1. Essay Questions

Q1: Edge AI – Reducing Latency and Enhancing Privacy

Edge AI refers to the execution of artificial intelligence algorithms directly on local hardware devices rather than in remote cloud servers. This local processing significantly reduces latency, allowing devices to make real-time decisions without waiting for data to travel to and from the cloud.

It also enhances data privacy, as sensitive information—such as video feeds or biometric readings—is not continuously transmitted over networks, minimizing exposure to potential breaches or surveillance. Real-world example: Autonomous drones equipped with Edge AI can identify hazards, avoid obstacles, or locate missing persons in disaster zones without relying on cloud-based communication. For instance, during wildfire monitoring, drones use onboard computer vision to map hot zones instantly, ensuring rapid response and operational secrecy in areas with limited connectivity.

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Q2: Quantum AI vs Classical AI in Optimization

Classical AI solves optimization problems through trial-and-error or heuristic methods, which can become computationally expensive as complexity grows. **Quantum AI**, in contrast, uses quantum bits (qubits) to represent and process vast possibilities simultaneously—making it particularly effective for highly complex optimization problems.

This quantum advantage becomes significant in industries like:

- **Logistics:** Route optimization for global supply chains, where there are billions of possible configurations.
- **Finance:** Portfolio optimization under market uncertainty and risk constraints.
- **Energy:** Efficient power grid distribution balancing real-time demands and renewable sources.

While practical Quantum AI is still emerging, early-stage experiments (e.g., DHL and Volkswagen using quantum annealing) show promise in dramatically speeding up problem-solving.

Q3: Societal Impact of Human-AI Collaboration in Healthcare

Human-AI collaboration in healthcare is transforming traditional roles, enhancing service delivery while preserving essential human judgment.

For example, **radiologists** now use AI to screen X-rays or MRIs for abnormalities. AI handles bulk analysis, improving detection speed and accuracy, while the radiologist verifies results and makes final interpretations.

Nurses benefit from AI-powered monitoring tools that predict patient deterioration (e.g., sepsis alert systems), allowing timely interventions. Documentation is streamlined with AI-enabled transcription and charting.

Societal impact: This collaboration leads to:

- More accurate diagnoses
- Reduced healthcare workload
- More time for patient-centered care

However, it also raises challenges around training, accountability, and maintaining trust in a semi-automated care system.

2. Case Study Critique: AI in Smart Cities (AI-IoT for Traffic Management)

How AI + IoT Improves Urban Sustainability

Integrating AI with IoT in traffic management allows cities to:

- **Predict and optimize traffic flows** using real-time data from sensors and cameras.
- **Reduce emissions** by minimizing idling and congestion through smart signals.
- **Improve public transport coordination** by dynamically adjusting schedules based on demand.

Together, these technologies make urban mobility more efficient, reducing environmental impact and enhancing quality of life.

AI-IoT integration in smart cities enhances **urban sustainability** by using connected sensors, traffic cameras, and AI algorithms to analyze traffic patterns and optimize flow. Benefits include:

- **Lower emissions**: By reducing traffic jams and idle time.
- **Improved public transit**: AI can adjust bus routes dynamically based on usage data.
- **Safer streets**: Smart crosswalks and traffic lights respond to pedestrian and vehicle movements in real time.

Challenges:

1. **Data Security:** The continuous collection of geolocation and behavioral data raises risks of hacking or surveillance misuse, requiring robust encryption and ethical governance.

2. **System Interoperability:** Cities often use a patchwork of old and new technologies. Getting them to communicate effectively without disruptions is technically challenging and expensive.