Semantic Multilayer SVM: Novel Artificial Intelligence and Computer Vision Applied to Prostate Cancer Grading and Breast Cancer Diagnosis

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We present Semantic Multilayer Support Vector Machine (SMLSVM), a novel prototype for artificial intelligence that uses a multilayer network of Support Vector Machines (SVM) to perform data abstraction. This capability allows SMLSVM to avoid the semantic gap and the curse of dimensionality by translating groups of related low-level data into valuable high-level concepts. SMLSVM avoids two major problems that plague current SVM technology and presents novel contributions to machine learning and deep learning. To demonstrate its real world significance, we train SMLSVM to perform Gleason Grading, the diagnosis of prostate cancer severity. To accomplish this, we develop Procist, a tissue analysis software that can intelligently and numerically describe the appearance of a prostate histology image. Procist and SMLSVM work as a seasoned digital pathologist to autonomously diagnose prostate cancers based on two Gleason Grades, a notable advance over current software that only considers a single Gleason Grade, which is clinically unrealistic. Procist presents new contributions to computer aided diagnosis and advances computational histopathology research towards achieving clinically realistic outcomes. After testing SMLSVM and Procist on 20 prostate cancer histologies from the Johns Hopkins Medical Institute and SMLSVM on the University of Wisconsin Breast Cancer Dataset, our algorithms diagnosed cancers more accurately than current approaches by 5% and 0.72%. On the prostate histologies, we achieved 100% accuracy with the two Gleason Grade innovation. We will expand the capabilities of our algorithms by adapting them to breast, colon, and renal cancers, and test our algorithms on larger and more clinically realistic image datasets to definitively validate our results.

Awards Won:
Second Award of $2,000
European Organization for Nuclear Research-CERN: All expense paid trip to tour CERN