Peer Robotics Interview Assignment

Objective:
This assignment tests your computer vision, ROS and programming skills. Develop a pallet detection & ground segmentation application in ROS2 for a manufacturing or warehousing environment. The solution should be optimized for deployment on edge devices like the NVIDIA Jetson AGX Orin, ensuring real-time performance suitable for mobile robotics applications.

Tasks:

1. **Dataset Acquisition and Preparation:**
    *   **Dataset Acquisition:** Use the link to access open source database for pallets in different scenarios { 🖼 Pallets }. You can find and use other open datasets for manufacturing/warehouse environments to further generalize your model.
    *   **Data Preparation:**
        *   Annotate **pallets** & **ground** using existing annotation tools (ex. DINO)
        *   Organize the dataset into training, validation, and test sets.
        *   Apply data augmentation techniques (e.g., varying lighting conditions) to simulate real-world scenarios.

2. **Object Detection and Semantic Segmentation:**
    *   **Model Development:**
        *   Train an object detection model (e.g., **YOLOv11** etc.) to detect pallets (GMA & Euro Pallets).
        *   Train a semantic segmentation model to segment ground
        *   Report training and validation stats.
    *   **Performance Evaluation:**
        *   Assess the models using metrics like mAP for detection and IoU.
        *   Ensure models perform robustly under varying environmental conditions.

3. **ROS2 Node Development:**
    *   **ROS2:**
        *   Develop a ROS2 Python Node to run inference on the model.
        *   Nodes should:
            *   Subscribe to image and depth topics from a simulated or real camera.
            *   Run inference on the input image for pallet detection & ground segmentation, and publish detections/segmentation overlaid on the input image.

4. **Edge Deployment Optimization (Optional) :**
   - **Model Optimization:**
     - Convert your models to formats suitable for edge deployment (e.g., **TensorRT**).
     - Apply optimization techniques like quantization and pruning to enhance performance.
   - **Docker Container:**
     - Dockerized the complete module that can natively run on different devices as long as Nvidia drivers are present.

5. **Evaluation Criteria:**
   - We will run the module on AGX Orin and feed live camera data from zed 2i
   - Performance will be measured based on pallet detection accuracy under varying conditions

To streamline the assessment create a git repository with:

1. README
2. Requirements.txt for all dependencies
3. Python file/notebook used for training
4. Link to the trained model
5. ros2 humble inference node which works off the shelf with the following [camera data](#) with output data overlaid on the original image:
   a. Pallet Detection published on /pallet_detection
   b. Ground Segmentation published on /ground_segmentation
6. [Optional] Python script that optimizes your model for a given GPU