

Part 1: Theoretical Analysis

1. Essay Questions

- **Q1:** How **Edge AI** reduces latency and enhances privacy compared to cloud-based AI.
 - First lets explain **Latency** - It's the time between a user's/system's action and the network's response, high latency can make a connection feel slow. Factors like physical distance, network congestion, and the number of devices between the source and destination all contribute to latency
 - **Edge AI** reduces this latency by minimizing the distance data must travel as data is processed directly on the devices or a local edge server eliminating the bottleneck of network congestion and transmission time. This is critical for applications that require **instantaneous responses**
- Provide a **real-world example**
 - The sensor-processing system in autonomous vehicles - AI models for object detection, lane-keeping, and pedestrian recognition run on powerful, dedicated chips **inside the vehicle**. Thus the need for ultra low latency for instantaneous decision making
- **Q2:** Compare **Quantum AI** and classical AI in solving optimization problems.

Quantum AI	Classical AI
Qubits (can be 0, 1, or both simultaneously via superposition) - Explores many possibilities simultaneously, which is much faster for specific, complex problems	Bits (0 or 1). Processes information sequentially or in parallel on a binary system - that can be time-consuming for complex issues.
Quantum algorithms, such as the Quantum Approximate Optimization Algorithm (QAOA) , can potentially provide a super-polynomial or exponential speedup for specific problem types.	Time complexity can grow exponentially with the size and complexity of the problem, making certain tasks intractable (too slow to solve).
A developing field, with hybrid approaches (combining quantum and classical computing) being used for current problems (e.g., error correction, maintaining coherence)	A mature technology used for a wide range of applications today (e.g., recommendation systems, self-driving cars, NLP).

- What industries could benefit most from Quantum AI?
 - Its benefit lies in its potential to solve problems where the number of variables is so large that the time required for a classical supercomputer to find the optimal solution would be thousands of years. These are; Finance/Investment, Pharmaceuticals and Materials Science, Logistics and Supply Chain and Energy and Manufacturing.

