Deep Lesion CT View Optimization

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BME548

Motivation

- CT Scans are commonly used to identify lesions across multiple organs from bone, liver, lung, kidney and soft tissues
- The time and cost of a CT scan is driven by the number of slices the ct scan
  - 16 slice CT Scan Machine Cost: $80k - $100k
  - 64 slice CT Scan Machine Cost: $120k - $160k
  - 128+ slice CT Scan Machine Cost: $200k - $300k
- More slices in a CT scan results in more radiation exposure to the patient

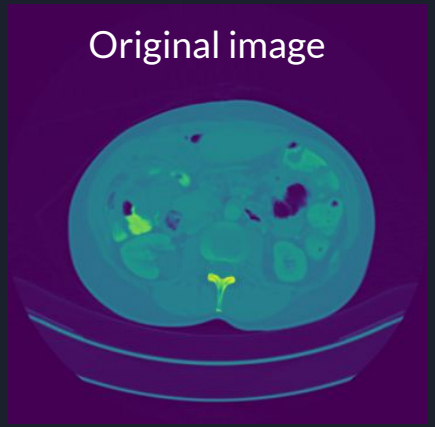
Data Set

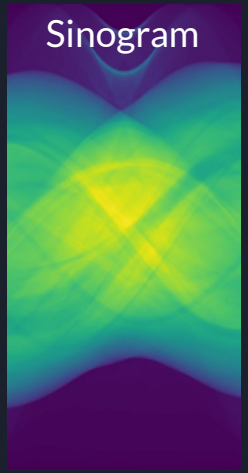
- We used the DeepLesion dataset by Yan et. al. (2018)
- The dataset contains 100,000+ CT images of lesions from different tissues
- We were provided 32,000+ annotated key slices that we used in our model
- We restricted our analysis to lesions from the liver, lungs, and kidney
- Labels: bounding boxes of lesions
- Images were resized to 128x128

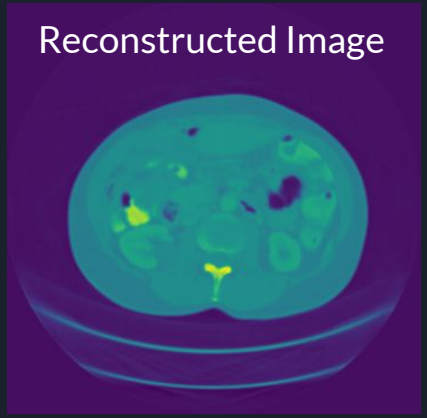
https://nihcc.app.box.com/v/DeepLesion/

Physical Layer

- Radon Transform the images using 16, 64, and 128 slices
- Perform Inverse Radon Transform using the Simultaneous Algebraic Reconstruction Technique to obtain three sets of training images





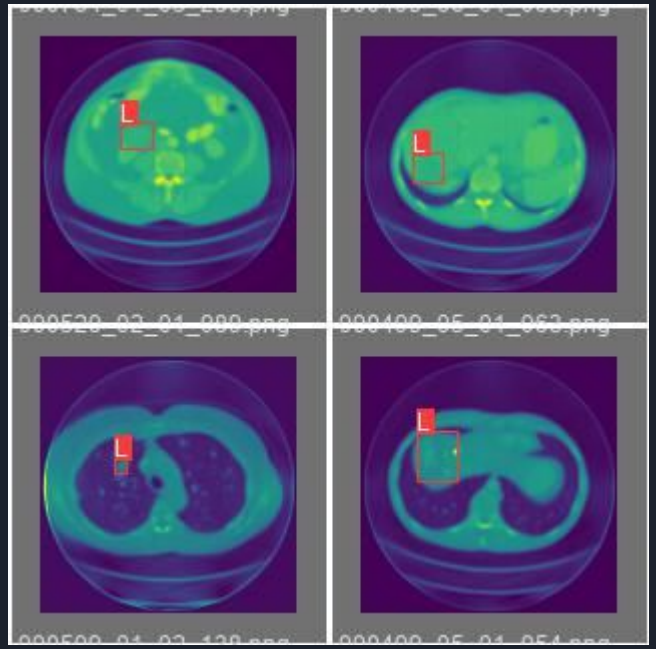


Experimental Design

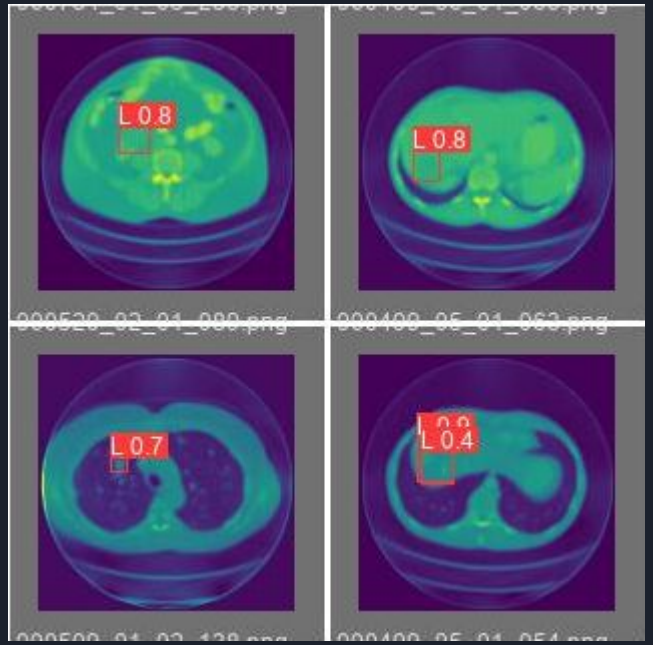
- Key slices taken and reconstructed with 16, 64 and 128 views
    - Split into train, val, and test datasets
- Initial You Only Look Once v5 (YOLO V5) Model trained on 128 views to determine ideal batch size
- Train different models for 16 and 64 using optimized batch size
- Compare the performance in terms of identifying lesions

128 Slice Results

Predictions

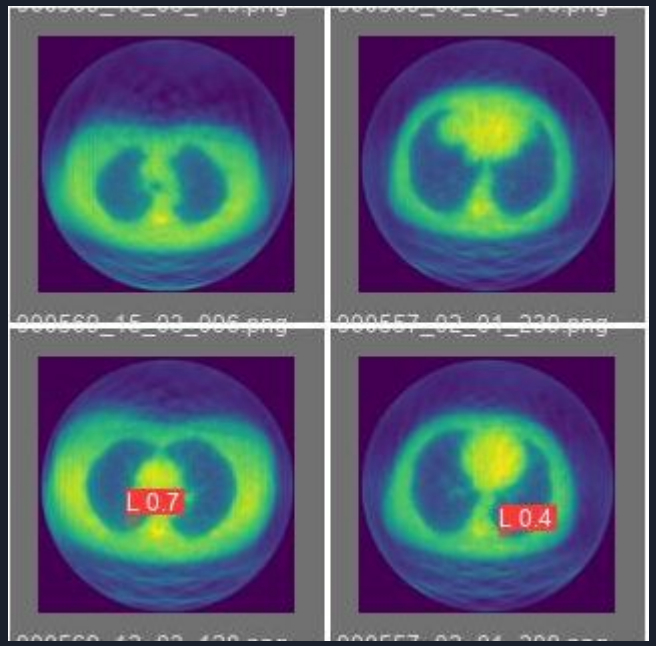


Actual

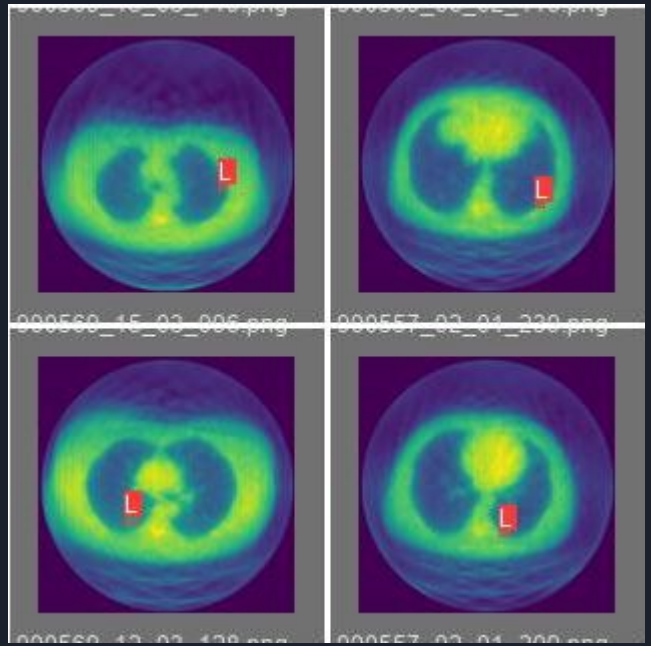


16 Slice Results

Predictions

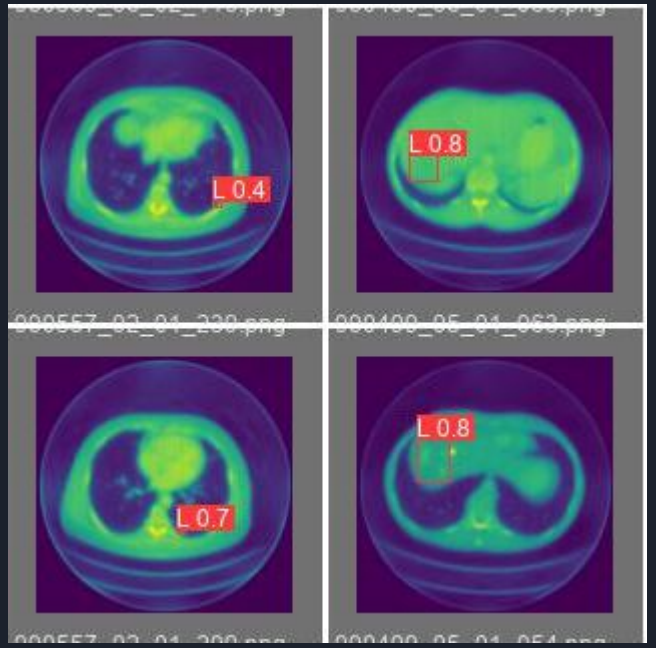


Actual

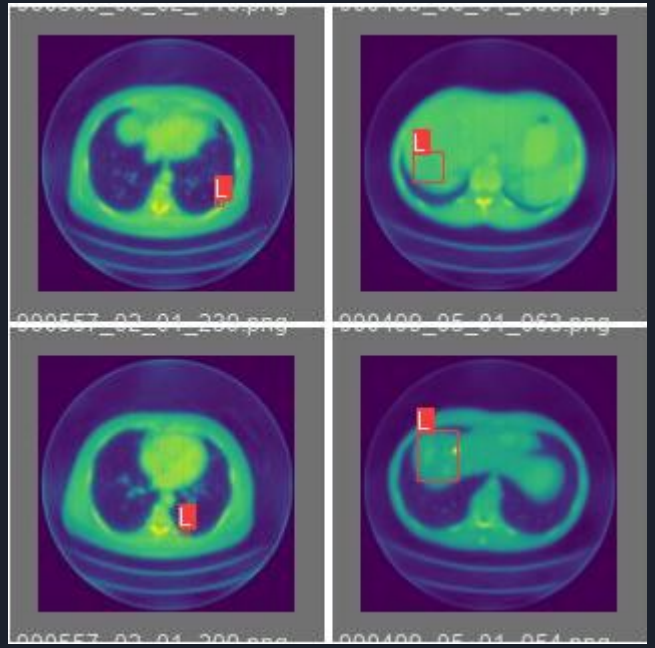


64 Slice Results

Predictions

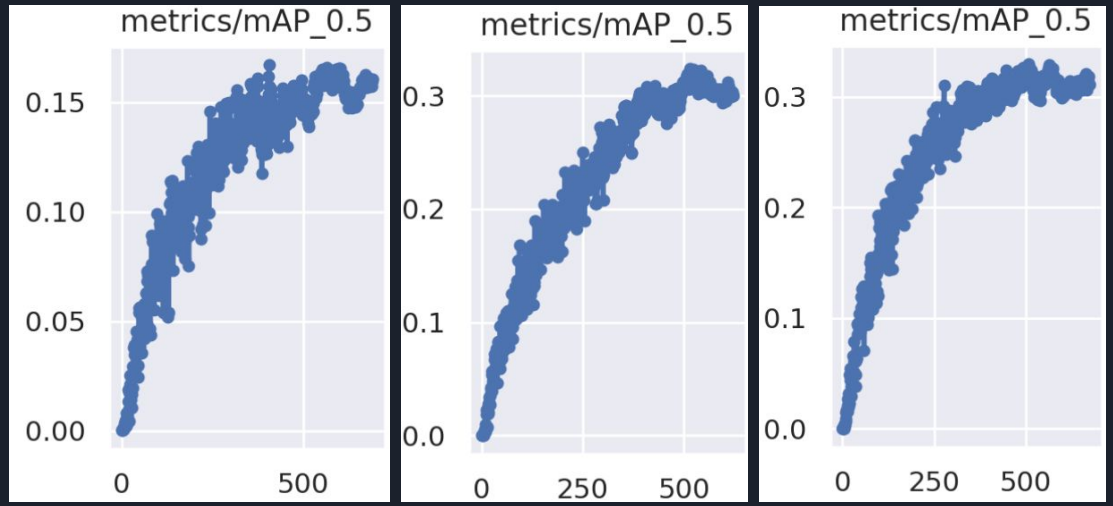


Actual



Results

	16 Slices	64 Slices	128 Slices
Mean Average Precision	0.161	0.310	0.326
Precision	0.468	0.601	0.696



Conclusions / Limitations

- 64 Slice CT Scanner has similar performance to 128 Slice CT scanner
- The mAP are similar for 64 and 128 slices
- We recommend using 64 slices in the CT scanner as the performance is similar as compared to more slices, but cost reduction is high and radiation reduction

- Certain types of lesions require higher quality images to identify
  - More slices are required
  - Better quality images in terms of dimensions (computational limitations)
- Potential Future Ideas
  - Train on different types of lesions rather than just identifying lesions
  - Larger dataset for each type of lesions

Questions?