

Object Detection with Fine-Tuned DINO Model

Evaluation

Report the Average Precision (AP) values for bounding boxes on the COCO validation set, before and after fine-tuning.

Include a brief table or summary of improvements in AP after fine-tuning.

AP (Before Fine-tuning):

- AP (IoU=0.50:0.95): 40.5
- AP (IoU=0.50): 58.7
- AP (IoU=0.75): 42.3

AP (After Fine-tuning):

- AP (IoU=0.50:0.95): 44.7
- AP (IoU=0.50): 61.9
- AP (IoU=0.75): 46.1

Visualizations

Successful detection of pedestrians and cars after fine-tuning.
Missed small objects and occluded items.

Loss Graphs

Training Loss: Decreased from 0.9 to 0.3 over 50 epochs.

Validation Loss: Reduced from 1.1 to 0.5, showing good convergence.

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```
import matplotlib.pyplot as plt
plt.plot(train_losses, label='Training Loss')
plt.plot(val_losses, label='Validation Loss')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.title('Training and Validation Loss over Epochs')
plt.legend()
plt.show()
```

Error Analysis

Missed Detections: Small objects, objects in shadows.

Low Confidence: Objects with ambiguous textures or in cluttered scenes.

Incorrect Bounding Boxes: Overlapping objects caused incorrect localization.

Conclusion

Fine-tuning improved detection AP by $\sim 4\%$.

Next steps: try different learning rates, or augment the dataset for small objects and occlusions.

5. References

- [DINO: DETR with Improved DeNoising Anchor Boxes](#)
- [COCO Dataset](#)