Project Name: Ages of the brain

Project Description: The human lifespan is seen as a sequence of stages, starting with embryonic development and continuing until all functions get extinguished. Interestingly, we have understood how development follows a "plan/map" that allows a single cell to become a human being. Growth and adulthood are also seen as structured sequences of events that follow a prescribed plan. Aging, on the other hand, is mostly understood as a process of increasing entropy and decay. This view has an impact on the strategies that we choose to delay or reverse aging by trying to prop up an organ or a function that is already altered by the effects of aging. If we were able to understand the sequence of events that lead to the aging of the brain, we should be able to be much more effective in extending health span. In this project, we are aiming to analyze multiple data types: genotypes, health records, functional and structural MRI, circulating blood proteins etc. Our aim is to time the sequence of events that lead to cognitive impairment and dementia.
The ideal data set would be thousands of individuals followed over their entire life span where all the above data types are collected. Since, it is unlikely that this data set will exist in the near future, instead we use our 'secret weapon' that is a hybrid data set of longitudinal and population data. We have developed an algorithm that follows the idea that "ontogenesis replicates phylogenesis" (translation: The individual aging process is "mostly" similar to the population aging process). We use just a couple of visits per person and the overall trends in the population to predict the most likely trajectory for every individual. We will use this synthetic data set to determine different aging profiles at old age, slow aging vs fast aging. A deep network AI will be trained to recognize the cognitively impaired profiles from the profiles with healthy cognition. We will use the synthetic longitudinal data set to project these profiles in their past and will attempt to decode the cognitive status of the same individuals based on their young selves. We will be able to find the distinguishing parameters at young age that increase the risk of cognitive decline in older age.

Desired Skills or Experience: Completed coursework in computer science with an emphasis on machine learning. Coding would be mostly in R or Python. Familiarity with biological data and understanding on biological variability is a plus.

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