



Assignment

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HUMAN ACTIVITY RECOGNITION

The dataset, acquired from WISDM Lab, consists of data collected from 36 different users performing six types of human activities (ascending and descending stairs, sitting, walking, jogging, and standing) for specific periods of time.

This data was acquired from accelerometers, which can detect the orientation of the device measuring the acceleration along the three different dimensions. They were collected using a sample rate of 20 Hz (1 sample every 50 millisecond) that is equivalent to 20 samples per second.

These time-series data can be used to perform various techniques, such as human activity recognition.

Fields:

- **user:** the user who acquired the data (integer from 1 to 36).
- **activity:** the activity that the user was carrying out. It could be:
 1. Walking
 2. Jogging
 3. Sitting
 4. Standing
 5. Upstairs
 6. Downstairs.
- **timestamp:** generally, the phone's uptime in nanoseconds.
- **x-axis:** The acceleration in the x direction as measured by the android phone's accelerometer.
Floating-point values between -20 and 20. A value of 10 = $1g = 9.81 \text{ m/s}^2$, and 0 = no acceleration.
The acceleration recorded includes gravitational acceleration toward the center of the Earth, so that when the phone is at rest on a flat surface the vertical axis will register ± 10 .
- **y-axis:** same as x-axis, but along y axis.
- **z-axis:** same as x-axis, but along z axis.

ANALYSIS:

Importing the libraries in notebook:

```
# Import Libraries

import numpy as np
import pandas as pd
import time
# plots
import matplotlib.pyplot as plt
import plotly.express as px
import seaborn as sns
```

Iterates through all files in the (../recon2) directory and its subdirectories, then prints the full paths of each file to the console to verify the location of the dataset file.

```
# Print list of files into '../recon2' directory

import os
for dirname, _, filenames in os.walk('../recon2'):
    for filename in filenames:
        print(os.path.join(dirname, filename))
```

```
../recon2\activities.jpg
../recon2\time_series_data_human_activities.csv
../recon2\WISDM_ar_latest.tar.gz
../recon2\zzzread.txt
```

Reads a CSV file named "time_series_data_human_activities.csv" located in the (../recon2) directory, measures the time taken to load the data, and prints the elapsed time.

```
# Read time_series_data_human_activities.csv file
# load data
# need to import where we use the packages.
import time
import pandas as pd
import numpy as np

t1 = time.time()
df = pd.read_csv('../recon2/time_series_data_human_activities.csv')
t2 = time.time()
print('Elapsed time [s]:', np.round(t2-t1,4))
```

Output: Elapsed time [s]: 1.094

defines parameters for processing time series data:

- window: Sets the time window size in seconds (e.g., 1 second).
- fs: Sets the sampling frequency in Hz (e.g., 20 samples per second).
- windows_size: Calculates the number of samples per window based on window and fs (e.g., if window=1 and fs=20, then windows_size=20).

```
# Define timeseries parameters
window = 1          # window dimention in seconds
fs = 20             # frequency in Hz
windows_size = window * fs # number of samples for each time window
```

Summary/Structure of the Data Frame's contents.

```
# structure of data
df.info()
```

Output:

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1073623 entries, 0 to 1073622
Data columns (total 6 columns):
#   Column   Non-Null Count  Dtype
---  ---
0  user      1073623 non-null  int64
1  activity  1073623 non-null  object
2  timestamp 1073623 non-null  int64
3  x-axis    1073623 non-null  float64
4  y-axis    1073623 non-null  float64
5  z-axis    1073623 non-null  float64
dtypes: float64(3), int64(2), object(1)
memory usage: 49.1+ MB
```

Analyzes the number of different activities in the dataset.

```
# Visualize number of different activites
# eval activities
activity_stats = df.activity.value_counts()
print(activity_stats)
activities = activity_stats.index.tolist()
print(activities)
```

Output:

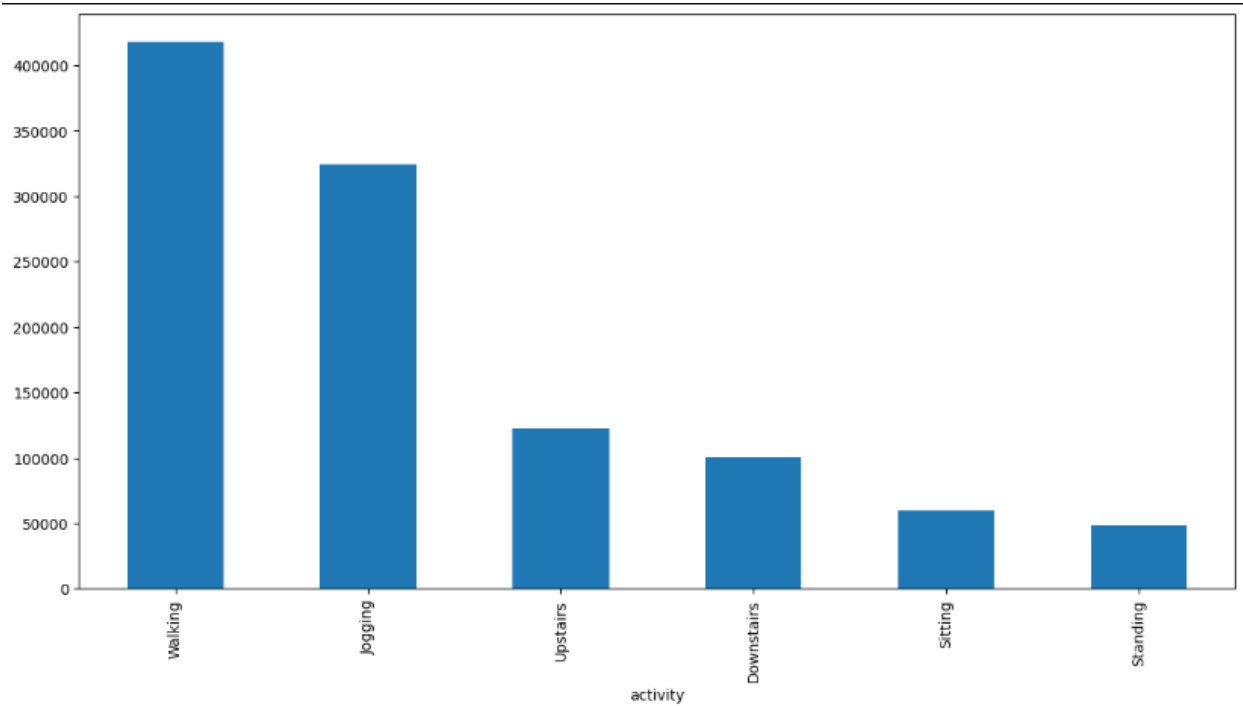
```
activity
Walking    417901
Jogging     324600
Upstairs    122598
Downstairs  100192
Sitting      59939
Standing    48393
```

```
Name: count, dtype: int64  
['Walking', 'Jogging', 'Upstairs', 'Downstairs', 'Sitting', 'Standing']
```

Bar chart to visualize the number of occurrences for each activity in the dataset.

```
activity_stats.plot(kind='bar', figsize=(14, 7))  
plt.show()
```

Output:



Crosstabulation to provide an overview of how activities are distributed across subjects in the dataset.

```
# Overview on Activities distribution per Subject.  
  
# activity vs. user  
pd.crosstab(df.user, df.activity)
```

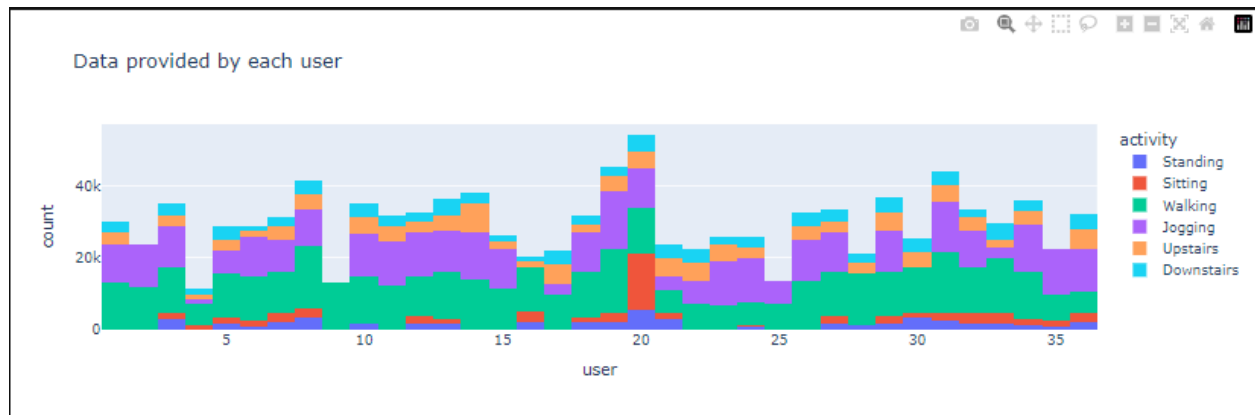
Output:

activity	Downstairs	Jogging	Sitting	Standing	Upstairs	Walking
user						
1	2941	11056	0	0	3120	12861
2	0	11786	0	0	0	11739
3	3326	11018	1609	2824	3411	12970
4	1761	895	1257	0	1377	6079
5	3281	6405	1664	1515	3387	12257
6	1431	10961	1679	709	1661	12262
7	2257	9183	2529	2364	3601	11033
8	3345	10313	2699	3269	4453	17108
9	0	0	0	0	0	12923
10	3792	12084	0	1659	4294	13046
11	2574	12454	0	0	4392	12138
12	2870	12360	2289	1670	2654	10798
13	4240	11301	1179	1659	4637	13047
14	2875	13279	0	0	8179	13859
15	1762	10798	0	0	2055	11467
16	1574	0	2984	1979	1411	12521
17	3767	2887	0	0	5689	9677
18	2410	10911	1467	1954	2409	12554
19	2613	16201	2534	2132	4280	17622
20	4673	10728	15644	5389	4833	13027
21	4036	3864	1609	2859	4841	6494
22	3625	6224	0	0	5430	7029
23	1939	12309	0	0	4836	6589
24	2929	12278	690	544	3039	6256
25	0	6489	0	0	0	6979
26	3837	11913	0	0	3618	13210
27	3442	10855	2099	1630	3064	12366
28	2997	0	0	1300	2892	14169
29	4265	11458	2319	1603	4769	12354
30	3872	0	1559	3098	4226	12579
31	3892	14075	2148	2612	4679	16876
32	2208	10249	3059	1669	3797	12375
33	4535	2946	3248	1612	2214	14898
34	2856	12869	1575	1349	3921	13377
35	0	12564	1599	1069	0	7162
36	4167	11887	2500	1925	5429	6200

Histogram to visualize the distribution of data points across different users in the human activity dataset.

```
fig = px.histogram(df, x='user', title='Data provided by each user',
color="activity")#, pattern_shape="Activity"
fig.show()
del fig
```

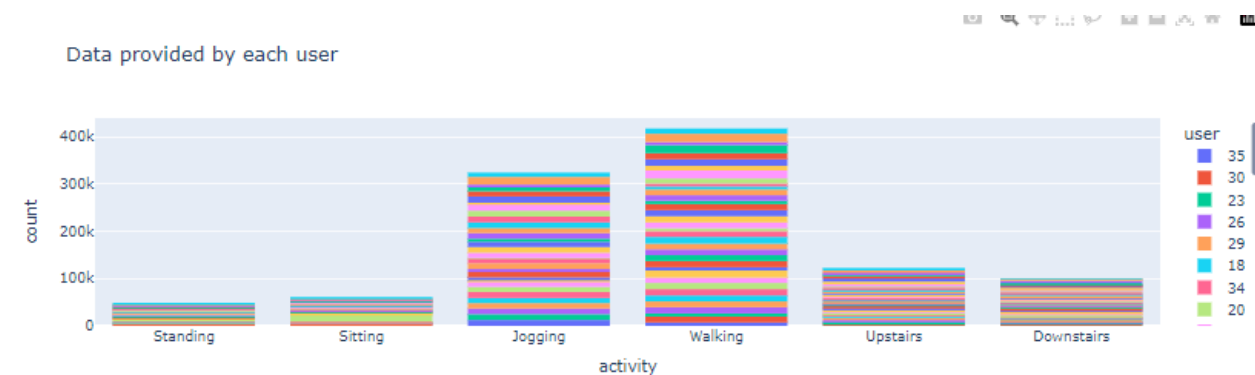
Output:



Histogram to visualize the distribution of data points across different activities in the human activity dataset:

```
fig = px.histogram(df, x='activity', title='Data provided by each user',
color="user")#,pattern_shape="subject"
fig.show()
del fig
```

Output:



Analyze the data of one specific user.

```
# Look at one specific user
# select user
sel_user = 3
df_user = df[df.user==sel_user]
df_user
```

Output:

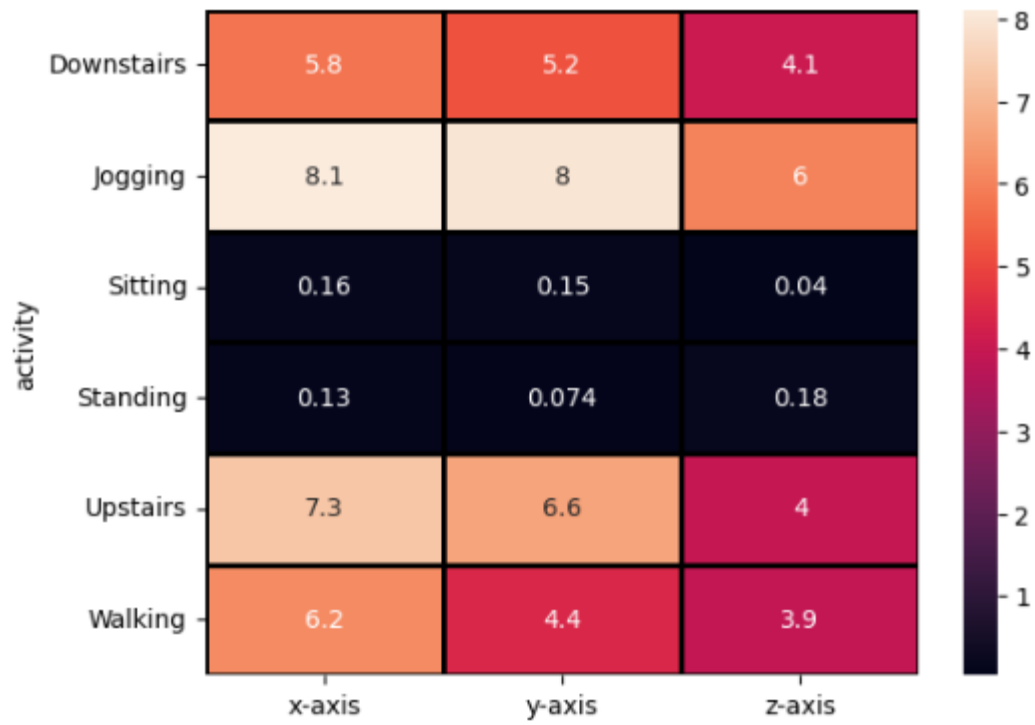
	user	activity	timestamp	x-axis	y-axis	z-axis	Time_Interval
53503	3	Walking	1970-01-02 04:00:32.351478	2.87	18.81	-0.89	0 days 11:09:25.259151
53504	3	Walking	1970-01-02 04:00:32.391547	-0.38	8.24	-1.27	0 days 00:00:00.040069
53505	3	Walking	1970-01-02 04:00:32.431556	1.33	7.16	-1.95	0 days 00:00:00.040009
53506	3	Walking	1970-01-02 04:00:32.471839	4.06	9.66	-1.84	0 days 00:00:00.040283
53507	3	Walking	1970-01-02 04:00:32.551551	1.69	6.55	-0.11	0 days 00:00:00.079712
...
88656	3	Downstairs	1970-01-02 04:41:00.241614	-3.87	7.55	3.30	0 days 00:00:00.039978
88657	3	Downstairs	1970-01-02 04:41:00.321693	-4.06	8.08	4.79	0 days 00:00:00.080079
88658	3	Downstairs	1970-01-02 04:41:00.365577	-6.32	8.66	4.94	0 days 00:00:00.043884
88659	3	Downstairs	1970-01-02 04:41:00.403083	-5.37	11.22	3.06	0 days 00:00:00.037506
88660	3	Downstairs	1970-01-02 04:41:00.443305	-5.79	9.92	2.53	0 days 00:00:00.040222

35158 rows × 7 columns

Heatmap to visualize the distribution of data points across activities and potentially subjects, with values annotated within each cell (assuming stats_by_act is a pre-computed data structure).

```
# and a more visual version
sns.heatmap(stats_by_act, annot=True, linewidths=1, linecolor='black')
plt.show()
```

Output:



References:

Dataset :

WISDM LAB : <https://www.cis.fordham.edu/wisdm/dataset.php>

GitHub:

Link : <https://github.com/sarmadalij/ActivityRecognitionAndResearch>