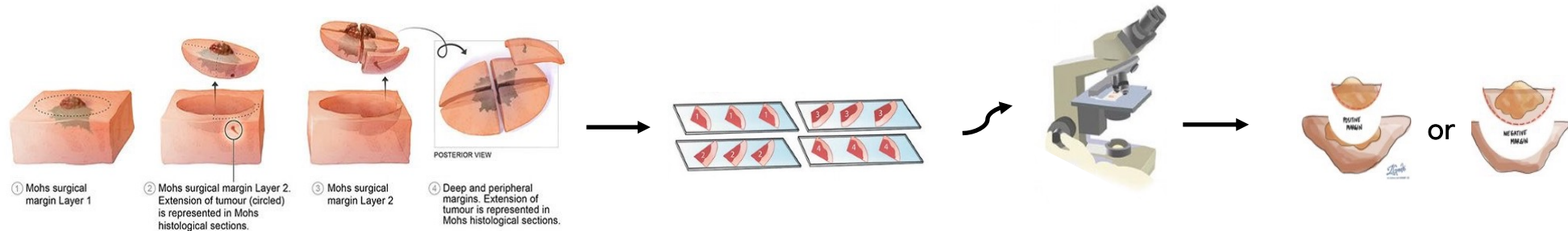


Intraoperative Histological Analysis of Squamous Cell Carcinoma Tumor Margins Using a Convolutional Neural Network

Introduction

Squamous Cell Carcinoma (SCC) is the second most common form of non-melanoma skin cancer.



MOHS Micrographic Surgery with **intraoperative margin assessment** is used for the removal of SCC tumors to prevent metastasis. However, margin assessment is **confounded** by **multiple variables**: slide quality, specimen complexity, time limitations

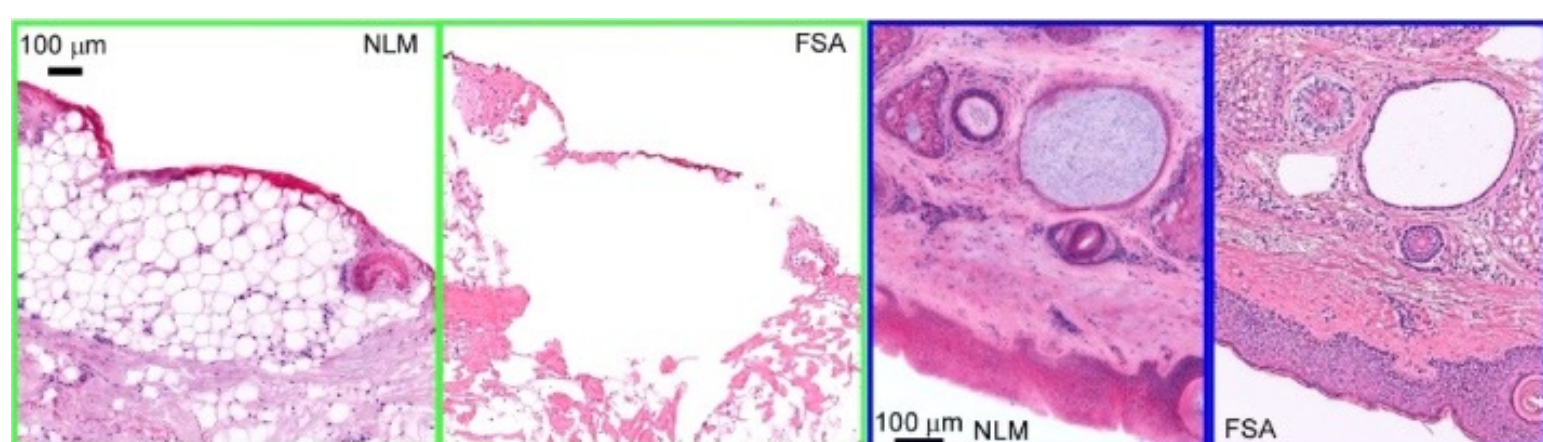


Figure 1: Post-operative (NLM) WSIs maintains original tissue appearance and structure. Intraoperative (FSA) WSIs have distorted tissue structure and appearance. Image source: Giacomelli et. al., 2019

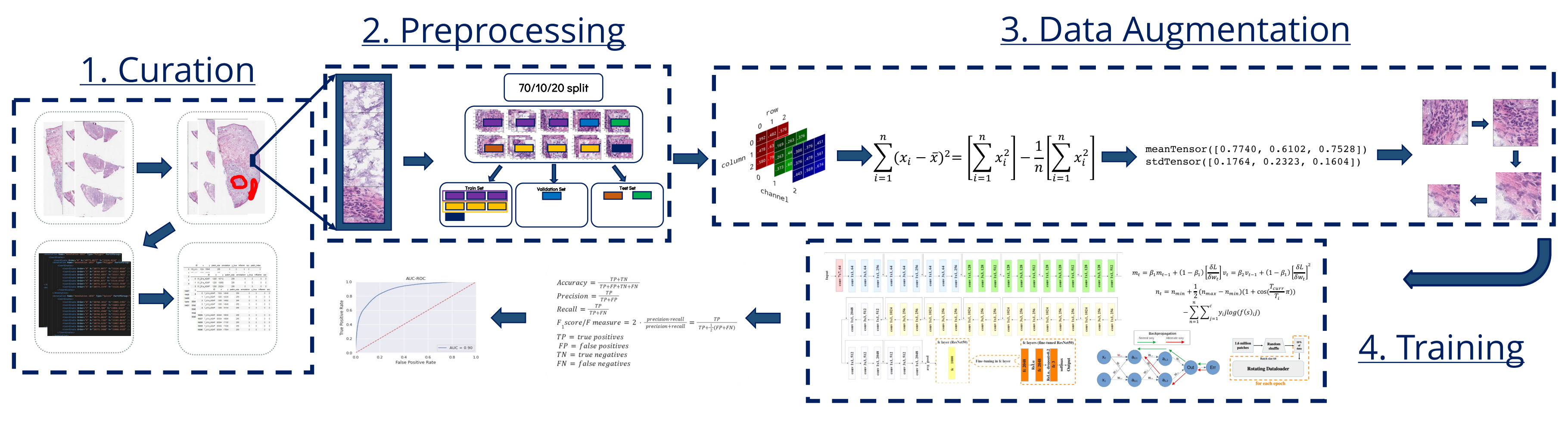
Objectives

Develop a **robust, accurate, and quick to run** model to automate intraoperative assessment using a **Convolutional Neural Network**

Selected References

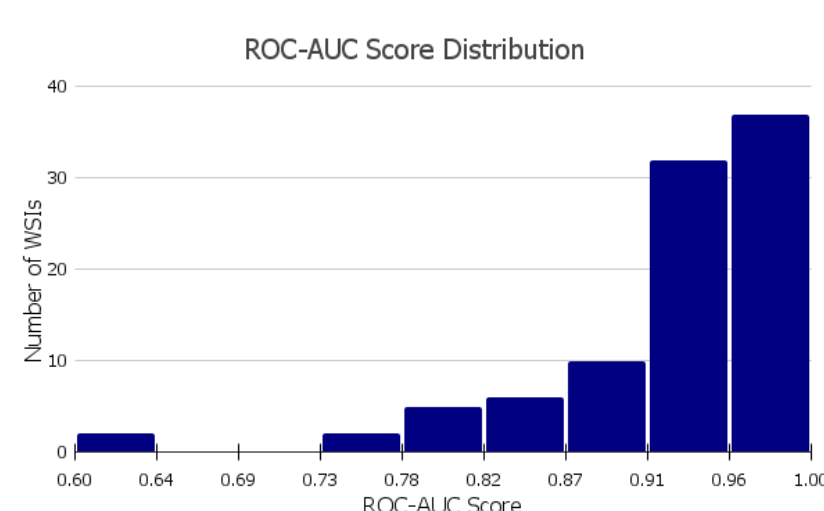
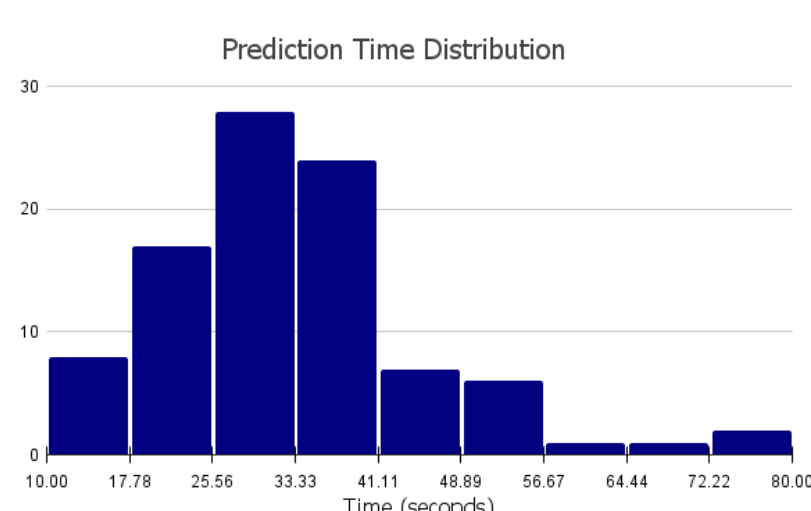
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- *All figures and charts produced by student unless otherwise stated

Methods



Results

- Model achieves **AUC of 0.90** on previously unseen test dataset of 320,000 patches
- Model evaluated on entire dataset of **95 WSIs**
 - Average **AUC-ROC score of 0.923** AUC-ROC scores of 0.96+ for more than a third of the dataset
 - Average **prediction rate of 33s per WSI.**
- Average prediction rate for each **patient case is 57s per WSI**, with a confidence interval of 56.754 ± 23.995 .



Conclusions + Future Works

Approach	Data Site + Size	AUC	Precision	Recall	F1	Accuracy
Wako et. al.	828 images, 7 sites	0.952	0.950	0.960	0.950	N/A
Santos et. al.	15 WSIs, Oral SCC	0.770	0.911	0.929	0.920	0.976
Halicek et. al.	381 WSIs, Head + Neck SCC	0.954	N/A	0.847	0.948	0.890
Ma et. al.	15 slides, Head + Neck SCC	0.937	N/A	0.888	N/A	0.824
My approach	95 WSIs, multiple sites	0.923	0.960	0.970	0.960	0.960

- Model achieves **high performance scores and quick prediction rates.**
- Model obtained the **best performance metrics** for 3/5 scores and comparable AUCs and accuracies.
- Model predictions demonstrate **high accuracy in localizing tumors within WSIs**, which would significantly **assist pathologists with the histologic examination** process during surgery.
- Future directions include utilizing **Graph convolutional networks (GCNs)** to factor in patch level relations and **more expansive datasets**