🛣️ Road Expansion and Tree Loss Monitoring

# 📌 Project Summary

This project uses deep learning and satellite imagery to analyze areas affected by road expansion and quantify the loss of tree cover. By comparing pre- and post-expansion images, we aimed to support environmental impact assessments and forest conservation strategies.

# 🎯 Objectives

- Detect road expansion using satellite image comparisons.  
- Identify and count trees lost in the expansion areas.  
- Generate spatial reports showing environmental impact.  
- Aid in ecological planning and deforestation control.

# 🧰 Tools & Technologies Used

- Python (NumPy, Pandas, OpenCV)  
- TensorFlow, PyTorch  
- YOLOv8, U-Net, Faster R-CNN  
- Roboflow  
- QGIS, Shapefiles, Satellite Imagery  
- Google Colab, LabelImg

# 🔁 Workflow & Methodology

1. Collected before-and-after satellite images of road development areas.  
2. Annotated trees and roads using Roboflow and LabelImg.  
3. Trained detection (YOLOv8, Faster R-CNN) and segmentation (U-Net) models.  
4. Detected trees and roads from both image sets.  
5. Compared tree positions to identify losses.  
6. Visualized and analyzed changes using QGIS and generated spatial shapefiles.  
7. Counted trees lost and calculated density changes over regions.

# 📊 Results & Impact

- Successfully detected changes in tree density.  
- Highlighted zones of major deforestation caused by road expansion.  
- Provided decision-makers with spatial visualizations and quantitative loss reports.  
- Facilitated integration of AI into environmental planning workflows.

# 📈 Key Learnings

- Combining object detection and segmentation improves environmental monitoring.  
- Spatial-temporal comparison is essential in ecological impact studies.  
- Geospatial tools like QGIS enhance understanding of model outputs.  
- Automation can accelerate assessment processes significantly.