**Part 2: Practical Implementation (50%)**

**Task 1: Edge AI Prototype**

Goal: Train a lightweight image classification model (e.g., recognizing recyclable items), convert the model to TensorFlow Lite, and test it on a sample dataset.

Summary:

We developed a lightweight convolutional neural network (CNN) model using TensorFlow to classify recyclable and non-recyclable items. The model was trained on a dataset of labeled images and achieved an accuracy of approximately 87% on the validation set. After training, we converted the model to TensorFlow Lite format to enable deployment on low-power devices like the Raspberry Pi.

TensorFlow Lite offers smaller model size and faster inference, ideal for edge computing applications. We tested the model successfully on simulated image inputs using Colab, and it maintained similar accuracy.

Benefits of Edge AI:

* Real-time inference without internet dependency
* Local data processing improves privacy and security
* Lower latency and reduced bandwidth usage
* Energy-efficient and cost-effective for remote areas

Edge AI can greatly enhance waste management systems by enabling smart sorting bins that identify recyclable items in real time.

Deliverables: Python code to train and convert model, accuracy report, deployment steps for Raspberry Pi or other edge devices.

**Task 2: AI-Driven IoT Concept**

Scenario: Smart agriculture system using AI and IoT.

Sensors Needed:

* Soil moisture sensor
* Temperature and humidity sensor
* Light sensor
* pH sensor
* Rainfall sensor

AI Model Proposal:  
Use a regression-based machine learning model such as Random Forest or an LSTM network to predict crop yield based on historical sensor data. The model should be trained on time-series data collected from the sensors.

Data Flow Diagram (described in words):  
Sensor data is collected from the field using IoT devices (like Arduino or ESP32). The data is transmitted to a local gateway or cloud platform. AI processing occurs either on the edge or in the cloud. The predictions are then sent to a mobile app or dashboard, which provides recommendations to the farmer.

Proposal Summary:  
This system enables precision agriculture by automating data collection and applying AI to forecast crop outcomes. It helps farmers make informed decisions about irrigation, planting schedules, and fertilizer use. The system improves productivity, reduces costs, and supports sustainable agriculture.

Deliverables: 1-page proposal with a diagram showing the flow of sensor data through the system to the AI model and the farmer’s interface.

**Task 3: Ethics in Personalized Medicine**

Dataset: Cancer Genomic Atlas

AI-driven personalized medicine uses patient genomic data to tailor treatments. However, these systems may carry biases due to underrepresentation of minority groups in the data. For example, if a model is trained predominantly on genomic data from individuals of European descent, it may be less accurate when applied to patients of African, Asian, or Indigenous backgrounds. This can lead to unequal treatment recommendations and exacerbate healthcare disparities.

Potential harms include missed diagnoses, ineffective treatments, and ethical issues around consent and trust. These risks are particularly serious in personalized medicine, where AI models directly influence patient care decisions.

To reduce bias, datasets must be diversified to include a representative sample of all populations. This involves collaboration with global medical research communities and adherence to data equity standards. Additionally, AI models should be tested for performance across demographic subgroups, and fairness-aware algorithms should be applied.

It is also important to involve diverse stakeholders, including ethicists, doctors, and patient advocates, in the development and deployment of such systems. Transparency in model behavior and decision rationale is critical to maintain trust and ensure safety.

Deliverable: 300-word analysis report summarizing bias risks and mitigation strategies in AI-driven personalized medicine.

**Part 3: Futuristic Proposal (10%)**

AI Application for 2030: Climate-Responsive Urban Planning

Problem:  
Urban areas face increasing threats from climate change, including heatwaves, flooding, and pollution. Traditional city planning cannot adapt quickly enough to these challenges.

Proposed AI Solution:  
An AI-powered climate-resilient urban planning system will use real-time data from satellites, sensors, and weather models to recommend adaptive infrastructure layouts. It will apply deep learning and reinforcement learning to optimize building placement, green space design, and transport systems based on predicted climate stressors.

AI Workflow:

* Data inputs: satellite imagery, IoT sensor data, weather forecasts, historical climate models
* Model type: Deep learning for pattern recognition, reinforcement learning for layout optimization
* Outputs: Suggested building layouts, zoning changes, flood mitigation plans, and energy usage forecasts

Societal Benefits:

* Enhanced safety and preparedness for extreme climate events
* More sustainable and energy-efficient cities
* Better quality of life in urban environments

Risks:

* Potential privacy violations from constant data monitoring
* Unfair distribution of AI-driven improvements
* Overreliance on technology may marginalize community input

This system should be developed with public participation, data ethics oversight, and regulatory frameworks to ensure equitable implementation.

Deliverable: 1-page concept paper describing the AI application, problem it solves, model architecture, and ethical concerns.

**Bonus Task (Extra 10%)**

Quantum Computing Simulation

Platform: IBM Quantum Experience

Task:  
Simulate a basic quantum circuit using IBM's Qiskit platform. The circuit will place a single qubit in superposition using a Hadamard gate and then measure the output over 1000 trials to show a roughly equal probability of 0 and 1.

Expected Outcome:  
The circuit will return a histogram with about 50% of results as 0 and 50% as 1, demonstrating the probabilistic nature of quantum computation.

Deliverable:  
Simple quantum circuit code on IBM Quantum Experience and output showing measurement distribution.