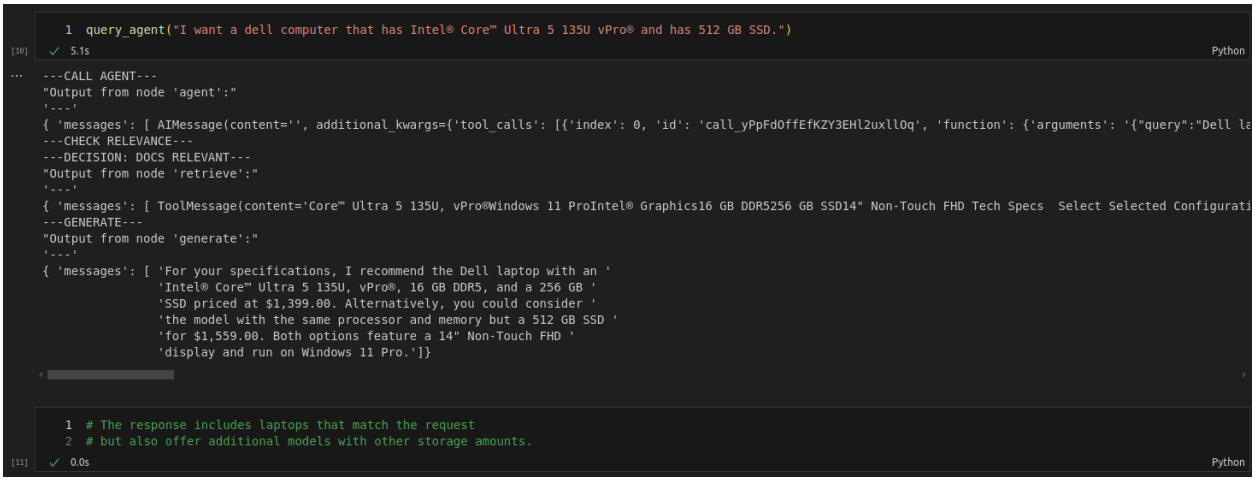
## Requirement 3: Inspect and comment on four queries

The first query sent to the agent was *'I want a dell computer for travel that has Intel® Core™ 7 150U.'* The response is reproduced below. While the response does not mention travel, specifically, it did recommend ultralight designs. Perhaps this was the agent addressing the travel component? These laptops do have Intel 7 processors, so in that sense they are accurate.

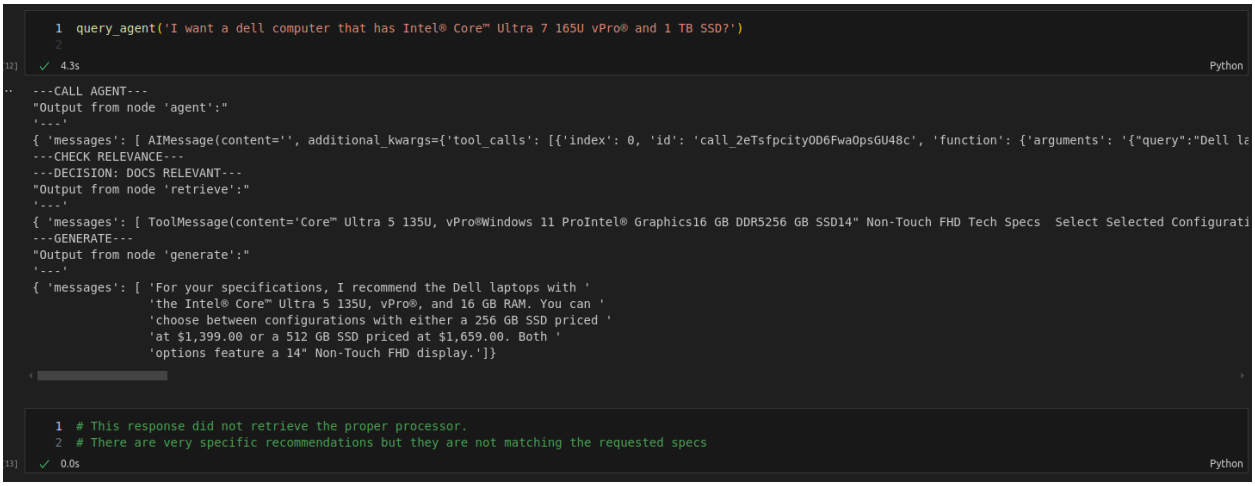


```
1  # requirement #3
2  query_agent("I want a dell computer for travel that has Intel® Core™ 7 150U.")
✓ 5.9s                                                                    Python

---CALL AGENT---
"Output from node 'agent':"
'---'
{ 'messages': [ AIMessage(content='', additional_kwargs={'tool_calls': [{'index': 0, 'id': 'call_30h3OdYUPNUL5tC8o8Pl6zXj', 'functior
---CHECK RELEVANCE---
---DECISION: DOCS RELEVANT---
"Output from node 'retrieve':"
'---'
{ 'messages': [ ToolMessage(content='16:10 displays, enhanced audio, ultralight option and Intel® Core™ Ultra processor.1. Select bas
---GENERATE---
"Output from node 'generate':"
'---'
{ 'messages': [ 'For laptops with 16:10 displays, enhanced audio, ultralight '
                'options, and Intel® Core™ Ultra processors, consider the Dell '
                'XPS 14 Laptop or the Dell Inspiron 14 2-in-1 Laptop 7440. '
                'Both models feature Intel processors and are designed for '
                'portability and performance. The Dell Latitude 5450 is '
                'another option, though it may vary in specifications.']}

1  # While the response does not mention travel, specifically, it did recommend ultralight designs.
2  # These laptops do have intel 7 processors, so in that sense they are accurate.
✓ 0.0s                                                                    Python
```

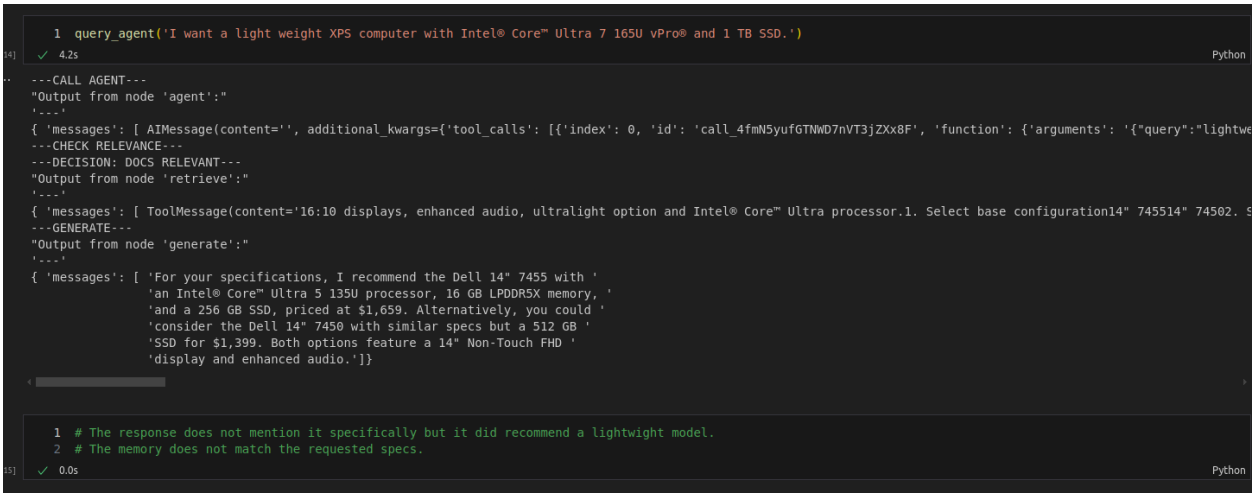
The second query, *'I want a dell computer that has Intel® Core™ Ultra 5 135U vPro® and has 512 GB SSD.'*, and its response are displayed below. It included specific requirements on the desired memory. The response addresses this but also includes other options that have different memory specifications.



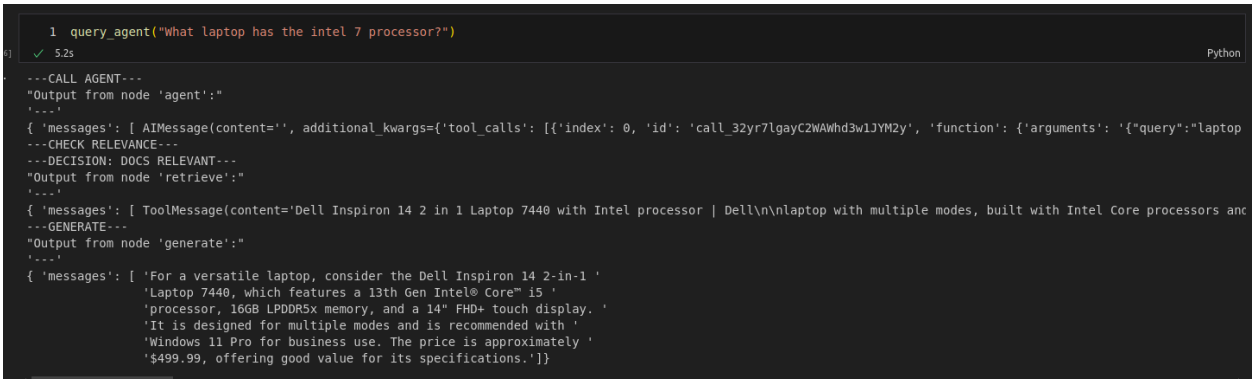

The third query, *'I want a dell computer that has Intel® Core™ Ultra 7 165U vPro® and 1 TB SSD'*, takes a similar approach- requesting a particular processor with a particular amount of storage. The agent performs poorly on this query. The recommended laptop was wrong on both counts. The agent is not ensuring the requested specifications are being honored.




The final query is *'I want a light weight XPS computer with Intel® Core™ Ultra 7 165U vPro® and 1 TB SSD.'* It is very similar to the prior query however the agent handled it better. The recommended models are all 'ultralight.'




In my experimentation I noticed the agent does better when the prompt is phrased as a question. To test this hypothesis I ran one additional query: *'What laptop has the Intel 7 processor?'* The agent handles this one perfectly with a complete response that accurately and coherently addresses the prompt.




## Requirement 4: Response consistency

The experiments conducted in the assignment show that responses from the agent lack consistency. This is curious when we note the low (0.2) temperature we use when invoking the LLM. Running the same query over and over provides varied results. Sometimes the agent fails to see the question as relevant, sometimes the agent provides a very inaccurate response and sometimes the agent provides a suitable answer that addresses the prompt (directly or indirectly) with varying amounts of extraneous information. This is a focus for the proposed improvements to the agent listed below.

### Requirement 5: Agent improvements

There are two primary issues that must be addressed. The first, is the agent failing to recommend laptops that meet the specifications in the prompt. Sometimes they are ignored, other times the recommendations are not limited to those specs. To improve this we can construct another node- recommendation vetting. This step can have the LLM evaluate the proposed response against the original human message. If the response does not meet the test the agent must circle back around and try again.

The second flaw that needs to be addressed is the lack of consistency. This might be mitigated by altering the way we preprocess the documents that are available for inclusion in the context. It may be advantageous to extract the specifications from the documents and store these along side the raw source material. Our experiment has suggested the agent performs well when simply listing the specs of a given model. The LLM could be leveraged to distill the components of each available model and, in turn, provide a clear manifest for subsequent queries.

[1]:
```
############################################################
# MSDS 442: AI Agent Design and Development
# Spring '25
# Dr. Bader
#
# Assignment 2 - Electronics Product Design Agent
#
# Kevin Geidel
#
############################################################

# OBJECTIVE:
#   The following will construct an AI agent using the LangChain & LangGraph␣
 ↪frameworks
#   The agent will act as a sales assistant to recommend laptop models and␣
 ↪customization
#   based on customer input.

# Load environment variables
from dotenv import load_dotenv
load_dotenv()

# Python native imports
import os, sys, pprint

# Third party library import
from langchain import hub
from langchain_core.prompts import PromptTemplate
from langchain_community.document_loaders import PyPDFLoader
from langchain_openai import ChatOpenAI, OpenAIEmbeddings
from langchain_core.output_parsers import StrOutputParser
from langgraph.prebuilt import tools_condition
from langgraph.graph import END, StateGraph, START
from langchain_core.vectorstores import InMemoryVectorStore
from langgraph.prebuilt import ToolNode
from langchain.document_loaders import WebBaseLoader
os.environ['USER_AGENT'] = 'Mozilla/5.0 (Windows NT 10.0; Win64; x64)␣
 ↪AppleWebKit/537.36 (KHTML, like Gecko) Chrome/58.0.3029.110 Safari/537.3'
__import__('pysqlite3')
sys.modules['sqlite3'] = sys.modules.pop('pysqlite3')
from langchain_chroma import Chroma
from langchain_text_splitters import RecursiveCharacterTextSplitter
from langchain.tools.retriever import create_retriever_tool
from typing import Annotated, Sequence, Literal
from typing_extensions import TypedDict
from langchain_core.messages import BaseMessage, HumanMessage
from langgraph.graph.message import add_messages
```

```
from pydantic import BaseModel, Field

# Assign experiment-wide variables
model_name = 'gpt-4o-mini'
```

[2]:
```
# Requirment 1: building the graph of the agent
# Requirment 2: Use WebBaseLoader from LangChain to load the following webpage␣
 ↪into a document

urls = [
    "https://www.dell.com/en-us/shop/dell-laptops/inspiron-14-2-in-1-laptop/spd/
 ↪inspiron-14-7440-2-in-1-laptop",
    "https://www.dell.com/en-us/shop/dell-laptops/latitude-5450-laptop/spd/
 ↪latitude-14-5450-laptop",
    "https://www.dell.com/en-us/shop/dell-laptops/latitude-7450-laptop/spd/
 ↪latitude-14-7450-2-in-1-laptop",
    "https://www.dell.com/en-us/shop/dell-laptops/xps-14-laptop/spd/
 ↪xps-14-9440-laptop",
]

# Use WebBaseLoader from LangChain to load the Dell product pages into a␣
 ↪document.
docs = [WebBaseLoader(url).load() for url in urls]
docs_list = [item for sublist in docs for item in sublist]

text_splitter = RecursiveCharacterTextSplitter.from_tiktoken_encoder(
    chunk_size=100, chunk_overlap=50
)
doc_splits = text_splitter.split_documents(docs_list)

# Store the document in the Chroma vector store
vector_store = Chroma.from_documents(
    documents=doc_splits,
    collection_name="rag-chroma",
    embedding=OpenAIEmbeddings(),
)

# Create a retriever tool that will be used by the AI Agent to verify that the␣
 ↪document is relevant to the prompt
retriever = vector_store.as_retriever()

retriever_tool = create_retriever_tool(
    retriever,
    "retrieve_dell_docs",
    """Search Dell Knowledge base in the vector store and return information for:
        - Picking laptop models by use case and desired components
```

```
        - Special features of laptop models
        - Types of laptops""",
)

tools = [retriever_tool]
tools
```

[2]:
```
[Tool(name='retrieve_dell_docs', description='Search Dell Knowledge base in the
vector store and return information for:\n        - Picking laptop models by use
case and desired components\n        - Special features of laptop models\n
- Types of laptops', args_schema=<class
'langchain_core.tools.retriever.RetrieverInput'>,
func=functools.partial(<function _get_relevant_documents at 0x7fc48fb9f4c0>,
retriever=VectorStoreRetriever(tags=['Chroma', 'OpenAIEmbeddings'],
vectorstore=<langchain_chroma.vectorstores.Chroma object at 0x7fc48fb7ce10>,
search_kwargs={}),
document_prompt=PromptTemplate(input_variables=['page_content'], input_types={},
partial_variables={}, template='{page_content}'), document_separator='\n\n',
response_format='content'), coroutine=functools.partial(<function
_aget_relevant_documents at 0x7fc48fb9f600>,
retriever=VectorStoreRetriever(tags=['Chroma', 'OpenAIEmbeddings'],
vectorstore=<langchain_chroma.vectorstores.Chroma object at 0x7fc48fb7ce10>,
search_kwargs={}),
document_prompt=PromptTemplate(input_variables=['page_content'], input_types={},
partial_variables={}, template='{page_content}'), document_separator='\n\n',
response_format='content'))]
```

[3]:
```
# The following classes are used to maintain agent state
# and a agent graph that maps the nodes and edges

class AgentState(TypedDict):
    # The add_messages function defines how an update should be processed
    # Default is to replace. add_messages says "append"
    messages: Annotated[Sequence[BaseMessage], add_messages]
```

[4]:
```
### Edges

def grade_documents(state) -> Literal["generate", "rewrite"]:
    """
    Determines whether the retrieved documents are relevant to the question.

    Args:
        state (messages): The current state

    Returns:
        str: A decision for whether the documents are relevant or not
    """

    print("---CHECK RELEVANCE---")

    # Data model
    class grade(BaseModel):
        """Binary score for relevance check."""

        binary_score: str = Field(description="Relevance score 'yes' or 'no'")

    # LLM
#    model = ChatOpenAI(temperature=0, model="gpt-4-0125-preview",␣
 ↪streaming=True)
    model = ChatOpenAI(temperature=0, model="gpt-4o-mini", streaming=True)

    # LLM with tool and validation
    llm_with_tool = model.with_structured_output(grade)

    # Prompt
    prompt = PromptTemplate(
        template="""You are a sales person providing recommendations about which␣
 ↪dell laptop meets their needs. \n
        Here is the retrieved document: \n\n {context} \n\n
        Here is the user question: {question} \n
        If the document contains keyword(s) or semantic meaning related to the␣
 ↪user question, grade it as relevant. \n
        Give a binary score 'yes' or 'no' score to indicate whether the document␣
 ↪is relevant to the question.""",
        input_variables=["context", "question"],
    )

    # Chain
    chain = prompt | llm_with_tool

    messages = state["messages"]
    last_message = messages[-1]
```

```
    question = messages[0].content
    docs = last_message.content

    scored_result = chain.invoke({"question": question, "context": docs})

    score = scored_result.binary_score

    if score == "yes":
        print("---DECISION: DOCS RELEVANT---")
        return "generate"

    else:
        print("---DECISION: DOCS NOT RELEVANT---")
        print(score)
        return "rewrite"


### Nodes

def agent(state):
    """
    Invokes the agent model to generate a response based on the current state. Given
    the question, it will decide to retrieve using the retriever tool, or simply end.

    Args:
        state (messages): The current state

    Returns:
        dict: The updated state with the agent response appended to messages
    """
    print("---CALL AGENT---")
    messages = state["messages"]
    model = ChatOpenAI(temperature=0, streaming=True, model="gpt-4o-mini")

    model = model.bind_tools(tools)
    response = model.invoke(messages)
    return {"messages": [response]}

def rewrite(state):
    """
    Transform the query to produce a better question.

    Args:
        state (messages): The current state
```

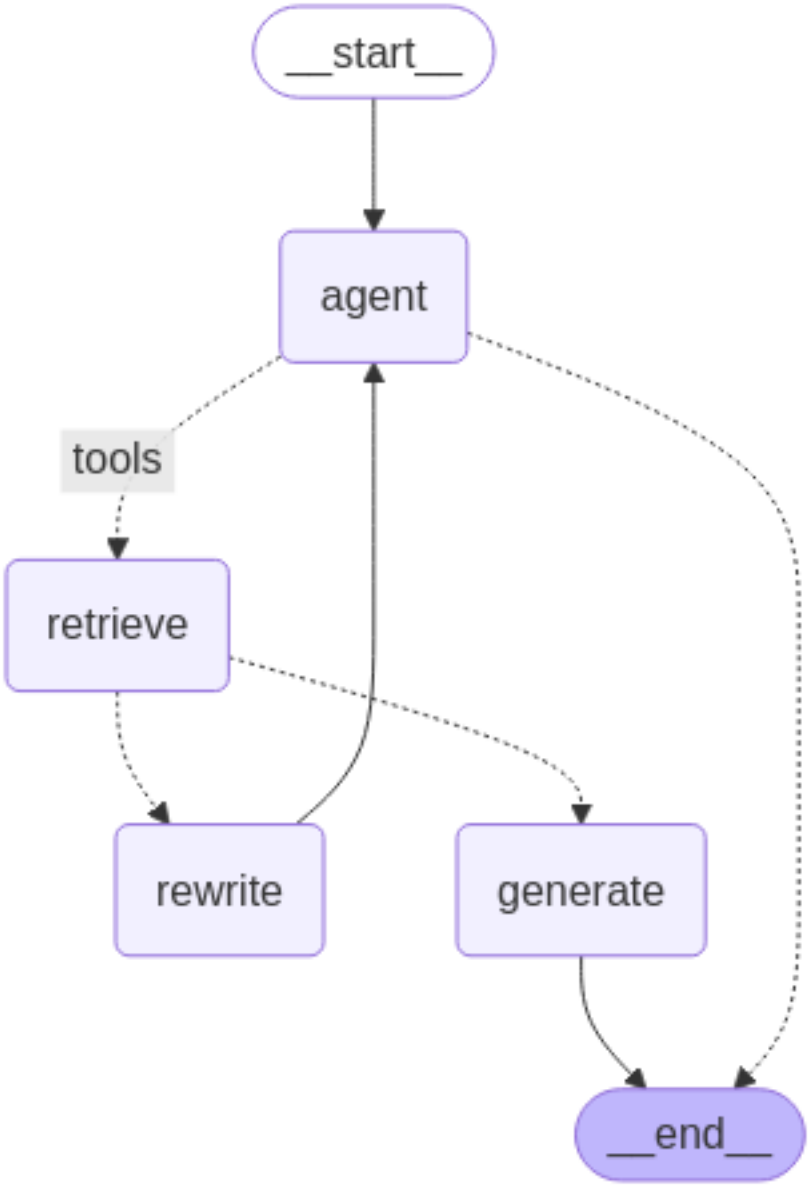
```
    Returns:
        dict: The updated state with re-phrased question
    """

    print("---TRANSFORM QUERY---")
    messages = state["messages"]
    question = messages[0].content

    msg = [
        HumanMessage(
            content=f""" \n
    Look at the input and try to reason about the underlying semantic intent /␣
 ↪meaning. \n
    Here is the initial question:
    \n ------- \n
    {question}
    \n ------- \n
    Formulate an improved question: """,
        )
    ]

    # Grader
    model = ChatOpenAI(temperature=0, model="gpt-4o-mini", streaming=True)
    response = model.invoke(msg)
    return {"messages": [response]}


def generate(state):
    """
    Generate answer

    Args:
        state (messages): The current state

    Returns:
         dict: The updated state with re-phrased question
    """
    print("---GENERATE---")
    messages = state["messages"]
    question = messages[0].content
    last_message = messages[-1]

    docs = last_message.content

    # Prompt
    prompt = hub.pull("rlm/rag-prompt")
```

```
    # LLM
    llm = ChatOpenAI(model_name="gpt-4o-mini", temperature=0, streaming=True)

    # Post-processing
    def format_docs(docs):
        return "\n\n".join(doc.page_content for doc in docs)

    # Chain
    rag_chain = prompt | llm | StrOutputParser()

    # Run
    response = rag_chain.invoke({"context": docs, "question": question})
    return {"messages": [response]}


print("*" * 20 + "Prompt[rlm/rag-prompt]" + "*" * 20)
prompt = hub.pull("rlm/rag-prompt").pretty_print()
```

```
**********Prompt[rlm/rag-prompt]**********
================================ Human Message

==================================

You are an assistant for question-answering tasks. Use the following pieces of
retrieved context to answer the question. If you don't know the answer, just say
that you don't know. Use three sentences maximum and keep the answer concise.
Question: {question}
Context: {context}
Answer:
```

[5]:
```python
# Define a new graph
workflow = StateGraph(AgentState)

# Define the nodes we will cycle between
workflow.add_node("agent", agent)  # agent
retrieve = ToolNode([retriever_tool])
workflow.add_node("retrieve", retrieve)  # retrieval
workflow.add_node("rewrite", rewrite)  # Re-writing the question
workflow.add_node(
    "generate", generate
)  # Generating a response after we know the documents are relevant
# Call agent node to decide to retrieve or not
workflow.add_edge(START, "agent")

# Decide whether to retrieve
workflow.add_conditional_edges(
    "agent",
    # Assess agent decision
    tools_condition,
    {
        # Translate the condition outputs to nodes in our graph
        "tools": "retrieve",
        END: END,
    },
)

# Edges taken after the `action` node is called.
workflow.add_conditional_edges(
    "retrieve",
    # Assess agent decision
    grade_documents,
)
workflow.add_edge("generate", END)
workflow.add_edge("rewrite", "agent")

# Compile
graph = workflow.compile()
```

[6]:
```python
# View the graph
from IPython.display import Image, display
display(Image(graph.get_graph(xray=True).draw_mermaid_png()))
```


__start__
agent
tools
retrieve
rewrite
generate
__end__

[7]:
```
# Assemble the function that will send a user message to the agent

def query_agent(user_message):
    inputs = {
        "messages": [
            ("system", """
                Instructions:
                        - Check on the user question, query, statement or prompt␣
 ↪content and use the tools to retrieve data from your knowledge base in the␣
 ↪vector store.
                        - Provide laptop recommendations for laptops that match␣
 ↪specifications in the user's prompt.
                        - For greeting type messaages, respond with message that␣
 ↪you can help with questions related to Dell laptops.
                            otherwsie reply with the message: Sorry this is out␣
 ↪of scope. You could use Google to search for this type of content/question"""),

            ("user", user_message),

        ]
    }
    for output in graph.stream(inputs):
        for key, value in output.items():
            pprint.pprint(f"Output from node '{key}':")
            pprint.pprint("---")
            pprint.pprint(value, indent=2, width=80, depth=None)
```

[8]:
```
# requirement #3
query_agent("I want a dell computer for travel that has Intel® Core™ 7 150U.")
```

```
---CALL AGENT---
"Output from node 'agent':"
'---'
{ 'messages': [ AIMessage(content='', additional_kwargs={'tool_calls':
[{'index': 0, 'id': 'call_30h3OdYUPNUL5tC8o8Pl6zXj', 'function': {'arguments':
'{"query":"Dell laptop for travel with Intel® Core™ 7 150U"}', 'name':
'retrieve_dell_docs'}, 'type': 'function'}]},
response_metadata={'finish_reason': 'tool_calls', 'model_name':
'gpt-4o-mini-2024-07-18', 'system_fingerprint': 'fp_0392822090'},
id='run-064b70f1-7846-46f2-b256-10a69683aaa4-0', tool_calls=[{'name':
'retrieve_dell_docs', 'args': {'query': 'Dell laptop for travel with Intel®
Core™ 7 150U'}, 'id': 'call_30h3OdYUPNUL5tC8o8Pl6zXj', 'type': 'tool_call'}])]}
---CHECK RELEVANCE---
---DECISION: DOCS RELEVANT---
"Output from node 'retrieve':"
'---'
{ 'messages': [ ToolMessage(content='16:10 displays, enhanced audio, ultralight
```

```
option and Intel® Core™ Ultra processor.1. Select base configuration14" 745514"
74502. Select your configurationConfiguration 1Configurable Compare Select 2 or
more products to compare them side-by-sideDell Price $1,659.00Intel® Core™ Ultra
5 135U, vPro®Windows 11 ProIntel® Graphics16 GB LPDDR5X256 GB SSD14" Non-Touch
FHD+\n\nXPS 14 Laptop | Dell\n\nDell Inspiron 14 2 in 1 Laptop 7440 with Intel
processor | Dell\n\nDell Latitude 5450 14 Inch Laptop | Dell',
name='retrieve_dell_docs', id='ca72a6b4-3e8c-4da9-9545-5a812388c1ee',
tool_call_id='call_30h3OdYUPNUL5tC8o8Pl6zXj')]}
---GENERATE---
"Output from node 'generate':"
'---'
{ 'messages': [ 'For laptops with 16:10 displays, enhanced audio, ultralight '
                'options, and Intel® Core™ Ultra processors, consider the Dell '
                'XPS 14 Laptop or the Dell Inspiron 14 2-in-1 Laptop 7440. '
                'Both models feature Intel processors and are designed for '
                'portability and performance. The Dell Latitude 5450 is '
                'another option, though it may vary in specifications.']}
```

[9]:
```
# While the response does not mention travel, specifically, it did recommend␣
↪ultralight designs.
# These laptops do have intel 7 processors, so in that sense they are accurate.
```

[10]:
```
query_agent("I want a dell computer that has Intel® Core™ Ultra 5 135U vPro® and␣
↪has 512 GB SSD.")
```

```
---CALL AGENT---
"Output from node 'agent':"
'---'
{ 'messages': [ AIMessage(content='', additional_kwargs={'tool_calls':
[{'index': 0, 'id': 'call_yPpFdOffEfKZY3EHl2uxllOq', 'function': {'arguments':
'{"query":"Dell laptop with Intel Core Ultra 5 135U vPro and 512 GB SSD"}',
'name': 'retrieve_dell_docs'}, 'type': 'function'}]},
response_metadata={'finish_reason': 'tool_calls', 'model_name':
'gpt-4o-mini-2024-07-18', 'system_fingerprint': 'fp_0392822090'},
id='run-900a2bff-9b98-47db-a2e5-98fd5d7aa9c1-0', tool_calls=[{'name':
'retrieve_dell_docs', 'args': {'query': 'Dell laptop with Intel Core Ultra 5
135U vPro and 512 GB SSD'}, 'id': 'call_yPpFdOffEfKZY3EHl2uxllOq', 'type':
'tool_call'}])]}
---CHECK RELEVANCE---
---DECISION: DOCS RELEVANT---
"Output from node 'retrieve':"
'---'
{ 'messages': [ ToolMessage(content='Core™ Ultra 5 135U, vPro®Windows 11
ProIntel® Graphics16 GB DDR5256 GB SSD14" Non-Touch FHD Tech Specs  Select
Selected Configuration 1 Configuration 2 Compare Select 2 or more products to
compare them side-by-sideDell Price $1,399.00Intel® Core™ Ultra 5 135U,
vPro®Windows 11 ProIntel® Graphics16 GB DDR5512 GB SSD14" Non-Touch FHD Tech
Specs  View\n\nhas been added to your cart.  CustomizationTech
```

```
SpecsFeaturesReviewsSupportTech SpecsProcessorIntel® Core™ Ultra 5 135U, vPro®
(12 cores, up to 4.4 GHz Turbo Max 3.0)Operating SystemWindows 11 Pro, English,
Brazilian Portuguese, French, SpanishGraphics CardIntegrated Intel® Graphics,
Core™ Ultra 5 135U vPRO Processor, 16GB LPDDR5x MemoryDisplayLaptop
14.0",\n\nPrice $1,399.00Intel® Core™ Ultra 5 135U, vPro®Windows 11 ProIntel®
Graphics16 GB DDR5512 GB SSD14" Non-Touch FHD Tech Specs  View Special Offers
Select Selected Configuration 2 Configuration 3 Compare Select 2 or more
products to compare them side-by-sideDell Price $1,559.00 Estimated Value
$1,799.00 You Save  $240.00Intel® Core™ Ultra 7\n\n16:10 displays, enhanced
audio, ultralight option and Intel® Core™ Ultra processor.1. Select base
configuration14" 745514" 74502. Select your configurationConfiguration
1Configurable Compare Select 2 or more products to compare them side-by-sideDell
Price $1,659.00Intel® Core™ Ultra 5 135U, vPro®Windows 11 ProIntel® Graphics16
GB LPDDR5X256 GB SSD14" Non-Touch FHD+', name='retrieve_dell_docs',
id='7efab7e7-1637-47a5-b8ba-ec60cc52cf64',
tool_call_id='call_yPpFdOffEfKZY3EHl2uxllOq')]}
---GENERATE---
"Output from node 'generate':"
'---'
{ 'messages': [ 'For your specifications, I recommend the Dell laptop with an '
                'Intel® Core™ Ultra 5 135U, vPro®, 16 GB DDR5, and a 256 GB '
                'SSD priced at $1,399.00. Alternatively, you could consider '
                'the model with the same processor and memory but a 512 GB SSD '
                'for $1,559.00. Both options feature a 14" Non-Touch FHD '
                'display and run on Windows 11 Pro.']}
```

[11]:
```
# The response includes laptops that match the request
# but also offer additional models with other storage amounts.
```

[12]:
```
query_agent('I want a dell computer that has Intel® Core™ Ultra 7 165U vPro® and␣
↪1 TB SSD?')
```

```
---CALL AGENT---
"Output from node 'agent':"
'---'
{ 'messages': [ AIMessage(content='', additional_kwargs={'tool_calls':
[{'index': 0, 'id': 'call_2eTsfpcityOD6FwaOpsGU48c', 'function': {'arguments':
'{"query":"Dell laptop with Intel Core Ultra 7 165U vPro and 1 TB SSD"}',
'name': 'retrieve_dell_docs'}, 'type': 'function'}]},
response_metadata={'finish_reason': 'tool_calls', 'model_name':
'gpt-4o-mini-2024-07-18', 'system_fingerprint': 'fp_0392822090'}, id='run-
af92c412-08c0-4570-b9a9-bfc19cdc7766-0', tool_calls=[{'name':
'retrieve_dell_docs', 'args': {'query': 'Dell laptop with Intel Core Ultra 7
165U vPro and 1 TB SSD'}, 'id': 'call_2eTsfpcityOD6FwaOpsGU48c', 'type':
'tool_call'}])]}
---CHECK RELEVANCE---
---DECISION: DOCS RELEVANT---
"Output from node 'retrieve':"
```

```
'---'
{ 'messages': [ ToolMessage(content='Core™ Ultra 5 135U, vPro®Windows 11
ProIntel® Graphics16 GB DDR5256 GB SSD14" Non-Touch FHD Tech Specs  Select
Selected Configuration 1 Configuration 2 Compare Select 2 or more products to
compare them side-by-sideDell Price $1,399.00Intel® Core™ Ultra 5 135U,
vPro®Windows 11 ProIntel® Graphics16 GB DDR5512 GB SSD14" Non-Touch FHD Tech
Specs  View\n\nside-by-sideDell Price $1,659.00Intel® Core™ Ultra 5 135U,
vPro®Windows 11 ProIntel® Graphics16 GB LPDDR5X256 GB SSD14" Non-Touch FHD+
(1920x1200) Tech Specs  Select Selected Configuration 1 Configuration 2 Compare
Select 2 or more products to compare them side-by-sideDell Price $1,889.00Intel®
Core™ Ultra 7 165U vPro®, 12\n\nPrice $1,399.00Intel® Core™ Ultra 5 135U,
vPro®Windows 11 ProIntel® Graphics16 GB DDR5512 GB SSD14" Non-Touch FHD Tech
Specs  View Special Offers  Select Selected Configuration 2 Configuration 3
Compare Select 2 or more products to compare them side-by-sideDell Price
$1,559.00 Estimated Value  $1,799.00 You Save  $240.00Intel® Core™ Ultra
7\n\n16:10 displays, enhanced audio, ultralight option and Intel® Core™ Ultra
processor.1. Select base configuration14" 745514" 74502. Select your
configurationConfiguration 1Configurable Compare Select 2 or more products to
compare them side-by-sideDell Price $1,659.00Intel® Core™ Ultra 5 135U,
vPro®Windows 11 ProIntel® Graphics16 GB LPDDR5X256 GB SSD14" Non-Touch FHD+',
name='retrieve_dell_docs', id='8cd79139-89be-4896-babf-6e1ac93502c0',
tool_call_id='call_2eTsfpcityOD6FwaOpsGU48c')]}
---GENERATE---
"Output from node 'generate':"
'---'
{ 'messages': [ 'For your specifications, I recommend the Dell laptops with '
                'the Intel® Core™ Ultra 5 135U, vPro®, and 16 GB RAM. You can '
                'choose between configurations with either a 256 GB SSD priced '
                'at $1,399.00 or a 512 GB SSD priced at $1,659.00. Both '
                'options feature a 14" Non-Touch FHD display.']}
```

[13]:
```
# This response did not retrieve the proper processor.
# There are very specific recommendations but they are not matching the␣
 ↪requested specs
```

[14]:
```
query_agent('I want a light weight XPS computer with Intel® Core™ Ultra 7 165U␣
 ↪vPro® and 1 TB SSD.')
```

```
---CALL AGENT---
"Output from node 'agent':"
'---'
{ 'messages': [ AIMessage(content='', additional_kwargs={'tool_calls':
[{'index': 0, 'id': 'call_4fmN5yufGTNWD7nVT3jZXx8F', 'function': {'arguments':
'{"query":"lightweight XPS laptop Intel Core Ultra 7 165U vPro 1 TB SSD"}',
'name': 'retrieve_dell_docs'}, 'type': 'function'}]},
response_metadata={'finish_reason': 'tool_calls', 'model_name':
'gpt-4o-mini-2024-07-18', 'system_fingerprint': 'fp_0392822090'},
id='run-e1bff67d-343e-4dff-b395-97b9ce7739bc-0', tool_calls=[{'name':
```

```
'retrieve_dell_docs', 'args': {'query': 'lightweight XPS laptop Intel Core Ultra
7 165U vPro 1 TB SSD'}, 'id': 'call_4fmN5yufGTNWD7nVT3jZXx8F', 'type':
'tool_call'}])]}
---CHECK RELEVANCE---
---DECISION: DOCS RELEVANT---
"Output from node 'retrieve':"
'---'
{ 'messages': [ ToolMessage(content='16:10 displays, enhanced audio, ultralight
option and Intel® Core™ Ultra processor.1. Select base configuration14" 745514"
74502. Select your configurationConfiguration 1Configurable Compare Select 2 or
more products to compare them side-by-sideDell Price $1,659.00Intel® Core™ Ultra
5 135U, vPro®Windows 11 ProIntel® Graphics16 GB LPDDR5X256 GB SSD14" Non-Touch
FHD+\n\nCore™ Ultra 5 135U, vPro®Windows 11 ProIntel® Graphics16 GB DDR5256 GB
SSD14" Non-Touch FHD Tech Specs  Select Selected Configuration 1 Configuration 2
Compare Select 2 or more products to compare them side-by-sideDell Price
$1,399.00Intel® Core™ Ultra 5 135U, vPro®Windows 11 ProIntel® Graphics16 GB
DDR5512 GB SSD14" Non-Touch FHD Tech Specs  View\n\nside-by-sideDell Price
$1,659.00Intel® Core™ Ultra 5 135U, vPro®Windows 11 ProIntel® Graphics16 GB
LPDDR5X256 GB SSD14" Non-Touch FHD+ (1920x1200) Tech Specs  Select Selected
Configuration 1 Configuration 2 Compare Select 2 or more products to compare
them side-by-sideDell Price $1,889.00Intel® Core™ Ultra 7 165U vPro®, 12\n\nhas
been added to your cart.  CustomizationTech SpecsFeaturesReviewsSupportTech
SpecsProcessorIntel® Core™ Ultra 5 135U, vPro® (12 cores, up to 4.4 GHz Turbo
Max 3.0)Operating SystemWindows 11 Pro, English, Brazilian Portuguese, French,
SpanishGraphics CardIntegrated Intel® Graphics, Core™ Ultra 5 135U vPRO
Processor, 16GB LPDDR5x MemoryDisplayLaptop 14.0",', name='retrieve_dell_docs',
id='56b418bc-0a4a-4fff-bfa4-f77a774306ba',
tool_call_id='call_4fmN5yufGTNWD7nVT3jZXx8F')]}
---GENERATE---
"Output from node 'generate':"
'---'
{ 'messages': [ 'For your specifications, I recommend the Dell 14" 7455 with '
                'an Intel® Core™ Ultra 5 135U processor, 16 GB LPDDR5X memory, '
                'and a 256 GB SSD, priced at $1,659. Alternatively, you could '
                'consider the Dell 14" 7450 with similar specs but a 512 GB '
                'SSD for $1,399. Both options feature a 14" Non-Touch FHD '
                'display and enhanced audio.']}
```

[15]:
```
# The response does not mention it specifically but it did recommend a␣
↪lightwight model.
# The memory does not match the requested specs.
```

[16]:
```
query_agent("What laptop has the intel 7 processor?")
```

```
---CALL AGENT---
"Output from node 'agent':"
'---'
{ 'messages': [ AIMessage(content='', additional_kwargs={'tool_calls':
[{'index': 0, 'id': 'call_32yr7lgayC2WAWhd3w1JYM2y', 'function': {'arguments':
'{"query":"laptop with Intel 7 processor"}', 'name': 'retrieve_dell_docs'},
'type': 'function'}]}, response_metadata={'finish_reason': 'tool_calls',
'model_name': 'gpt-4o-mini-2024-07-18', 'system_fingerprint': 'fp_0392822090'},
id='run-093294c3-3553-4430-ad28-b4cbb7cf5579-0', tool_calls=[{'name':
'retrieve_dell_docs', 'args': {'query': 'laptop with Intel 7 processor'}, 'id':
'call_32yr7lgayC2WAWhd3w1JYM2y', 'type': 'tool_call'}])]}
---CHECK RELEVANCE---
---DECISION: DOCS RELEVANT---
"Output from node 'retrieve':"
'---'
{ 'messages': [ ToolMessage(content='Dell Inspiron 14 2 in 1 Laptop 7440 with
Intel processor | Dell\n\nlaptop with multiple modes, built with Intel Core
processors and DDR5 memory.Select your configurationDell Technologies recommends
Windows 11 Pro for business. Warranty support options vary by operating system:
Dell offers support plans for businesses with Windows Pro and support plans for
personal use with Windows Home.Configuration 1 Compare Select 2 or more products
to compare them side-by-sideDell Price $499.99 Estimated Value  $679.99 You Save
$180.0013th Gen Intel® Core™\n\nhas been added to your cart.  CustomizationTech
SpecsFeaturesReviewsSupportTech SpecsProcessorIntel® Core™ Ultra 5 135U, vPro®
(12 cores, up to 4.4 GHz Turbo Max 3.0)Operating SystemWindows 11 Pro, English,
Brazilian Portuguese, French, SpanishGraphics CardIntegrated Intel® Graphics,
Core™ Ultra 5 135U vPRO Processor, 16GB LPDDR5x MemoryDisplayLaptop
14.0",\n\ncart.  CustomizationTech SpecsFeaturesReviewsSupportTech
SpecsProcessor13th Gen Intel® Core™ i5-1334U (10 cores, up to 4.6 GHz)Operating
System(Dell Technologies recommends Windows 11 Pro for business)Windows 11 Home,
English, French, SpanishGraphics CardIntel® UHD GraphicsDisplay14", Touch, FHD+
1920x1200, 60Hz, WVA, IPS, 250 nit, ComfortViewMemory *8',
name='retrieve_dell_docs', id='0c475ab9-5820-48f2-838b-854702b5984b',
tool_call_id='call_32yr7lgayC2WAWhd3w1JYM2y')]}
---GENERATE---
"Output from node 'generate':"
'---'
{ 'messages': [ 'For a versatile laptop, consider the Dell Inspiron 14 2-in-1 '
                'Laptop 7440, which features a 13th Gen Intel® Core™ i5 '
                'processor, 16GB LPDDR5x memory, and a 14" FHD+ touch display. '
                'It is designed for multiple modes and is recommended with '
                'Windows 11 Pro for business use. The price is approximately '
                '$499.99, offering good value for its specifications.']}
```