Optimizing Neural Networks for Fast and Accurate Breast Cancer Detection

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In the spring of 2025, my aunt tragically passed away from a long and hard-fought battle with breast cancer. My grief inspired me to develop a way to help diagnose breast cancer more efficiently. Early diagnosis is critical for improving survival rates, especially for aggressive cancers such as Inflammatory Breast Cancer and Triple-Negative Breast Cancer. The current standard of care is time-consuming, costly, and reliant on experts. My project explores how Deep Neural Networks (DNNs) can be optimized to improve the speed and accuracy of breast cancer diagnosis. To investigate this idea, I trained several machine learning models using the Wisconsin Diagnostic Breast Cancer Dataset. This dataset contains 30 numerical measurements of cell nuclei collected from FNA samples (e.g., radius, texture, concavity) that can be used to distinguish between benign and malignant tumors. In my experiments, I used 11 machine learning models, 9 of which were DNNs with distinct hidden layer architectures and dropout rates. I trained these models at 100, 125, 150, 175, and 200 epochs and evaluated them using recall and F1 scores to measure diagnostic performance. The results partially support my hypothesis: the medium-level models performed as I predicted, but the large and small models did not. My experimentation led me to conclude that optimizing DNNs for speed and accuracy in breast cancer detection requires careful and thorough experimentation to avoid overfitting. Overall, my project optimizes DNNs such that they can be later implemented into a faster and more affordable breast cancer diagnosis procedure. In the future, my research could make breast cancer diagnosis more accessible for uninsured patients and people in rural areas without access to expert pathologists.

Awards Won: