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Research Methods

12 September 2024

Problem Statement Topic

"Glioblastoma is a very aggressive brain cancer with no cure. It grows and spreads quickly, so by the time it's diagnosed, survival chances are low." Patients who get treatment typically live 12-15 months, while those who don't usually live only 4 months (Kwatra). Glioblastoma is the most common type of malignant brain tumor, accounting for 47.7% of all cases (Thakkar et al.). Because there is no cure yet to the tumor, the best and only way is early detection and removal of the tumor from the brain (Kwatra). Oftentimes it is too late and the tumor is unnoticed, but using artificial intelligence it may be possible to detect the presence of the tumor in the person's body. By using a Public database like the The Cancer Genome Atlas Program, we can find public data about previous genomic data of Glioblastoma patients (TCGA). Using a artifical intelligence algorithm, we can train a model to be able to detect and find patterns in the genomic data of patients and use it for testing future patients. The genomic data of a person can be found as easily by looking at a single strand of hair, but contains valuable information about the person. We will look at different AI algorithms and features from genomic data (independent variables) and measure the model's accuracy, precision, recall, and F1 score (dependent variables). The goal is to see which AI methods are best at identifying important mutations in glioblastoma. We can do this by using the PyTorch library with the Python language

to create a model that can help detect glioblastoma in early stages. In the past there has been research done to try to predict glioblastoma, but usually they are done using sensors and different machinery that is placed into the brain and surrounding area to try to get a sense of how the tumor looks and if it is there (Ahmad Zavaran Hosseini et al.). This experiment will help advance scientific research to better detect early cases of glioblastoma.

Title: Artificial Intelligence-Driven Detection of Genetic Mutations in Glioblastoma Multiforme Using Genomic Data

Topic: The use of artificial intelligence (AI) to identify specific genetic mutations in glioblastoma multiforme (GBM), a common and aggressive brain cancer, by analyzing genomic data.

Problem Statement: Glioblastoma multiforme has many genetic changes, making it hard to treat and very aggressive. Finding these mutations early can improve treatment and outcomes. Traditional methods are slow and complicated, so we need an AI-based approach to quickly and accurately find these important mutations.

Research Question: How can an AI model be trained to accurately detect and classify genetic mutations in glioblastoma multiforme using genomic data, and how does its performance compare to traditional mutation detection methods?

Independent Variable: Type of AI algorithm, training dataset, what specific data used to train (whole gene, specific type of gene, specific part of gene etc.).

Dependent Variable: Accuracy of AI algorithm, by cross testing with known cases of Glioblastoma multiforme. Comparing correct detections / total detections tested.

Resources:

1. https://portal.gdc.cancer.gov/projects/TCGA-GBM
2. https://www.genome.gov/dna-day/15-ways/dna-sequencing
3. https://www.cancer.gov/ccg/research/genome-sequencing/tcga
4. https://www.python.org/
5. https://pytorch.org/

6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10199620/

Works Cited

Ahmad Zavaran Hosseini, et al. “Recent Advances in the Detection of Glioblastoma, from Imaging-Based Methods to Proteomics and Biosensors: A Narrative Review.” *Cancer Cell International*, vol. 23, no. 1, 20 May 2023, https://doi.org/10.1186/s12935-023-02947-1. Accessed 27 Oct. 2023.

Kwatra, Gita. “Glioblastoma: What Every Patient Needs to Know.” *Glioblastoma Foundation*, Glioblastoma Foundation, 30 Aug. 2021, glioblastomafoundation.org/news/glioblastoma-multiforme#:~:text=It%20grows%20fast%20and%20can. Accessed 18 Sept. 2024.

National Cancer Institute. “The Cancer Genome Atlas Program (TCGA) - NCI.” *Www.cancer.gov*, 13 May 2022, www.cancer.gov/ccg/research/genome-sequeț0ncing/tcga.

Thakkar, Jigisha, et al. “Glioblastoma Multiforme.” *American Association of Neurological Surgeons*, AANS, 15 Apr. 2024, www.aans.org/patients/conditions-treatments/glioblastoma-multiforme/. Accessed 18 Sept. 2024.