Segmenting CT Slices: Optimizing Lesion Detection through Mask Region-based Convolutional Neural Networks

Chen, Liam (School: Olentangy Liberty High School)
Dashora, Nitish (School: Olentangy Liberty High School)

Lesions, or abnormalities in tissue, are common and can be very severe. Before they become lethal, it is imperative that they are properly scanned and detected, so that proper measures can be taken in a timely manner [16]. Current research provides a way to coarsely segment lesions autonomously in 16-bit CT scans [25], but our research utilized different imaging formats. The purpose of this project was to determine if deep learning algorithms can be applied on NIH data [2,5] and what imaging format works best to efficiently segment lesions autonomously. This was done by experimenting with 2D and 3D representations of 8-bit CT scans. It was implemented through the use of a Mask Region-based Convolutional Neural Network [10,11] in tandem with Tensorflow Object Detection API [3,6]. We concluded that segmentation in 8-bit is much more efficient with 3D images, but is not efficient enough for professional use. Thus, 8-bit images and 2D imaging should be avoided when autonomously detecting lesions. Since the use of 16-bit data would not introduce any new variables and yields higher accuracies [25], CT segmentation would be optimized through use of 3D, 16-bit data. Implementing this conclusion, we used seven multi-propagated 16-bit cross-sections and a Convolutional Generative Adversarial Network to produce accurate volumetric data. These were then fed into a 3D U-Net architecture to continue our optimization. The volumetric results were much better than the original 3D and 2D approaches which further improves the technique of lesion segmentation.