Abstract

In essence, an abnormal increase of brain cells is referred to as a brain tumor. Tumors come in two varieties: benign (non-cancerous) and malignant (cancerous). Cancerous tumors can originate in the brain itself (Primary) or spread from elsewhere from other parts of the body as well (secondary or metastatic tumors). One of the most aggressive and malignant forms of brain tumor is Glioblastoma which is also known as glioblastoma multiforme (GBM). Glial cells are the supportive cells in the brain which is the main origin of GBM tumors. The rapid growth of GBM and its tendency to spread into nearby brain tissue makes complete surgical removal of the tumor challenging. The main purpose of this study was to build an efficient model with the application of deep learning techniques to detect glioblastoma accurately. We implemented a binaraized version of ResNet18, VGG16, and DenseNet121 with the Binary Weight Networks (BWN) approach. This conversion to binary values saved almost 30x memory. In Binary Weight Networks (BWN) the weights are binary value but the inputs are not binarized, input data remains full-precision format. Applying binary operation in convolution layers helped 40x faster operations in convolution compared to full precision operations. This memory savings will help us to run those models in real-time only using CPU rather than heavy GPU. Our simple binary models are efficient and accurate also on detecting Glioma. We evaluated our model's performance with TCGA-GBM and IXI dataset using accuracy, confusion matrix, and ROC curve matrics. For ResNet18 we got 89% accuracy. For DenseNet121, we got 85% accuracy. And for VGG16, we got 87% accuracy. The classification with a Binary Weight Network version of ResNet18, DenseNet121, and VGG16 is as closely accurate as the full precision. We compared our binary models with full-precision models, which gave us a balance between accuracy and efficiency, with a 33x reduction in model size and 30x memory saving.

Keywords: Glioblastoma detection, MRI, Binarized Neural Networks, ResNet18, VGG16, DenseNet121, Binary-Weight-Networks, Deep Learning.