**Assignment 2: Learning and Memory PSY 306 (Winter 2023)**

**Name:**

**Roll Number:**

**Instructions:** Please write your own responses and do not copy or lift text/code from any source. If you are referring to credible external sources other than the attached paper for your answers, please cite those sources (within the body of text and the provide a reference list at the end) in the APA citation format (<https://www.mendeley.com/guides/apa-citation-guide>). Word limits given are indicative and less than the indicated numbers may also be used.

**Please download this MS word question-cum-response template to TYPE your answers and feel free to add sheets as required. Convert this document to a PDF before submitting. Please note that answers in this template only will be evaluated and hand-written or scanned answer sheets will not be evaluated. Please submit ONLY ONE PDF and no extra files as it increases the time to evaluate them. DO NOT change the basic structure of the template. DO NOT remove the marks assigned for each question.**

**[Strict deadline for submission: 23 March 2023, 11 PM]**

**Q2) Please read the following for this question:**

* **A researcher recorded electromyogram (EMG) from the extraocular muscles of a human participant as a tone was delivered through headphones and air-puff delivered to the eyes through an apparatus to the participant. The tone stimulus onset is at time = 0 ms (beginning of the trial) and continues until 650 ms. The air-puff stimulus onset is at time = 600 ms and continues for the next 50 ms.**
* **The above was done for five trials/day for four subsequent days and the EMG responses recorded as data. Download the attached data file- Data-Assignment2A.xlsx**
* **Each sheet of the excel file contains EMG recording from one day of experiment. Each sheet has 5 rows (trials) x 1000 columns (EMG amplitudes recorded at an interval of 1 millisecond). Thus each row has 1000 ms (1 second) of recording.**

**Now do the following…**

**Insert a figure (wherever required) and paste the MATLAB/Python code for the same. All figures must be properly labelled, carry necessary units of measurement with accompanying captions/legends to provide all information necessary to interpret the figures.**

**A) Run the following steps…**

* **Take the average of data across all trials per day for each time point to get one averaged signal per day.**
* **Run a 'moving average filter' across the averaged signal with a window width of 20 ms to get a filtered signal. Ensure that the raw and filtered signal are of the same length.**
* **Do a full wave rectification of the above moving average filtered signal.**
* **Plot the amplitude vs time of the raw signal (as blue curve) - one signal for each day in four different subplots of one bigger plot.**
* **Plot the amplitude vs time of the filtered and rectified signal (as red curve) – one signal for each day on top of the raw signal in the same subplots.**

**After creating the above plot, explain the learning mechanism evident in the above plot with all necessary components of learning that you think are involved in this case. Calculate exact time points of the peaks from the above data to draw your quantitative conclusions about the learning mechanism and its components.**

**[10 points]**

[Answer]

**B) An experimenter carries out three pilot experiments of 30 trials each in human subjects to study the relationship between time (# trials) and Associative learning between the exposure to sets of environmental stimuli (Conditioned and Unconditioned Stimuli). She collects and averages the data across equal number of subjects for each pilot experiment. This data is entered in the Data-Assignment2B.xlsx. Each row = 1 pilot experiment. Each column is the value/magnitude of the CR (arbitrary units). Now carry out the following...**

**i) Computationally estimate the Rates and Asymptotes of Learning for the three pilot experiments. Create three subplots for three experiments as part of one larger plot to graph the individual data points (as open circle markers; black colour) and overlay of the learning curve (blue colour) on each subplot. Indicate the Learning rate and Learning asymptote on top of each subplot (as title).**

**Also, report any one metric of "goodness of fit" for each of the three learning curves to the underlying experimental data and briefly explain the quality of your curve fit to the experimental data based on the metric.**

**Hint: - Use unconstrained nonlinear optimization to find the optimal parameters of the negatively accelerated learning curve which best describes the relationship within the data, quantitatively.**

**For a measure of goodness of curve fit to the experimental data, explore and report any one of these metrics - sum of squared errors OR R square OR adjusted R square.**

**ii) Based on your analysis of the data what can you conclude about the intensities of**

**the Unconditioned Stimuli in the three pilot experiments and why?**

[Answer]

**[8+2 points]**