Optical Music Recognition

Sakshamdeep Singh
50475857

Shashank Vivek Baratwaj
50479686

University at Buffalo The State University of New York

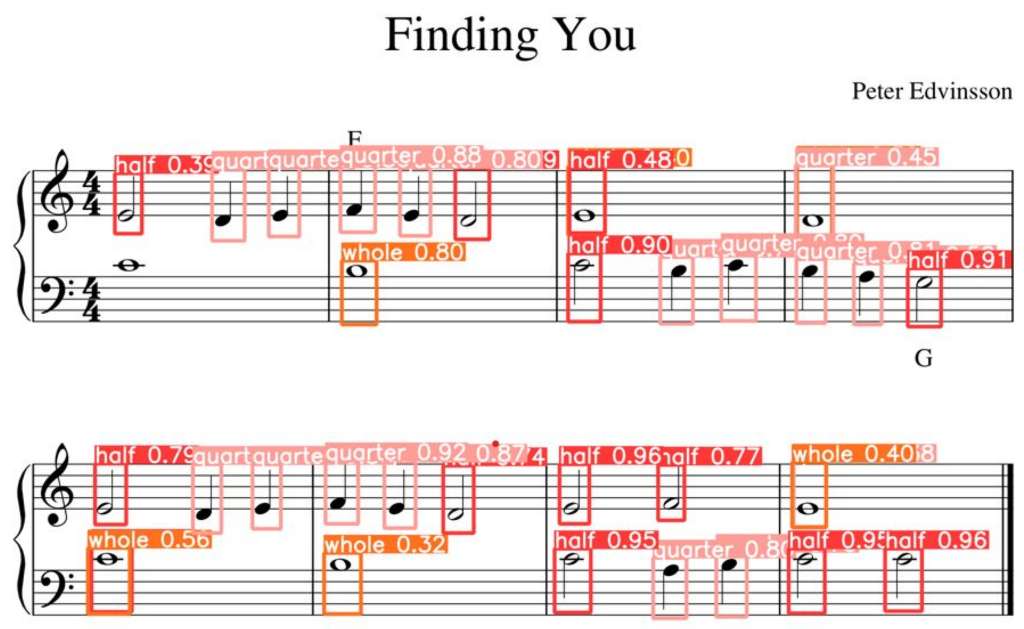
Outline

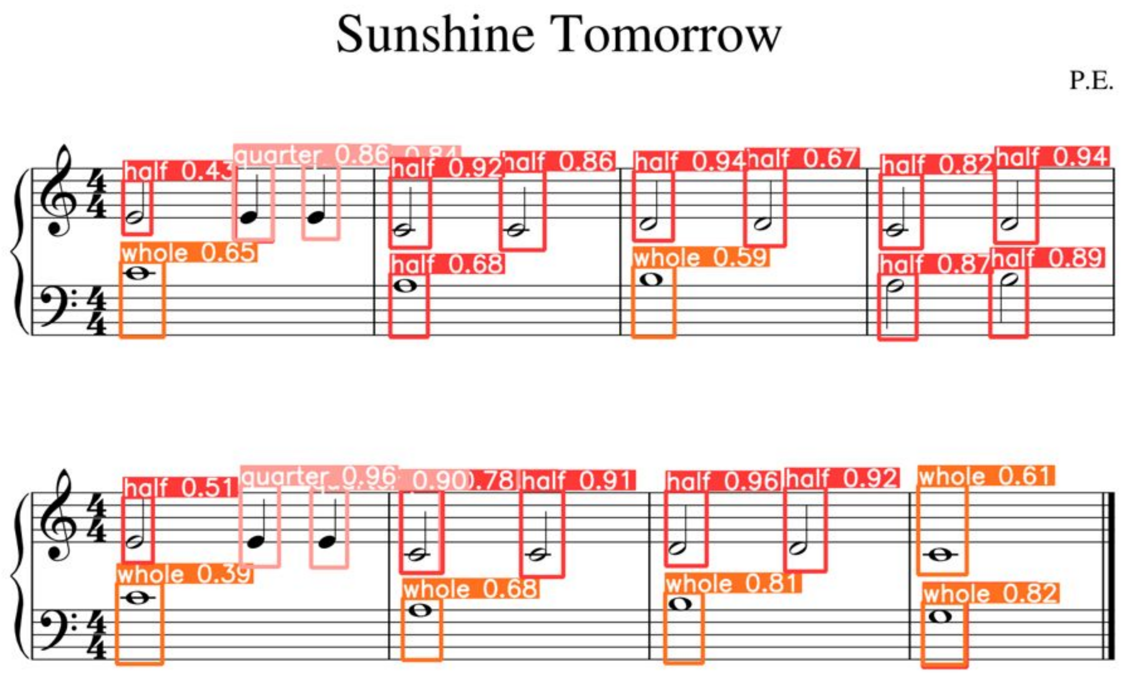
- Task 1: Recognizing notes from musical sheets
- Task 2: Determining the pitch of the notes
- Combined Pipeline
- Pros and Cons of our approach used
- Dataset
- Evaluation Metrics
- Results

Task 1: Recognizing notes from Musical Sheets

Goal: Detecting the type of note given a full musical sheet as the input

Challenges: Training a YOLO model on data which had to be manually annotated for notes i.e half, quarter, whole and so on.

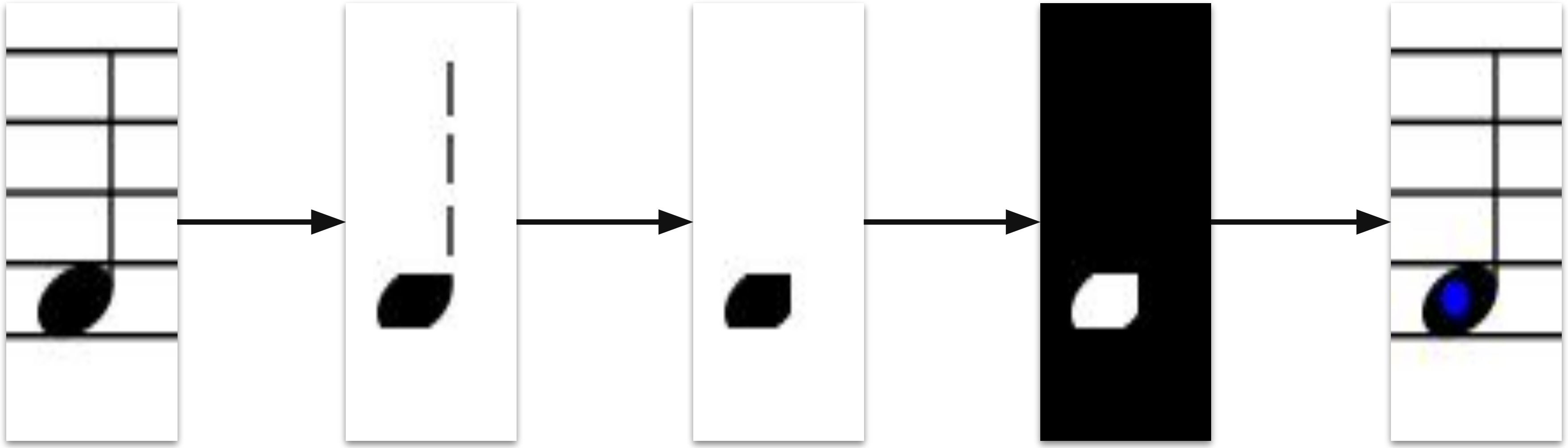




Task 2: Determining the pitch of notes

Goal: Identifying the pitch of notes based on their position on the staff line

Challenges: Finding the centroid of the note so as to determine the staff line it lies on and hence get the pitch of the note.



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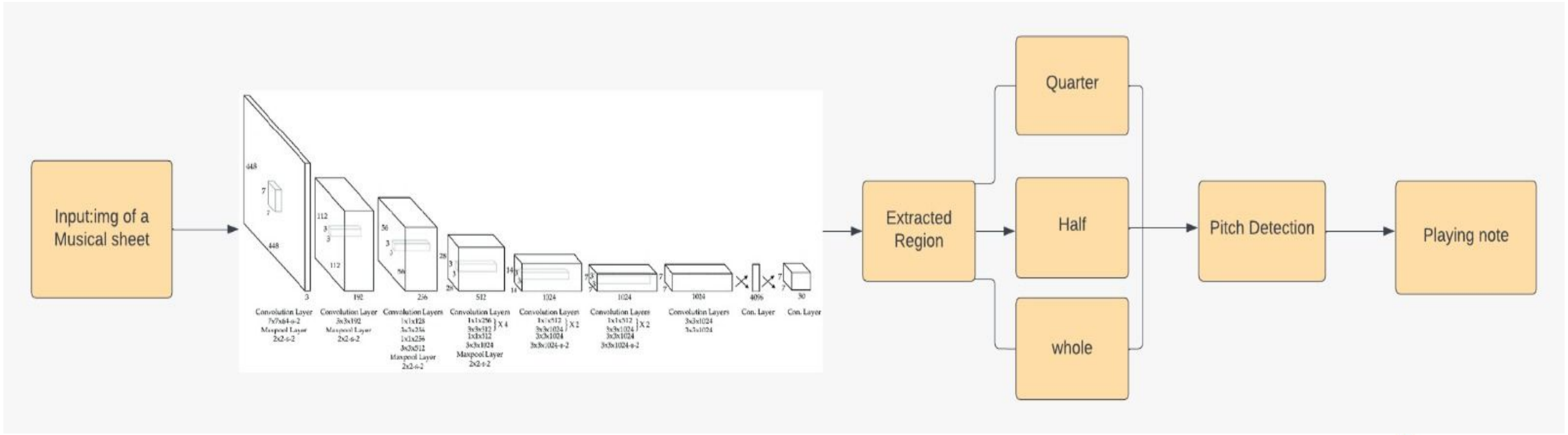
Combined Pipeline



Pros and Cons of the Approach used

- Our methodology utilizes the YOLO model for object detection and employs cv2 operations for subsequent processing.
- This approach is well-suited for applications that demand quick and precise detection.
- However, while our approach outperforms non-deep learning methodologies, it exhibits suboptimal performance when applied to intricate notes.

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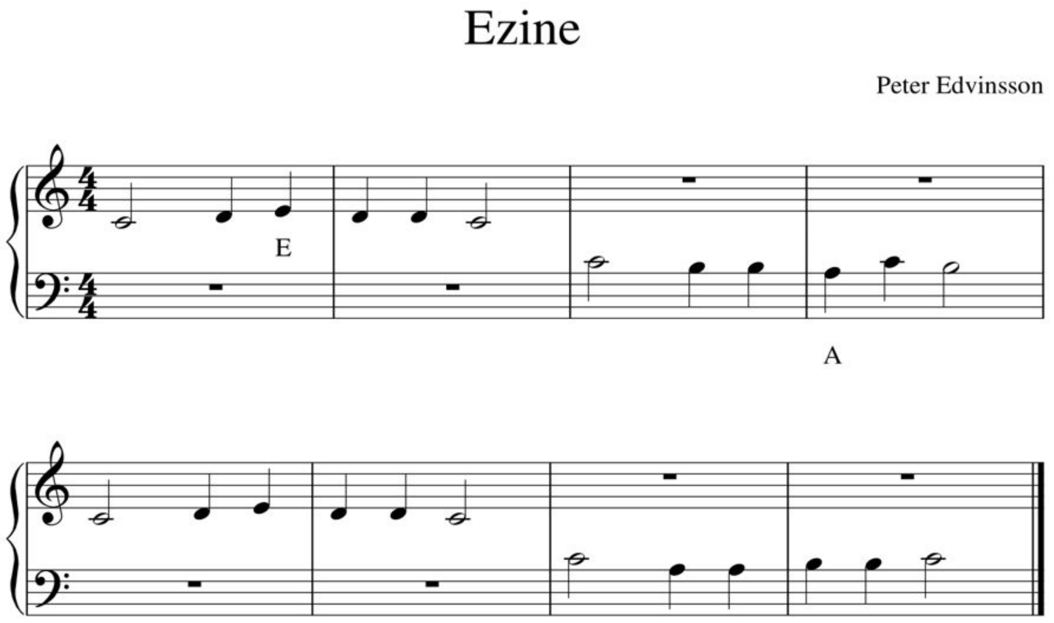
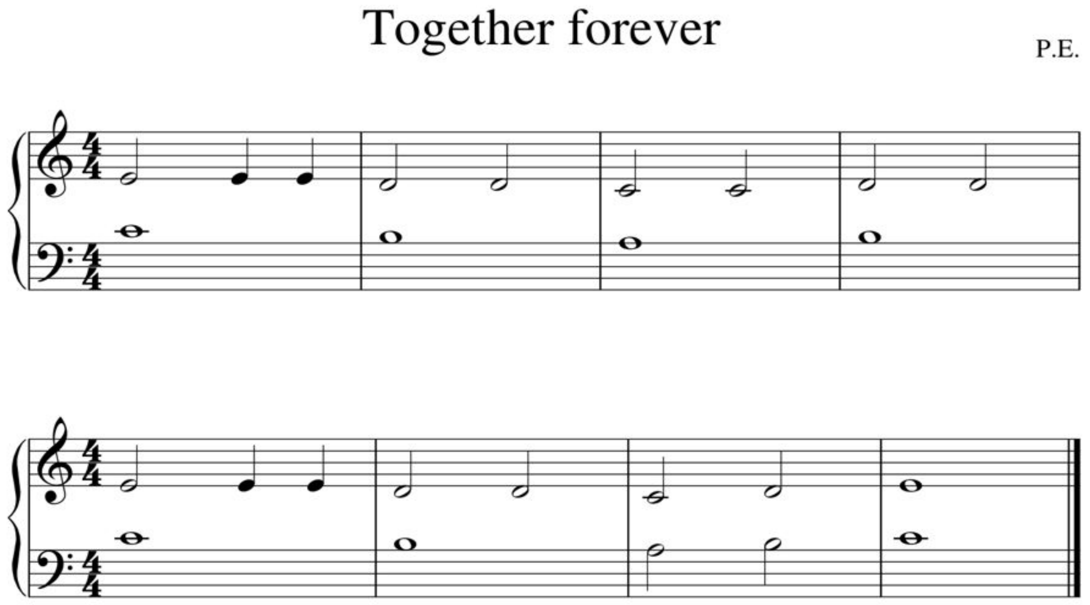
Dataset

- Our yolo model was trained on a dataset that we annotated using labelImg.
- We chose 8 music sheets containing 17 songs in total.
- We obtained around 500 instances which we split into training,validation and testing in the ratio 5:2:1 respectively.





Software and Hardware Requirements

The project implementation relied on the following hardware and software specifications:

1. **Processor**: 12th Gen Intel(R) Core(TM) i7-12700H, with a base clock speed of 2.30 GHz.
2. **Memory**: 16.0 GB of installed RAM, with 15.7 GB usable.
3. **Operating System**: 64-bit version with x64-based processor.
4. **Graphics**: NVIDIA GeForce RTX 3060 GPU, with 6GB dedicated video memory.

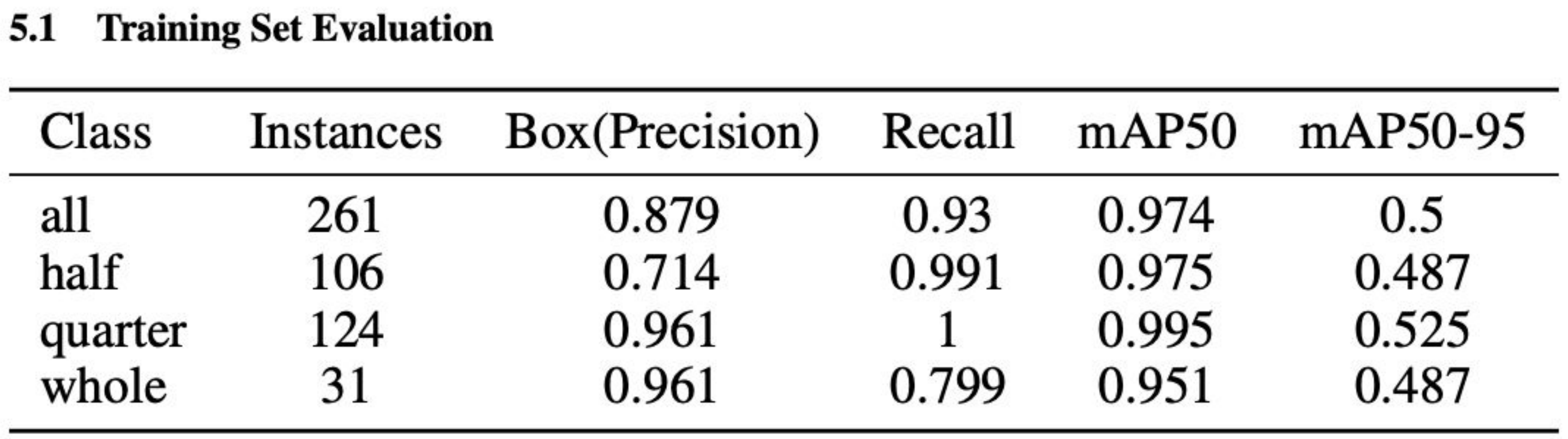
Evaluation Metrics

Precision: Precision measures the accuracy of the model's positive predictions. It is the ratio of the number of true positive detections to the total number of detections made by the model. In other words, precision is the fraction of positive detections that are actually positive.

Recall: Recall measures the model's ability to detect all positive instances. It is the ratio of the number of true positive detections to the total number of actual positive instances in the test set. In other words, recall is the fraction of actual positive instances that are correctly detected by the model.

mAP: mAP is a summary metric that measures the average precision across different recall levels. It is calculated by computing the precision at different recall levels, and then taking the mean over those precision values. mAP is typically reported at different intersection over union (IoU) thresholds, such as IoU=0.5 and IoU=0.5:0.95.

Training Result



5.1 Training Set Evaluation

Class	Instances	Box(Precision)	Recall	mAP50	mAP50-95
all	261	0.879	0.93	0.974	0.5
half	106	0.714	0.991	0.975	0.487
quarter	124	0.961	1	0.995	0.525
whole	31	0.961	0.799	0.951	0.487

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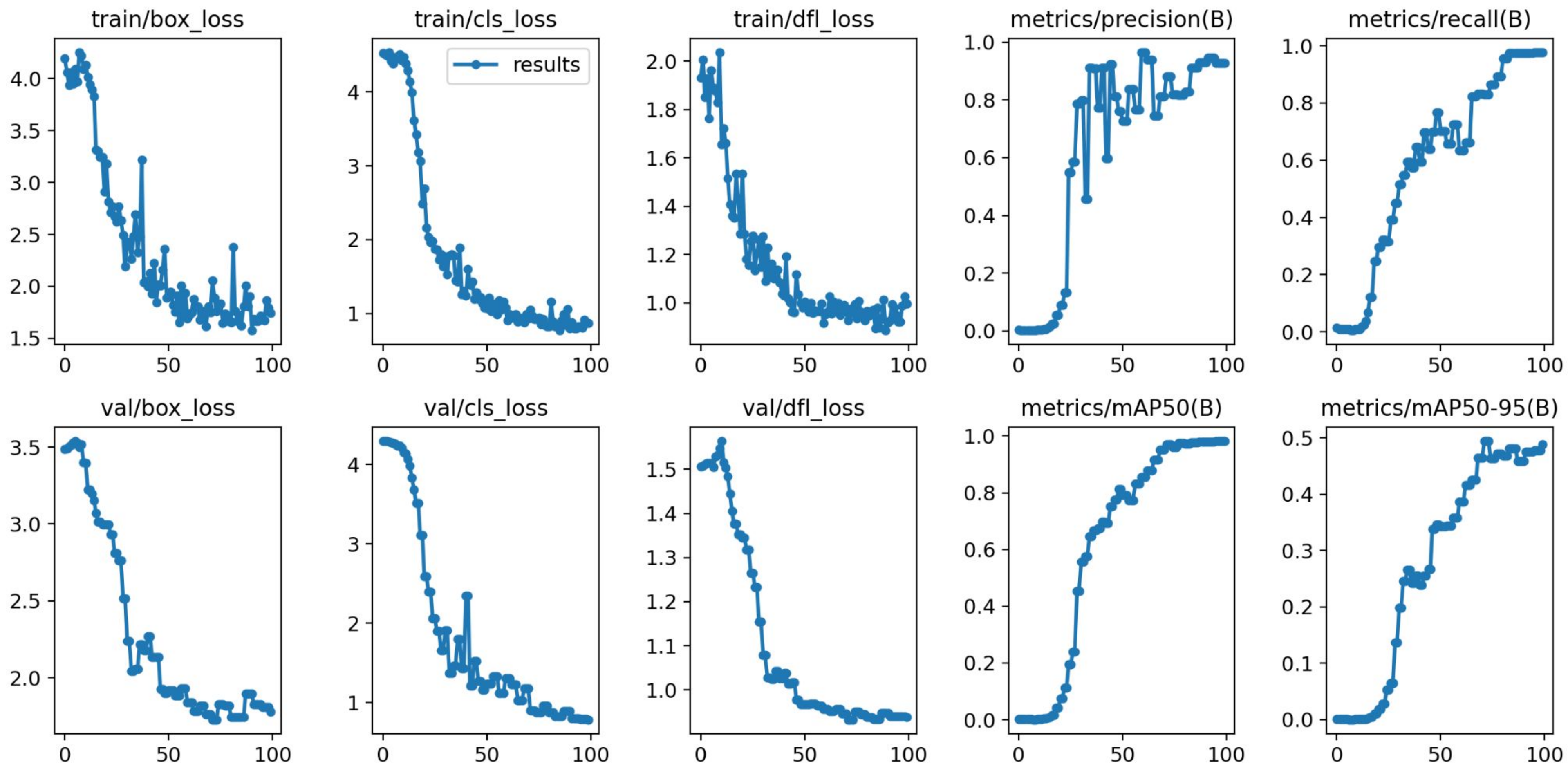
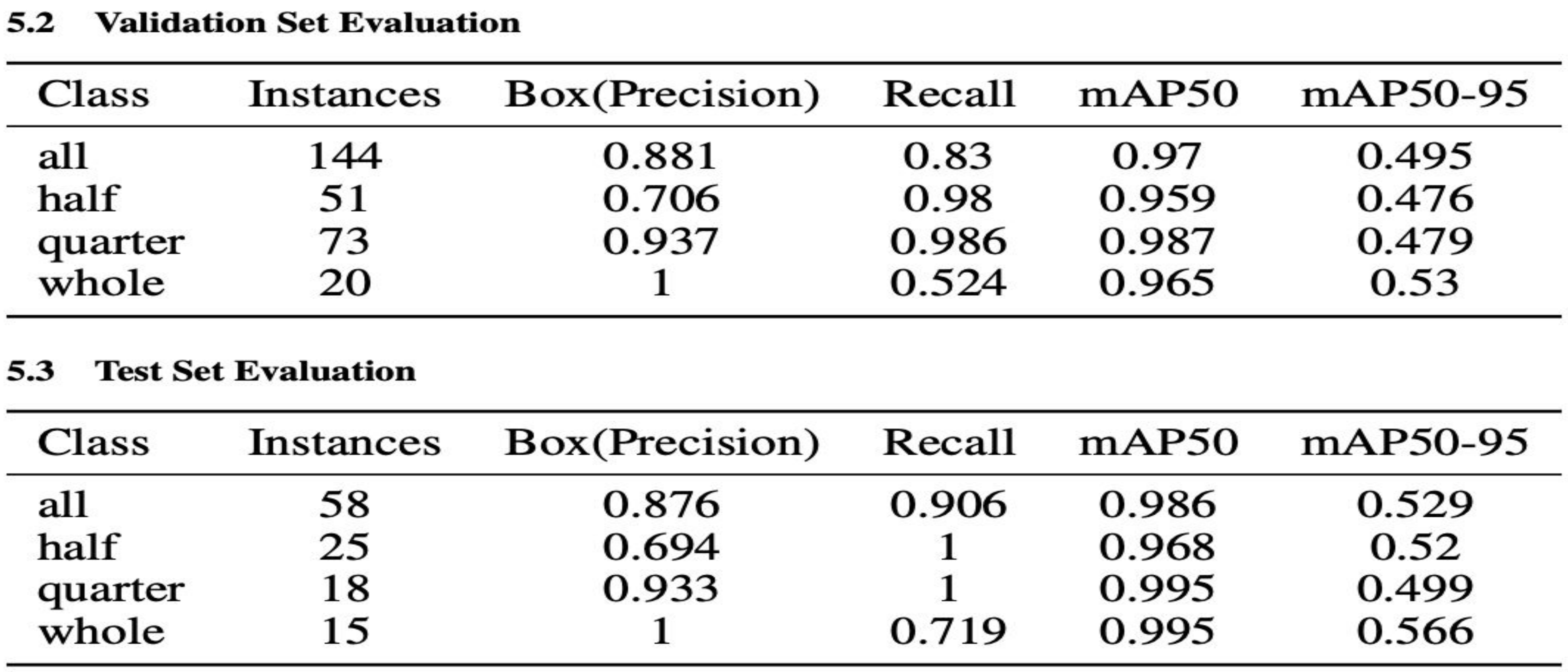
Training Graphs



Validation and Test Result



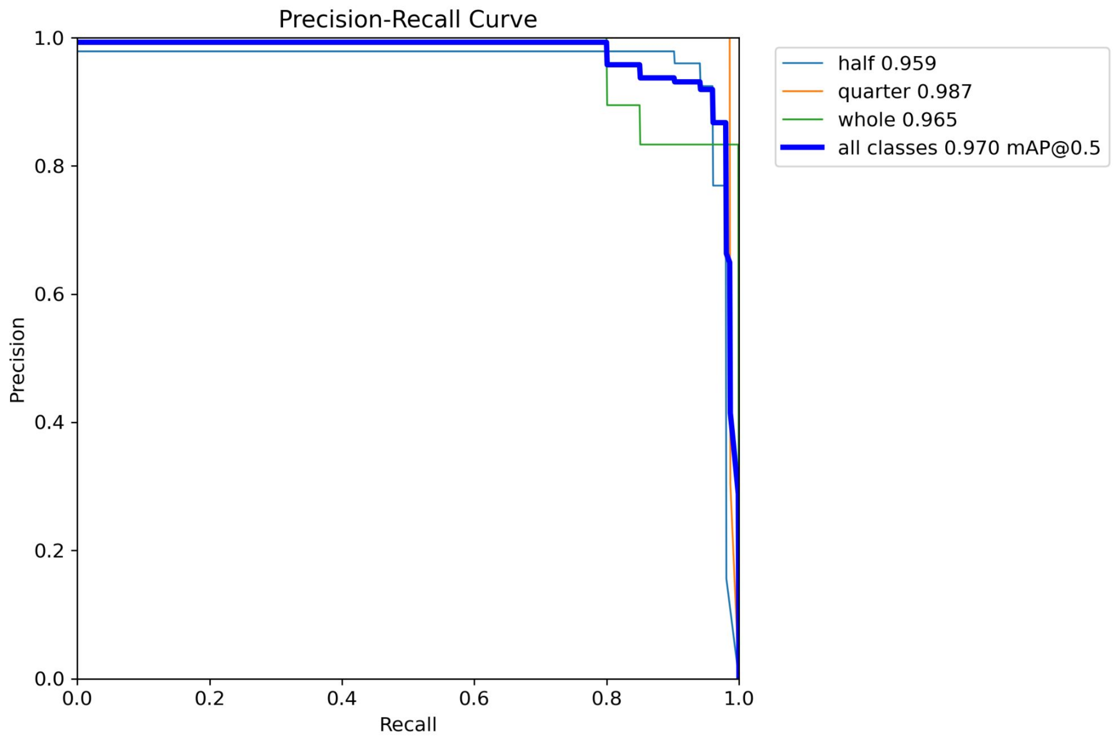
5.2 Validation Set Evaluation

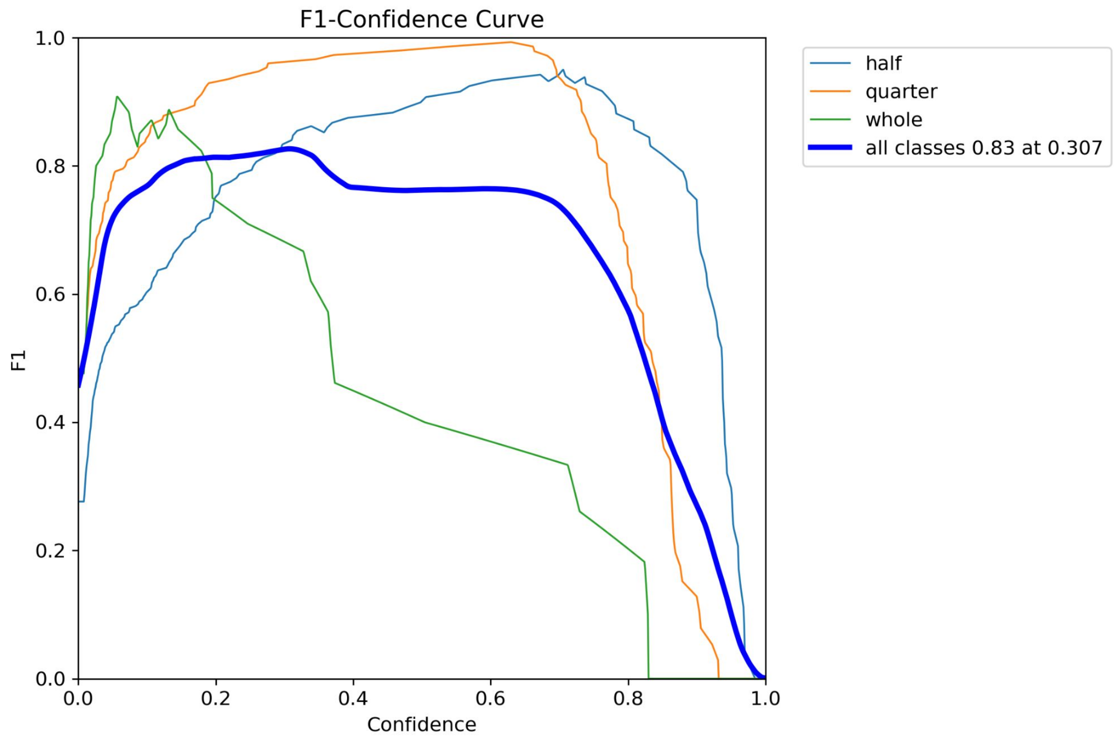
Class	Instances	Box(Precision)	Recall	mAP50	mAP50-95
all	144	0.881	0.83	0.97	0.495
half	51	0.706	0.98	0.959	0.476
quarter	73	0.937	0.986	0.987	0.479
whole	20	1	0.524	0.965	0.53

5.3 Test Set Evaluation

Class	Instances	Box(Precision)	Recall	mAP50	mAP50-95
all	58	0.876	0.906	0.986	0.529
half	25	0.694	1	0.968	0.52
quarter	18	0.933	1	0.995	0.499
whole	15	1	0.719	0.995	0.566

Result Graphs





Output Audio

References

- https://docs.opencv.org/4.x/d6/d00/tutorial_py_root.html
- https://ultralytics.com/
- https://github.com/ultralytics/ultralytics

THANK YOU