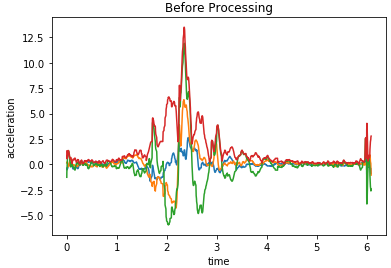
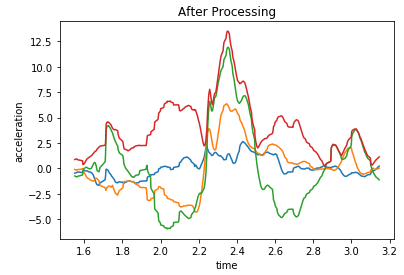
Data Processing

The raw data data produced by the Physics toolbox application consists of csv files with 4 columns: time, ax, ay, az , aT. The columns ax, ay, az are linear accelerations in the x, y, and z direction and aT is the vector sum calculated with the following equation. .

Most of the data contained large stretches of near zero acceleration due to the pause before performing an action and the delay before stopping data recording. Each csv file containing a particular action requires trimming near the beginning and the end. Each action has an approximate time duration of less than two seconds. In order to find the window of time to trim, the max value of the vector sum is computed. From the max value of the vector sum, we only keep the data from +/- 0.9 time frames of the time where the max vector sum occurs. See the figure below for the time versus acceleration graph of before and after data processing.



After processing each csv file for each action, the average acceleration in the x, y, z direction is calculated along with the average vector sum. Additionally, the maximum values of vector sum and acceleration in x, y ,z direction was extracted as well. The values obtained was then stored in a pandas dataframe as a row. Each dataframe created represented an action: fall, sit, lie down, or drop. Each row of each dataframe represents a sample of an action.

Analysis of Variance Test

An ANOVA test was performed on each of the various attributes collected from the data processing. Each of the averages of acceleration in each direction: x ,y ,z and averages of vector sum of each action was tested. Therefore 4 separate ANOVA tests were performed to determine if there was a difference in the means of each separate action for each attribute. Additionally, the same was performed for max values for a total of 8 separate ANOVA tests. The results of each of the 8 ANOVA tests produced a p-value significantly lower than 0.05. Therefore, the means of the tested attributes for each actions have some significant differences.

Post Hoc Analysis

Due to the significance of the 8 ANOVA tests, 8 separate post hoc analysis were performed to complement the ANOVA tests. For the testing of average vector sums, it was found that dropping our data collector (phone) and falling as similar means. This is expected as the two actions have similar linear acceleration graphs. For the average acceleration in the x direction, drop vs fall and fall vs lie have similar means. The remaining data regarding the fall action versus other actions against the remaining attributes resulted in significant differences in means.

This Post Hoc Analysis revealed that it could be possible to identify a falling action versus siting and lying down. However, it may be difficult to differentiate between dropping a phone and falling.

print(posthoc\_avg\_aT)

Multiple Comparison of Means - Tukey HSD, FWER=0.05

==============================================================

group1 group2 meandiff p-adj lower upper reject

--------------------------------------------------------------

drop\_avg\_aT fall\_avg\_aT 0.4701 0.4491 -0.3513 1.2914 False

drop\_avg\_aT lie\_avg\_aT -1.3672 0.001 -2.1886 -0.5459 True

drop\_avg\_aT sit\_avg\_aT -2.864 0.001 -3.6853 -2.0426 True

fall\_avg\_aT lie\_avg\_aT -1.8373 0.001 -2.6587 -1.0159 True

fall\_avg\_aT sit\_avg\_aT -3.3341 0.001 -4.1554 -2.5127 True

lie\_avg\_aT sit\_avg\_aT -1.4968 0.001 -2.3181 -0.6754 True

--------------------------------------------------------------

print(posthoc\_avg\_ax)

Multiple Comparison of Means - Tukey HSD, FWER=0.05

==============================================================

group1 group2 meandiff p-adj lower upper reject

--------------------------------------------------------------

drop\_avg\_ax fall\_avg\_ax -0.0655 0.9 -0.3603 0.2294 False

drop\_avg\_ax lie\_avg\_ax 0.0271 0.9 -0.2678 0.3219 False

drop\_avg\_ax sit\_avg\_ax -0.3997 0.0032 -0.6945 -0.1048 True

fall\_avg\_ax lie\_avg\_ax 0.0925 0.8278 -0.2023 0.3874 False

fall\_avg\_ax sit\_avg\_ax -0.3342 0.0194 -0.6291 -0.0394 True

lie\_avg\_ax sit\_avg\_ax -0.4268 0.0014 -0.7216 -0.1319 True

--------------------------------------------------------------

print(posthoc\_avg\_ay)

Multiple Comparison of Means - Tukey HSD, FWER=0.05

==============================================================

group1 group2 meandiff p-adj lower upper reject

--------------------------------------------------------------

drop\_avg\_ay fall\_avg\_ay -0.4789 0.001 -0.7577 -0.2001 True

drop\_avg\_ay lie\_avg\_ay -0.8619 0.001 -1.1406 -0.5831 True

drop\_avg\_ay sit\_avg\_ay 0.4599 0.001 0.1811 0.7387 True

fall\_avg\_ay lie\_avg\_ay -0.3829 0.0027 -0.6617 -0.1042 True

fall\_avg\_ay sit\_avg\_ay 0.9388 0.001 0.66 1.2176 True

lie\_avg\_ay sit\_avg\_ay 1.3217 0.001 1.043 1.6005 True

--------------------------------------------------------------

print(posthoc\_avg\_az)

Multiple Comparison of Means - Tukey HSD, FWER=0.05

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group1 group2 meandiff p-adj lower upper reject

------------------------------------------------------------

drop\_avg\_az fall\_avg\_az 1.2883 0.001 1.0161 1.5605 True

drop\_avg\_az lie\_avg\_az 1.6948 0.001 1.4226 1.967 True

drop\_avg\_az sit\_avg\_az 1.7281 0.001 1.4559 2.0003 True

fall\_avg\_az lie\_avg\_az 0.4065 0.001 0.1343 0.6787 True

fall\_avg\_az sit\_avg\_az 0.4398 0.001 0.1676 0.7121 True

lie\_avg\_az sit\_avg\_az 0.0333 0.9 -0.2389 0.3056 False

------------------------------------------------------------

print(posthoc\_max\_aT)

Multiple Comparison of Means - Tukey HSD, FWER=0.05

================================================================

group1 group2 meandiff p-adj lower upper reject

----------------------------------------------------------------

drop\_max\_aT fall\_max\_aT -36.4563 0.001 -45.8015 -27.111 True

drop\_max\_aT lie\_max\_aT -57.527 0.001 -66.8723 -48.1817 True

drop\_max\_aT sit\_max\_aT -62.9083 0.001 -72.2536 -53.5631 True

fall\_max\_aT lie\_max\_aT -21.0708 0.001 -30.416 -11.7255 True

fall\_max\_aT sit\_max\_aT -26.4521 0.001 -35.7974 -17.1068 True

lie\_max\_aT sit\_max\_aT -5.3813 0.4437 -14.7266 3.964 False

----------------------------------------------------------------

print(posthoc\_max\_ax)

Multiple Comparison of Means - Tukey HSD, FWER=0.05

================================================================

group1 group2 meandiff p-adj lower upper reject

----------------------------------------------------------------

drop\_max\_ax fall\_max\_ax -11.3915 0.001 -18.1458 -4.6373 True

drop\_max\_ax lie\_max\_ax -23.6671 0.001 -30.4214 -16.9129 True

drop\_max\_ax sit\_max\_ax -26.7472 0.001 -33.5015 -19.993 True

fall\_max\_ax lie\_max\_ax -12.2756 0.001 -19.0299 -5.5214 True

fall\_max\_ax sit\_max\_ax -15.3557 0.001 -22.11 -8.6015 True

lie\_max\_ax sit\_max\_ax -3.0801 0.6212 -9.8343 3.6741 False

----------------------------------------------------------------

print(posthoc\_max\_ay)

Multiple Comparison of Means - Tukey HSD, FWER=0.05

================================================================

group1 group2 meandiff p-adj lower upper reject

----------------------------------------------------------------

drop\_max\_ay fall\_max\_ay -8.1527 0.0053 -14.4487 -1.8567 True

drop\_max\_ay lie\_max\_ay -12.9233 0.001 -19.2193 -6.6273 True

drop\_max\_ay sit\_max\_ay -16.5168 0.001 -22.8128 -10.2208 True

fall\_max\_ay lie\_max\_ay -4.7706 0.2045 -11.0666 1.5254 False

fall\_max\_ay sit\_max\_ay -8.3641 0.004 -14.6601 -2.0681 True

lie\_max\_ay sit\_max\_ay -3.5935 0.4515 -9.8895 2.7025 False

----------------------------------------------------------------

print(posthoc\_max\_az)

Multiple Comparison of Means - Tukey HSD, FWER=0.05

================================================================

group1 group2 meandiff p-adj lower upper reject

----------------------------------------------------------------

drop\_max\_az fall\_max\_az -26.5014 0.001 -33.5688 -19.434 True

drop\_max\_az lie\_max\_az -39.7905 0.001 -46.8579 -32.7231 True

drop\_max\_az sit\_max\_az -41.8961 0.001 -48.9635 -34.8287 True

fall\_max\_az lie\_max\_az -13.2891 0.001 -20.3565 -6.2217 True

fall\_max\_az sit\_max\_az -15.3947 0.001 -22.4621 -8.3273 True

lie\_max\_az sit\_max\_az -2.1056 0.8509 -9.173 4.9618 False

----------------------------------------------------------------