A Fast, Sensitive, and Non-Invasive Approach to Detecting Breast Cancer Using a Fully Convolutional Neural Network

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I developed and implemented a Computer Aided Diagnosis (CAD) system that is fully autonomous, non-invasive, cheap, and effectively instantaneous, all while outperforming radiologists and other neural network-based architectures. Currently, though most breast cancer clinics already employ CAD in place of a second radiologist, the existing systems are slow, costly, and dependent on hand-crafted features that fail to differentiate between naturally dense breast tissue, benign masses, and malignant tumors, thus increasing the false positive rate of detection without significantly improving the sensitivity. Additionally, with the US Food and Drug Administration's recent proposal to send post-mammogram summary letters to certain women informing them that their dense breast tissue obscures tumors and makes cancer screening more prone to error, there is an obvious necessity for a quick and sensitive CAD system resistant to falsely classifying dense breasts. Using a Region-based Fully Convolutional Network (R-FCN)—a novel framework comprised of two convolutional neural networks that share learned features between stages—I developed a state-of-the-art machine learning algorithm that locates malignant tumors in an average of 90ms while achieving a sensitivity of 0.94 and a false positive rate of 0.24 on mammograms from the Digital Database for Screening Mammography. Tested on mammograms with both dense and normal breast tissue, my detector has shown no significant difference in performance on mammograms with varying tumor subtlety. Being easily accessible and requiring no mammogram preprocessing, my detector serves as a step forward in the field of bioinformatics and is very encouraging for the prospects of fully-automated cancer detection.

Awards Won:

Third Award of $1,000

Fondazione Bruno Kessler: Award to Travel to Trento, Italy to participate in summer school "Web Valley"