A Novel Integrative WSI-Based Deep Learning Framework For Breast Cancer IMS Classification

Konidala, Laasya (School: Mills E. Godwin High School)

Breast cancer is the second-leading cause of cancer-related deaths in women globally. Advanced diagnosis of intrinsic molecular subtype is key to evaluating intermediate survival; however, biological variance and staining inconsistencies make the standard manual analysis of H&E-stained images a challenging task. Recent advancements in neural network architecture introduce a robust mechanism to address this task. A novel Multiscale-Based Classifier (M-BC) proposed here analyzes patch representations of cancer-dense clusters in three spatial localities. After H&E slide pre-processing, the concatenated vectors of tumors were assessed for cancer enrichment. A one-versus-all adaptation of a support vector machine distinguished Luminal A, Luminal B, HER2, and Basal subtypes. The performance was evaluated against a local-based classifier (L-BC), analyzing cellular structures, and a global-based classifier (G-BC), analyzing the tissue interactions. A five-fold cross-validation indicated the statistically significant high predictive power of the M-BC, supporting the research hypothesis. The robust paradigm had state-of-the-art performance because it interpreted morphological interdependencies on varying spatial levels of information, allowing the aggregation of the patch representations to extract key features of the whole slide image. Interestingly, the structural detection of subclonal diversity in cancer cell receptor expression denotes the novel application for breast cancer heterogeneity detection. With further work mapping molecular expression to the multiscale patch representations, the advanced feature extraction, low computational cost, and non-domain specific knowledge of the M-BC model accelerates the application to standard biomarker prognostic procedures.

Awards Won:
Third Award of $1,000