

Edge vs Cloud Computing – Practical Comparison Using IoT Systems

Module 1: Introduction to Edge and Cloud Concepts (4 Hours)

- Edge, Cloud, and Fog computing – key differences
- Use cases and real-world examples
- Device–Edge–Cloud architecture overview
- Role of ESP32 and Raspberry Pi in IoT systems

Hands-on: Explore hardware setup and run a demo showing ESP32 publishing sensor data over MQTT.

Module 2: Device Setup and Communication using MQTT (6 Hours)

- Flashing Raspberry Pi OS (Lite) and headless setup
- SSH access, Wi-Fi configuration, and Linux basics
- Installing and testing Mosquito MQTT broker
- Modifying ESP32 code to send data to Raspberry Pi

Hands-on: Set up Raspberry Pi and test two-way MQTT communication between ESP32 and Pi.

Module 3: Data Visualization with Node-RED (6 Hours)

- Installing and accessing Node-RED on Raspberry Pi
- Building flows to display data (gauges, charts)
- Filtering noisy or out-of-range data
- Real-time alert system logic using flow-based programming

Hands-on: Build a Node-RED dashboard to visualize sensor data from ESP32 in real time.

Module 4: Cloud Integration using AWS IoT (6 Hours)

- Setting up AWS CLI and IoT Core
- Registering devices and securing cloud connection
- Creating AWS IoT Rules and triggering Lambda
- Storing incoming data in DynamoDB

Hands-on: Connect Raspberry Pi to AWS IoT Core and publish sensor data to the cloud securely.

Module 5: Edge Data Processing and Automation (4 Hours)

- Writing Python scripts for data processing on Raspberry Pi
- Creating local logs and triggering alerts

- Automating services using systemd or startup scripts
- Optional: Email or Telegram alerts

Hands-on: Write a Python script on Pi to analyze MQTT data and trigger alerts or store logs.

Module 6: Final Project Build and Demonstration (4 Hours)

- Group-wise project planning and development
- Building a complete edge-to-cloud system
- Documentation and presentation guidelines

Hands-on: Build and present a complete mini project demonstrating data flow from ESP32 to AWS via Raspberry Pi.