Project Proposal Report Template (due by 10/21/2020)

Tentative project title: The Shape of Trauma - Identifying Motifs in PTSD FMRI Scans
Type: Research
Team member(s):

Name	Level
Zion Steiner	Undergrad

Project summary:
The main goal of this project is to classify the presence of PTSD in patients based on FMRI time-series. A secondary goal of this project is to attempt to identify time-series motifs representative of PTSD. The motivation for identifying motifs in the data is that motifs function as visual heuristics for classification. Because human healthcare professionals are a major consumer of this data, heuristics are often just as valuable as higher performing black box models because of the intuitive reasoning behind "rules of thumb."

Two methods will be applied for motif discovery: STOMP, and a convolutional neural network. The STOMP algorithm is an exact algorithm for motif detection using the matrix profile datastructure, and will serve as a baseline for any motifs present in the dataset. Then, we will train a convolutional neural network on the PTSD classification task, and visualize the CNN's "knowledge" to see if the CNN is using the same discriminative motifs identified by the STOMP algorithm. Learned knowledge can be visualized through intermediate network outputs, convolution filter maximization, and input image activation heatmapping. We can see what motifs the network learned by viewing time-series activation heatmaps, and compare these to the findings of the STOMP algorithm.

I will compare the classification performance of the above methods with the method described by Franceschi et al. This method uses an unsupervised method to learn a time-series embedding that is linearly separable. An SVM can then be used to classify this data.

References:

Chollet, F. (2018). *Deep learning with Python*. Shelter Island, NY: Manning Publications.

Matrix Profile I: All Pairs Similarity Joins for Time Series: A Unifying View that Includes Motifs, Discords and Shapelets. Chin-Chia Michael Yeh, Yan Zhu, Liudmila Ulanova, Nurjahan Begum, Yifei Ding, Hoang Anh Dau, Diego Furtado Silva, Abdullah Mueen, Eamonn Keogh (2016). IEEE ICDM 2016

Franceschi, J., Dieuleveut, A., & Jaggi, M. (2020, January 03). Unsupervised Scalable Representation Learning for Multivariate Time Series. Retrieved October 21, 2020, from https://arxiv.org/abs/1901.10738

Availability of dataset/code:

https://tslearn.readthedocs.io/

https://matrixprofile.docs.matrixprofile.org/

https://github.com/pradlanka/malini/tree/master/Functional%20connectivity%20data/PTSD/