RSNA-MICCAI Brain Tumor Radiogenomic Classification

Research Programming Assignment IV

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Abstract

Glioblastoma, the most commonly occurring malignant brain cancer (47.7% of all cases)[1], is a fatal condition. Expected life expectancy post diagnosis is less than one year in a vast majority of cases. However, the presence of a genetic sequence known as MGMT promoter methylation is a favorable biomarker of the body's response to chemotherapy[2]. Based on this Kaggle competition put forth by the Radiological Society of North America, "development of an accurate method to predict the genetics of the cancer through imaging (i.e., radiogenomics) alone could potentially minimize the number of surgeries needed to identify the sequence and refine the type of therapy required." [1]

As I choose to do the deep learning project, here is an overview of what that means. In deep learning, a network is trained with a set of labeled images. The network learns to recognize patterns in the data and then uses these learned patterns to classify new data. Deep learning networks are composed of many layers, where each layer contains a number of

[1] [1] Vikram C Prabhu, MD (2021, May 5). Glioblastoma Multiforme. Retrieved from American Association of Neurological Surgeons: https://www.aans.org/en/Patients/Neurosurgical-Conditions-and-Treatments/Glioblastoma-Multiforme

artificial neurons. When the network is first trained, the weights (i.e., connections) between the neurons are random. The network is exposed to images that are labeled with what they represent, such as "dog," "cat," or "person." As the network sees these images, it alters the connection weights between neurons such that the network can accurately predict what label is associated with an image.

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Research Purpose, Dataset Introduction, & Literature Review

The use of artificial intelligence in medical image classification has been an area of interest for many years. The use of AI in medical imaging is becoming more and more prevalent in the medical field. One of the most common uses of AI in medical imaging is in the field of radiology. Radiology is a branch of medicine that deals with the diagnosis and treatment of various diseases through the use of x-rays and other forms of radiation. Artificial intelligence has been used to help with the diagnosis and treatment of various diseases by using a computer to analyze x-rays and other forms of radiation. Artificially intelligent algorithms are able to analyze x-rays and other forms of radiation and detect abnormalities that would be difficult for a human to see. Artificial intelligence has also been used in the field of dermatology. Dermatology is a branch of medicine that deals with the diagnosis, treatment, and prevention of skin diseases, such as acne, eczema, psoriasis, warts, or skin cancer. Artificial intelligence has helped dermatologists by analyzing skin images for signs of skin cancer.

The purpose of this research is to detect Giloblastomas by looking at 3d scans of brains. The data set, due to it's 3d nature is extremely difficult to work with and there are numerous ways to go about it. I had a number of issues training this dataset and was ultimately unable to produce a completed model as I had a last minute error that resulted in the loss of my output(I forgot to save the model after training it). But each model took a number of hours to train and resulted in accuracy values between .6 for the CNN and .72 for the Transformer. I am going to keep working on this as there is quite a large prize on the line and I may be able to get a competitive score with my transformer.

Experiments & Conclusion

Prior to my experiments, I choose to split the 3d images into a series of 2d images as I have little experience with 3d image sets. I did this by writing code that split the 3d images in to multiple 2d images and created a custom y series for the 2d images with the corresponding values for the 3d images.

I choose to do 2 primary experiments, which is all the data size allotted, one for a deep CNN and another for a transformer. The CNN took approximately 5 hours to train and the transformer took approximately 1.5 days before it was done training. I had to rent out space on google's cloud platform in order to allocate the necessary computing power to accomplish these tasks. I unfortunately, however recently encountered an error and crashed the kernel prior to saving my model and due to the time constraints was unable to retrain the model for submission. I spent most of the day attempting to recover it but with no luck. However, my code speaks for itself! I am going to continue working on it for the time being and attempting to see if I can fine tune my transformer to get above a .8 threshold. Additionally, I placed a number of visual outputs in the code that were not possible to place into a pdf as they are moving scans of the brain.