Matthew Lewis
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# Week 8

**Applications of Foundation Models and Efficient Diffusion Models to Dental Radiography to Assist Dental Treatment Planning**
**Melody Halbert, MS and Laura Brattain, PhD**

# Project Overview

- Teeth charting is a manual process at the office
- It is a two person job and is error prone
- We aim to use AI to automate teeth charting
- Since dental datasets are limited, we are using foundation models
- To assist in pre-surgical planning and patient education we aim to apply diffusion models to generate synthetic teeth for fitting

# Proposed AI Tasks

Automated Segmentation of Teeth

- Zero-Shot ✓
- Fine tuning ✓
- YOLO Segmentation ✓
- YOLO prompt for fine tuning ✓

Diffusion Model for Synthetic Teeth Generation

# What Has Been Finished

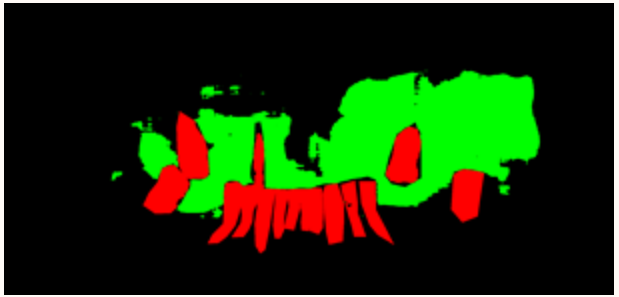
## Zero-shot with MedSAM

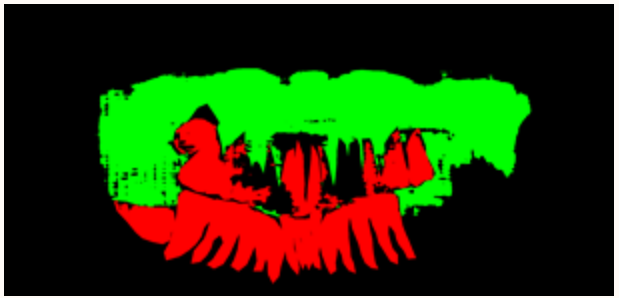
Zero-shot





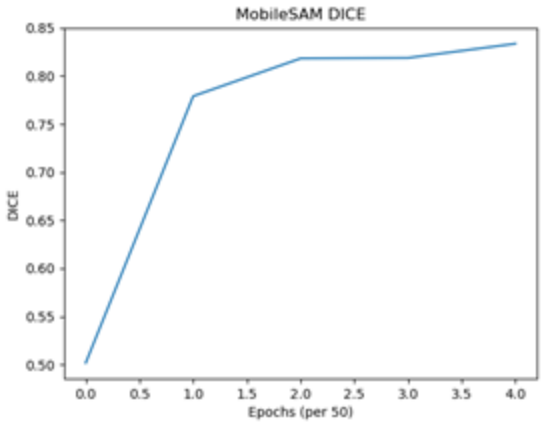
Zero-shot compared with Ground Truth





# What Has Been Finished

Fine tuning with MobileSAM




Ground Truth Mask gt_mask_20.png

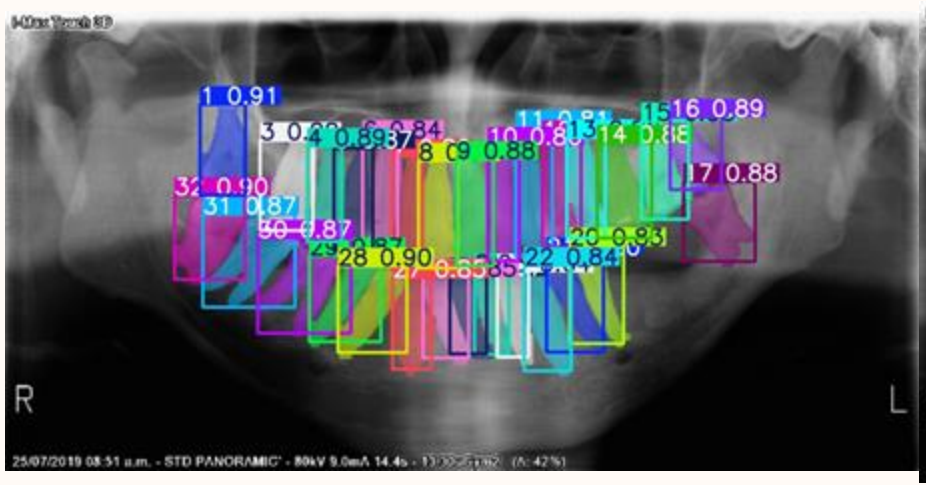


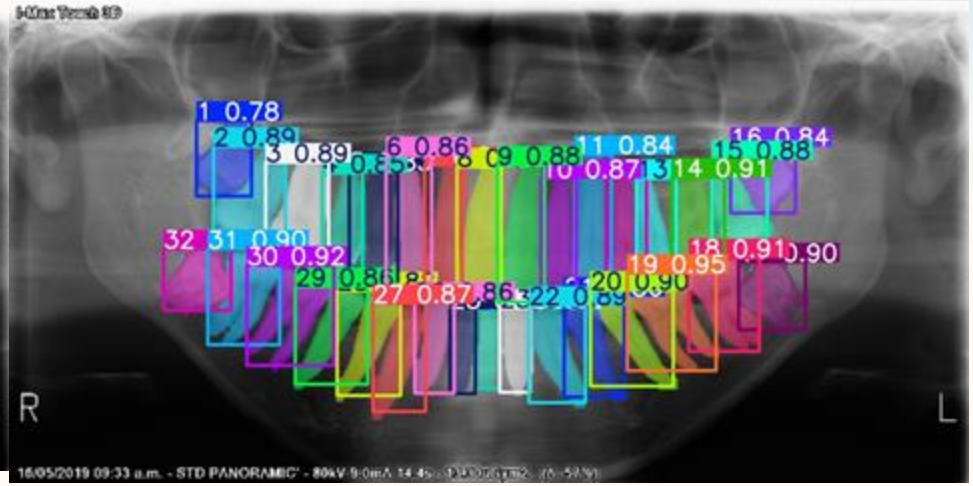
Predicted MobileSAM Mask



# What Has Been Finished

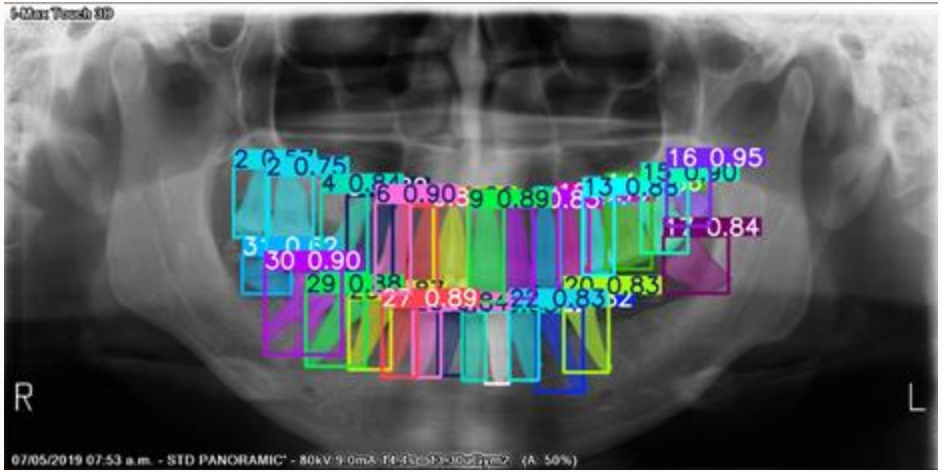
## YOLOv8 Segmentation and Labeling



# What Has Been Finished

YOLO Bounding Boxes with MobileSAM Fine Tuning Segmentation

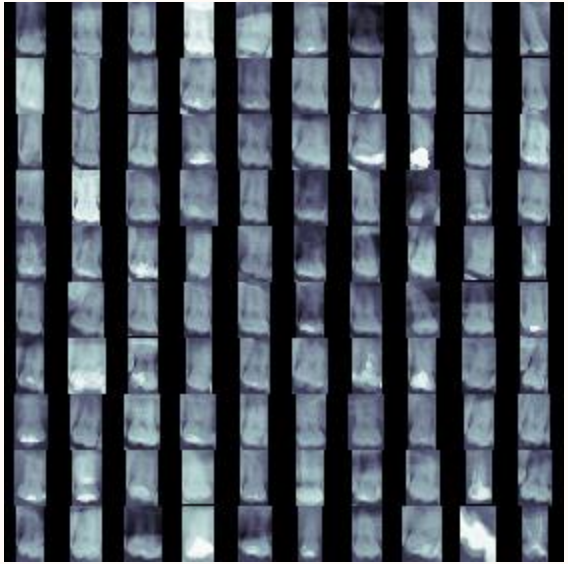




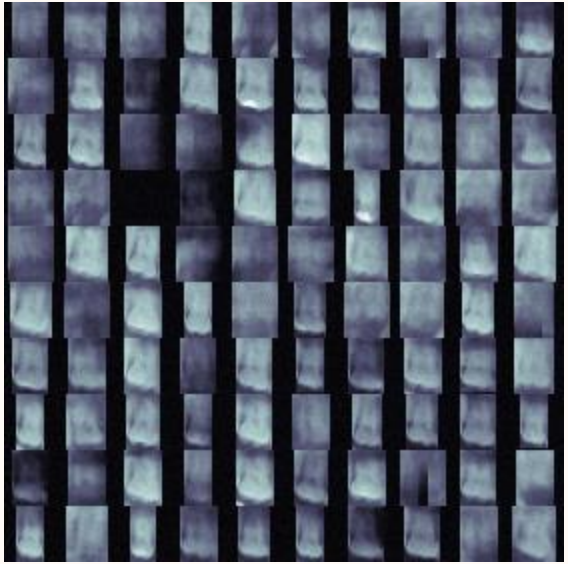

# What Was Done This Week

- Implemented Diffusion for Singular Teeth
  - U-Net Architecture
  - Batch Normalization
  - Added Padding to Achieve Uniformity in the Input Images (28x28)
  - https://github.com/varun-ml/diffusion-models-tutorial
  - This is a baseline, plan to improve starting here

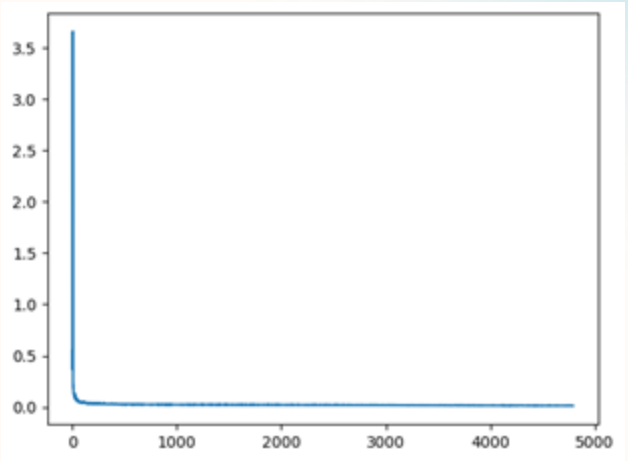
# What Was Done This Week



Actual teeth #3s

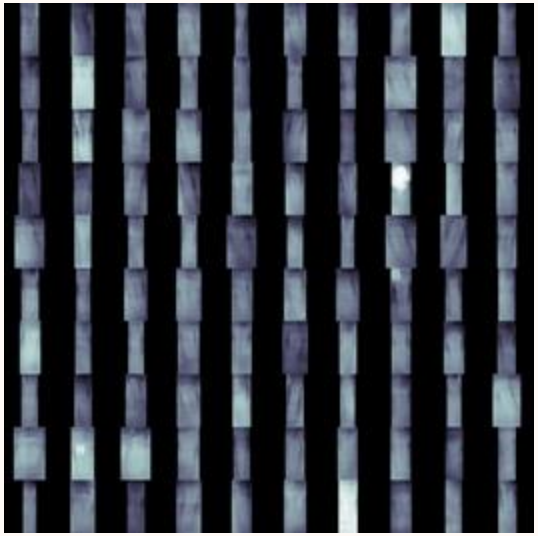


Generated teeth #3s

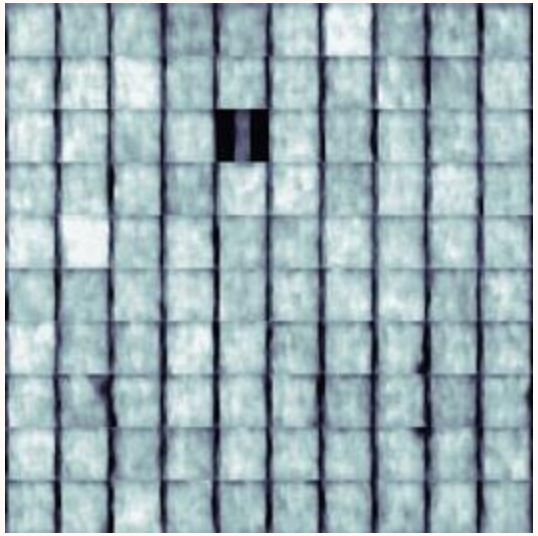



Loss

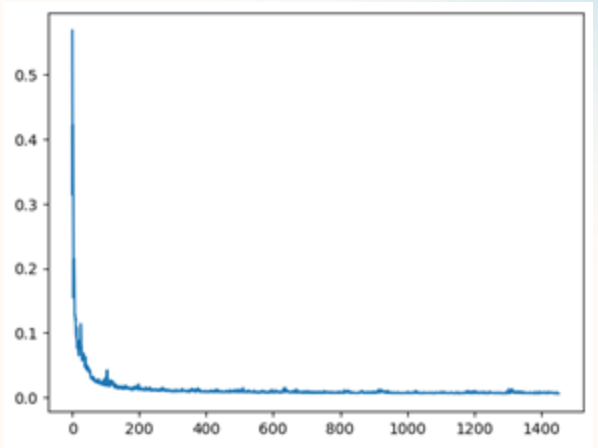
# What Was Done This Week



Actual teeth #24s 64x64

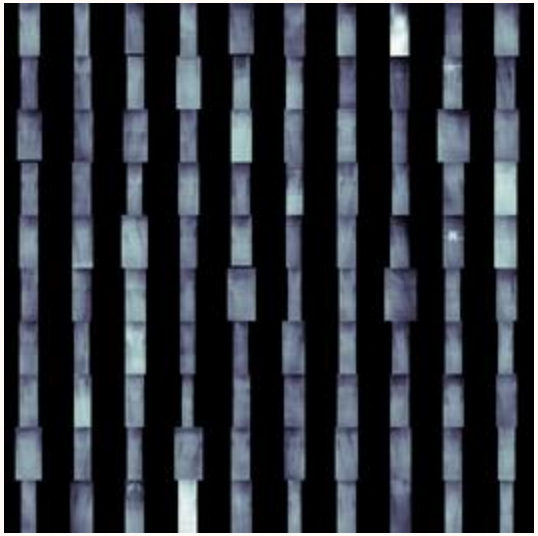


(Failed) Generated teeth #24s 64x64

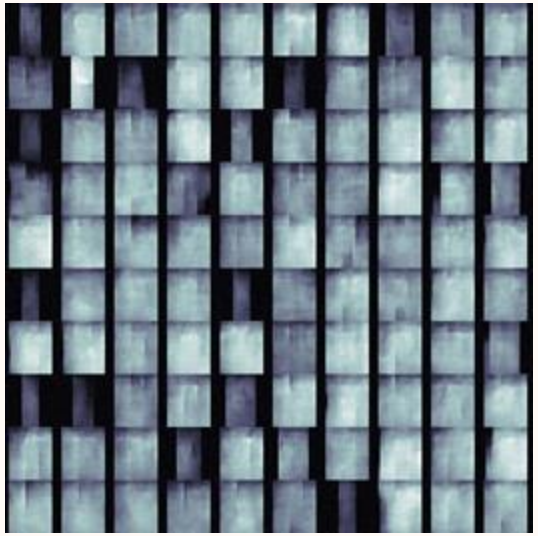



Loss

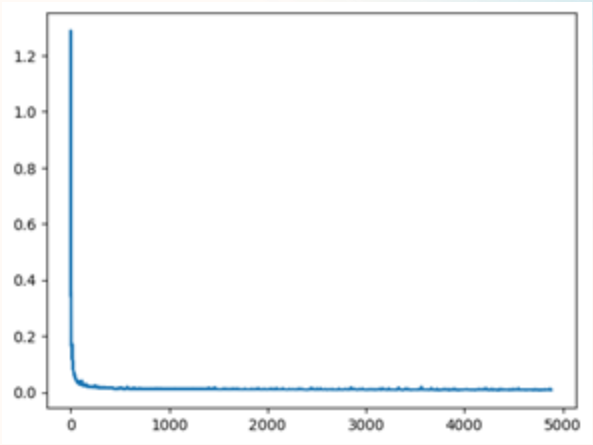
# What Was Done This Week



Actual teeth #24s



Generated teeth #24s



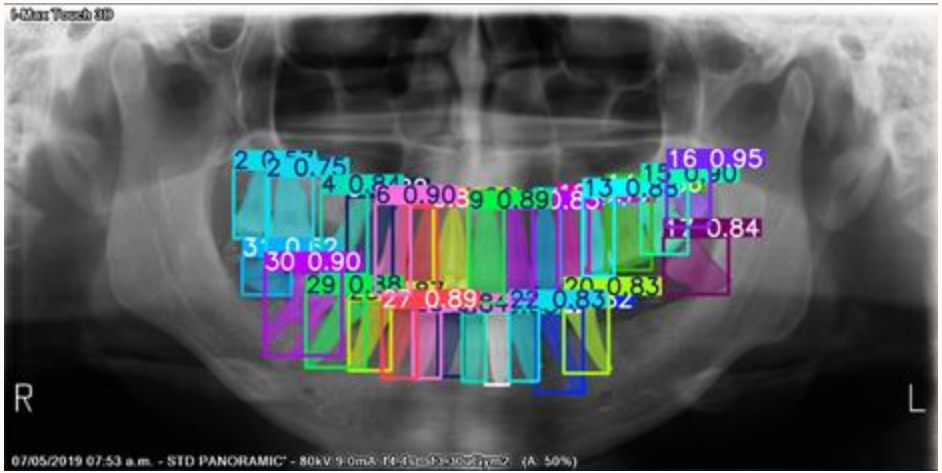

Loss

- Resizing with padding isn't going to work, need to figure out resizing method for varying dimensions
- Might need to try ElasticDiffusion

# What Was Done This Week

## Improved YOLO Bounding Boxes with MobileSAM Fine Tuning Segmentation

- Lower learning rate + longer training time

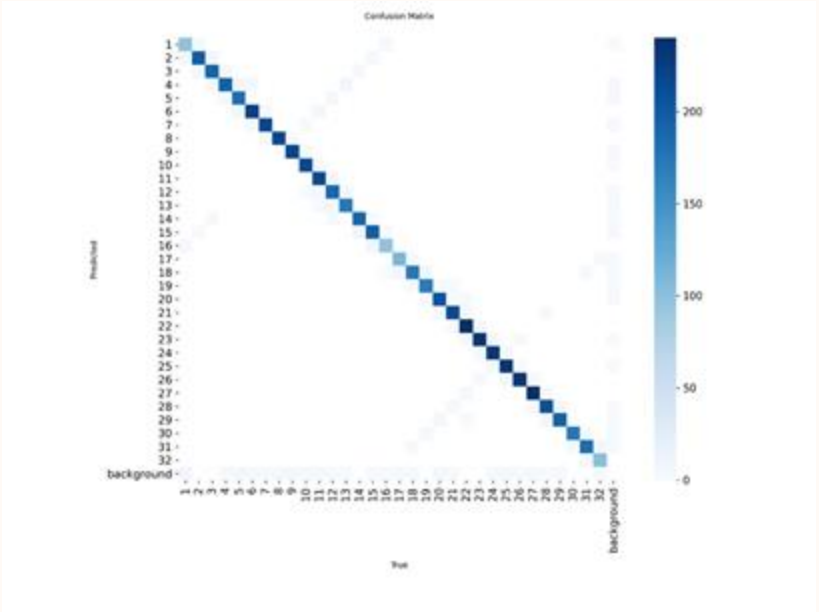


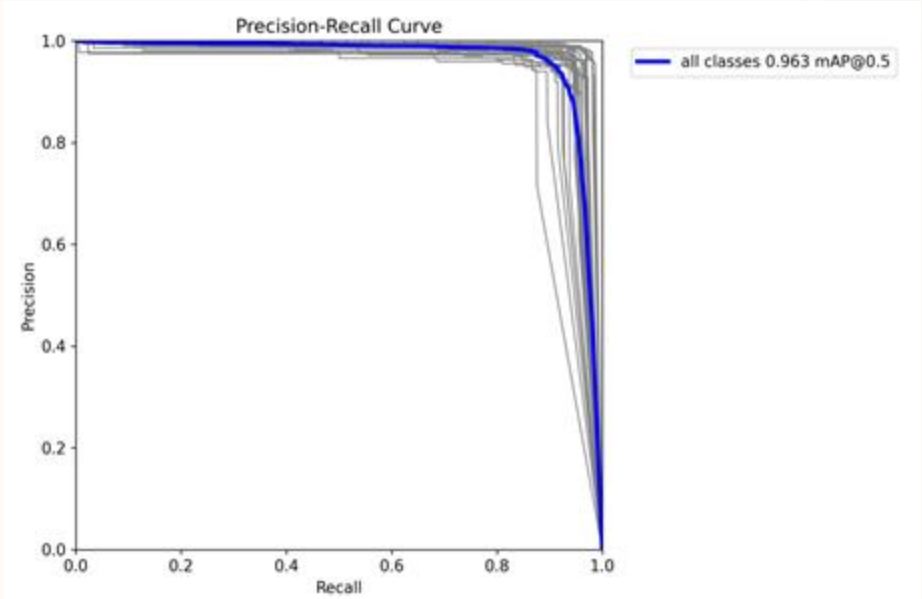



# What Was Done This Week

## Improved YOLO Bounding Boxes with MobileSAM Fine Tuning Segmentation

- Lower learning rate + longer training time



# Next Week

- Run tests and collect metrics for poster presentations including:
  - YOLOv8 vs. YOLOv8 + MobileSAM Fine tuning IOU comparison
  - Removing teeth duplicates in YOLO post processing
  - Generating more types of teeth in the diffusion model
  - Testing resizing without padding for tooth generation

# References

SuperMedIntel. (n.d.). *GitHub - SuperMedIntel/Medical-SAM-Adapter: Adapting Segment Anything Model for Medical Image Segmentation*. GitHub. https://github.com/SuperMedIntel/Medical-SAM-Adapter/tree/main

https://zaradental.com/teeth-numbers-and-names/

https://www.kaggle.com/datasets/humansintheloop/teeth-segmentation-on-dental-x-ray-images/data

https://github.com/bowang-lab/MedSAM

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# Thanks!