

## 1. Theoretical Depth & Insight

For each theme below, prepare a concise but insightful explanation, citing current trends, key technologies, and ethical considerations:

### Edge AI:

AI models running locally on devices for real-time low-latency processing without cloud reliance.

Applications: autonomous vehicles, smart assistants, surveillance.

Ethical topics: data privacy enhanced by local processing, reduced dependence on cloud (security risks), equitable access.

### AI-IoT Integration:

IoT devices equipped with AI models (Edge AI) enabling autonomous, intelligent decisions on-device.

Discuss data flow, communication protocols (MQTT, REST APIs), and challenges in synchronization and privacy.

### Human-AI Collaboration:

AI as an augmenting partner (e.g., voice AI assistants with fallback human agents).

Ethical concerns: transparency, trust, and managing AI limitations for responsible handoff.

### Quantum AI:

Using quantum computing to accelerate AI model training and optimization.

Introduce IM Quantum Experience as a resource for experimentation.

Ethical perspectives on quantum advantage and technology access.

### Personalized Medicine:

AI leveraging genomics and patient data (e.g., TCGA dataset) for tailored treatment plans.

Ethical issues: sensitive health data handling, informed consent, bias in AI diagnostic models.

## Ethical Challenges:

Biases in AI datasets, security of on-device data, transparency of AI decisions, sustainability of AI infrastructure

## Case Study Critique: AI in Smart Cities

### How Integrating AI with IoT Improves Urban Sustainability

Integrating AI with IoT turns cities into adaptive systems that continuously monitor and optimize resource use, cutting waste and emissions while improving quality of life.

- Real-time traffic management: AI ingests IoT sensor and camera feeds to adjust signal timings dynamically, cutting vehicle idle time and lowering fuel consumption and emissions.
- Predictive infrastructure maintenance: IoT-enabled streetlights, water meters, and waste bins stream operational data to AI models that forecast failures before they occur, extending asset life and avoiding emergency repairs.
- Demand-driven public transport: Sensor-based passenger counts feed AI algorithms that optimize schedules and routes, reducing energy use per rider and improving service efficiency.

### Key Challenges

#### - Data Security

IoT devices often lack strong embedded defenses. A breach can disrupt critical services—traffic systems, utilities—and expose AI controls to manipulation, posing safety risks and undermining public trust.

#### - Data Privacy

Continuous, fine-grained collection of mobility and usage data raises privacy concerns. Without robust anonymization, consent frameworks, and compliance measures, smart-city initiatives risk regulatory violations and citizen pushback.

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