ScolAI

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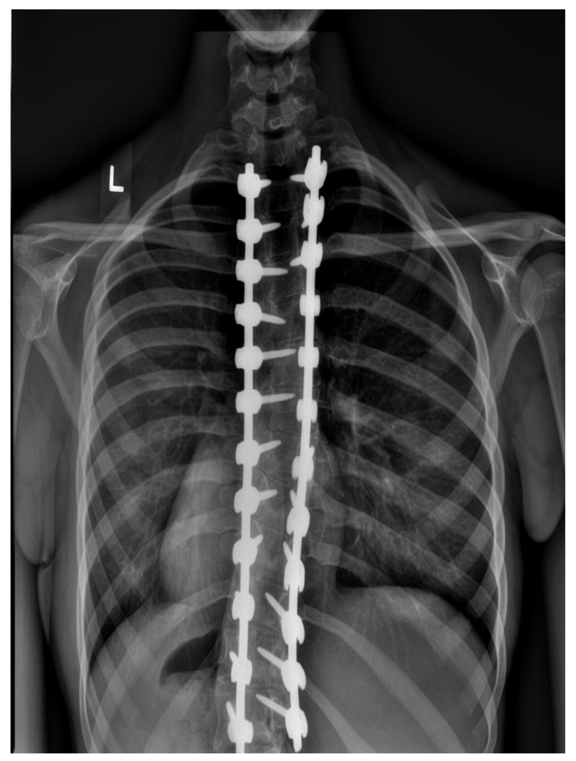
Introduction



- The Cobb angle serves as a key metric for quantifying the degree of spinal curvature
- Manual Cobb angle measurement is time-consuming, labor intensive, and prone to variability between clinicians
- Such inconsistencies can significantly affect scoliosis diagnosis & treatment

Objectives

- This project aims to develop a machine learning tool for automated
- Using ML, the tool aims to reduce variability in Cobb angle measurements and enhance clinical decision-making in scoliosis care

Materials and Methods

Dataset: The data came in the form of AP X-Rays from scoliosis patients. Due to lack of ground-truth segmentation masks, hip segmentation was used as a proxy task.

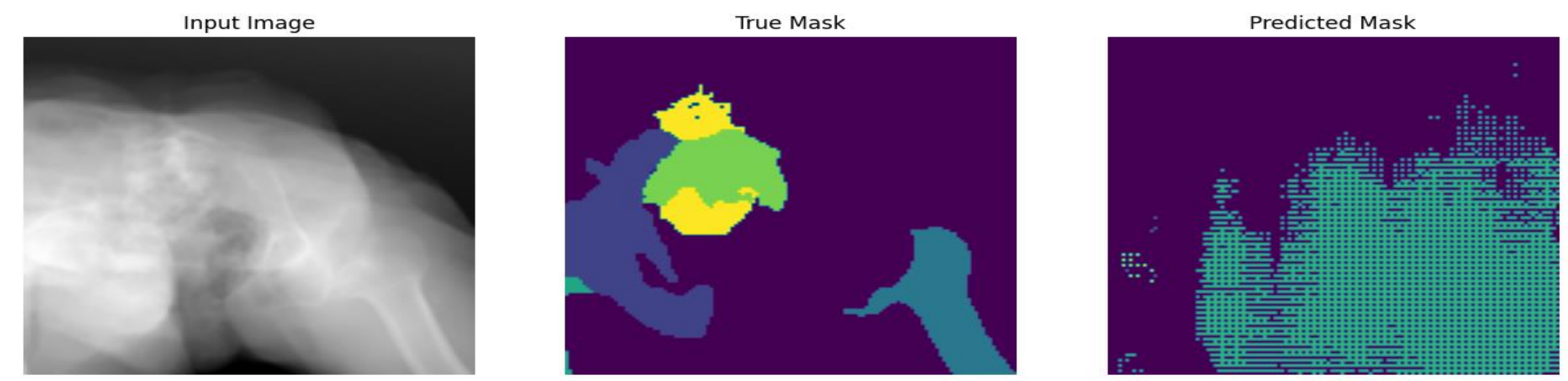
__Methodologies:__

1. **Hip Segmentation:** We used a U-Net neural network to segment six anatomical regions on grayscale hip X-rays.
2. **Direct Angle Regressio**n: an end-to-end model that takes in a spinal X-ray and directly outputs the Cobb angle

We used three model architectures for the final regression pipeline:

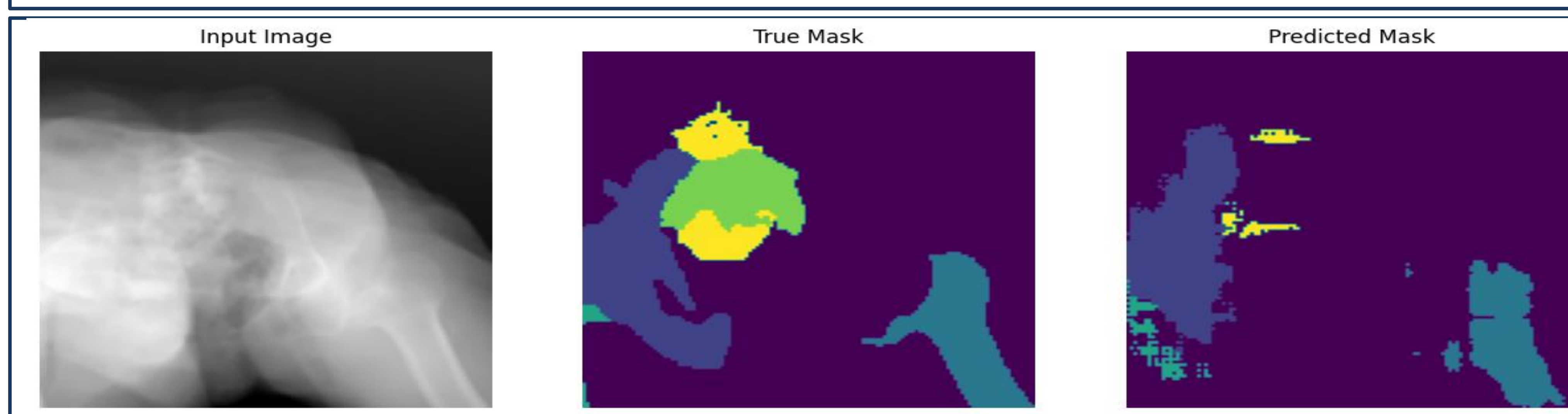
- **ConvNeXT**: A hybrid model combining CNNs and transformer-inspired design
- **Swin Transformer**: Uses shifted windows to efficiently handle large images while maintaining context
- **ResNet-50**: A proven deep CNN known for robustness and simplicity through residual connections

Results



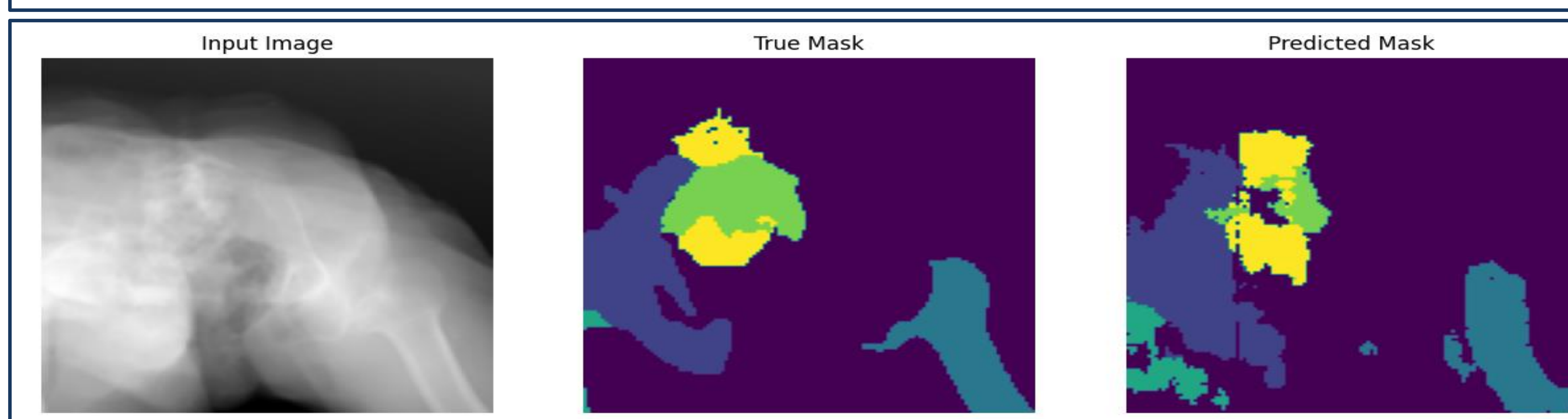
Model After First Epoch

- 80% training data & 20% validation data
- Model only sees set of training data once
- Predicted mask is noisy & does not resemble true mask



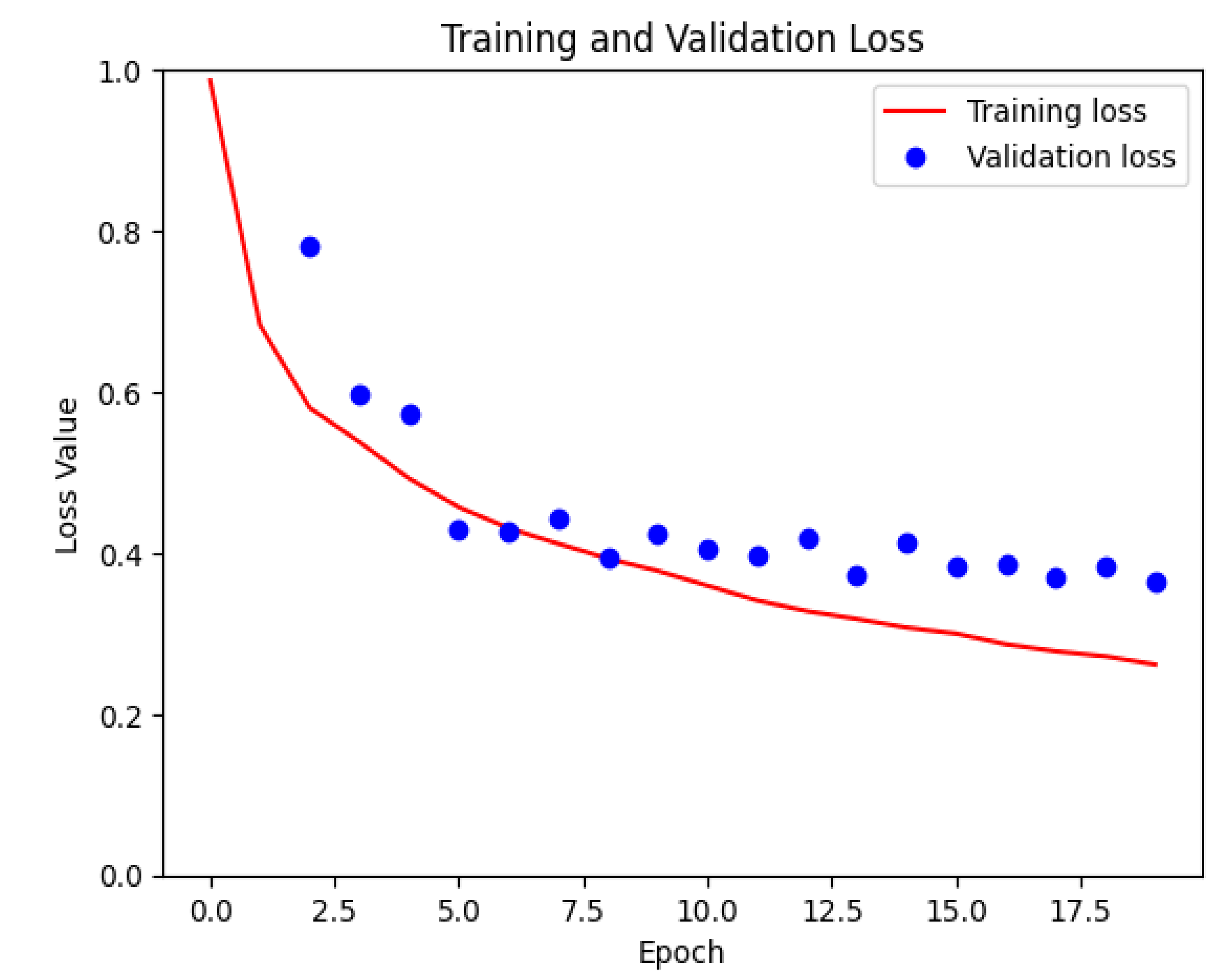
Model After 10th Epoch

- Model sees set of training data 10 times
- Begins to recognize key anatomical members at a higher rate
- Predicted mask becomes cleaner & begins to slightly resemble the true mask



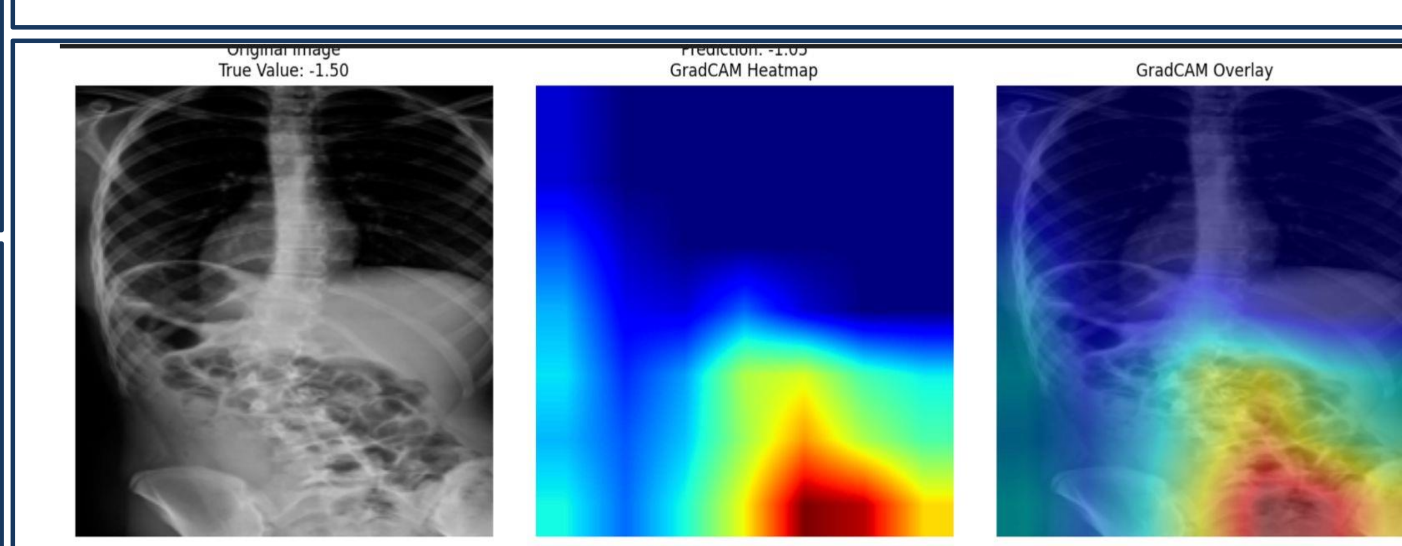
Model After 20th Epoch

- Model sees set of training data 20 times
- Model is learning with the training set over time & recognizing anatomical points
- Predicted mask closely resembles the ground truth mask



Model Training & Validation Loss Curve

- Training loss decreases steadily, showing the model learning effectively
- Validation loss decreases early, indicating effective generalization
- Overall, the curves reflect stable model training



Performance Model

- ConvNext: 1.1 cm^2 error
- Swim Transformer: 0.9 cm^2 error
- ResNet50: 0.8 cm^2 error

Conclusion

ScolAI began with a vision for automated Cobb angle measurement. We've now built a functional pipeline that performs competitively and is ready to be adapted to spinal data once annotations become available. We're optimistic about ScolAI's potential in clinical workflows.