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Research Statement

I am interested in doing PhD because of my zeal to carry on a detailed research in the biomedical field and apply bioinformatics knowledge to develop some computational techniques that could pave a way to analyze complex biological datasets like RNA-Seq and Neuroimaging data but is not limited to this. Through my PhD at IIIT Delhi I can apply pursue this goal as I will get the platform and most importantly the resources that will help me in carrying out the work that I intend to. My broad research interest is the identification of biomarkers in different disease types and specially focused on cancer and neurodegenerative diseases and developing computational techniques for the analysis of high-throughput complex biological datasets. My potential projects should involve the following areas of research:

1. The therapeutic effects of different cell-cycle machinery in liver cancer.

2. The influence of synaptic degeneration and the identification of potential synaptic biomarkers as a tool to monitor the progression of Alzheimer's in older adults.

3. The therapeutic effects of forced-exercise on Parkinson's disease.

4. Developing pipelines and machine learning models that can be utilized for analyzing complex biological datasets related to different human related diseases.

The first research area is directly related to my master's research project that I undertook at the University of Allahabad. I developed these projects based on the research techniques I had learned during my masters on studies involving breast, brain and liver cancer. The goal of the current studies is to study the abnormal behavior of cell-cycle machinery involved in different cancer types. These machineries play a vital role in tumorigenesis and metastasis. The genes involved in the regulation of cell cycle process can be a potential biomarker and hence the identification of these genes through high-throughput data analysis could pave the way to discover new therapeutic target for inhibiting the progression of tumorigenesis and metastasis resulting in better survival rates of the cancer patients. The proteins involved in the cellular machinery could be a potential drug target for controlling the cell division and hence prohibit the abnormal behavior of different cancer types.

My second research area of interest involves studying the influence of neurodegeneration caused by degrading synapses. The accumulation of tau and amyloid-beta proteins near the synaptic vesicles results in degradation of synapses and this further result in cognitive deficits. This phenomenon is common in older adults and later causes Alzheimer's that progresses with age of the older adult. Identification of potential synaptic biomarkers could be a way to monitor and control the progression of this disease and early identification could result in developing potential drug targets that could help in controlling the synaptic failure and neurodegeneration.

My third current area of research involves the use of forced exercise as a therapeutic intervention in Parkinson's disease. This paradigm was developed in one of the related studies and I want to further extend the research on this

topic. In this study, forced-exercise is defined as a mode of aerobic exercise in which exercise rate on a stationary bike is mechanically augmented by a custom-designed motor to assist the patient in achieving and maintaining an exercise rate that is significantly greater than their preferred voluntary rate of exercise. Thus, the patient is actively contributing to the exercise and not being passively moved through the exercise. The data indicate that forced exercise leads to global improvements in motor functioning, brain activation patterns, and even in the sense of smell in Parkinson's disease, whereas normal voluntary aerobic exercise failed to elicit similar responses. It is hypothesized that this exercise intervention will significantly delay the onset of levodopa therapy, which would be indicative of neuroprotection.

My immediate and final research goal is to join a laboratory having strong collaborations that will allow me to advance my current work. I will be responsible for developing different high-throughput computational tools and techniques to analyze the mass spectrometry and RNA-Seq datasets for the above diseases and to find the potential dysregulated genes that could be potential biomarkers for monitoring these diseases. The developed pipeline using bash scripting, R and python programming can aid in identifying these biomarkers based on statistical interpretation of the results. These can also be obtained through more advanced computational approach that includes docker, conda, nextflow, and snakemake workflow. Further, for neuroimaging data, I would like to develop various machine learning models using python programming as these could produce an efficient results for those data and will be effective in analyzing neurodegenerative diseases like Alzheimer's and Parkinson's for the data obtained from patients suffering from these disease types.