Problem Statement:

How do we identify an emotional state like stress preemptively, as to alert a user that they may be approaching a stressed state, and corrective action should be taken? This type of technology could be applied in the area of workplace ergonomics, for example in high stress environments like police work.

How do we describe emotional states like amusement, with a quantitative approach? With an understanding of how stress manifests itself in our biological systems, we can use this information to make better design decisions. This could be applied to A/B testing in environmental or UX design; Think, designing a dentist or doctor’s office to optimize neutral emotional states.

Literature Survey:

Alberdi, A., Aztiria, A., & Basarab, A. (2015, November 28). Towards an automatic early stress recognition system for office environments based on multimodal measurements: A review. Retrieved July 8, 2020, from <https://www.sciencedirect.com/science/article/pii/S1532046415002750>

In this study a framework for office stress monitoring was developed using contextual, physiological, and psychological signals – as well as providing evidence to support that, out of all signals captured, which were the most indicative of stress states. Additionally, with the incorporation of contextual and psychological data, distinctions are made between cognitive stimulation and stress.

Dawans, B., Kirschbaum, C., & Heinrichs, M. (2010, September 16). The Trier Social Stress Test for Groups (TSST-G): A new research tool for controlled simultaneous social stress exposure in a group format. Retrieved July 9, 2020, from https://www.sciencedirect.com/science/article/abs/pii/S0306453010002088?via=ihub

This study focused on group behavior, taking groups of 6 out of a total pool of 25 participants to apply the Trier Social Stress Test – involving public speaking and mental math recitation scenarios. The test collected physiological data including ECG, respiration, heartrate, and cortisol level measurements. This study provides a valuable foundation for future experiments involving group based physiological response stress research.

Proposed work:

* Our project will require no additional data collection, we are using the WESAD dataset, described later in our summary. The dataset fully describes the system that we are working to analyze, so there is no need to enrich our information or integrate any additional features.
* First, we have read the source files (.pkl ‘pickle’) into the defined data structure or class. We will include the subject ID along with the ECG, EDA, EMG, respiration, and temperature measurements. Our team has decided to eliminate the use of the data collected from the accelerometers, as the analysis would require more time than available for this activity.
* The data is collected at disparate rates – some at a rate of 70 per second, down to 1 every 2 seconds. We will want to summarize some of the readings to several per second, as the collection rates likely are high enough to support this reduction. We will make this determination during the initial EDA process.
* During the EDA process we will try to identify correlation between the sensor outputs and the emotional response, **this is our primary objective for this project**. An interesting python library was highlighted during research; Neurokit. This package can be used to read or analyze variables such as ECG and EDA, that may return more valuable features that can be applied to our predictive model.
* Another approach that could be valuable would be time series. If a generally correlated feature is identified, some window of historical data could be transposed onto each incoming ‘new’ record, where the sequence of states for the given variable all become useful features.



* Once we have identified the highest quality features generated during the process, we will attempt to build a predictive model. Though our overarching objective is to identify features that are correlated to emotional state, our stretch goal is to build a model that could ingest incoming data and provide a user a response of their predicted emotional state (amusement, neutral, or stress).

Evaluation Methods –

We will apply the following evaluation methods:

* Chi Square or 2 Way ANOVA during our exploratory data analysis. This can help us generalize the relationship between some selected explanatory variable and our response to evaluate which features should be allowed further consideration.
* During the model development phase of the project we will apply a cross validation cross validation approach, there is a scikit learn workflow that was identified during our research that can be easily integrated into our process. We will use the cross validation score to evaluate our success.
* We will use a confusion matrix to understand the performance of our models as we test various configurations. With this analysis we can generate the standard metrics of precision, recall, and accuracy. And as suggested by one of our classmates during the feedback session, we will also incorporate the F1 metric.