Master's Thesis Proposition: Modeling Uncertainty in H. pylori Diagnosis Using Histopathological Image Analysis

Helicobacter pylori (H. pylori) infection is a leading cause of gastric diseases, with histopathological diagnosis using immunohistochemistry (IHC)-stained tissue being a gold standard. However, automated deep learning models struggle with inconsistencies caused by artifacts and staining variations, leading to misclassifications that impact diagnostic reliability.

This study will aim to model uncertainty in H. pylori classification by leveraging deep learning and uncertainty quantification techniques. The objective is to identify and characterize misclassified patches, distinguishing those affected by artifacts from truly ambiguous cases. Uncertainty will be quantified by analyzing classification inconsistencies across multiple models, such as convolutional neural networks (CNNs) and Vision Transformers, and assessing model confidence using Bayesian methods, Monte Carlo Dropout, and ensemble learning. Feature space analysis will be employed to visualize patterns in misclassified patches, enabling a clearer distinction between noise-induced errors and difficult-to-classify regions.

By integrating uncertainty-aware classification, this research seeks to enhance the robustness and interpretability of automated diagnosis, ultimately improving patient-level decision-making and increasing trust in deep learning models for histopathological analysis.