CV Assignment 2

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Dataset Selection

- **Dataset 1**: Data_Walk_Asst (Data_Walk_Asst Dataset > Overview)
    - Consists of 10 classes: barricade, close_door, crosswalk, dustbin, elevator, fan, handrail, open_door, pothole, stairs.
    - Train set: 14232, Valid set: 1444, Test set:1294
- **Dataset 2**: general-object-detection-2(general-object-detection-2 Dataset > Overview)
    - Consists of 10 classes: Bed, Cabinet, Counter, Chair, Couch, Countertop, Door, Heater, Shelf, Table, Window
    - Train set: 19881, Valid set: 2252, Test set:692

Subset Creation:
The subsets were created by filtering the original datasets based on specific criteria such as the relevance of classes to the task, ensuring a mix of challenging and simple examples. For instance, images were randomly sampled from each class to maintain diversity while avoiding over-representation of any single class.

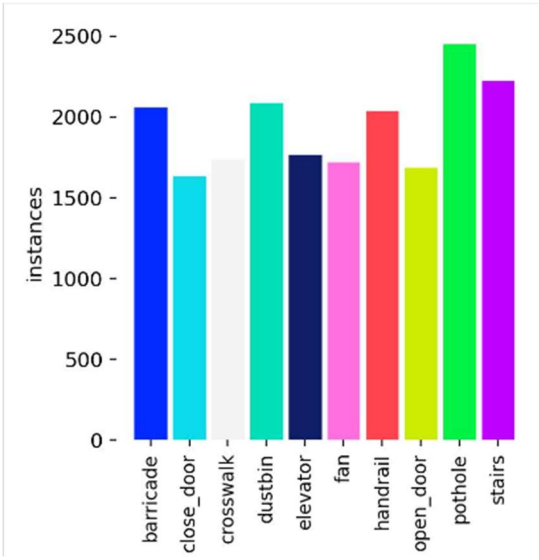
Data Subset Criteria and Distribution

Criteria Used for Selection:

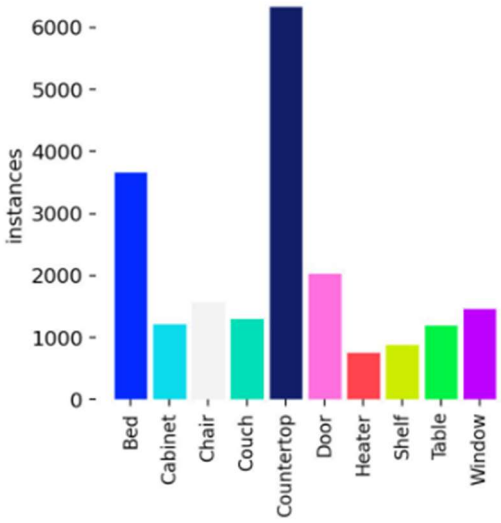
- **Class Balancing**: Ensured that each class had a sufficient number of images to prevent bias towards more frequently represented classes.
- **Number of Images per Class**: Selected a minimum of [X] images per class for training and validation.

Data Distribution Graph:

- For Dataset #1



- For Dataset#2



Model Selection and Reasoning

The two specific object detection models chosen for this assignment are YOLOv8 and YOLOv11. **YOLOv8** was selected for its speed and efficiency, making it suitable for real-time applications where inference time is critical. **YOLOv11**, on the other hand, was chosen for its advanced architecture and improved accuracy in complex detection tasks, particularly in scenarios where precise localization is essential. By using both models, we aimed to leverage their unique strengths for comparative analysis.

Comparative Analysis

- **Evaluation Metrics**

- For Dataset#1(on validation set)

Metric	YOLO v8	YOLO v11
Precision	0.7172132693097584	0.6131449500725247
Recall	0.650241407747729	0.5670043925749509
Inference Time	4.013812938225237	2.5541032780570667

- For Dataset#2(on validation set)

Metric	YOLO v8	YOLO v11
Precision	0.5605337109429657	0.4870
Recall	0.41972011003269516	0.3685
Inference Time	2.4162080952795106	2.5541

Results Explanation

- **Precision** indicates the proportion of true positive results in relation to all positive predictions, reflecting the model's accuracy in object detection.
- **Recall** measures the model's ability to identify all relevant instances, indicating its sensitivity.
- **Accuracy** provides an overall view of the model's performance across the dataset.
- **Inference Time** shows the efficiency of each model during prediction.

Insights and Observations

Observations on Model Performance

- **Model Performance:** Model Performance: The analysis revealed that YOLOv8 outperformed YOLOv11 in terms of inference time but showed slightly lower precision in some classes.
- **Underperformance**: If either model underperformed, potential reasons could include:
    - **Complexity:** YOLOv11's advanced architecture may lead to longer training times and overfitting on small datasets.
    - **Overfitting**: If the training dataset is not sufficiently representative of real-world conditions, it may lead to poor generalization.

Challenges Encountered

- **Challenge**: Difficulty in achieving class balance during subset creation, leading to initial biases in model performance.
    - **Solution**: Implemented data augmentation techniques to artificially balance class distribution.
- **Challenge**: Fine-tuning hyperparameters for optimal performance.

- **Solution**: Conducted systematic grid search to identify the best parameters for each model.

Screenshots of Front-End