CAPCODRE: A Computational Systems Biology and Machine Learning-Based Approach to Predict Cognitive Disorder Risk in the Elderly

Mamidala, Srilekha (School: Garnet Valley High School)

As global life expectancy improves, the population of the elderly, persons that are aged 65 years and older, is steadily increasing as well. However, with aging populations a greater prevalence of cognitive impairment has emerged, ranging from mild dementia to severe dementias such as Alzheimer's disease due to genetic and environmental influences, among others. The purpose of this research was to develop a computational algorithm to predict the risk of developing cognitive disorders using a dual machine learning and systems biology approach. The proposed method CAPCODRE (Computational Approach to Predict COgnitive Disorder Risk for the Elderly) utilized air, water, and noise environmental pollution data coupled with a gene-protein interaction network, in addition to cognitive impairment hospitalizations in the United States to create a tailorable, interactive network able to predict risk of dementia and Alzheimer's disease. This network was inputted into a random selection optimization algorithm to select optimal training parameters for training via k-nearest neighbors, random forest regression, and decision trees. CAPCODRE was successfully able to predict and model risk of cognitive health issues through measures of specificity, sensitivity, and accuracy of >85%. The algorithm was integrated into an app for users to receive personalized predictions based on their medical history and geographic location. CAPCODRE can point to the extent of environmental pollution on human health and reveal steps to mitigate risk of severe cognitive impairment. This research also has the potential to address racial disparities in cognitive disorder diagnoses and treatment, promoting more equitable and accessible care.

Awards Won:

Fondazione Bruno Kessler: Award to participate in summer school "Web Valley"