

# Capstone Project Proposal

## Satellite Image Classification and Explanation with Deep Learning

### Project Description:

This project will develop a deep learning model to classify satellite images from the EuroSAT RGB dataset into 10 land cover classes such as forest, river, residential, and crop fields. A convolutional neural network (CNN) will be trained using PyTorch with image preprocessing and augmentation. Grad-CAM will be used to visualize important regions influencing predictions. A multimodal Large Language Model (LLM), like GPT-4 Vision, will receive the input image, model prediction, and Grad-CAM heatmap to generate natural language explanations. The system will be deployed via a Gradio web application for user interaction.

### Why This Is a Good Project:

It uses a well-known, publicly available remote sensing dataset relevant for environmental monitoring. The project integrates deep learning, explainability, and multimodal LLMs, aligning with course outcomes and the professor's challenge. The interactive UI demonstrates deployment skills.

### Methodology:

- Use EuroSAT RGB dataset (27,000 images, 10 classes)
- Preprocess images (resize, normalize) and augment training data
- Train a CNN (e.g., ResNet18) for classification
- Generate Grad-CAM heatmaps for interpretability
- Pass image, prediction, and heatmap to a multimodal LLM for explanation
- Build a Gradio app to display predictions, heatmaps, and explanations

### Dataset Information:

- **Name:** EuroSAT RGB
- **Source:** <https://github.com/phelber/EuroSAT>
- Contains 27,000 labeled satellite images at 64×64 resolution across 10 land use classes

### Performance Evaluation:

- Metrics: accuracy, precision, recall, F1-score
- Confusion matrix for class-wise analysis
- Qualitative evaluation of Grad-CAM and LLM explanations
- User feedback on Gradio UI experience