ITAI 3377
AI at the Edge and IIOT Environments

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Kllle/ITAI-3377-Spring-2025

About the Course

- This course offers an exciting journey into the future of technology, where the integration of Artificial Intelligence (AI) with Edge Computing, IoT (Internet of Things), and IIoT (Industrial Internet of Things) is revolutionizing industries.
- Positioned at the forefront of technological innovation, the course equipped me with the knowledge and skills to:
  - Design, implement, and optimize AI-driven solutions for smart devices and interconnected systems.
  - Deploy AI models on simulated edge devices and IoT systems.
  - Explore real-world applications across domains such as industrial automation, smart cities, healthcare monitoring, and more.

Key Skills Developed

Hands-on experience with:

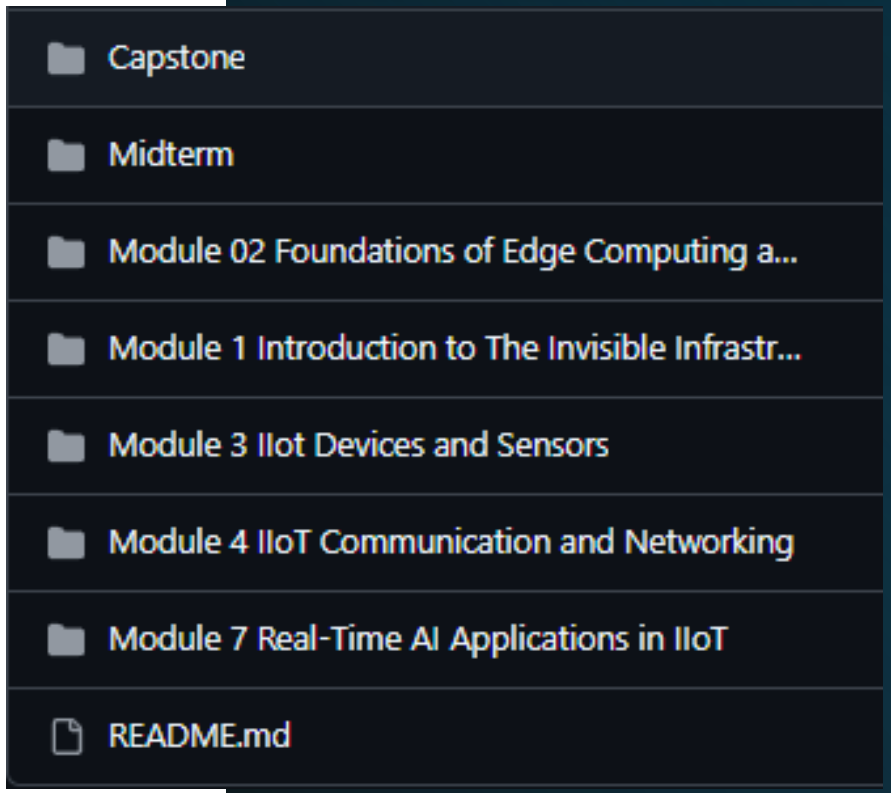
- Edge computing concepts
- Machine Learning deployment
- Real-time AI systems

Tools used:

- Python
- Jupyter
- Node.js
- GitHub
- Tensor Flow
- Google Colab
- Edge Impulse CLI

Portfolio Overview

- The portfolio showcases my growth in applying AI, edge computing, and IoT concepts through research, simulations, and practical design.
- Module Folders :Contain assignments, notes, and reflections for each course topic
- Midterm Project: Cybersecurity plan for a smart factory with simulated penetration tests
- Capstone Project: AI-based predictive maintenance system using IIoT architecture



Module 1 – The Invisible Infrastructure

- This module focused on developing a conceptual understanding of the key development environments and tools used in Edge AI and IoT projects.

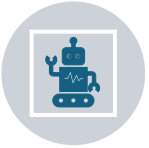
VS Code
Lightweight, flexible code editor used for Python, JS, and ML development.

Node.js
Runs real-time JavaScript apps, often used for edge dashboards and APIs.

Edge Impulse CLI
Tool for training and deploying ML models to edge devices.

TensorFlow / TensorFlow Lite
Used to build and optimize models; Lite version is for low-power devices.

Google Colab
Cloud-based notebook for training models with free GPU support.



GitHub Copilot
AI assistant that helps write and debug code faster.

Case Study – Liverpool Smart Pedestrians Project

Goal:
Use edge AI and computer vision to monitor traffic and pedestrians in real time.

Highlights:

- Used **YOLO V3** on **Jetson TX2** to process CCTV video at the edge
- Maintained **privacy** by sending only metadata—not raw footage
- Helped optimize crosswalks, bike lanes, and emergency evacuation routes
- **Key Insight:**
  Edge computing enables real-time decision-making while reducing bandwidth and improving data privacy in smart cities.

Article: Edge-Computing Video Analytics for Real-Time Traffic Monitoring in a Smart City - PMC

Midterm

Project Title: Cybersecurity Strategy for AI-Integrated Smart Factory

Key Components:

- Identified threats: outdated firmware, weak passwords, AI model poisoning
- Proposed solutions: Zero-trust model, network segmentation, MFA, encryption
- Simulated attacks: phishing, IoT hijacking, MitM, ransomware, adversarial input

Insight:

Securing AI and IoT systems requires both strong technical defenses and employee training.

Capstone

Project Title:
AI-Powered Predictive Maintenance in IIoT Environments

Core Ideas:

- Used LSTM, CNN, and Autoencoders for fault prediction
- Designed a modular architecture for data collection, real-time analysis, and decision-making
- Addressed challenges: data scarcity, security, explainability

Key Takeaways*:* Predictive maintenance reduces downtime and costs, but must be secure, ethical, and scalable.

Lessons Learned

AI at the edge requires trade-offs
Balancing model complexity with hardware limitations is essential

Security is critical for smart environments
A strong system design must account for network, device, and human vulnerabilities

Conceptual design is just as important as code
Projects required high-level planning, not just implementation

Continuous learning improves model performance
Feedback loops and retraining are vital in dynamic environments

Privacy-first design matters
Edge AI can reduce cloud dependency and protect sensitive data

The right tools make all the difference
Tools like VS Code, Colab, Edge Impulse CLI, and TensorFlow Lite made development smoother

Final Notes & Github

This course gave me hands-on experience with real-world AI and IoT applications, from system design to deployment and security. I gained a deeper understanding of how edge computing enables smarter, faster decision-making in industries like manufacturing and urban planning. The combination of technical skills and conceptual knowledge has prepared me to contribute to the growing field of AI-driven edge systems.

GitHub Portfolio: Kllle/ITAI-3377-Spring-2025

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