STRIDE CLASSIFICATION DATASET, FEATURES, AND MODEL GENERATION

Installing SensiML

```
!pip install sensiml-dev -U
```

```
Requirement already satisfied: sensiml-dev in /usr/local/lib/python3.7/dist-packages (2021.1.0)
Requirement already satisfied: requests-oauthlib>=0.7.0 in /usr/local/lib/python3.7/dist-packages (from sensiml-dev) (1.3.0)
Requirement already satisfied: semantic-version>=2.6.0 in /usr/local/lib/python3.7/dist-packages (from sensiml-dev) (2.8.5)
Requirement already satisfied: pyserial in /usr/local/lib/python3.7/dist-packages (from sensiml-dev) (3.5)
Requirement already satisfied: numpy in /usr/local/lib/python3.7/dist-packages (from sensiml-dev) (1.19.5)
Requirement already satisfied: seaborn in /usr/local/lib/python3.7/dist-packages (from sensiml-dev) (0.11.1)
Requirement already satisfied: appdirs==1.4.3 in /usr/local/lib/python3.7/dist-packages (from sensiml-dev) (1.4.3)
Requirement already satisfied: prompt-toolkit in /usr/local/lib/python3.7/dist-packages (from sensiml-dev) (1.0.18)
Requirement already satisfied: wurlitzer in /usr/local/lib/python3.7/dist-packages (from sensiml-dev) (2.1.1)
Requirement already satisfied: cookiejar==0.0.2 in /usr/local/lib/python3.7/dist-packages (from sensiml-dev) (0.0.2)
Requirement already satisfied: matplotlib in /usr/local/lib/python3.7/dist-packages (from sensiml-dev) (3.2.2)
Requirement already satisfied: pandas in /usr/local/lib/python3.7/dist-packages (from sensiml-dev) (1.1.5)
Requirement already satisfied: requests>=2.14.2 in /usr/local/lib/python3.7/dist-packages (from sensiml-dev) (2.23.0)
Requirement already satisfied: cookiecutter in /usr/local/lib/python3.7/dist-packages (from cookiejar==0.0.2->sensiml-dev) (1.7.3)
Collecting argparse
  Using cached argparse-1.4.0-py2.py3-none-any.whl (23 kB)
Requirement already satisfied: pager in /usr/local/lib/python3.7/dist-packages (from cookiejar==0.0.2->sensiml-dev) (3.3)
Requirement already satisfied: urllib3!=1.25.0,!=1.25.1,<1.26,>=1.21.1 in /usr/local/lib/python3.7/dist-packages (from requests>=2.14.2->sensiml-dev) (1.24.3)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.7/dist-packages (from requests>=2.14.2->sensiml-dev) (2021.5.30)
Requirement already satisfied: chardet<4,>=3.0.2 in /usr/local/lib/python3.7/dist-packages (from requests>=2.14.2->sensiml-dev) (3.0.4)
Requirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.7/dist-packages (from requests>=2.14.2->sensiml-dev) (2.10)
Requirement already satisfied: oauthlib>=3.0.0 in /usr/local/lib/python3.7/dist-packages (from requests-oauthlib>=0.7.0->sensiml-dev) (3.1.1)
Requirement already satisfied: Jinja2<4.0.0,>=2.7 in /usr/local/lib/python3.7/dist-packages (from cookiecutter->cookiejar==0.0.2->sensiml-dev) (2.11.3)
Requirement already satisfied: six>=1.10 in /usr/local/lib/python3.7/dist-packages (from cookiecutter->cookiejar==0.0.2->sensiml-dev) (1.15.0)
Requirement already satisfied: click>=7.0 in /usr/local/lib/python3.7/dist-packages (from cookiecutter->cookiejar==0.0.2->sensiml-dev) (7.1.2)
Requirement already satisfied: jinja2-time>=0.2.0 in /usr/local/lib/python3.7/dist-packages (from cookiecutter->cookiejar==0.0.2->sensiml-dev) (0.2.0)
Requirement already satisfied: poyo>=0.5.0 in /usr/local/lib/python3.7/dist-packages (from cookiecutter->cookiejar==0.0.2->sensiml-dev) (0.5.0)
Requirement already satisfied: binaryornot>=0.4.4 in /usr/local/lib/python3.7/dist-packages (from cookiecutter->cookiejar==0.0.2->sensiml-dev) (0.4.4)
Requirement already satisfied: python-slugify>=4.0.0 in /usr/local/lib/python3.7/dist-packages (from cookiecutter->cookiejar==0.0.2->sensiml-dev) (5.0.2)
Requirement already satisfied: MarkupSafe>=0.23 in /usr/local/lib/python3.7/dist-packages (from Jinja2<4.0.0,>=2.7->cookiecutter->cookiejar==0.0.2->sensiml-dev) (2.0.1)
Requirement already satisfied: arrow in /usr/local/lib/python3.7/dist-packages (from jinja2-time>=0.2.0->cookiecutter->cookiejar==0.0.2->sensiml-dev) (1.1.1)
Requirement already satisfied: text-unidecode>=1.3 in /usr/local/lib/python3.7/dist-packages (from python-slugify>=4.0.0->cookiecutter->cookiejar==0.0.2->sensiml-dev) (1.3)
Requirement already satisfied: typing-extensions in /usr/local/lib/python3.7/dist-packages (from arrow->jinja2-time>=0.2.0->cookiecutter->cookiejar==0.0.2->sensiml-dev) (3.7.4.3)
Requirement already satisfied: python-dateutil>=2.7.0 in /usr/local/lib/python3.7/dist-packages (from arrow->jinja2-time>=0.2.0->cookiecutter->cookiejar==0.0.2->sensiml-dev) (2.8.1)
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.7/dist-packages (from matplotlib->sensiml-dev) (0.10.0)
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 in /usr/local/lib/python3.7/dist-packages (from matplotlib->sensiml-dev) (2.4.7)
Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.7/dist-packages (from matplotlib->sensiml-dev) (1.3.1)
Requirement already satisfied: pytz>=2017.2 in /usr/local/lib/python3.7/dist-packages (from pandas->sensiml-dev) (2018.9)
Requirement already satisfied: wcwidth in /usr/local/lib/python3.7/dist-packages (from prompt-toolkit->sensiml-dev) (0.2.5)
Requirement already satisfied: scipy>=1.0 in /usr/local/lib/python3.7/dist-packages (from seaborn->sensiml-dev) (1.4.1)
Installing collected packages: argparse
Successfully installed argparse-1.4.0
WARNING: The following packages were previously imported in this runtime:
  [argparse]
You must restart the runtime in order to use newly installed versions.
```

RESTART RUNTIME

Login into the Project

```
import pandas as pd
from sensiml import SensiML
dsk = SensiML()
```

```
/usr/local/lib/python3.7/dist-packages/sensiml/client.py:112: UserWarning: Config option `use_jedi` not recognized by `IPCompleter`.
  mgc("%config Completer.use_jedi = False")
```

Sensor Data

```
dsk.project = 'Stride Classification'
dsk.project.columns()
```

```
dict_keys(['GyroscopeX', 'GyroscopeY', 'GyroscopeZ', 'AccelerometerX', 'AccelerometerY', 'AccelerometerZ'])
```

Metadata

```
dsk.project.metadata_columns()
```

```
['Cont or Event', 'Type', 'Side', 'Subject', 'capture_uuid', 'segment_uuid']
```

Data Samples

```
dsk.project.get_project_summary().T
```

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Capture Name	Rafael_Normal 2021-07-31 16_00_17.csv	Martin_Heel Striking 2021-07-30 08_06_42.csv	Rafael_Pronation 2021-07-31 16_13_34.csv	Rafael_Pronation 2021-07-31 16_14_27.csv	Rafael_Supination 2021-07-30 21_12_49.csv	Rafael_Over Supination 2021-07-31 16_26_03.csv	Rafael_Pronation 2021-07-28 07_28_37.csv	Rafael_Pronation 2021-07-31 16_15_03.csv	Martin_Heel Striking 2021-07-30 08_24_32.csv	Martin_Supination 2021-07-30 08_26_39.csv	Martin_Normal 2021-07-30 08_05_56.csv	Martin_Over Supination 2021-07-30 08_19_56.csv	Rafael_Over Supination 2021-07-31 16_21_42.csv	Rafael_Normal 2021-07-31 16_33_55.csv	Rafael_Over Pronation 2021-07-31 16_20_46.csv	Rafael_Supination 2021-07-31 16_12_12.csv	Rafael_Supination 2021-07-31 16_11_39.csv	S 0
Capture UUID	01267146-efa1-4bfb-ad0f-f27d64db23ab	062dddc8-7474-48e0-8b4c-fdece0a6a453	0779527e-a0c8-4c51-8c99-68f837196a70	1629d4c8-b571-4eb9-bb85-f1106668e56a	1b7a563d-311d-4b41-9bdb-e1d28aeda6d5	227d454e-ea7f-4172-a3ae-958d39e9d44f	22f47e0a-cf35-4106-8695-31b0fbb2a24e	24ee543f-2b4f-4467-9d71-cf79d2fdbeb8	2a5c0303-99e5-4b3c-a1fb-5f89b50d313f	2ef1c534-daf1-4d6b-966c-007b2ca123a5	39fd2f79-b066-46a2-97b4-98eb442df4a4	3aad6577-f3c2-4f57-ab30-37e18387c9da	3def2270-154f-41d4-a634-a790015e1ae1	3ff47016-36d5-43bb-af38-deef07dd2777	41b704e1-6ea5-40b3-913c-62e73cb6a44b	48dd262a-fb47-4562-9013-15cffec53379	4d3d20b8-e6f9-4637-a789-bb526a005ee1	2
Total Event Count	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Size (MB)	0.01	0.02	0.02	0.02	0.08	0.02	0.10	0.02	0.02	0.02	0.01	0.02	0.02	0.01	0.02	0.02	0.02	
Cont or Event	Continuous	None	Continuous	Continuous	Discrete Event	Continuous	Continuous	Continuous	Continuous	Continuous	None	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	
Side	Right	Right	Right	Right	Right	Right	Right	Right	Left	Left	Right	Right	Right	Right	Right	Right	Right	
Subject	Rafael	Martin	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Martin	Martin	Martin	Martin	Rafael	Rafael	Rafael	Rafael	Rafael	
Type	Train	Train	Train	Train	Train	Test	Train	Train	Train	Train	Train	Train	Train	Train	Test	Train	Train	

Project Pipeline

```
dsk.pipeline = 'Pipeline Final'
```

Feature Generator

```
pd.set_option("display.max_rows",150)
dsk.list_functions(qgrid=False).head(100)
```

	NAME	TYPE	SUBTYPE	DESCRIPTION	KP FUNCTION
0	Add Convolve	Augmentation	Supervised	Add Convolve:\n Convolve (smoothing...	False
1	Add Quantize	Augmentation	Supervised	Add Quantize:\n Quantize time serie...	False
2	Add Noise	Augmentation	Supervised	Add Noise:\n Add random noise to ti...	False
3	Add Drift	Augmentation	Supervised	Add Drift:\n The augmenter drifts t...	False
4	Add Dropout	Augmentation	Supervised	Add Dropout:\n Dropout values of so...	False
5	Add Pool	Augmentation	Supervised	Add Pool:\n Reduce the temporal res...	False
6	Add Reverse	Augmentation	Supervised	Add Reverse:\n Reverse the time lin...	False
7	Add TimeWarp	Augmentation	Supervised	Add Timewarp:\n Random time warping...	False
8	PME	Classifier	Clustering	PME or pattern matching engine is a distance b...	False
9	Decision Tree Ensemble	Classifier	Ensemble	The decision tree ensemble classifier is an en...	False
10	Boosted Tree Ensemble	Classifier	Ensemble	The boosted tree ensemble classifier is an ens...	False
11	Bonsai	Classifier	Ensemble	Bonsai is a tree model for supervised learning...	False
12	TF Micro	Classifier	NN	The Tensorflow Micro Classifier uses Tensorflo...	False
13	Global Peak to Peak of High Frequency	Feature Generator	Amplitude	Global peak to peak of high frequency. The hig...	True
14	Global Peak to Peak of Low Frequency	Feature Generator	Amplitude	Global peak to peak of low frequency. The low ...	True
15	Max Peak to Peak of first half of High Frequency	Feature Generator	Amplitude	Max Peak to Peak of first half of High Frequen...	True
16	Global Peak to Peak	Feature Generator	Amplitude	Global Peak to Peak of signal.\n\n Args:\n ...	True
17	Global Min Max Sum	Feature Generator	Amplitude	This function is the sum of the maximum and mi...	True
18	Total Area	Feature Generator	Area	Total area under the signal. Total area = sum(...	True
19	Absolute Area	Feature Generator	Area	Absolute area of the signal. Absolute area = s...	True
20	Total Area of Low Frequency	Feature Generator	Area	Total area of low frequency components of the ...	True
21	Absolute Area of Low Frequency	Feature Generator	Area	Absolute area of low frequency components of t...	True
22	Total Area of High Frequency	Feature Generator	Area	Total area of high frequency components of the...	True
23	Absolute Area of High Frequency	Feature Generator	Area	Absolute area of high frequency components of ...	True
24	Absolute Area of Spectrum	Feature Generator	Area	Absolute area of spectrum.\n\n Args:\n ...	True
25	Two Column Mean Difference	Feature Generator	Column Fusion	Compute the mean difference between two column...	True
26	Cross Column Mean Crossing Rate	Feature Generator	Column Fusion	Compute the crossing rate of column 2 of over ...	True
27	Abs Max Column	Feature Generator	Column Fusion	Returns the index of the column with the max a...	True
28	Cross Column Correlation	Feature Generator	Column Fusion	Compute the correlation of the slopes between ...	True
29	Min Column	Feature Generator	Column Fusion	Returns the index of the column with the min v...	True
30	Two Column Min Max Difference	Feature Generator	Column Fusion	Compute the min max difference between two col...	True
31	Two Column Peak To Peak Difference	Feature Generator	Column Fusion	Compute the max value for each column, then su...	True
32	Max Column	Feature Generator	Column Fusion	Returns the index of the column with the max v...	True
33	Cross Column Mean Crossing with Offset	Feature Generator	Column Fusion	Compute the crossing rate of column 2 of over ...	True
34	Two Column Median Difference	Feature Generator	Column Fusion	Compute the median difference between two colu...	True
35	Two Column Peak Location Difference	Feature Generator	Column Fusion	Computes the location of the maximum value for...	True
36	Average Energy	Feature Generator	Energy	Average Energy.\n\n 1) Calculate the elemen...	True
37	Total Energy	Feature Generator	Energy	Total Energy.\n\n 1) Calculate the element-...	True
38	Average Demeaned Energy	Feature Generator	Energy	Average Demeaned Energy.\n\n 1) Calculate t...	True
39	MFCC	Feature Generator	Frequency	Translates the data stream(s) from a segment i...	True
40	Dominant Frequency	Feature Generator	Frequency	Calculate the dominant frequency for each spec...	True
41	Spectral Entropy	Feature Generator	Frequency	Calculate the spectral entropy for each specif...	True
42	Peak Frequencies	Feature Generator	Frequency	Calculate the peak frequencies for each specif...	True
43	Histogram	Feature Generator	Histogram	Translates to the data stream(s) from a segmen...	True
44	Histogram Auto Scale Range	Feature Generator	Histogram	Translates to the data stream(s) from a segmen...	True
45	Average of Movement Intensity	Feature Generator	Physical	Calculates the average movment intensity defin...	True
46	Variance of Movement Intensity	Feature Generator	Physical	Variance of movement intensity\n\n Args:\n ...	True
47	Average Signal Magnitude Area	Feature Generator	Physical	Average signal magnitude area.\n \n .. m...	True
48	Mean Difference	Feature Generator	Rate of Change	Calculate the mean difference of each specifie...	True
49	Threshold Crossing Rate	Feature Generator	Rate of Change	The total number of threshold crossings are fo...	True
50	Mean Crossing Rate	Feature Generator	Rate of Change	Calculates the rate at which mean value is cro...	True

51	Zero Crossing Rate	Feature Generator	Rate of Change	Calculates the rate at which zero value is cro...	True
52	Sigma Crossing Rate	Feature Generator	Rate of Change	Calculates the rate at which standard deviatio...	True
53	Second Sigma Crossing Rate	Feature Generator	Rate of Change	Calculates the rate at which 2nd standard devi...	True
54	Threshold With Offset Crossing Rate	Feature Generator	Rate of Change	The total number of threshold crossings are fo...	True
55	Downsample	Feature Generator	Sampling	This function takes `input_data` dataframe as ...	True
56	Downsample Average with Normalization	Feature Generator	Sampling	This function takes `input_data` dataframe as ...	True
57	Downsample Max With Normaliztion	Feature Generator	Sampling	This function takes `input_data` dataframe as ...	True
58	Difference of Peak to Peak of High Frequency b...	Feature Generator	Shape	Difference of peak to peak of high frequency b...	True
59	Ratio of Peak to Peak of High Frequency betwee...	Feature Generator	Shape	Ratio of peak to peak of high frequency betwee...	True
60	Shape Median Difference	Feature Generator	Shape	Computes the difference in median between the ...	True
61	Shape Absolute Median Difference	Feature Generator	Shape	Computes the absolute value of the difference ...	True
62	Kurtosis	Feature Generator	Statistical	Kurtosis is the degree of 'peakedness' or 'tai...	True
63	Maximum	Feature Generator	Statistical	Computes the maximum of each column in 'column...	True
64	Absolute Mean	Feature Generator	Statistical	Computes the arithmetic mean of absolute value...	True
65	Mean	Feature Generator	Statistical	Computes the arithmetic mean of each column in...	True
66	Variance	Feature Generator	Statistical	Computes the variance of desired column(s) in ...	True
67	Zero Crossings	Feature Generator	Statistical	Computes the number of times the selected inpu...	True
68	Positive Zero Crossings	Feature Generator	Statistical	Computes the number of times the selected inpu...	True
69	Negative Zero Crossings	Feature Generator	Statistical	Computes the number of times the selected inpu...	True
70	Median	Feature Generator	Statistical	The median of a vector V with N items, is the ...	True
71	Linear Regression Stats	Feature Generator	Statistical	Calculate a linear least-squares regression an...	True
72	Standard Deviation	Feature Generator	Statistical	The standard deviation of a vector V with N it...	True
73	Skewness	Feature Generator	Statistical	The skewness is the measure of asymmetry of th...	True
74	Interquartile Range	Feature Generator	Statistical	The IQR (inter quartile range) of a vector V w...	True
75	25th Percentile	Feature Generator	Statistical	Computes the 25th percentile of each column in...	True
76	75th Percentile	Feature Generator	Statistical	Computes the 75th percentile of each column in...	True
77	100th Percentile	Feature Generator	Statistical	Computes the 100th percentile of each column i...	True
78	Minimum	Feature Generator	Statistical	Computes the minimum of each column in 'column...	True
79	Sum	Feature Generator	Statistical	Computes the cumulative sum of each column in ...	True
80	Absolute Sum	Feature Generator	Statistical	Computes the cumulative sum of absolute values...	True
81	Abs Percent Time Over Threshold	Feature Generator	Time	Percentage of absolute value of samples in the...	True
82	Average Time Over Threshold	Feature Generator	Time	Average of the time spent above threshold for ...	True
83	Duration of the Signal	Feature Generator	Time	Duration of the signal. It is calculated by di...	True
84	Percent Time Over Zero	Feature Generator	Time	Percentage of samples in the series that are p...	True
85	Percent Time Over Sigma	Feature Generator	Time	Percentage of samples in the series that are a...	True
86	Percent Time Over Second Sigma	Feature Generator	Time	Percentage of samples in the series that are a...	True
87	Percent Time Over Threshold	Feature Generator	Time	Percentage of samples in the series that are a...	True
88	Transpose Signal	Feature Generator	Transpose	Turns raw signal into a feature over a range.\...	True
89	Interleave Signal	Feature Generator	Transpose	Turns raw signal into a feature over a range. ...	True
90	Recursive Feature Elimination	Feature Selector	Supervised	This is a supervised method of feature selecti...	False
91	Univariate Selection	Feature Selector	Supervised	Select features with the highest univariate (A...	False
92	Tree-based Selection	Feature Selector	Supervised	Select features using a supervised tree-based ...	False
93	Information Gain	Feature Selector	Supervised	This is a supervised feature selection algorit...	False
94	Custom Feature Selection	Feature Selector	Supervised	This is a feature selection method which allow...	False
95	Custom Feature Selection By Index	Feature Selector	Supervised	This is a feature selection method which allow...	False
96	t-Test Feature Selector	Feature Selector	Supervised	This is a supervised feature selection algorit...	False
97	Variance Threshold	Feature Selector	Unsupervised	Feature selector that removes all low-variance...	False
98	Correlation Threshold	Feature Selector	Unsupervised	This is an unsupervised feature selection algo...	False
99	Undersample Majority Classes	Sampler	Balance Data	Create a balanced data set by undersampling th...	False

```
dsk.pipeline.add_feature_generator?
```

Pipeline Datasets

```
dsk.list_queries()
```

	Name	Created	UUID
0	Final reduced	2021-07-31 22:17:56	1bf06b9f-5d8c-4872-b049-48c727738627
1	Continuous Final	2021-07-31 20:54:37	6f4da48d-4b60-4c81-be9c-939c3ed1202a
2	Events	2021-07-31 03:35:41	7712f087-2631-415e-8204-32a8fc76072c
3	Discrete Event	2021-07-31 02:42:44	7c2de9e9-b85e-4d45-bd88-cb0c73aa4cf2

```
dsk.pipeline.reset()
dsk.pipeline.set_input_query("Continuous Final")
dsk.pipeline.describe()
```

```
--------------------------------------------------------------------------------
 0.     Name: Continuous Final                          Type: query
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
```

```
print(dsk.snippets.Segmenter.Windowing())
```

```
    dsk.pipeline.add_transform("Windowing", params={"window_size": 250,
                                "delta": 250,
                                "train_delta": 0,
                                "return_segment_index": False,
                                })
```

```
dsk.function_description("Windowing")
```

```
                ----
                    Subject     Class  Rep  accelx  accely  accelz
                0       s01  Crawling    1     377     569    4019
                1       s01  Crawling    1     357     594    4051
                2       s01  Crawling    1     333     638    4049
                3       s01  Crawling    1     340     678    4053
                4       s01  Crawling    1     372     708    4051
                5       s01  Crawling    1     410     733    4028
                6       s01  Crawling    1     450     733    3988
                7       s01  Crawling    1     492     696    3947
                8       s01  Crawling    1     518     677    3943
                9       s01  Crawling    1     528     695    3988
                10      s01  Crawling    1      -1    2558    4609
                11      s01   Running    1     -44   -3971     843
                12      s01   Running    1     -47   -3982     836
                13      s01   Running    1     -43   -3973     832
                14      s01   Running    1     -40   -3973     834
                15      s01   Running    1     -48   -3978     844
                16      s01   Running    1     -52   -3993     842
                17      s01   Running    1     -64   -3984     821
                18      s01   Running    1     -64   -3966     813
                19      s01   Running    1     -66   -3971     826
                20      s01   Running    1     -62   -3988     827
                21      s01   Running    1     -57   -3984     843

        >>> dsk.pipeline.set_input_data('test_data', df, force=True,
                                data_columns=['accelx', 'accely', 'accelz'],
                                group_columns=['Subject', 'Class', 'Rep'],
                                label_column='Class')

        >>> dsk.pipeline.add_transform('Windowing',
                                        params={'window_size' : 5,
                                                'delta': 5})

        >>> results, stats = dsk.pipeline.execute()
        >>> print results
```

```
out:
```

	Class	Rep	SegmentID	Subject	accelx	accely	accelz
0	Crawling	1	0	s01	377	569	4019
1	Crawling	1	0	s01	357	594	4051
2	Crawling	1	0	s01	333	638	4049
3	Crawling	1	0	s01	340	678	4053
4	Crawling	1	0	s01	372	708	4051
5	Crawling	1	1	s01	410	733	4028
6	Crawling	1	1	s01	450	733	3988
7	Crawling	1	1	s01	492	696	3947
8	Crawling	1	1	s01	518	677	3943
9	Crawling	1	1	s01	528	695	3988
10	Running	1	0	s01	-44	-3971	843
11	Running	1	0	s01	-47	-3982	836
12	Running	1	0	s01	-43	-3973	832
13	Running	1	0	s01	-40	-3973	834
14	Running	1	0	s01	-48	-3978	844
15	Running	1	1	s01	-52	-3993	842
16	Running	1	1	s01	-64	-3984	821
17	Running	1	1	s01	-64	-3966	813
18	Running	1	1	s01	-66	-3971	826
19	Running	1	1	s01	-62	-3988	827

```
dsk.pipeline.add_transform("Windowing", params={"window_size":250, "delta":100,"train_delta":50})
dsk.pipeline.describe()
```

```
--------------------------------------------------------------------------
 0.     Name: Continuous Final                          Type: query
--------------------------------------------------------------------------
--------------------------------------------------------------------------
 1.     Name: Windowing                                 Type: segmenter
--------------------------------------------------------------------------
        group_columns: ['Cont or Event', 'Side', 'Stride', 'Subject', 'Type', 'segment_uuid']
        window_size: 250
        delta: 100
        train_delta: 50
        return_segment_index: False
--------------------------------------------------------------------------
```

Adding Feature Mannually to the Dataset

```
dsk.pipeline.add_transform("Strip",params={"input_columns":["AccelerometerX","AccelerometerY","AccelerometerZ"],
                                           "type":"mean",},)
dsk.pipeline.describe()
dsk.pipeline.add_transform("Strip",params={"input_columns":["GyroscopeX","GyroscopeY","GyroscopeZ"],
                                           "type":"mean",},)
dsk.pipeline.describe()
```

```
--------------------------------------------------------------------------
 0.     Name: Continuous Final                          Type: query
--------------------------------------------------------------------------
--------------------------------------------------------------------------
 1.     Name: Windowing                                 Type: segmenter
--------------------------------------------------------------------------
        group_columns: ['Cont or Event', 'Side', 'Stride', 'Subject', 'Type', 'segment_uuid']
        window_size: 250
        delta: 100
        train_delta: 50
        return_segment_index: False
--------------------------------------------------------------------------
 2.     Name: Strip                                     Type: transform
--------------------------------------------------------------------------
        group_columns: ['Cont or Event', 'SegmentID', 'Side', 'Stride', 'Subject', 'Type', 'segment_uuid']
        input_columns: ['AccelerometerX', 'AccelerometerY', 'AccelerometerZ']
        type: mean
--------------------------------------------------------------------------

--------------------------------------------------------------------------
 0.     Name: Continuous Final                          Type: query
--------------------------------------------------------------------------
--------------------------------------------------------------------------
 1.     Name: Windowing                                 Type: segmenter
--------------------------------------------------------------------------
        group_columns: ['Cont or Event', 'Side', 'Stride', 'Subject', 'Type', 'segment_uuid']
        window_size: 250
        delta: 100
        train_delta: 50
        return_segment_index: False
--------------------------------------------------------------------------
 2.     Name: Strip                                     Type: transform
--------------------------------------------------------------------------
        group_columns: ['Cont or Event', 'SegmentID', 'Side', 'Stride', 'Subject', 'Type', 'segment_uuid']
        input_columns: ['GyroscopeX', 'GyroscopeY', 'GyroscopeZ']
        type: mean
--------------------------------------------------------------------------
```

Adding Features with Feature Generator (Rate of Change & Statistical)

```
dsk.pipeline.add_feature_generator?
```

```
sensor_columns = ['AccelerometerX', 'AccelerometerY', 'AccelerometerZ','GyroscopeX', 'GyroscopeY', 'GyroscopeZ']
dsk.pipeline.add_feature_generator([
                                    {'subtype_call':'Rate of Change'},
                                    {'subtype_call':'Statistical'},
                                    {"name":"MFCC",
                                     "params": {
                                        "columns":sensor_columns,
                                        "sample_rate":100,
                                        "cepstra_count":10,
                                    }},
                                     ],
                                     function_defaults={'columns':sensor_columns},
                                    )
```

```
fv, s = dsk.pipeline.execute()
```

```
    Executing Pipeline with Steps:

    ------------------------------------------------------------------------
     0.     Name: Continuous Final                          Type: query
    ------------------------------------------------------------------------
    ------------------------------------------------------------------------
     1.     Name: Windowing                                 Type: segmenter
    ------------------------------------------------------------------------
    ------------------------------------------------------------------------
     2.     Name: Strip                                     Type: transform
    ------------------------------------------------------------------------
    ------------------------------------------------------------------------
     3.     Name: generator_set                             Type: generatorset
    ------------------------------------------------------------------------
    ------------------------------------------------------------------------



    Results Retrieved... Execution Time: 0 min. 0 sec.
```

Features Added

```
dsk.pipeline.describe()
```

```
    ------------------------------------------------------------------------
     0.     Name: Continuous Final                          Type: query
    ------------------------------------------------------------------------
    ------------------------------------------------------------------------
     1.     Name: Windowing                                 Type: segmenter
    ------------------------------------------------------------------------
            group_columns: ['Cont or Event', 'Side', 'Stride', 'Subject', 'Type', 'segment_uuid']
            window_size: 250
            delta: 100
            train_delta: 50
            return_segment_index: False
    ------------------------------------------------------------------------
     2.     Name: Strip                                     Type: transform
    ------------------------------------------------------------------------
            group_columns: ['Cont or Event', 'SegmentID', 'Side', 'Stride', 'Subject', 'Type', 'segment_uuid']
            input_columns: ['GyroscopeX', 'GyroscopeY', 'GyroscopeZ']
            type: mean
    ------------------------------------------------------------------------
     3.     Name: generator_set                             Type: generatorset
    ------------------------------------------------------------------------
             0. Name: MFCC
             1. Name: MFCC
             2. Name: MFCC
             3. Name: MFCC
             4. Name: MFCC
             5. Name: MFCC
             6. Name: Mean Difference
             7. Name: Threshold Crossing Rate
             8. Name: Mean Crossing Rate
             9. Name: Zero Crossing Rate
            10. Name: Sigma Crossing Rate
            11. Name: Second Sigma Crossing Rate
            12. Name: Threshold With Offset Crossing Rate
            13. Name: Kurtosis
            14. Name: Maximum
            15. Name: Absolute Mean
            16. Name: Mean
            17. Name: Variance
            18. Name: Zero Crossings
            19. Name: Positive Zero Crossings
            20. Name: Negative Zero Crossings
```

```
        21. Name: Median
        22. Name: Linear Regression Stats
        23. Name: Linear Regression Stats
        24. Name: Linear Regression Stats
        25. Name: Linear Regression Stats
        26. Name: Linear Regression Stats
        27. Name: Linear Regression Stats
        28. Name: Standard Deviation
        29. Name: Skewness
        30. Name: Interquartile Range
        31. Name: 25th Percentile
        32. Name: 75th Percentile
        33. Name: 100th Percentile
        34. Name: Minimum
        35. Name: Sum
        36. Name: Absolute Sum
        group_columns: ['Cont or Event', 'SegmentID', 'Side', 'Stride', 'Subject', 'Type', 'segment_uuid']
    ------------------------------------------------------------------------
```

New Shape With The Added Features

```
fv.T.shape
```

```
(241, 67)
```

```
fv.T.head(100)
```

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Cont or Event	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
SegmentID	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Side	Right	Right	Right	Right	Right	Right	Right	Right	Right	Right	Right	Right	Right	Right	Right	Right
Stride	Normal	Normal	Normal	Normal	Normal	Over Pronation	Over Pronation	Over Pronation	Over Pronation	Over Pronation	Over Supination	Over Supination	Over Supination	Over Supination	Over Supination	Pronation
Subject	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael
Type	Train	Train	Train	Train	Train	Train	Train	Train	Train	Train	Train	Train	Train	Train	Train	Train
segment_uuid	0dbde19a-d028-47ae-9642-ef056e4dcdf0	2a28cd32-0193-4b52-a0ed-5e25da32832c	2d4326a4-61cd-415c-9af5-dc27933bbb0a	bed1d3fa-096a-4bb2-859f-f45c391b3117	cd3188d4-7ea5-4b02-86b8-d04647388e01	1ecfeac3-276e-412c-b229-fc23dc180294	7933ef33-774b-44b9-9b07-51e21486dc38	9b7fc31a-39d9-4792-b228-cacac7e4c468	ca1aeefe-b19f-4263-a0dd-f1f5a527c85b	d6c57bff-5706-4488-952a-dc3e545ca8c3	4b0fd010-84b5-442c-94ef-297c963488d1	6e43fb28-9173-4567-922d-415e1b4d8149	7076c4db-b5ce-431a-8088-400f01f5ba53	70982ffb-6bb7-4e86-9396-7709890b3a7e	7c2156e9-3cc6-4e3d-bffa-b0f03da46a7e	3b475970-361c-4abc-a98f-c5f4d1b7214a
gen_0001_AccelerometerXmfcc_000000	330571	330408	322229	330449	335191	318918	328760	322643	328487	315458	330741	335700	336712	322798	336426	340719
gen_0001_AccelerometerXmfcc_000001	-96066	-72169	-91373	-91681	-74911	-75976	-76448	-79221	-97713	-81024	-93480	-78744	-88018	-89667	-67643	-76815
gen_0001_AccelerometerXmfcc_000002	-90505	-105532	-73317	-65779	-55228	-59155	-34823	-55773	-79142	-45242	-59635	-76818	-78884	-52125	-68111	-15089
gen_0001_AccelerometerXmfcc_000003	-34643	-39155	-51241	-69776	-22128	-29118	-50249	-36504	-10783	-13184	-12861	-38648	-16325	1615	-29380	-24479
gen_0001_AccelerometerXmfcc_000004	-9615	-14631	-26385	-43273	-26628	-10866	-31783	-30651	-22724	1722	-38167	-29796	-19397	-25190	-34902	-29206
gen_0001_AccelerometerXmfcc_000005	-56522	-17195	-42642	3125	-45874	2485	-12814	-27990	-15751	254	-15152	-44340	-2084	-15587	-13889	-53683
gen_0001_AccelerometerXmfcc_000006	-32336	-9984	-71405	-1239	-59447	-3130	-18701	651	-13495	-1742	26579	-38948	2551	-35223	-21067	-7665
gen_0001_AccelerometerXmfcc_000007	-28055	10705	-49373	-24692	-10367	-11177	-35335	-15648	-13187	-44072	-24159	-56940	12694	-47527	-3261	5003
gen_0001_AccelerometerXmfcc_000008	-7462	-8046	7528	-8849	17510	-29100	9365	17741	-320	-7639	-32380	-5327	-3423	5458	-4733	18654
gen_0001_AccelerometerXmfcc_000009	-21134	33507	-9233	9162	5130	5003	25766	-2531	-30100	51475	-29811	-3490	693	1444	-48310	-1687
gen_0002_AccelerometerYmfcc_000000	362054	359008	345784	362635	361120	354323	358411	356338	352847	343035	363472	362873	359853	355964	347679	347514
gen_0002_AccelerometerYmfcc_000001	-60355	-57397	-47997	-61148	-51068	-61235	-62379	-47782	-63120	-58326	-70393	-66055	-69462	-64354	-61071	-47107
gen_0002_AccelerometerYmfcc_000002	-38405	-20586	-12613	-26600	-39955	-45222	-26604	-31806	-27260	-50551	-29535	-14884	-37319	-41762	-51055	-14745
gen_0002_AccelerometerYmfcc_000003	-23059	-28082	-38464	-43181	-33373	-18341	-22307	-33101	-12900	-23326	-54298	-40174	-21215	-36682	-11635	-34253
gen_0002_AccelerometerYmfcc_000004	-7128	-57807	-27268	-69936	-24440	-17965	-28886	-28296	-25218	1535	-30943	-32707	-76675	-34993	-40363	-45663
gen_0002_AccelerometerYmfcc_000005	5684	-13782	-11805	-45119	2600	-1387	-38696	-40673	-49541	4380	-6219	-39377	-33569	-5480	-12781	-35529
gen_0002_AccelerometerYmfcc_000006	1322	34924	19483	-3502	-5281	14724	10812	-8988	3939	33341	3781	19213	27492	12759	28181	7944
gen_0002_AccelerometerYmfcc_000007	-2923	14919	12632	31182	-8111	11750	45158	45999	27654	35365	41507	59329	18641	46429	41723	10100
gen_0002_AccelerometerYmfcc_000008	-23784	-7330	9773	26094	11622	23156	3521	8925	-8728	21241	26788	24708	41338	37463	82103	23706
gen_0002_AccelerometerYmfcc_000009	-2254	28701	7625	-18465	19191	32248	-10735	2495	-20695	-13843	26032	-4472	13264	20393	21757	-34271
gen_0003_AccelerometerZmfcc_000000	358888	364146	349770	339836	355298	352063	340023	346833	344927	336231	357109	358663	356519	353718	352211	336780
gen_0003_AccelerometerZmfcc_000001	-59583	-74721	-84067	-42384	-36704	-81132	-52866	-53721	-72859	-59146	-84354	-69129	-62207	-62138	-46758	-53618
gen_0003_AccelerometerZmfcc_000002	-61659	-30949	-29252	-29063	-43972	-101671	-23833	-34072	-76851	-60282	-37311	-56958	-66808	-42221	-72264	-47099
gen_0003_AccelerometerZmfcc_000003	-49375	-25036	-57891	-37322	-34498	-65532	-50962	-36971	-5776	-32833	-36609	-50979	-39299	-33268	-8611	-14799
gen_0003_AccelerometerZmfcc_000004	-32922	-55792	-44857	-44718	-10511	-67790	-57501	-43704	-62746	-57251	-49158	-24871	-42690	-37216	-51971	-63142
gen_0003_AccelerometerZmfcc_000005	-46546	-19434	-43035	-51583	-24807	-53954	-95397	-53724	-84044	-86357	-52264	-14767	-82124	-54979	-60574	-53716
gen_0003_AccelerometerZmfcc_000006	-14753	20321	-22809	-46706	-10776	-1928	-82385	-15712	-51931	-24671	-11866	-1630	-36583	-18646	-34264	-1528
gen_0003_AccelerometerZmfcc_000007	12171	18815	7300	-31029	23112	-6983	1363	33694	-31870	-9055	8715	-34895	4029	-1815	-7086	-9988
gen_0003_AccelerometerZmfcc_000008	23376	7461	9982	-5195	-13064	-9554	25126	52707	20140	-13758	-5955	-2763	22925	-2312	1177	6724
gen_0003_AccelerometerZmfcc_000009	-11578	219	-24484	-15749	3189	-7626	-27049	35009	33634	-21318	-10769	18152	5372	-13600	-10746	-7985
gen_0004_GyroscopeXmfcc_000000	408617	411602	407686	400857	403183	404861	403496	397844	399902	401208	406038	396385	394367	401354	406669	397774
gen_0004_GyroscopeXmfcc_000001	-53967	-41599	-51958	-26909	-43613	-60173	-49811	-38841	-44236	-48649	-33941	-49885	-45668	-42453	-55542	-55909
gen_0004_GyroscopeXmfcc_000002	-30662	-41180	-17094	-13237	-38799	-50604	-19881	-28924	-33187	-7117	-43902	-24985	-31224	-22714	-10420	-5182
gen_0004_GyroscopeXmfcc_000003	-48879	-41889	-47893	-23849	-53491	-75396	-32800	-29698	-39305	-35473	-17951	-42452	-36214	-52132	-37077	-45749
gen_0004_GyroscopeXmfcc_000004	-64712	-56348	-58300	-43885	-64101	-88012	-48977	-60363	-78398	-51971	-60078	-44052	-76973	-50089	-27719	-44135
gen_0004_GyroscopeXmfcc_000005	-76234	-71181	-69491	-54110	-50377	-91862	-99253	-80681	-91197	-65373	-46596	-47227	-48811	-52871	-61788	-43290
gen_0004_GyroscopeXmfcc_000006	-30306	-27232	-25454	-43130	-52052	-45924	-49724	-52238	-55666	-17705	-35996	-9006	-65119	-45840	-27326	-32932
gen_0004_GyroscopeXmfcc_000007	9741	-8060	-257	-7722	-46266	-27081	-13084	-8665	-2154	48357	14427	33694	-90399	-11362	-7752	-16202
gen_0004_GyroscopeXmfcc_000008	-17566	4303	-19085	4787	17147	-12646	-17434	3995	2872	43539	34855	4215	-6659	9949	-9554	6207
gen_0004_GyroscopeXmfcc_000009	-24588	-31001	-53463	-34571	-752	-7904	-1664	-18834	-49465	-37691	-7222	-31579	-25825	-5535	1559	-20891
gen_0005_GyroscopeYmfcc_000000	356623	355832	359888	353534	360381	348314	347558	344254	353450	337316	358022	354611	357277	347027	361682	368757
gen_0005_GyroscopeYmfcc_000001	-69547	-64082	-83156	-57871	-55917	-95024	-67469	-40914	-84193	-47004	-55729	-67687	-66889	-64808	-60675	-74108

gen_0005_GyroscopeYmfcc_000002	-26096	-44201	-38102	-26333	-50616	-59266	-43447	-35851	-49731	-49071	-22205	-43607	-48608	-48128	-55773	-28752
gen_0005_GyroscopeYmfcc_000003	-38291	-17723	-92489	-23900	-44997	-50194	-42630	-37005	-28378	-30210	6338	-73753	-12387	-25153	-74728	-34794
gen_0005_GyroscopeYmfcc_000004	-12470	-13054	-62572	923	-16027	-4558	-33075	-53701	-54965	6141	-32193	-46629	-44850	-15214	-63434	-7948
gen_0005_GyroscopeYmfcc_000005	8227	-27285	-29967	19007	-6301	20910	-20648	-33511	-33314	-2699	-52289	-22683	-7810	-25636	-26227	-1764
gen_0005_GyroscopeYmfcc_000006	39134	35511	-22920	-27782	-10757	14901	-28872	-16708	-34879	14482	4852	-15237	29513	-29486	-382	2952
gen_0005_GyroscopeYmfcc_000007	3476	410	-22580	-31162	3137	2522	-42790	-55833	-23995	933	-29911	-26312	32607	-54613	-13987	-8070
gen_0005_GyroscopeYmfcc_000008	-56626	-19756	-8255	-32215	30552	8584	-2884	-8992	-52598	165	-21176	13911	-12789	-31191	-8376	-16487
gen_0005_GyroscopeYmfcc_000009	-40522	-27685	-24831	-13450	-41596	-21422	14084	-4772	-60384	-1133	-35496	-1399	-22913	-7280	3212	4263
gen_0006_GyroscopeZmfcc_000000	339095	344003	339778	333009	338488	345587	336952	337522	339745	340087	334674	336380	334793	332744	329191	356815
gen_0006_GyroscopeZmfcc_000001	-65024	-57661	-59572	-64744	-51707	-61117	-52966	-58559	-66171	-77161	-58246	-54285	-54857	-44177	-47977	-49770
gen_0006_GyroscopeZmfcc_000002	-58274	-54211	-24218	-57810	-44898	-37011	-36356	-33613	-45292	-21980	-56117	-10150	-57355	-14249	-44652	-11253
gen_0006_GyroscopeZmfcc_000003	-14821	-42079	-48072	-47554	-58776	-61767	-63934	-69542	-61060	-38408	-71163	-41873	-41973	-28467	-29235	-35133
gen_0006_GyroscopeZmfcc_000004	3390	-56320	-27024	-37362	-48380	-21522	-32749	-71631	-59043	-31526	-57327	-50248	-45538	-21515	-44684	-34916
gen_0006_GyroscopeZmfcc_000005	-16629	-67498	-53527	-39245	-33823	14347	-8368	-49114	-48638	-37441	-19451	-57285	-60213	-345	14954	-33889

```
fv.T.tail(100)
```

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
gen_0081_AccelerometerZZeroCrossings	53	57	46	36	46	52	52	41	47	58	54	58	40	51	45	50	52	52
gen_0082_GyroscopeXZeroCrossings	22	33	29	18	35	24	24	27	20	18	31	38	16	21	35	29	26	29
gen_0083_GyroscopeYZeroCrossings	67	75	70	60	57	73	80	59	84	58	60	71	75	56	50	57	68	47
gen_0084_GyroscopeZZeroCrossings	60	57	52	58	46	67	62	60	66	58	59	60	44	50	43	23	28	24
gen_0085_AccelerometerXPositiveZeroCrossings	36	34	39	38	40	36	37	39	39	34	36	36	36	41	36	36	34	34
gen_0086_AccelerometerYPositiveZeroCrossings	29	31	25	22	24	38	35	27	30	30	36	37	36	31	39	27	32	36
gen_0087_AccelerometerZPositiveZeroCrossings	27	28	23	18	23	26	26	20	24	29	26	29	20	26	22	26	26	26
gen_0088_GyroscopeXPositiveZeroCrossings	11	17	15	8	18	12	12	14	10	8	15	20	8	10	18	14	13	14
gen_0089_GyroscopeYPositiveZeroCrossings	33	38	35	29	29	36	40	30	42	28	30	34	37	28	26	29	33	24
gen_0090_GyroscopeZPositiveZeroCrossings	30	28	26	29	23	33	31	30	32	29	30	30	22	24	20	11	14	11
gen_0091_AccelerometerXNegativeZeroCrossings	35	33	40	38	41	38	36	36	39	32	36	36	36	40	37	37	34	33
gen_0092_AccelerometerYNegativeZeroCrossings	29	33	25	22	25	37	35	27	31	32	35	37	36	34	41	27	32	36
gen_0093_AccelerometerZNegativeZeroCrossings	26	29	23	18	23	26	26	21	23	29	28	29	20	25	23	24	26	26
gen_0094_GyroscopeXNegativeZeroCrossings	11	16	14	10	17	12	12	13	10	10	16	18	8	11	17	15	13	15
gen_0095_GyroscopeYNegativeZeroCrossings	34	37	35	31	28	37	40	29	42	30	30	37	38	28	24	28	35	23
gen_0096_GyroscopeZNegativeZeroCrossings	30	29	26	29	23	34	31	30	34	29	29	30	22	26	23	12	14	13
gen_0097_AccelerometerXMedian	67	61	68	68.5	41.5	208	186	162.5	171.5	225	21	16.5	50	-17	-6	59.5	82	69.5
gen_0098_AccelerometerYMedian	-1065.5	-1041.5	-1050	-1009	-1032	-988	-1003.5	-1018.5	-1001.5	-991	-997	-1018.5	-1002.5	-1038	-1007	-993.5	-1008	-985
gen_0099_AccelerometerZMedian	251.5	247.5	229.5	245.5	256.5	118.5	203	175.5	183	133	244	188	223.5	230	201	219	232	236
gen_0100_GyroscopeXMedian	420.5	179.5	198.5	433	-54	228.5	437	137	323	288	37	-23	386.5	276	178.5	169	235	62
gen_0101_GyroscopeYMedian	23	35.5	-84	72.5	-46.5	-35	39	-13	8.5	-14.5	48	-44	65	38	-23.5	-30.5	-64	36.5
gen_0102_GyroscopeZMedian	46.5	93	81	1	106.5	25.5	-8	14	-1.5	28.5	26	-1	-12	-2	-26	234.5	243.5	171.5
gen_0103_AccelerometerXLinearRegressionSlope_0000	0.409442	0.34456	0.157505	-0.406847	0.123613	-0.0698479	-0.311631	0.400351	0.0143695	-0.158726	-0.0194058	-0.153205	0.0319789	0.582936	0.325769	-0.103222	-0.967542	0.509599
gen_0103_AccelerometerXLinearRegressionIntercept_0001	20.6204	36.0702	66.8306	137.028	35.2062	197.86	216.594	95.8163	176.475	223.465	4.52402	9.09807	9.94263	-135.372	-90.9422	97.6671	135.359	-36.657
gen_0103_AccelerometerXLinearRegressionR_0002	0.118953	0.0922733	0.0543575	-0.124587	0.0378737	-0.0298264	-0.106523	0.171754	0.00497532	-0.0722154	-0.00664734	-0.0409584	0.00918335	0.187654	0.0884594	-0.0238045	-0.137194	0.114235
gen_0103_AccelerometerXLinearRegressionStdErr_0003	0.217018	0.236106	0.183725	0.205748	0.207104	0.148639	0.18471	0.145816	0.183396	0.139206	0.185374	0.237324	0.221115	0.193755	0.232934	0.275273	0.443591	0.281417
gen_0104_AccelerometerYLinearRegressionSlope_0000	-0.652842	-0.711249	-1.3895	0.552391	-0.345383	-0.8354	1.04626	-1.08548	0.080919	-0.184068	-0.189959	-0.260136	1.07957	-0.171028	-0.79286	-0.575826	0.551134	0.07877
gen_0104_AccelerometerYLinearRegressionIntercept_0001	-1051.05	-1069.69	-966.679	-1094.38	-1090.68	-969.709	-1197.69	-966.954	-1089.14	-1029.6	-1045.65	-1082.16	-1202.45	-1045.42	-985.653	-1035.03	-1114.93	-1097.14
gen_0104_AccelerometerYLinearRegressionR_0002	-0.0996941	-0.106102	-0.212366	0.0729511	-0.0537304	-0.138824	0.165904	-0.178673	0.0139885	-0.0434758	-0.0280155	-0.0372219	0.17466	-0.0286943	-0.13622	-0.106648	0.0803575	0.014436
gen_0104_AccelerometerYLinearRegressionStdErr_0003	0.413755	0.423267	0.406001	0.479545	0.407593	0.378423	0.394906	0.37957	0.367291	0.268592	0.430393	0.44348	0.386458	0.378325	0.366152	0.340901	0.434108	0.346452
gen_0105_AccelerometerZLinearRegressionSlope_0000	-0.262553	0.118281	0.387147	-0.244663	0.377588	0.0940173	0.179082	0.239034	0.175446	0.114408	-0.666893	1.19532	-0.0136233	-0.224167	0.424276	0.642417	1.19601	-0.607243
gen_0105_AccelerometerZLinearRegressionIntercept_0001	330.512	213.018	231.024	266.809	290.506	68.0028	180.784	127.832	117.601	152.384	347.532	33.0432	222.924	232.797	115.35	139.619	103.789	339.186
gen_0105_AccelerometerZLinearRegressionR_0002	-0.0346871	0.017639	0.0588776	-0.0442424	0.058246	0.0148189	0.0307902	0.04468	0.0327971	0.0268063	-0.106147	0.182497	-0.00212013	-0.0396612	0.0626298	0.145492	0.180625	-0.151181
gen_0105_AccelerometerZLinearRegressionStdErr_0003	0.480354	0.425744	0.416817	0.350815	0.410948	0.402827	0.369154	0.33938	0.339506	0.270918	0.3967	0.408927	0.408032	0.358624	0.429327	0.277401	0.413551	0.252126
gen_0106_GyroscopeXLinearRegressionSlope_0000	1.39734	-0.806297	-0.868409	-0.430535	1.16046	2.36654	-0.768193	2.49536	2.17563	0.391936	3.37045	0.0114501	2.26305	-3.16917	4.27359	2.74991	-0.878042	-0.0187716
gen_0106_GyroscopeXLinearRegressionIntercept_0001	-174.789	100.892	108.149	53.5056	-143.55	-295.038	94.944	-310.568	-271.166	-49.364	-419.021	-1.16954	-281.846	394.358	-531.753	-341.756	108.456	2.40506
gen_0106_GyroscopeXLinearRegressionR_0002	0.0459089	-0.0245146	-0.0292402	-0.0146371	0.0450248	0.083021	-0.0271009	0.100025	0.0796216	0.0156881	0.128775	0.000453126	0.0951565	-0.125771	0.158365	0.123249	-0.0371633	-0.000916241
gen_0106_GyroscopeXLinearRegressionStdErr_0003	1.93073	2.08792	1.88509	1.86758	1.63498	1.80384	1.79929	1.57621	1.72961	1.58623	1.64815	1.60459	1.50333	1.58736	1.69197	1.406	1.49925	1.30096
gen_0107_GyroscopeYLinearRegressionSlope_0000	0.519364	-0.00783789	0.89864	0.932667	0.914738	0.224034	-0.0610778	0.130674	0.39484	0.559174	0.383692	1.10564	1.32664	-0.219873	0.203717	0.251733	-0.549904	-0.205141
gen_0107_GyroscopeYLinearRegressionIntercept_0001	-63.9128	1.29982	-111.153	-116.093	-113.577	-27.3562	8.03618	-16.1409	-48.4056	-68.6772	-47.4497	-136.749	-164.747	28.1422	-25.2987	-30.9728	68.991	25.7481
gen_0107_GyroscopeYLinearRegressionR_0002	0.0871932	-0.0010145	0.115603	0.134165	0.128201	0.0426573	-0.011359	0.0246412	0.0726293	0.1412	0.0602551	0.164695	0.198251	-0.0384034	0.0245363	0.0282162	-0.0524271	-0.0250526
gen_0107_GyroscopeYLinearRegressionStdErr_0003	0.376796	0.490591	0.490307	0.437438	0.449346	0.333195	0.341421	0.336644	0.344299	0.248951	0.40362	0.420473	0.416492	0.363292	0.527061	0.566296	0.665131	0.519802
gen_0108_GyroscopeZLinearRegressionSlope_0000	-0.913795	-0.59439	-0.121848	-0.443276	-1.00758	-0.149276	0.661859	0.0396686	-0.658028	0.101876	-0.361381	-0.506975	-0.522693	-0.356327	-1.27182	1.05817	0.856659	0.737072
gen_0108_GyroscopeZLinearRegressionIntercept_0001	113.38	73.7575	14.666	55.7839	125.296	19.4728	-83.0374	-5.31474	81.4925	-12.9716	44.952	62.8544	64.6153	43.5187	157.374	-131.974	-107.246	-92.6454
gen_0108_GyroscopeZLinearRegressionR_0002	-0.203484	-0.102509	-0.0281039	-0.110648	-0.225549	-0.0280893	0.154643	0.00917086	-0.135098	0.0238749	-0.0813912	-0.124084	-0.128876	-0.0841263	-0.296759	0.125367	0.0788468	0.084141
gen_0108_GyroscopeZLinearRegressionStdErr_0003	0.279197	0.36626	0.275202	0.252831	0.276359	0.337326	0.268505	0.274658	0.306457	0.270883	0.281008	0.257439	0.255395	0.268008	0.259884	0.531748	0.687771	0.554285
gen_0109_AccelerometerXStd	248.406	269.485	209.113	235.67	235.544	169.005	211.126	168.221	208.433	158.622	210.683	269.946	251.309	224.186	265.773	312.938	508.956	321.94
gen_0110_AccelerometerYStd	472.59	483.776	472.193	546.462	463.902	434.285	455.12	438.439	417.47	305.546	489.337	504.367	446.069	430.146	420.049	389.659	494.967	393.786
gen_0111_AccelerometerZStd	546.254	483.936	474.538	399.094	467.84	457.865	419.745	386.093	386.059	308.01	453.414	472.686	463.731	407.899	488.893	318.658	477.863	289.875
gen_0112_GyroscopeXStd	2196.6	2373.65	2143.33	2122.75	1860.06	2057.18	2045.66	1800.41	1971.97	1802.98	1888.86	1823.63	1716.33	1818.49	1947.51	1610.2	1705.09	1478.55
gen_0113_GyroscopeYStd	429.868	557.56	560.998	501.686	514.933	379.023	388.052	382.714	392.334	285.798	459.552	484.486	482.931	413.188	599.188	643.855	756.967	590.943

gen_0114_GyroscopeZStd	324.089	418.461	312.893	289.119	322.392	383.525	308.874	312.164	351.512	307.948	320.431	294.86	292.699	305.677	309.292	609.14	784.097	632.191	78
gen_0115_AccelerometerXSkew	-0.625668	0.948534	0.173924	-0.0719813	0.261581	-0.630694	0.854035	0.411024	0.481925	-0.765358	-0.172651	-0.725966	-0.302312	-1.0083	-0.922119	-0.00976726	-1.02285	-1.03642	1.5
gen_0116_AccelerometerYSkew	0.221493	0.0539103	1.01509	0.805895	0.6484	-0.029751	0.508465	0.418117	0.185758	0.434383	0.901546	0.550052	1.26378	0.930171	1.08906	-0.284227	0.726283	0.487601	0.6
gen_0117_AccelerometerZSkew	0.043257	-0.1054	0.662632	-0.329531	0.95102	-0.858709	-0.0381277	-0.832546	-1.5526	-0.345356	0.360151	-0.427451	-0.371715	-0.123362	-0.575168	-0.614225	0.0554966	-0.831462	-0.0
gen_0118_GyroscopeXSkew	-0.402658	-0.343616	-0.0418966	-0.104486	-0.074723	-0.0948365	-0.457498	-0.355346	-0.280805	-0.418484	-0.236078	-0.528644	-0.428751	-0.470215	-0.326433	-0.166008	-0.0593829	-0.373852	-0.5
gen_0119_GyroscopeYSkew	0.0786959	-0.619565	0.726375	0.0493481	0.495227	0.160913	-0.61991	0.529404	0.691891	-0.279939	-0.557152	0.658237	0.822233	0.144418	0.671503	0.669738	0.108006	0.198271	0.2
gen_0120_GyroscopeZSkew	-0.670558	-0.761377	-0.416821	0.0138191	-0.962182	0.126925	0.276342	0.226512	0.722952	0.332561	0.543434	-0.621436	0.2808	0.040865	0.0231178	-0.788613	-1.10066	-1.16319	-0.7
gen_0121_AccelerometerXIQR	178.25	141	177	153.25	168.75	164.75	173.75	167.75	161.5	147.75	162	188.75	179.75	179.75	150.25	229.25	285.5	167.75	
gen_0122_AccelerometerYIQR	389.75	448	482.5	440.75	426.25	403.5	327.5	426.75	422.5	277.25	422.25	438.5	411.25	341.5	318.75	366	312	406	
gen_0123_AccelerometerZIQR	210.75	243	235.5	222.5	195	257.5	234.75	189.5	231.5	195.75	221.5	257.5	206.25	284	245.75	183.25	211.25	152.75	1
gen_0124_GyroscopeXIQR	3111.5	2036.25	2629.5	3118.25	1615.5	2666.5	1965.5	1603.5	2558.75	1665.5	1400.75	1650	2041	2531	1686.75	1576.25	1921	741.75	11

Feature Selection (using Variance Threshol, Correlation Threshold & t-Test Feature Selector) and Scaling the output data before training the model.

gen_0128_AccelerometerY25Percentile	-1352.25	-1402.5	-1446.75	-1350	-1383.5	-1342.75	-1269.5	-1375	-1364.75	-1217.5	-1368.5	-1392.25	-1375.25	-1303.75	-1284.75	-1323	-1264.25	-1361.25	

```
dsk.pipeline.add_feature_selector([{'name':'Variance Threshold','params':{"threshold":0.05}},
                                   {'name':'Correlation Threshold','params':{"threshold":0.95}},
                                   {'name':'t-Test Feature Selector','params':{"Feature_number":2}},
                                   ])
dsk.pipeline.add_transform(
    "Min Max Scale",)
dsk.pipeline.describe()
```

```
--------------------------------------------------------------------------
 0.     Name: Continuous Final                          Type: query
--------------------------------------------------------------------------
--------------------------------------------------------------------------
 1.     Name: Windowing                                 Type: segmenter
--------------------------------------------------------------------------
        group_columns: ['Cont or Event', 'Side', 'Stride', 'Subject', 'Type', 'segment_uuid']
        window_size: 250
        delta: 100
        train_delta: 50
        return_segment_index: False
--------------------------------------------------------------------------
 2.     Name: Strip                                     Type: transform
--------------------------------------------------------------------------
        group_columns: ['Cont or Event', 'SegmentID', 'Side', 'Stride', 'Subject', 'Type', 'segment_uuid']
        input_columns: ['GyroscopeX', 'GyroscopeY', 'GyroscopeZ']
        type: mean
--------------------------------------------------------------------------
 3.     Name: generator_set                             Type: generatorset
--------------------------------------------------------------------------
         0. Name: MFCC
         1. Name: MFCC
         2. Name: MFCC
         3. Name: MFCC
         4. Name: MFCC
         5. Name: MFCC
         6. Name: Mean Difference
         7. Name: Threshold Crossing Rate
         8. Name: Mean Crossing Rate
         9. Name: Zero Crossing Rate
        10. Name: Sigma Crossing Rate
        11. Name: Second Sigma Crossing Rate
        12. Name: Threshold With Offset Crossing Rate
        13. Name: Kurtosis
        14. Name: Maximum
        15. Name: Absolute Mean
        16. Name: Mean
        17. Name: Variance
        18. Name: Zero Crossings
        19. Name: Positive Zero Crossings
        20. Name: Negative Zero Crossings
        21. Name: Median
        22. Name: Linear Regression Stats
        23. Name: Linear Regression Stats
        24. Name: Linear Regression Stats
        25. Name: Linear Regression Stats
        26. Name: Linear Regression Stats
        27. Name: Linear Regression Stats
        28. Name: Standard Deviation
        29. Name: Skewness
        30. Name: Interquartile Range
        31. Name: 25th Percentile
        32. Name: 75th Percentile
        33. Name: 100th Percentile
        34. Name: Minimum
        35. Name: Sum
        36. Name: Absolute Sum
        group_columns: ['Cont or Event', 'SegmentID', 'Side', 'Stride', 'Subject', 'Type', 'segment_uuid']
--------------------------------------------------------------------------
```

Executing the Pipeline

```
fv_t, s_t = dsk.pipeline.execute()
```

```
    Executing Pipeline with Steps:

    ------------------------------------------------------------------------
     0.     Name: Continuous Final                          Type: query
    ------------------------------------------------------------------------
    ------------------------------------------------------------------------
     1.     Name: Windowing                                 Type: segmenter
    ------------------------------------------------------------------------
    ------------------------------------------------------------------------
     2.     Name: Strip                                     Type: transform
    ------------------------------------------------------------------------
    ------------------------------------------------------------------------
     3.     Name: generator_set                             Type: generatorset
    ------------------------------------------------------------------------
    ------------------------------------------------------------------------
     4.     Name: selector_set                              Type: selectorset
    ------------------------------------------------------------------------
    ------------------------------------------------------------------------
     5.     Name: Min Max Scale                             Type: transform
    ------------------------------------------------------------------------
    ------------------------------------------------------------------------


    Results Retrieved... Execution Time: 0 min. 0 sec.
```

Significant Features Selected (reduced to a few)

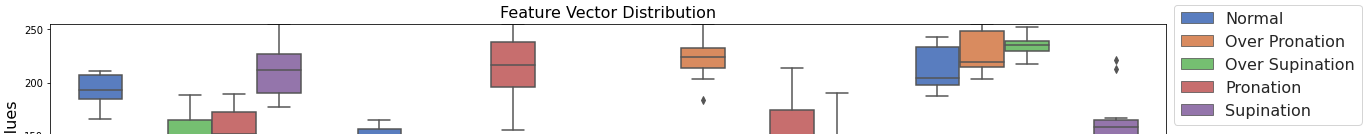
```
fv_t.T
```

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
gen_0099_AccelerometerZMedian	199	193	166	190	207	0	127	85	97	22	188	104	157	167	124	151	170
gen_0102_GyroscopeZMedian	125	156	148	96	165	112	90	104	94	114	112	94	87	94	78	249	255
gen_0133_AccelerometerX75Percentile	133	104	135	122	87	232	225	184	222	255	49	65	79	0	16	175	214
gen_0150_GyroscopeZminimum	187	198	243	233	199	217	206	251	216	249	235	229	248	238	219	28	28
Cont or Event	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
SegmentID	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Side	Right	Right	Right	Right	Right	Right	Right	Right	Right	Right	Right	Right	Right	Right	Right	Right	Right
Stride	Normal	Normal	Normal	Normal	Normal	Over Pronation	Over Pronation	Over Pronation	Over Pronation	Over Pronation	Over Supination	Over Supination	Over Supination	Over Supination	Over Supination	Pronation	Pronation
Subject	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael	Rafael
Type	Train	Train	Train	Train	Train	Train	Train	Train	Train	Train	Train	Train	Train	Train	Train	Train	Train
segment_uuid	0dbde19a-d028-47ae-9642-ef056e4dcdf0	2a28cd32-0193-4b52-a0ed-5e25da32832c	2d4326a4-61cd-415c-9af5-dc27933bbb0a	bed1d3fa-096a-4bb2-859f-f45c391b3117	cd3188d4-7ea5-4b02-86b8-d04647388e01	1ecfeac3-276e-412c-b229-fc23dc180294	7933ef33-774b-44b9-9b07-51e21486dc38	9b7fc31a-39d9-4792-b228-cacac7e4c468	ca1aeefe-b19f-4263-a0dd-f1f5a527c85b	d6c57bff-5706-4488-952a-dc3e545ca8c3	4b0fd010-84b5-442c-94ef-297c963488d1	6e43fb28-9173-4567-922d-415e1b4d8149	7076c4db-b5ce-431a-8088-400f01f5ba53	70982ffb-6bb7-4e86-9396-7709890b3a7e	7c2156e9-3cc6-4e3d-bffa-b0f03da46a7e	3b475970-361c-4abc-a98f-c5f4d1b7214a	c8b6cfe0-290f-4b12-a0db-63f764eb8c71

```
fv_t.T.shape
```

```
    (11, 67)
```

```
dsk.pipeline.visualize_features(fv_t)
```



Creating Train and Test Datasets

```
x_train, x_test, x_validate, y_train, y_test, y_validate, class_map = dsk.pipeline.features_to_tensor(fv_t,test=0.0, validate=.2)
```

```
    -----  Summary  -----
    Class Map: {'Normal': 0, 'Over Pronation': 1, 'Over Supination': 2, 'Pronation': 3, 'Supination': 4}
    Train:
     total:  53
     by class: [ 6. 15. 12. 11.  9.]
    Validate:
     total:  14
     by class: [3. 1. 4. 4. 2.]
    Train:
     total:  0
     by class: [0. 0. 0. 0. 0.]
```

```
x_train.shape
```

```
    (53, 4)
```

Creating the NN Aerchitecture Model in Tensorflow

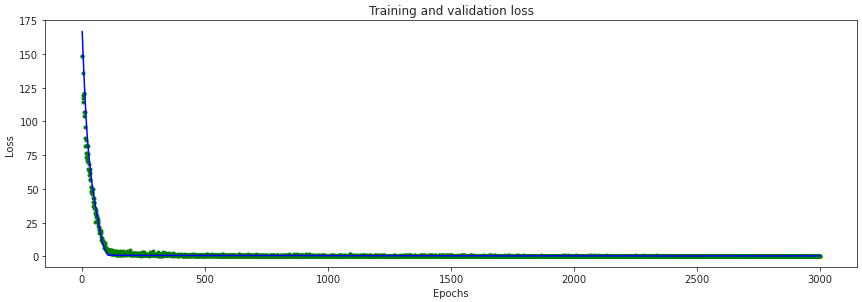
```
from tensorflow.keras import layers
import tensorflow as tf

tf_model = tf.keras.Sequential()

tf_model.add(layers.Dense(11, activation='relu',kernel_regularizer='l1',input_shape=(x_train.shape[1],)))
tf_model.add(layers.Dropout(0.1))
tf_model.add(layers.Dense(8, activation='relu',input_shape=(x_train.shape[1],)))
tf_model.add(layers.Dropout(0.1))
tf_model.add(layers.Dense(y_train.shape[1], activation='softmax'))

# Fitting the Model
tf_model.compile(optimizer='adam', loss='categorical_crossentropy', metrics=['accuracy'])

tf_model.summary()
train_history = {'loss':[],'val_loss':[],'accuracy':[],'val_accuracy':[]}
```

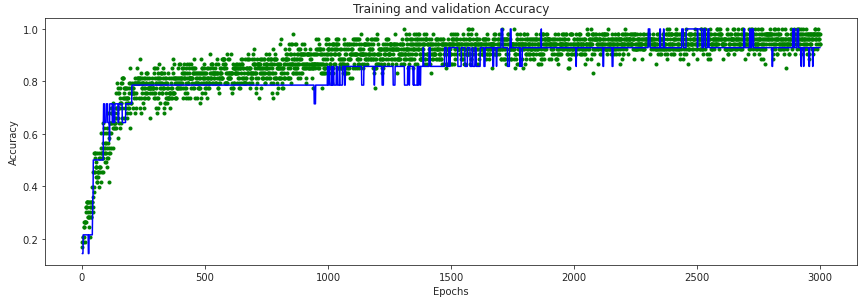
```
    Model: "sequential_1"
    _________________________________________________________________
    Layer (type)                 Output Shape              Param #
    =================================================================
    dense_3 (Dense)              (None, 11)                55
    _________________________________________________________________
    dropout_2 (Dropout)          (None, 11)                0
    _________________________________________________________________
    dense_4 (Dense)              (None, 8)                 96
    _________________________________________________________________
    dropout_3 (Dropout)          (None, 8)                 0
    _________________________________________________________________
    dense_5 (Dense)              (None, 5)                 45
    =================================================================
    Total params: 196
    Trainable params: 196
    Non-trainable params: 0
    _________________________________________________________________
```

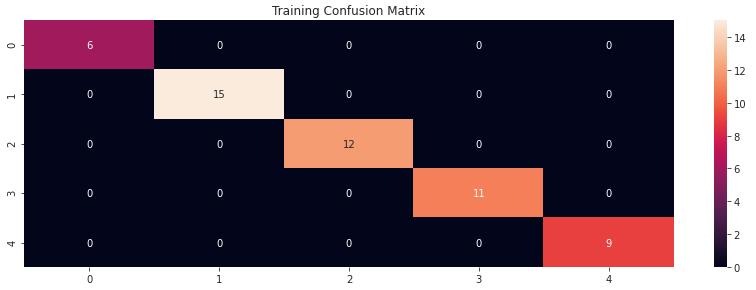
Trainning the Model

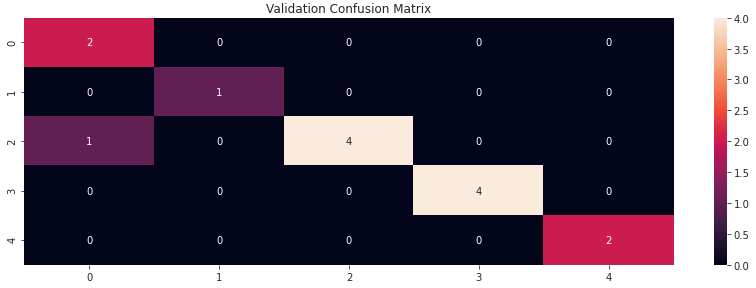
```
from IPython.display import clear_output
import sensiml.tensorflow.utils as sml_tf

num_iterations=30
epochs=100
batch_size=32

data = tf.data.Dataset.from_tensor_slices((x_train, y_train))
shuffle_ds = data.shuffle(buffer_size=x_train.shape[0], reshuffle_each_iteration=True).batch(batch_size)

for i in range(num_iterations):
  history = tf_model.fit( shuffle_ds, epochs=epochs, batch_size=batch_size, validation_data=(x_validate, y_validate), verbose=0)

  for key in train_history:
```

```
    train_history[key].extend(history.history[key])

clear_output()
sml_tf.plot_training_results(tf_model, train_history, x_train, y_train, x_validate, y_validate)
```









Qualtizing the Model for TFLite

```
import numpy as np
def representative_dataset_generator():
  for value in x_validate:
    yield[np.array(value, dtype=np.float32, ndmin=2)]


# Unquantized Model
converter = tf.lite.TFLiteConverter.from_keras_model(tf_model)
tflite_model_full = converter.convert()
print("Full Model Size", len(tflite_model_full))

# Quantized Model
converter = tf.lite.TFLiteConverter.from_keras_model(tf_model)
converter.optimizations = [tf.lite.Optimize.OPTIMIZE_FOR_SIZE]
converter.representative_dataset = representative_dataset_generator
tflite_model_quant = converter.convert()

print("Quantized Model Size", len(tflite_model_quant))
```

```
     INFO:tensorflow:Assets written to: /tmp/tmpbc2sh7ft/assets
     INFO:tensorflow:Assets written to: /tmp/tmpbc2sh7ft/assets
     Full Model Size 2600
     INFO:tensorflow:Assets written to: /tmp/tmpoyxd2z1b/assets
     INFO:tensorflow:Assets written to: /tmp/tmpoyxd2z1b/assets
     Quantized Model Size 2768
```

Uploading the Model Back to SensiML Project

```
class_map_tmp = {k:v+1 for k,v in class_map.items()} #+1 because 0 is unknown

dsk.pipeline.set_training_algorithm("Load Model TF Micro",
                                    params={"model_parameters":{
                                            "tflite":sml_tf.convert_tf_lite(tflite_model_full)},
                                    "class_map":class_map_tmp,
                                    "estimator_type":"classification",
                                    "threshold":0.0,
                                    "train_history":train_history,
                                    "model_json":tf_model.to_json()})

dsk.pipeline.set_validation_method("Recall",params={})
dsk.pipeline.set_classifier("TF Micro", params={})
dsk.pipeline.set_tvo()
results, stats = dsk.pipeline.execute()
```

```
    Executing Pipeline with Steps:

    ------------------------------------------------------------------------
     0.     Name: Continuous Final                          Type: query
    ------------------------------------------------------------------------
    ------------------------------------------------------------------------
     1.     Name: Windowing                                 Type: segmenter
    ------------------------------------------------------------------------
    ------------------------------------------------------------------------
     2.     Name: Strip                                     Type: transform
    ------------------------------------------------------------------------
    ------------------------------------------------------------------------
     3.     Name: generator_set                             Type: generatorset
    ------------------------------------------------------------------------
    ------------------------------------------------------------------------
     4.     Name: selector_set                              Type: selectorset
    ------------------------------------------------------------------------
    ------------------------------------------------------------------------
     5.     Name: Min Max Scale                             Type: transform
    ------------------------------------------------------------------------
    ------------------------------------------------------------------------
     6.     Name: tvo                                       Type: tvo
    ------------------------------------------------------------------------
            Classifier: TF Micro


            Training Algo: Load Model TF Micro
                    class_map: {'Normal': 1, 'Over Pronation': 2, 'Over Supination': 3, 'Pronation': 4, 'Supination': 5}
                    estimator_type: classification
                    model_json: {"class_name": "Sequential", "config": {"name": "sequential_1", "layers": [{"class_name": "InputLayer", "config": {"batch_input_shape": [null, 4], "dtype": "float32", "sparse": false, "ragged": false, "name": "dense_
                    model_parameters: {'tflite': '1c00000054464c3314002000040008000c0010001400000018001c0014000000030000001800000020000000b0000000200000005800000050000000020000009403000070010000010000000b40000000d000000d0090000cc090000c40800002c080
                    threshold: 0.0
                    train_history: {'loss': [148.83010864257812, 148.53164672851562, 136.0172576904297, 117.43523406982422, 114.4007797241211, 119.56187438964844, 121.40296173095703, 120.16360473632812, 107.19879150390625, 104.32524871826172, 107.1

            Validation Method: Recall


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



    Results Retrieved... Execution Time: 0 min. 0 sec.
```

```
results.summarize()
```

```
    TRAINING ALGORITHM: Load Model TF Micro
    VALIDATION METHOD:  Recall
    CLASSIFIER:         TF Micro

    AVERAGE METRICS:
                    F1_SCORE:  98.2  std: 0.00
                   PRECISION:  98.8  std: 0.00
                 SENSITIVITY:  97.8  std: 0.00

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

    RECALL MODEL RESULTS : SET VALIDATION

    MODEL INDEX: Fold 0
                    F1_SCORE:    train: 98.22  validation: 98.22
                 SENSITIVITY:    train: 97.78  validation: 97.78
```

Confusion Matrix

```
model = results.configurations[0].models[0]
model.confusion_matrix_stats['validation']
```

```
    CONFUSION MATRIX:
                 NormalOver PronationOver Supination PronationSupination       UNK       UNC   Support   Sens(%)
        Normal       8.0       0.0       1.0       0.0       0.0       0.0       0.0       9.0      88.9
    Over Pronation       0.0      16.0       0.0       0.0       0.0       0.0       0.0      16.0     100.0
    Over Supination       0.0       0.0      16.0       0.0       0.0       0.0       0.0      16.0     100.0
     Pronation       0.0       0.0       0.0      15.0       0.0       0.0       0.0      15.0     100.0
    Supination       0.0       0.0       0.0       0.0      11.0       0.0       0.0      11.0     100.0

         Total         8        16        17        15        11         0         0        67

    PosPred(%)     100.0     100.0      94.1     100.0     100.0                       Acc(%)      98.5
```

```
model.knowledgepack.save("TFu_With_SensiML_Features")
```

```
            0.8301886916160583,
            0.8679245114326477,
            0.9433962106704712,
            0.8301886916160583,
            0.849056601524353,
            0.8867924809455872,
            0.849056601524353,
```

```
0.9056603908538818,
0.8301886916160583,
0.8679245114326477,
0.8867924809455872,
0.8679245114326477,
0.9245283007621765,
0.9056603908538818,
0.8113207817077637,
0.8679245114326477,
0.9245283007621765,
0.8867924809455872,
0.8301886916160583,
0.9245283007621765,
0.9056603908538818,
0.8113207817077637,
0.8867924809455872,
0.9056603908538818,
0.8867924809455872,
0.8301886916160583,
0.9056603908538818,
0.9433962106704712,
0.9056603908538818,
0.8301886916160583,
0.8679245114326477,
0.9056603908538818,
0.9056603908538818,
0.8679245114326477,
0.849056601524353,
0.8679245114326477,
0.9056603908538818,
0.849056601524353,
0.9433962106704712,
0.8679245114326477,
0.9245283007621765,
0.9056603908538818,
0.849056601524353,
0.7924528121948242,
0.849056601524353,
0.8113207817077637,
0.8679245114326477,
0.8679245114326477,
0.9056603908538818,
0.8679245114326477,
0.9056603908538818,
0.9056603908538818,
0.9056603908538818,
0.849056601524353,
0.9056603908538818,
0.8679245114326477,
0.849056601524353,
0.849056601524353,
0.9056603908538818,
```

Flashing

```
!pip install qgrid
```

```
!pip install bqplot
```

```
from sensiml import SensiML
from sensiml.widgets import *

dsk = SensiML()
FlashWidget(dsk, folder='pack').create_widget()

# Replace <Your Folder> with the directory folder path of your Knowledge Pack
# Note that the folder path needs double backslashes. See example:
# C:\\Users\\YourName\\Documents\\notebooks\\knowledgepacks
```

```
/usr/local/lib/python3.7/dist-packages/sensiml/client.py:112: UserWarning: Config option `use_jedi` not recognized by `IPCompleter`.
  mgc("%config Completer.use_jedi = False")
```

Platform: Nordic Thingy

Binary:

Flash Method: J-Link

Flash

✓ 3s completed at 7:53 PM