

## Week - 4 -Quantum Tutor BeeAI Agentic Chatbot

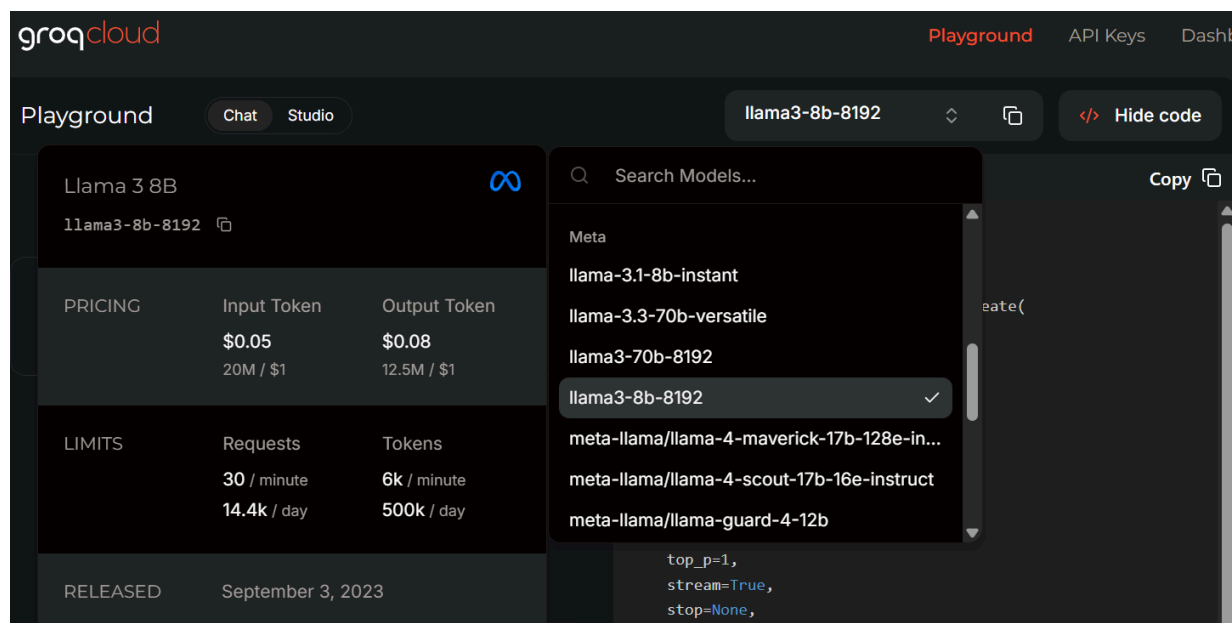
Previously I had offloaded Deepseek 7B LLM on my laptop and I had used my local VRAM and Google Collab T4 GPU the avg response time was about 20s

### **A)Problems faced with this method**

- i) When I tried to ask more than 10 qs my Collab runtime crashed and it wasn't efficient too,as the queries increased the VRAM only increase and the responses started to take more time
- ii)I wasn't able to experiment different llms and embedding models and compare each other



### **B)Solution to the Problem**

- i)I moved to a much more simple architecture using groq cloud api, now I don't need to offload 10GB-20GB files on my system
- ii)easier set up and initially I thought groq cloud was paid but I found few llms to be free in the platform,I chose llama3-8b-8192 as my llm
- iii)The logic of the framework still remains the same,it's just that now I have an efficient way of initializing queries
- iv) I initially thought it was paid,but it has a free-limit version too,for example the below image has about 14.4k free API calls free per day that's about 14.4k questions/queries to our chatbot if we were to ask so many questions.I felt this would be reasonable for our chatbot



v)The results are much better than previous prototype all of the reponses come down to below 5s and in some cases below 1s, I even got responses with a response time 0.54s too it depends on the traffic on groq api and the question but then **on an average of 6 queries I got a response time about 1.681s**

**Here are few responses from the chatbot**

 Ask your quantum computing question (or type 'exit' to quit):  
 Query: write a qiskit code to generate bell state IBM

 PERFORMANCE METRICS:  
• Total Time (measured): 4.00 seconds

 Category: code

 Agent Response:

-----  
\*\*Hook:\*\* Are you ready to unlock the secrets of Quantum computing and create a Bell state that's out of this world?

\*\*Let's dive in!\*\*

A Bell state is a fundamental concept in Quantum mechanics that describes the entangled state of two particles. In the context of Quantum computing, creating a Bell state is crucial for various applications, such as Quantum teleportation and Quantum cryptography. But don't worry, I'll guide you through it in a fun and easy-to-understand way!

\*\*Key points:\*\*

- **What is a Bell state?** A Bell state is a Quantum state where two particles are entangled, meaning their properties are connected in a way that can't be explained by classical physics. Think of it like two dancers performing a choreographed routine - their movements are connected, and if one dancer changes their step, the other dancer will too.
- **Why do we need Bell states?** Bell states are essential for Quantum computing because they allow us to perform Quantum operations and measurements on multiple qubits simultaneously. This enables us to solve complex problems that are too difficult for classical computers to solve.
- **How do we create a Bell state?** We can create a Bell state using a Quantum circuit on IBM Qiskit, a popular Quantum development environment. We'll use the `qiskit` library and write a simple Python code snippet to generate the Bell state.

\*\*Code snippet:\*\*  
```python

```

import qiskit

# Define the Quantum circuit
qc = qiskit.QuantumCircuit(2)

# Apply Hadamard gates to both qubits
qc.h(0)
qc.h(1)

# Apply a CNOT gate to entangle the qubits
qc.cx(0, 1)

# Measure the qubits
qc.measure_all()

# Print the Quantum circuit
print(qc)
` ``

```

This code creates a Quantum circuit with two qubits, applies Hadamard gates to both qubits, entangles them using a CNOT gate, and measures the qubits. The resulting Bell state is a superposition ⚡ of the two qubits being in the same or opposite states.

**\*\*Conclusion:\*\***

Woohoo! You've just created a Bell state using Qiskit! This is a fundamental concept in Quantum computing, and now you have the skills to generate it. Remember, the Bell state is like a dance between two particles - their movements are connected, and understanding this connection is key to unlocking the power of Quantum computing.

Keep exploring and experimenting with Qiskit and Quantum computing - the possibilities are endless!

-----

📖 Ask your quantum computing question (or type 'exit' to quit):

? Query: What problem does Grover's algorithm solve more efficiently than classical methods?

🕒 PERFORMANCE METRICS:

- Total Time (measured): 2.52 seconds

📁 Category: general

🤖 Agent Response:

-----

Buckle up, folks! We're about to embark on a thrilling adventure through the world of Quantum computing!

**\*\*Introduction\*\***

Imagine you're at a massive library with an infinite number of books. You're searching for a specific book, but you don't know the title or author. You start by browsing through shelves, opening books, and checking if they're the one you're looking for. Sounds like a daunting task, right?

**\*\*Grover's Algorithm to the Rescue!\*\***

Enter Grover's algorithm, a Quantum computing marvel that solves the problem of searching an unsorted database more efficiently than classical methods!

Here's how it works:

- **\*\*Classical search\*\***: Imagine you're searching for that book by manually checking each book on the shelf. It's like opening 100 books, then 200 books, and so on. The number of books you need to check grows exponentially with the size of the library. That's why classical search algorithms can be slow and impractical for large datasets.
- **\*\*Quantum search\*\***: Grover's algorithm uses Quantum computing's superpower – Quantum parallelism! It can search the entire library simultaneously, like flipping through all the books in the library at once. This reduces the number of "opens" needed to find the book, making it exponentially faster than classical methods.
- **\*\*Quantum supremacy\*\***: Grover's algorithm demonstrates Quantum supremacy by solving a problem that's computationally intractable for classical computers. It's like having a superpower that allows you to find that book in a fraction of the time it would take a classical computer!

**\*\*Conclusion\*\***

Grover's algorithm is a remarkable example of how Quantum computing can tackle complex problems more efficiently than classical methods. By harnessing the power of Quantum parallelism, it can search vast databases in a fraction of the time. So, the next time you're searching for something online, remember that Quantum computing is working behind the scenes to make it happen faster!

Keep exploring, and who knows what other Quantum wonders you'll discover!

-----



Ask your quantum computing question (or type 'exit' to quit):



Query: Illustrate comparison between Quantum Machine Learning and Machine Learning?



PERFORMANCE METRICS:

- Total Time (measured): 1.26 seconds



Category: general



Agent Response:

-----

Buckle up, folks! We're about to embark on a thrilling adventure through the realms of machine learning and Quantum computing!

**\*\*Introduction\*\***

Imagine you're on a treasure hunt, searching for the elusive "Golden Nugget" of knowledge. You've got two trusty maps to guide you: the traditional "Machine Learning Map" and the cutting-edge "Quantum Machine Learning Map". Both maps promise to lead you to the treasure, but which one will get you there faster and more efficiently?

### **\*\*Key Points: The Comparison\*\***

Here are the key differences between traditional Machine Learning and Quantum Machine Learning:

- **\*\*Algorithmic Approach\*\***: Traditional Machine Learning relies on classical algorithms, like Gaussian Mixture Models or Decision Trees, to learn from data. Quantum Machine Learning, on the other hand, leverages the power of Quantum computers to solve complex problems using Quantum algorithms, such as Quantum Approximate Optimization Algorithm (QAOA) or Quantum Support Vector Machines (QSVM).
- **\*\*Data Complexity\*\***: Traditional Machine Learning can handle relatively small to moderate-sized datasets. Quantum Machine Learning, with its exponential scaling, can tackle massive datasets and solve problems that are intractable with classical computers.
- **\*\*Speed\*\***: Quantum computers can process information at an exponential rate compared to classical computers. This means that Quantum Machine Learning algorithms can solve problems in a fraction of the time it would take traditional Machine Learning methods.
- **\*\*Problem-Solving\*\***: Traditional Machine Learning is great for solving specific, well-defined problems. Quantum Machine Learning, with its ability to explore an exponentially large solution space, is better suited for solving complex, real-world problems that involve multiple variables and interactions.
- **\*\*Noise and Error Correction\*\***: Quantum computers are prone to errors due to the noisy nature of Quantum systems. Quantum Machine Learning algorithms need to incorporate error correction mechanisms to ensure reliable results. Traditional Machine Learning algorithms are less susceptible to errors.

### **\*\*Conclusion\*\***

In conclusion, Quantum Machine Learning is like having a super-powerful GPS system that can navigate the most complex terrain, while traditional Machine Learning is like having a reliable compass that gets you to your destination, but with a bit more effort.

As you continue your treasure hunt, remember that Quantum Machine Learning is still an emerging field, and its applications are being actively explored. The potential for breakthroughs is vast, and the future of machine learning looks brighter than ever!

So, are you ready to upgrade your treasure-hunting skills with Quantum Machine Learning?

-----



Ask your quantum computing question (or type 'exit' to quit):

Query: How does quantum field theory reconcile particle and wave behavior?arXiv



#### PERFORMANCE METRICS:

- Total Time (measured): 1.39 seconds



Category: research



#### Agent Response:

-----  
\*\*QuantumTutor here, and we're about to dive into the fascinating world of Quantum field theory!\*\*

**\*\*Hook:\*\*** Imagine you're at a music festival, and you're grooving to your favorite band. The crowd is moving as one, waving their arms and dancing together. But if you zoom in on a single person, they're actually just moving their individual body parts. This is kinda like the paradox of particle and wave behavior in Quantum mechanics. How do we reconcile these two seemingly contradictory aspects?

**\*\*Key Points:\*\***

- **\*\*Waves and Particles:\*\*** In classical physics, objects can either be described as particles (like marbles) or waves (like ocean waves). However, in Quantum mechanics, particles can exhibit both wave-like and particle-like behavior depending on how we observe them.
- **\*\*Quantum Fields:\*\*** Quantum field theory introduces a new concept: fields. Think of fields like the air we breathe. They're all around us, and they can transmit energy and information. In Quantum field theory, particles aren't separate entities; they're excitations of these fields.
- **\*\*Excitations:\*\*** Imagine a guitar string. When you pluck it, it vibrates and produces a wave-like pattern. In Quantum field theory, particles are like these vibrations or excitations of the fields. When we observe them, we see the particle-like behavior. But when we don't, they behave like waves.
- **\*\*Reconciliation:\*\*** So, how do we reconcile the wave-like and particle-like behavior? The answer lies in the math. Quantum field theory uses mathematical equations to describe the behavior of these fields and the particles that arise from them. These equations show that both wave-like and particle-like behavior are inherent in the nature of the field itself.
- **\*\*Research Areas:\*\*** Researchers are actively exploring the connections between Quantum field theory and other areas, such as:
  - + Condensed matter physics: studying the behavior of particles in solids and liquids
  - + Particle physics: understanding the fundamental forces and interactions between particles
  - + Quantum information science: developing new technologies for Quantum computing and communication

**\*\*Conclusion:\*\*** Ah, the magic of Quantum field theory! By introducing the concept of fields and excitations, we can reconcile the seemingly contradictory aspects of particle and wave behavior. It's a mind-bending idea, but the math behind it is what makes it powerful. Want to dive deeper? Head over to arXiv, where you can find recent papers on Quantum field theory and related research areas. Who knows, you might just discover the next big breakthrough!

-----

👉 Ask your quantum computing question (or type 'exit' to quit):

? Query: Explain Quantum Entanglement

🕒 PERFORMANCE METRICS:

- Total Time (measured): 0.92 seconds

📁 Category: general

🤖 Agent Response:

-----  
\*\*Quantum entanglement 🔗: The Mysterious Connection!\*\*

Are you ready to uncover the mind-blowing secrets of Quantum entanglement 🔗? Imagine you have two toy boxes, each containing a different colored ball. You can't see inside the boxes, but somehow, you know that if you open one box and find a red ball, the other box will also contain a red ball, even if they're on opposite sides of the world! Sounds like magic, right? Well, it's not magic – it's Quantum entanglement 🔗!

\*\*Key Points:\*\*

- \*\*Entangled particles:\*\* Quantum entanglement 🔗 occurs when two or more particles become connected in such a way that their properties are correlated, regardless of the distance between them.
- \*\*Spooky connection:\*\* When something happens to one particle, it instantly affects the other entangled particles, even if they're separated by billions of kilometers. It's as if they're "talking" to each other in a way that's faster than the speed of light!
- \*\*Measurement affects both:\*\* When you measure the state of one particle, it instantly determines the state of the entangled particles, regardless of the distance. It's like they're "linked" in a way that transcends space and time.
- \*\*No communication required:\*\* Quantum entanglement 🔗 doesn't require any physical connection or communication between the particles. They just "know" what's happening to each other.
- \*\*Quantum weirdness:\*\* entanglement 🔗 is a fundamental aspect of Quantum mechanics, but it's still very strange and difficult to understand. It challenges our classical understanding of space, time, and reality!

\*\*Conclusion:\*\*

Quantum entanglement 🔗 is an amazing phenomenon that shows us the power and mystery of Quantum mechanics. It's a concept that can seem mind-boggling at first, but with a little practice and patience, you can wrap your head around it. Who knows? You might just discover the next breakthrough in Quantum computing or cryptography!

So, are you ready to explore the fascinating world of Quantum entanglement 🔗? Let's dive deeper and uncover the secrets of this mysterious connection !