Gesture Recognition Reading Muscle Activity

Project Phase 1 - Data Set Selection and Preparation

DS5230 / Spring 2024 Semester

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Version Control

- We have established a **GitHub Repository** for versional control: https://github.com/LiyangSong/Gesture-Recognition-Reading-Muscle-Activity.git
- Clone the repo to local including all data files, Jupyter Notebooks, python files, and other related information.

Reproducibility

All works are completed within Jupyter Notebooks and have been fully executed.

To reproduce:

- Download the **environment.yml** and recreate **project_venv** virtual environment using the command:

  ```
  (base) : conda env create -f environment.yml
  ```

- Activate **project_venv** using the command:

  ```
  (base) : conda activate usml_base_ds
  ```

- Create an ipykernel using the command:

  ```
  (usml_base_ds) : python -m ipykernel install --user –name usml_base_ds
  --display-name "Python (usml_base_ds)"
  ```

- Open **project_phase_1.ipynb** in browser, click **restart the kernel and rerun all cells** button to reproduce all works.

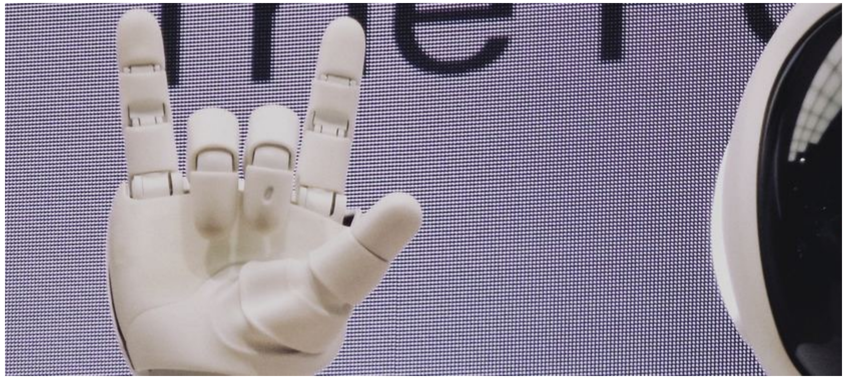
Data Set Information

- Data set: **Classify gestures by reading muscle activity.**

https://www.kaggle.com/datasets/kyr7plus/emg-4

- Data set description:

Each dataset line has 8 consecutive readings of all 8 sensors. so 64 columns of EMG data. The last column is a resulting gesture that was made while recording the data (classes 0-3).
So each line has the following structure:
[8sensors][8sensors][8sensors][8sensors][8sensors][8sensors][8sensors][8sensors][GESTURE_CLASS]
A classifier given 64 numbers would predict a gesture class (0-3).
Gesture classes were : rock - 0, scissors - 1, paper - 2, ok - 3.

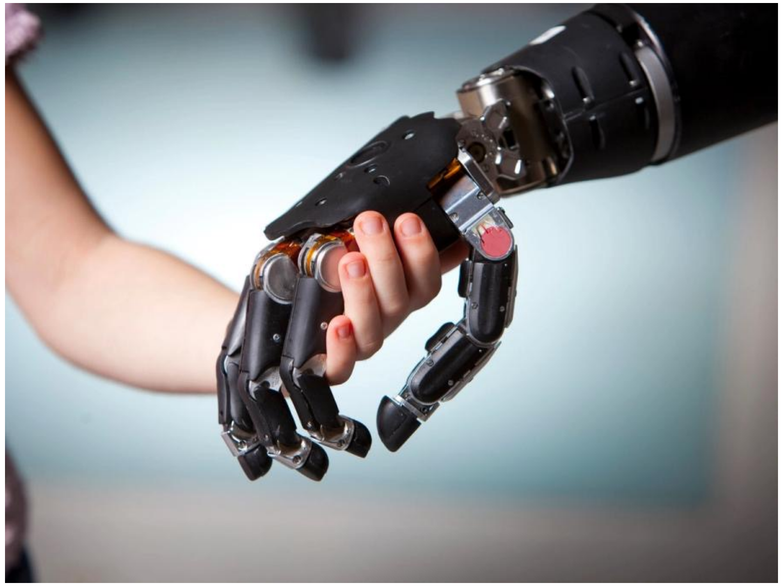


- Data set size: 4 separated CSV files with total size of **(11678, 65)**.

Data Set Information

- This project have the potential to make a significant difference in the lives of people who use **prosthetic limbs**. By mapping muscle movements to prosthetic actions, users can control their artificial limbs more naturally and effectively, improving their quality of life. It can also help individuals recovering from injuries or surgeries to regain muscle functions.

- Beyond prosthetics, this technology can also be applied to develop sophisticated **human-machine interfaces**. It can be integrated with VR or gaming devices where users could control game characters or navigate virtual environments using natural muscle movements.



Attributes Information

- **'muscle reading X sensor Y'**

meaning: the Xth reading data of sensor Y (total 64 columns)

dtype: float

measurement scale: interval or ratio scale. The true meaning of sensor digits was not given (not sure whether there is true zero)

missingness: 0

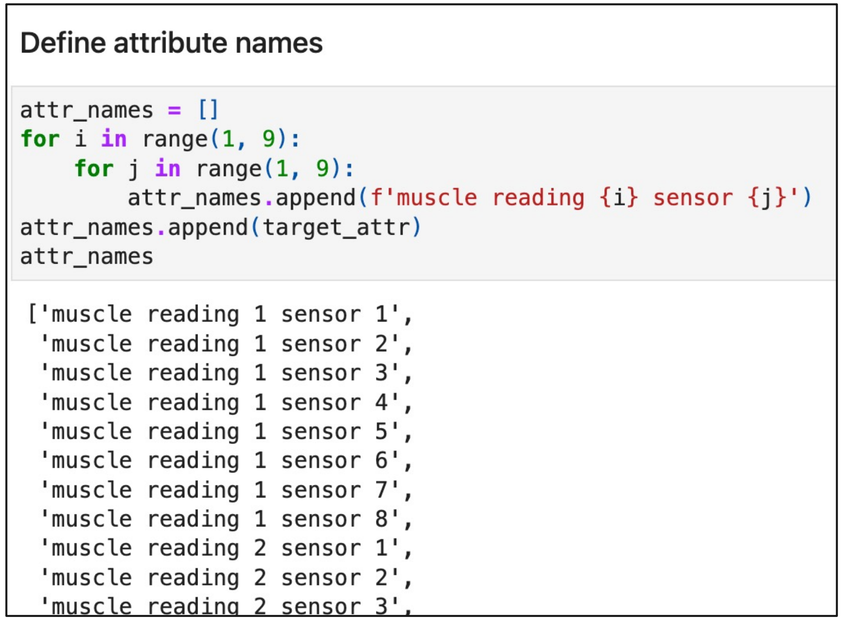
- **'gesture class (0-3)'**

meaning: gesture class. rock - 0, scissors - 1, paper - 2, ok - 3

dtype: integer

measurement scale: nominal scale. Classes are categorized but their rank has no meaning.

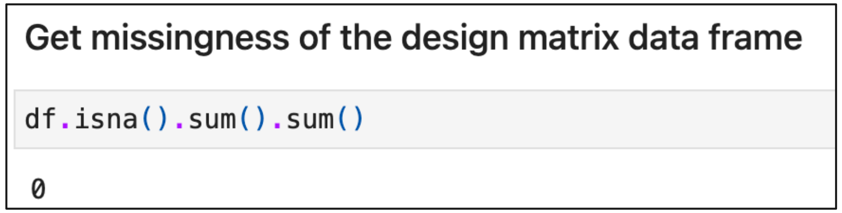
missingness: 0



Define attribute names

```
attr_names = []
for i in range(1, 9):
    for j in range(1, 9):
        attr_names.append(f'muscle reading {i} sensor {j}')
attr_names.append(target_attr)
attr_names
```

```
['muscle reading 1 sensor 1',
 'muscle reading 1 sensor 2',
 'muscle reading 1 sensor 3',
 'muscle reading 1 sensor 4',
 'muscle reading 1 sensor 5',
 'muscle reading 1 sensor 6',
 'muscle reading 1 sensor 7',
 'muscle reading 1 sensor 8',
 'muscle reading 2 sensor 1',
 'muscle reading 2 sensor 2',
 'muscle reading 2 sensor 3',
```

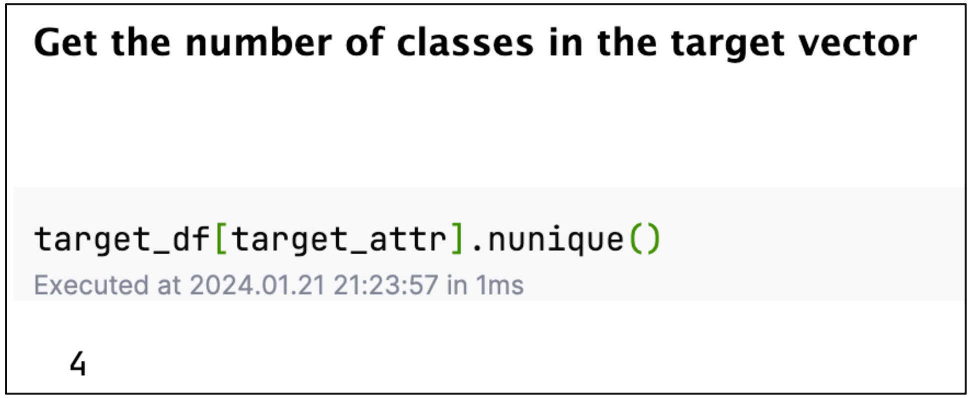


Get missingness of the design matrix data frame

```
df.isna().sum().sum()
```

```
0
```

Number of Classes in the Target Vector



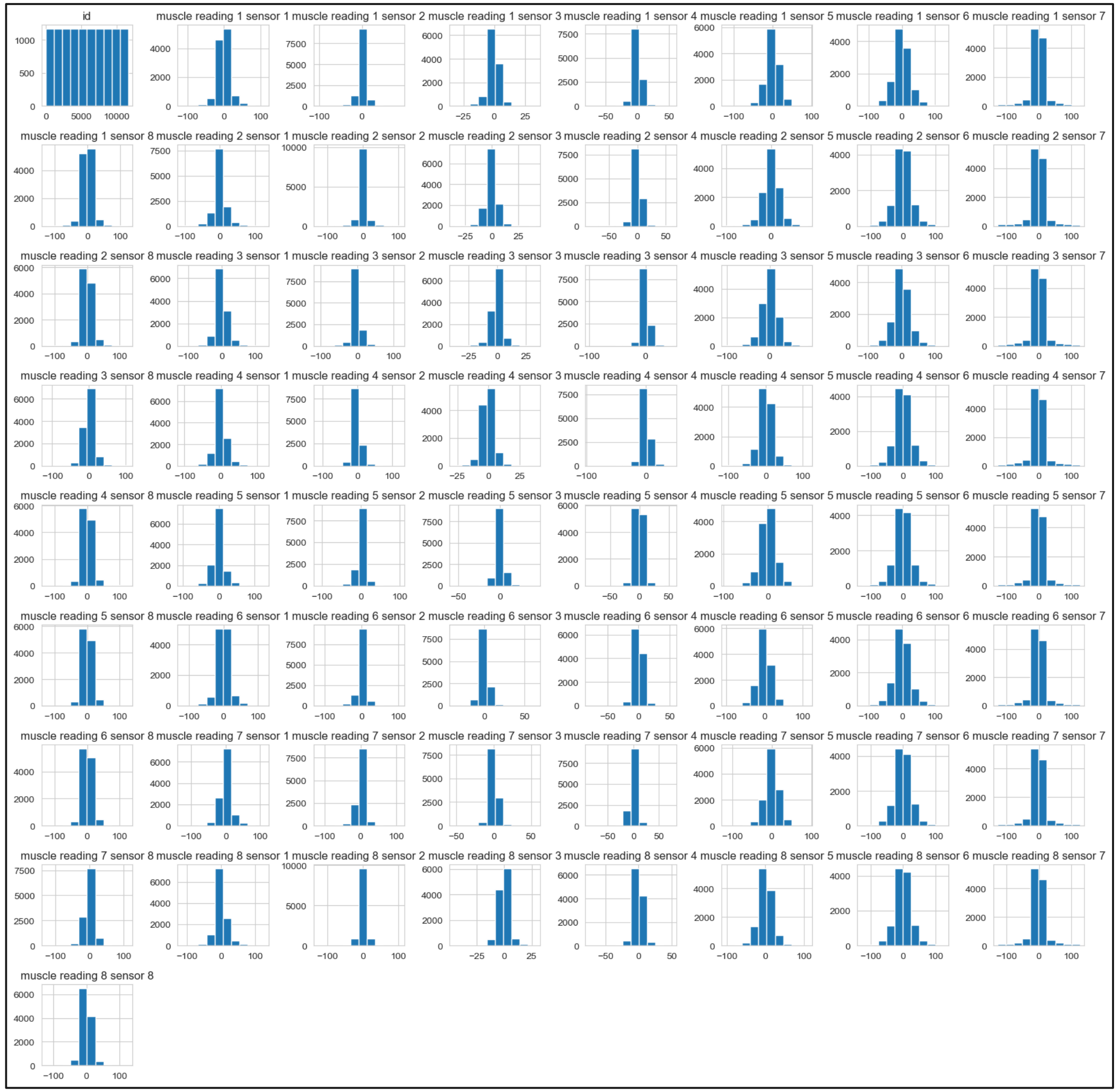
Get the number of classes in the target vector

```
target_df[target_attr].nunique()
```

Executed at 2024.01.21 21:23:57 in 1ms

```
4
```

Histograms of the Attributes in the Design Matrix Data Frame


id
muscle reading 1 sensor 1
muscle reading 1 sensor 2
muscle reading 1 sensor 3
muscle reading 1 sensor 4
muscle reading 1 sensor 5
muscle reading 1 sensor 6
muscle reading 1 sensor 7
muscle reading 1 sensor 8
muscle reading 2 sensor 1
muscle reading 2 sensor 2
muscle reading 2 sensor 3
muscle reading 2 sensor 4
muscle reading 2 sensor 5
muscle reading 2 sensor 6
muscle reading 2 sensor 7
muscle reading 2 sensor 8
muscle reading 3 sensor 1
muscle reading 3 sensor 2
muscle reading 3 sensor 3
muscle reading 3 sensor 4
muscle reading 3 sensor 5
muscle reading 3 sensor 6
muscle reading 3 sensor 7
muscle reading 3 sensor 8
muscle reading 4 sensor 1
muscle reading 4 sensor 2
muscle reading 4 sensor 3
muscle reading 4 sensor 4
muscle reading 4 sensor 5
muscle reading 4 sensor 6
muscle reading 4 sensor 7
muscle reading 4 sensor 8
muscle reading 5 sensor 1
muscle reading 5 sensor 2
muscle reading 5 sensor 3
muscle reading 5 sensor 4
muscle reading 5 sensor 5
muscle reading 5 sensor 6
muscle reading 5 sensor 7
muscle reading 5 sensor 8
muscle reading 6 sensor 1
muscle reading 6 sensor 2
muscle reading 6 sensor 3
muscle reading 6 sensor 4
muscle reading 6 sensor 5
muscle reading 6 sensor 6
muscle reading 6 sensor 7
muscle reading 6 sensor 8
muscle reading 7 sensor 1
muscle reading 7 sensor 2
muscle reading 7 sensor 3
muscle reading 7 sensor 4
muscle reading 7 sensor 5
muscle reading 7 sensor 6
muscle reading 7 sensor 7
muscle reading 7 sensor 8
muscle reading 8 sensor 1
muscle reading 8 sensor 2
muscle reading 8 sensor 3
muscle reading 8 sensor 4
muscle reading 8 sensor 5
muscle reading 8 sensor 6
muscle reading 8 sensor 7
muscle reading 8 sensor 8