1. Download the dataset. Make sure that you are able to load it with pandas or other csv-related package

**Ans**. Dataset has been downloaded and successfully loaded using pandas package.

1. Describe the target feature "Cls". What disease is represented by each class?

**Ans**. There are 3 classes which are used to identify if there is any motor neuron disease.

Class1-Normal

No sign of any disease. The muscle is free from any disease and healthy.

Class2-Motor neuron disease

This disease effect the working of functioning of the muscles as the control of brain and spinal cord over nerves get disturb. Motor neuron give electric signals as output which effect the overall functioning of the nerve.

These are of 3 stages: -

1. Early stage- mainly effecting limbs, mouth.
2. Middle stage-in this stage 50% of the body does not respond
3. Advanced stage-in this stage the respiratory system stops working which lead to death.

Class3-Myopathy

In this disease, the muscle weakens and effect the voluntary actions of the limbs.

1. Describe the experiment process, and provide the definition of the columns from 1 to 14.

**Ans. 1) Duration Mean in ms**- duration is basically the total time when the motor unit start sending electric signals. Taking mean is just for the easier evaluation of the data.

**2)Duration Standard Deviation in ms-** standard deviation is used to analysis the data as how near values are there to mean. Less the standard deviation more accuracy is seen.

**3)** **Amplitude in mV** -amplitude is the difference between the minimum positive peak and maximum negative peak.

**4)Spike duration in ms**- time taken to the first positive spike to last positive spike (spike-rectified MUAP)

**5)Spike area**-integrated sum of the spike in spike duration.

**6)Phase** -no of enclosed area in a spike with amplitude more then 25µV.

**7) Turns**-topmost for positive spike and lower most for negative spike is consider to be a turn from which the values start changing in opposite direction.

1. Propose the hypothesis about the dependencies between the features and the target you except to see during your further study of this dataset.

**Ans.** procedure followed by author is grouping MUAP vale according to the no of phases. Then the amplitude is calculated for each value.

Exchange is a term used by author to define the range which is[min Amp , β min Amp] where β=1.5 and all the values that do not fall in this range are consider in UnEXrange and this process continuously work till the UnEXrange is empty. This process is repeated for spike duration but β change to 1.2 and for duration class β is 0.2.

Then these two data are then analyzed using two algorithm that is knn clustering and artificial neural network.

Following is the table for the average of each class.

|  |  |  |  |
| --- | --- | --- | --- |
|  | normal | motor neuron | myopathy |
| Dur mn | 9.5933 | 13.4227 | 7.15 |
| dur sd | 2.5883 | 3.5445 | 1.8736 |
| amp mn | 0.3716 | 0.8318 | 0.2436 |
| amp sd | 0.1858 | 0.4863 | 0.1481 |
| spd mn | 5.4183 | 6.859 | 4.2145 |
| spd sd | 2.35 | 3.2918 | 1.5463 |
| spa mn | 2.35 | 0.5209 | 0.1627 |
| spa sd | 0.2341 | 0.31 | 0.1081 |
| ph mn | 0.1133 | 3.9681 | 2.7318 |
| ph sd | 2.5958 | 1.5454 | 0.9436 |
| tur mn | 0.7133 | 4.75 | 3.1363 |
| tur sd | 3.0625 | 2.0781 | 1.1972 |
| ar mn | 1.0208 | 0.6136 | 0.3154 |
| ar sd | 0.3758 | 0.3536 | 0.2309 |

1. Each parameter has greater value for motor neuron than normal except spike area(mean) and turn (standard deviation).
2. Parameters like amplitude (mean and standard deviation),spike area (sd) and area(sd), in these the difference between normal and motor neuron disease is not much which shows that they are not that important to evaluation.
3. Each parameter has lower value for myopathy than normal except phase(mean) and turn (mean) which is related as more no of phase the more will be turns in the graph.
4. Parameters like amplitude (mean and standard deviation) and area(sd), in these the difference between normal and myopathy is not much which shows that they are not that important to evaluation.

References:-

<https://www.intechopen.com/books/advances-in-clinical-neurophysiology/motor-unit-action-potential-duration-measurement-and-significance>