

Things that needed change from previous week :

- i) Responses were chunky and didn't make it easy to read for naive users
- ii) comparison between arxiv and rag agent wasn't reasonable

Changes made :

- i) I introduced a base prompt for both the rag and arxiv agent gave it a structuring so that the llm knows it has to follow a particular format while answering

Base prompt for arxiv and ibm api agents)

```
def build_prompt(self, message: str, category: str) -> str:
    base = f"""
    You are QuantumTutor, a friendly and enthusiastic tutor specializing in quantum computing.
    Explain the following query in a simple, fun, and structured way: '{message}'.
    Use analogies, real-world examples, and avoid complex jargon to make it learner-friendly.
    Structure your response with:
    - An introduction (start with a hook to grab attention)
    - Key points using bullet points (•) to break down the concept
    - A conclusion (wrap up with an encouraging note)
    """
```

By doing this the agent would give out more structured responses, but then I also noticed over few queries the agent was giving similar structured answers for queries related code too

Then I introduced a keyword based if-else snippet to resolve this issue and classify queries

```
def classify_query(self, message: str) -> str:
    lowered = message.lower()
    if any(k in lowered for k in ['code', 'python', 'program', 'implementation']):
        return 'code'
    elif any(k in lowered for k in ['arxiv', 'paper', 'research', 'journal', 'citation']):
        return 'research'
    elif any(k in lowered for k in ['difference', 'vs', 'compare']):
        return 'comparison'
    elif any(k in lowered for k in ['formula', 'derive', 'equation', 'proof', 'math']):
        return 'math'
    elif any(k in lowered for k in ['application', 'real world', 'industry']):
        return 'application'
    elif any(k in lowered for k in ['history', 'who discovered', 'origin']):
        return 'history'
    elif any(k in lowered for k in ['fun fact', 'joke', 'trivia']):
        return 'fun'
    elif any(k in lowered for k in ['mcq', 'quiz', 'questionnaire']):
        return 'quiz'
    elif any(k in lowered for k in ['translate', 'in hindi', 'in tamil', 'meaning in']):
        return 'translation'
    else:
        return 'general'
```

The same has been done to rag agent

I ingested a book named “Introduction to Classical and Quantum Computing” by Thomas G.Wong, and two research papers on quantum computing ,all together the document pages add up to 458 pages To which later a chunking strategy of size = 1000 and overlap = 200 was performed which gave 1122 document chunks.

To keep relevance in comparison I’ve asked same question to both the agents

a)Arxiv Agent responses

Q1)What is Quantum Superposition and how does it enable Quantum Parallelism?

ans) Introduction:

Quantum superposition is a fundamental principle in Quantum mechanics that allows particles to exist in multiple states at once. Imagine a coin that is spinning in mid-air, it can be considered as being in two states - heads or tails - until it lands. Similarly, a Quantum particle can be in multiple states at the same time.

Key points:

- Quantum superposition allows a Quantum particle to be in multiple states at once, similar to the spinning coin example.
- Quantum parallelism is the ability of a Quantum system to perform multiple calculations simultaneously, utilizing the principle of superposition.
- In a Quantum computer, Quantum bits (qubits) can exist in multiple states at once, enabling them to perform multiple calculations simultaneously.
- By using Quantum superposition, a Quantum computer can solve complex problems much faster than a classical computer.

Conclusion:

Quantum superposition is a fascinating concept that enables Quantum parallelism, allowing Quantum computers to perform multiple calculations simultaneously. By understanding this concept, you can appreciate the power of Quantum computing and the potential it has to revolutionize the way we solve complex problems. Remember, with Quantum computing, the sky's the limit!

b) RAG agent response

Q) What is quantum superposition, and how does it enable quantum parallelism?

Response:

1.1 Introduction to Quantum Superposition

Quantum superposition is a fundamental principle in quantum mechanics that allows particles to be in multiple states at once. In classical computing, a bit (short for binary digit) can be either a 0 or a 1, but in quantum computing, a qubit (quantum bit) can be in both states simultaneously. This unique

property enables quantum computing to perform multiple calculations in parallel, leading to the concept of quantum parallelism.

1.2 Explanation of Quantum Superposition

Quantum superposition is similar to the concept of Schrodinger's cat, a famous thought experiment that demonstrates the idea of being in multiple states at once. In the experiment, a cat placed in a sealed box is both alive and dead until the box is opened and observed. Similarly, a qubit can be in a superposition of 0 and 1 until measured, at which point it will collapse into one of those states.

1.3 Quantum Parallelism and Superposition

Quantum parallelism is the ability to perform many computations simultaneously using quantum bits (qubits) in a superposition state. The more qubits a quantum computer has, the more states it can be in, leading to more calculations being performed in parallel.

2.0 Example of Quantum Superposition and Parallelism

Consider a classical computer with a single bit. It can perform four possible calculations in parallel: 00, 01, 10, and 11. Now, consider a quantum computer with two qubits. It can be in a superposition of four states: 00, 01, 10, and 11. However, the quantum computer can also be in a superposition of two states representing two qubits: 00 and 11. This superposition of two states allows the quantum computer to perform more calculations in parallel than the classical computer.

2.1 Real-World Applications of Quantum Superposition

Quantum superposition has many potential applications in various fields, such as quantum computing, cryptography, and quantum simulations. By exploiting the principles of quantum superposition, quantum computers can perform complex calculations much faster than classical computers. This could lead to breakthroughs in fields like drug discovery, climate modeling, and artificial intelligence.

2.2 Implications of Quantum Superposition

Quantum superposition has far-reaching implications for our understanding of the universe. By studying the behavior of quantum systems, scientists can gain insights into the nature of reality and the fundamental principles of the universe. Moreover, as quantum computing becomes more advanced, it may lead to new technologies and discoveries that could revolutionize various industries and fields of study.

I've also asked many questions which aren't straight forward,I'll be showing the demo on Thursday mam

Thanking you,
Adithya Reddy.

