

# AI ASSIGNMENT WEEK 6

## TASK 1

### Q1: How Edge AI Reduces Latency and Enhances Privacy Compared to Cloud-Based AI

Edge AI refers to the deployment of artificial intelligence models directly on devices at the "edge" of the network, such as sensors, smartphones, or embedded systems. This local processing model contrasts sharply with cloud-based AI, which typically involves transmitting data to remote servers for analysis and response.

One of the major advantages of Edge AI is its ability to **reduce latency**. Since computation happens directly on the device, it eliminates the need for round-trip communication with cloud servers. This leads to faster response times, which is critical for applications requiring real-time decisions. For example, autonomous drones tasked with search and rescue operations must analyze environmental data instantly to navigate safely and locate individuals. Delays caused by remote processing could hinder mission success or even compromise safety.

Edge AI also significantly **enhances privacy**. When data is processed locally, it is not transmitted externally, which reduces the risk of interception, misuse, or breaches. This is especially beneficial in sensitive contexts like healthcare monitoring, smart homes, or industrial facilities, where personal or confidential data must be handled securely. By keeping data on-device, Edge AI supports compliance with privacy regulations and builds user trust.

The application of Edge AI in autonomous drones highlights these benefits. Drones equipped with on-board vision models can recognize obstacles, identify people, and make flight path adjustments instantly. Because the data never leaves the device, it protects the privacy of individuals being observed while ensuring rapid decision-making in mission-critical scenarios.

### Q2: Comparing Quantum AI and Classical AI in Solving Optimization Problems

Quantum AI is a new way of using computers to solve difficult problems. It works differently from classical AI, which is what we mostly use today. Classical AI solves problems step by step, and it can be slow when the problem has many variables or choices. Quantum AI, on the other hand, uses ideas from quantum physics that let it look at many options at once.

This helps Quantum AI solve optimization problems faster. Optimization means finding the best solution out of many possible ones, like choosing the best delivery route or figuring out the right mix of medicines. Quantum AI can do this better in some cases because it checks lots of answers at the same time, while classical AI has to try them one by one.

Industries that can gain a lot from Quantum AI include:

- **Healthcare:** It can speed up drug discovery by quickly testing how different molecules behave.
- **Logistics:** It can help companies plan delivery routes more efficiently.
- **Finance:** It can improve how banks pick investments or detect fraud.
- **Energy:** It can help balance power grids and plan energy use better.

Even though Quantum AI is still developing and not ready for all tasks, it's showing promise for solving problems that classical AI finds too slow or too complex.

### Q3: Societal Impact of Human-AI Collaboration in Healthcare

Human-AI collaboration is changing the way healthcare professionals work and how patients receive care. Instead of replacing people, AI is becoming a support tool that helps doctors and nurses make better, faster decisions.

In radiology, for example, AI systems can analyze medical images like X-rays or MRIs and highlight areas that might show signs of illness. This helps radiologists focus on critical cases and catch conditions that might be missed. While the final diagnosis still comes from the human expert, AI speeds up the process and adds another layer of accuracy.

For nurses, AI tools can monitor patient data in real time and alert staff to potential problems, such as changes in heart rate or breathing. This allows nurses to respond quickly and manage their time more efficiently. It can also reduce burnout by handling routine tasks like documentation or reminders.

On a broader scale, AI can help hospitals manage resources, predict patient needs, and support personalized treatment plans. This improves both care quality and patient outcomes.

However, it's important to consider the social impact. As AI becomes more common in hospitals, healthcare workers will need to learn new skills and adapt to technology. Patients might worry about privacy or feel unsure about machines making decisions. Building trust, maintaining transparency, and ensuring fairness will be key.

Overall, Human-AI collaboration in healthcare has the potential to transform the field by making care smarter, faster, and more personalized—while keeping people at the center.

### Case Study Critique: AI-IoT Integration for Traffic Management

Integrating AI with the Internet of Things (IoT) has become a key driver in building smart cities. In the context of traffic management, AI algorithms analyze data from IoT sensors to improve flow, reduce congestion, and increase public safety. This integration allows cities to make real-time decisions using inputs like vehicle density, pedestrian activity, and traffic signal timing.

One major benefit is **urban sustainability**. By adjusting traffic signals based on real-time data, AI can reduce fuel consumption and lower emissions. In Nairobi, for example, smart

traffic systems could help ease the heavy congestion on major roads, leading to cleaner air and better commute times. AI also supports adaptive public transport systems, helping buses and trains stay on schedule through predictive routing.

However, this integration also brings challenges:

1. **Data Security:** IoT devices collect vast amounts of personal and location-based data. If not protected, this information can be exposed to cyber threats. Strong encryption and secure transmission protocols are needed to keep urban systems safe.
2. **System Complexity and Maintenance:** Managing and maintaining a network of AI-enabled sensors and cameras across a city is technically demanding. Hardware failures, inconsistent data, or software bugs could disrupt services and require ongoing resources to fix.

## TASK 2

### SENSOR SELECTION & JUSTIFICATION

Sensor Type	Purpose
Soil Moisture	Guides irrigation to prevent water stress or waste
Temperature	Tracks heat levels affecting germination and crop development
Humidity	Helps assess disease risk and transpiration rates
Light Intensity	Influences photosynthesis, essential for healthy growth
Soil pH	Indicates nutrient absorption efficiency and fertilizer adjustment needs
CO <sub>2</sub> Concentration	Monitors respiration and growth conditions

## AI Model Proposal: Random Forest Regressor

Why It Works:

- **Nonlinear Relationships:** Crop yield depends on complex factors like soil moisture, sunlight, and temperature — Random Forests handle this beautifully.
- **Robust to Noise:** Sensor readings can be messy (missing or fluctuating) — this model averages predictions across decision trees for stability.
- **Feature Importance:** It shows which sensor inputs matter most (e.g., temperature vs. CO<sub>2</sub>), guiding improvements in system design.

How It Works:

- Collect historical sensor data: e.g., soil moisture, temperature, humidity, CO<sub>2</sub>, pH, sunlight
- Use labeled examples: Each input batch is tagged with actual crop yield outcomes (kg/acre, etc.)
- Train multiple decision trees: Each tree learns different patterns — some prioritize light intensity, others pH, and so on
- Average predictions: The forest votes on expected yield for new sensor inputs

## TASK 3

### 300-Word Analysis

## ☐ Ethical Analysis: Bias in AI for Personalized Medicine

AI models trained on genomic datasets such as The Cancer Genomic Atlas (TCGA) offer promising advancements in personalized treatment, but they also

risk reinforcing existing healthcare disparities. One critical issue is underrepresentation — many genomic samples in TCGA originate from individuals of European descent, with limited inclusion of African, Asian, and Indigenous populations. This lack of diversity compromises generalizability and may lead to less accurate recommendations for underrepresented groups.

For instance, a model trained predominantly on European genomic patterns might misclassify biomarkers or overlook key mutations present in other populations, resulting in unequal treatment outcomes. Additionally, differences in access to genomic testing can skew model predictions further, perpetuating structural healthcare inequities.

To mitigate these risks, several fairness strategies should be employed:

- **Inclusive Data Collection:** Expand datasets to include diverse ethnic and demographic groups, accounting for geographic and socioeconomic variability.
- **Fairness Metrics:** Implement tools like disparate impact analysis or equal opportunity measures to evaluate model performance across subgroups.
- **Bias Auditing:** Regularly test for algorithmic bias during development and post-deployment stages.
- **Collaborative Governance:** Engage bioethicists, patients, and marginalized communities in the design and oversight of AI systems.

Ultimately, ethical AI in medicine must prioritize equitable outcomes, ensuring that all individuals benefit from precision healthcare advancements. Diversity in data is not just a technical need—it's a moral imperative.

## **PART 3**

### **AI-Powered Climate Recovery Network (CRN)**

## 1. Overview

The Climate Recovery Network is a vision for 2030 that combines satellite technology, ground sensors, and AI to detect and reverse environmental damage. It forms a responsive ecosystem where autonomous agents coordinate real-time climate recovery efforts across different regions of the globe.

## 2. Problem Being Solved

Current efforts to combat climate change are reactive and often too slow. By the time policies are implemented or interventions occur, damage is already accelerating — from deforestation and rising sea levels to air and ocean degradation. We need systems that act proactively, quickly, and locally, while learning globally.

## 3. AI Workflow

Component	Description
<b>Inputs</b>	Satellite imagery, soil health data, ocean temperature, energy grid usage
<b>AI Models</b>	Convolutional Neural Networks (CNNs) for image analysis + Graph Neural Networks (GNNs) for modeling ecosystem relationships
<b>Processing</b>	Local AI agents analyze regional climate patterns, then share learning via a federated global network
<b>Outputs</b>	Recommendations for emission rerouting, reforestation targets, drought prevention, and energy optimization

Each agent adapts to its environment while contributing insights to a shared climate intelligence database. The network learns continuously and improves its interventions over time.

## 4. Societal Risks and Benefits

### Benefits

- Rapid detection and response to environmental threats
- Continuous learning that improves local decision-making
- Alignment with global sustainability goals, including SDG 13
- Transparent climate governance through open-source models

### Risks

- Overreliance on machines for critical decisions
- Possibility of misinterpreting natural ecosystems or overcorrecting
- Ethical concerns around surveillance and data collection

By embedding ethics, community oversight, and scientific transparency into the system's design, these risks can be addressed — making the CRN a powerful ally in global climate resilience.