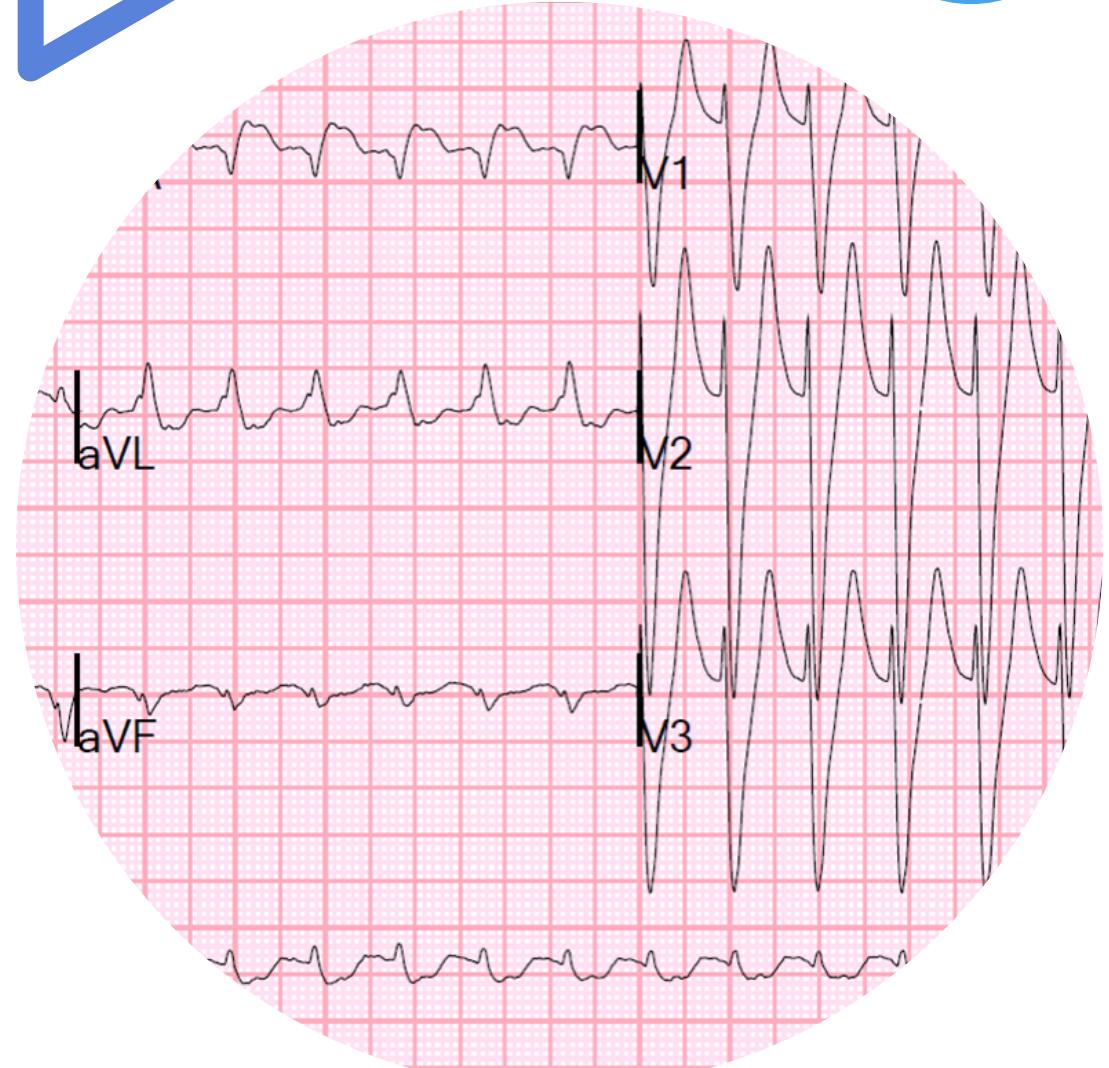


Epileptic seizure detection using RSFS

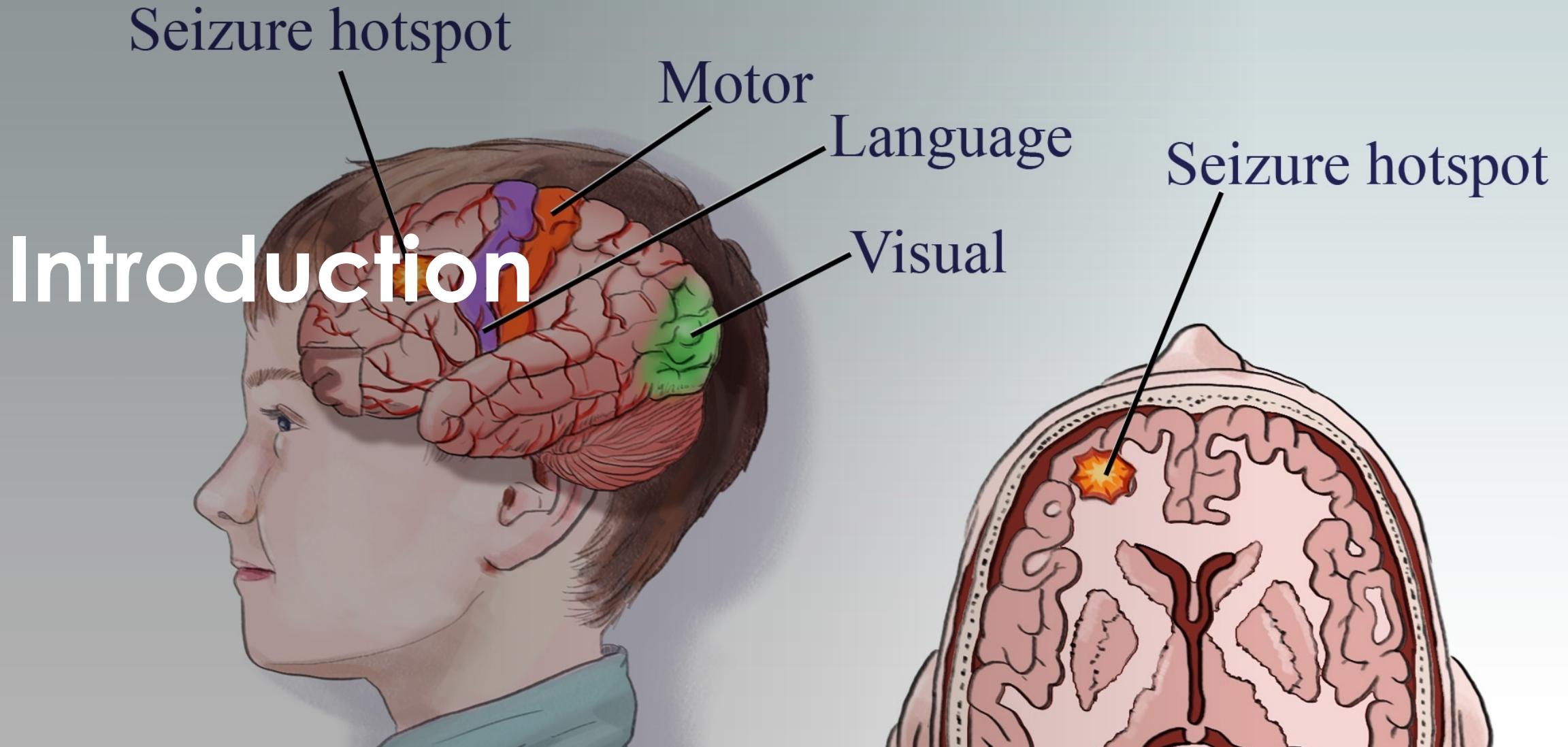
GROUP-3

Harshita Rathee, Shrey Agarwal,
Abhiram M V, Ranak Thakur,
Surya Deepak



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Epilepsy





Over
50 000 000
PEOPLE
around the world suffer from
Epilepsy

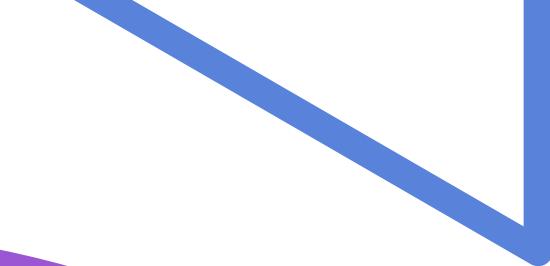
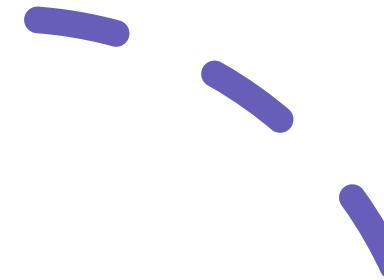
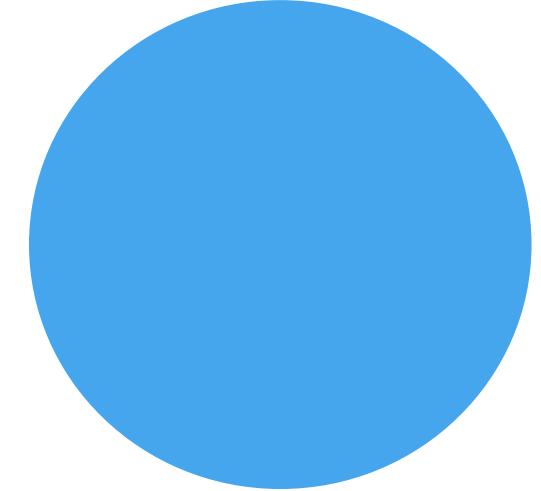
What is EEG?

Electroencephalography (EEG) is an electrophysiological monitoring method to record electrical activity of the brain.

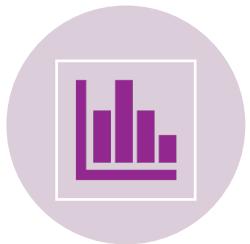
Our objectives

- Reducing the time taken for diagnosing
- Used RSFS technique which hasn't been used till date for feature extraction in EEG signals
- Improving the accuracy of diagnosis.

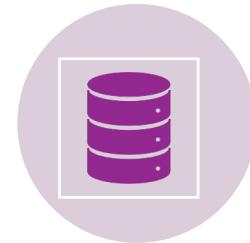
Data Understanding



About the dataset



Bonn university Dataset



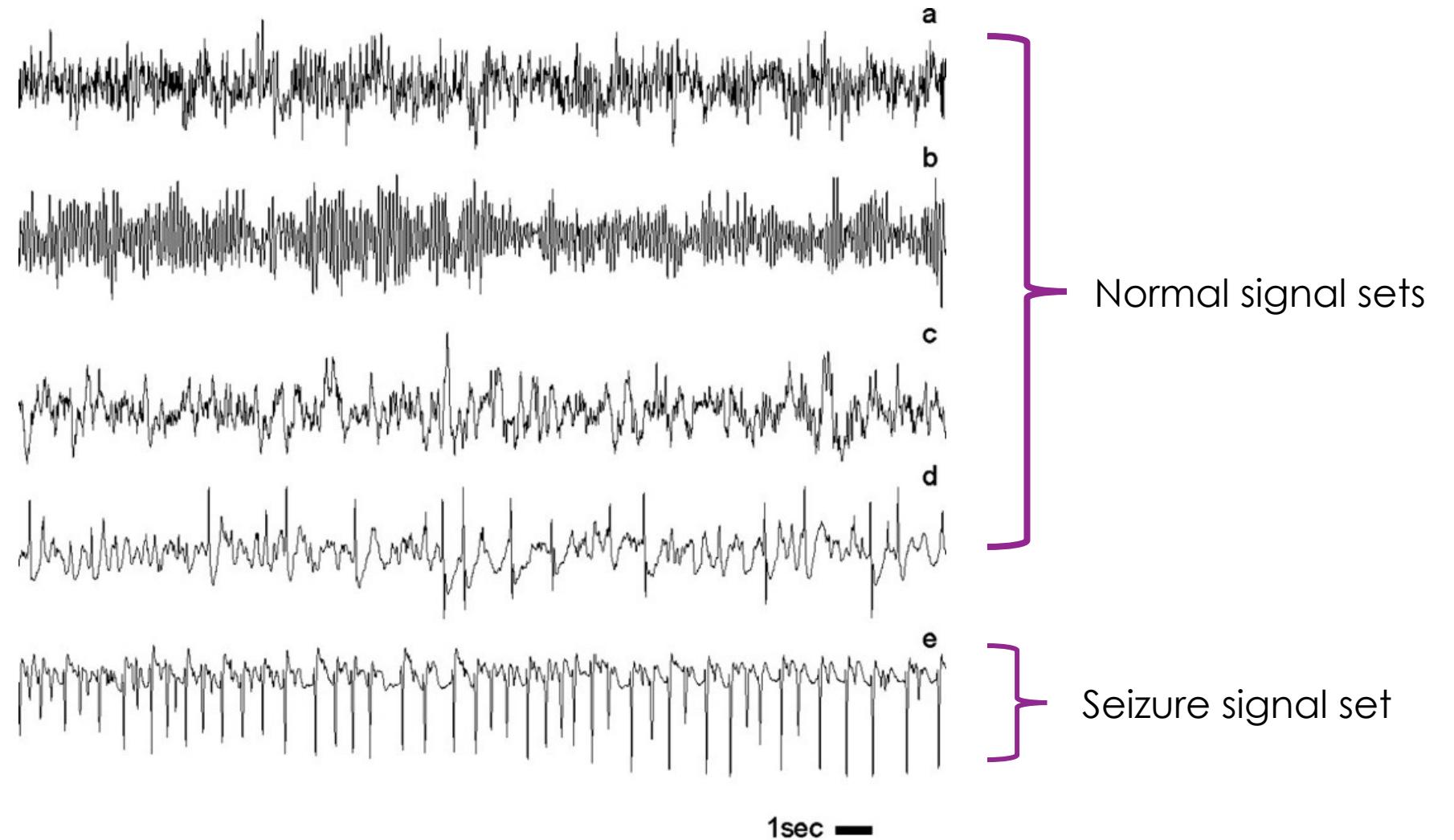
Consisted of 5 datasets : a, b, c, d, e → Seizure signals

Normal
signals

Dataset link: <https://www.ukbonn.org/epileptologie/ag-lehnertz-downloads/>



Graph of the signals in the 5 datasets



	A	B	C	D	E	F	G	H
1	S. No.	0	1	2	3	4	5	6
2	1	-2	-8	-27	-43	-39	-30	-30
3	2	31	25	17	7	4	4	4
4	3	-56	-50	-64	-91	-135	-140	-134
5	4	-45	-62	-76	-98	-108	-106	-83
6	5	37	50	58	58	58	45	29
7	6	-40	-13	43	69	55	12	,
8	7	69	69	65	59	43	23	11
9	8	-48	-52	-63	-55	-41	-31	-20
10	9	113	129	108	60	3	-21	-29
11	10	10	-6	-14	-14	-9	-7	1

4097 → features

Label:
0→Normal Signal
1→ Seizure Signal

	FAM	FAN	FAO	FAE	FAQ	FAR	FAS	FAT
1	4093	4094	4095	4096	Label			
2	43	21	17	-16	0			
3	18	23	28	65	0			
4	-180	-173	-162	-82	0			
5	9	-24	-56	49	0			
6	-55	-54	-56	-41	0			
7	-10	-21	-26	28	0			
8	-29	-17	-1	-3	0			
9	1	-5	-9	0	0			
10	-45	-41	-22	-5	0			
11	22	15	6	-46	0			

Total Number of observations:
 $100 \times 5 = 500$

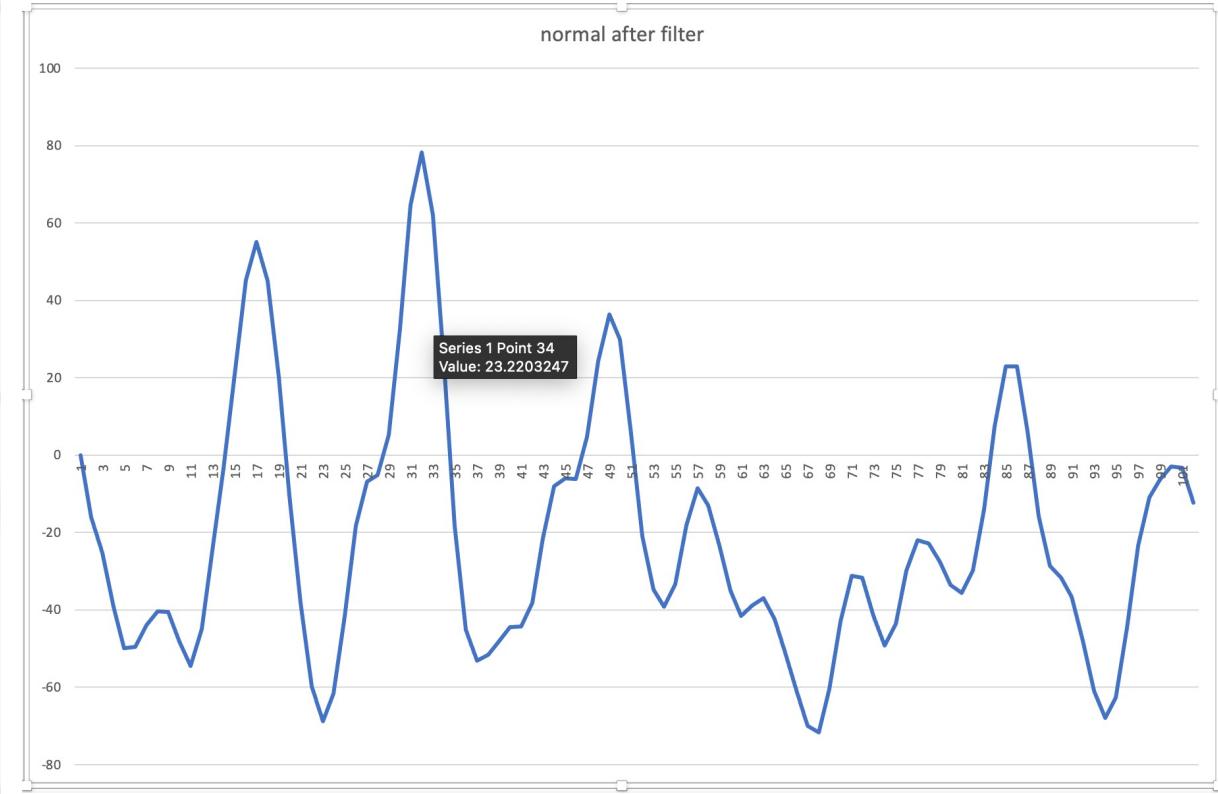
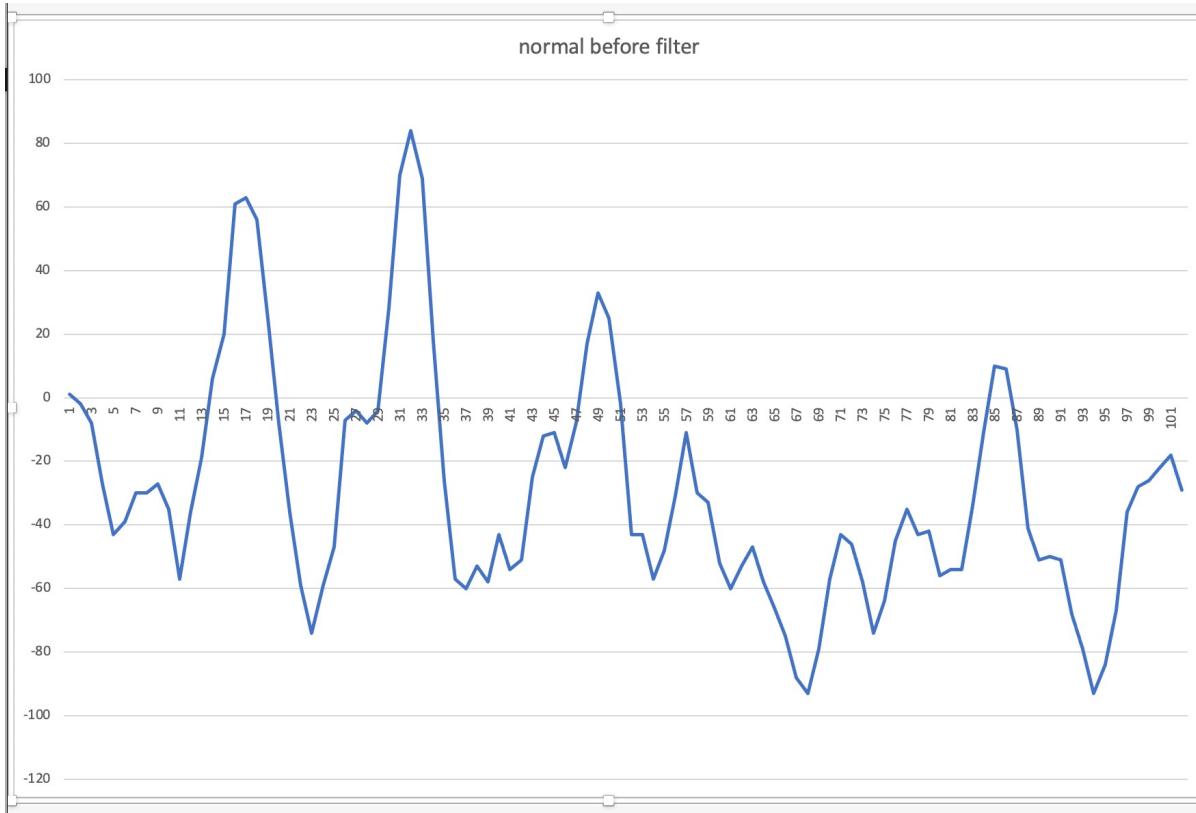
Statistical analysis - Epileptic

	count	mean	std	min	25%	50%	75%	max
X1	2300.0	-21.936522	342.361939	-1839.0	-193.25	-16.0	159.00	1314.0
X2	2300.0	-19.049130	343.398782	-1838.0	-191.25	-18.0	168.25	1356.0
X3	2300.0	-15.293913	337.489643	-1835.0	-187.00	-12.5	169.25	1274.0
X4	2300.0	-9.836087	332.354833	-1845.0	-184.00	-6.0	166.25	1226.0
X5	2300.0	-3.707391	332.211163	-1791.0	-174.25	-12.0	170.00	1518.0
...
X175	2300.0	-25.830870	339.650467	-1863.0	-195.00	-14.5	153.25	1205.0
X176	2300.0	-25.043913	335.747017	-1781.0	-192.00	-18.0	150.00	1371.0
X177	2300.0	-24.548261	335.244512	-1727.0	-190.25	-21.5	151.25	1445.0
X178	2300.0	-24.016522	339.819309	-1829.0	-189.00	-23.0	157.25	1380.0
y	2300.0	1.000000	0.000000	1.0	1.00	1.0	1.00	1.0

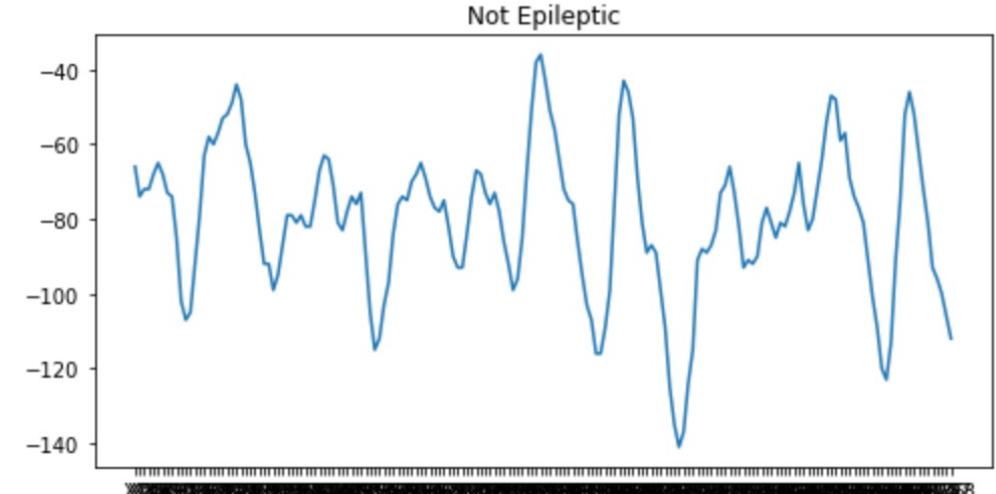
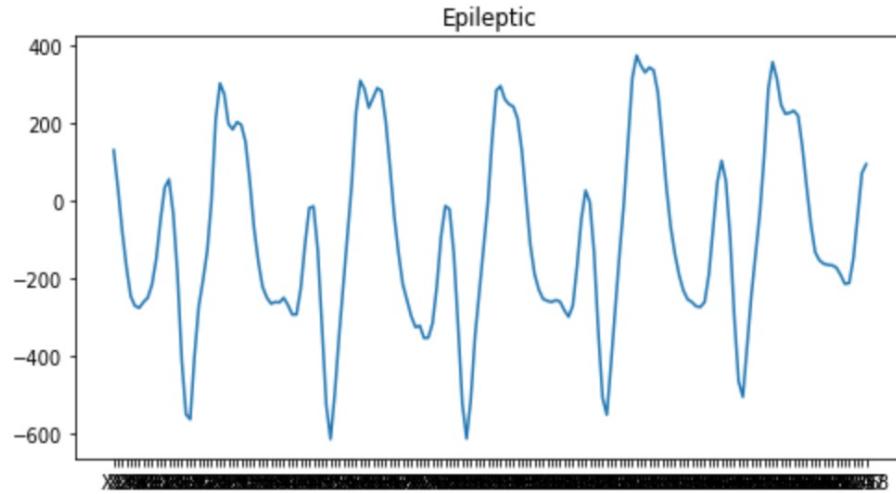
Statistical analysis - Non epileptic

	count	mean	std	min	25%	50%	75%	max
X1	9200.0	-8.992609	70.455286	-566.0	-44.0	-7.0	26.0	1726.0
X2	9200.0	-8.877174	70.560110	-609.0	-44.0	-7.0	27.0	1713.0
X3	9200.0	-8.910435	70.372582	-594.0	-45.0	-7.0	28.0	1697.0
X4	9200.0	-8.969783	70.030409	-549.0	-45.0	-8.0	27.0	1612.0
X5	9200.0	-9.085326	69.377958	-603.0	-45.0	-8.0	27.0	1437.0
...
X175	9200.0	-9.848587	69.550894	-570.0	-45.0	-9.0	27.0	1958.0
X176	9200.0	-9.620435	70.353607	-594.0	-46.0	-8.0	27.0	2047.0
X177	9200.0	-9.395435	70.934300	-563.0	-45.0	-9.0	27.0	2047.0
X178	9200.0	-9.240435	71.185850	-559.0	-45.0	-8.0	27.0	1915.0
y	9200.0	0.000000	0.000000	0.0	0.0	0.0	0.0	0.0

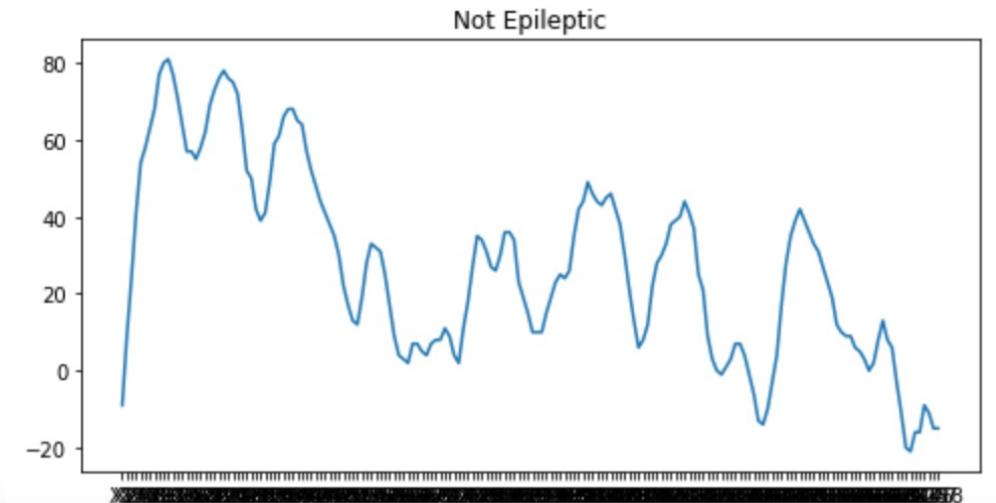
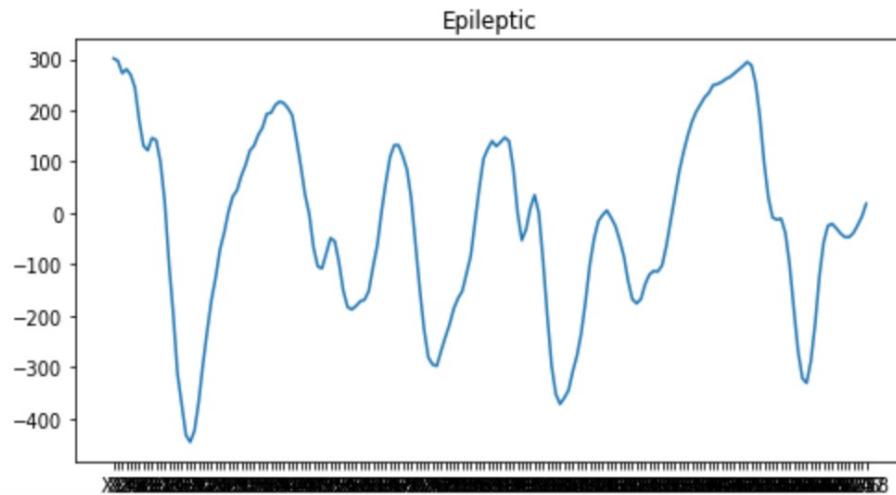
Usage of Butterworth filter



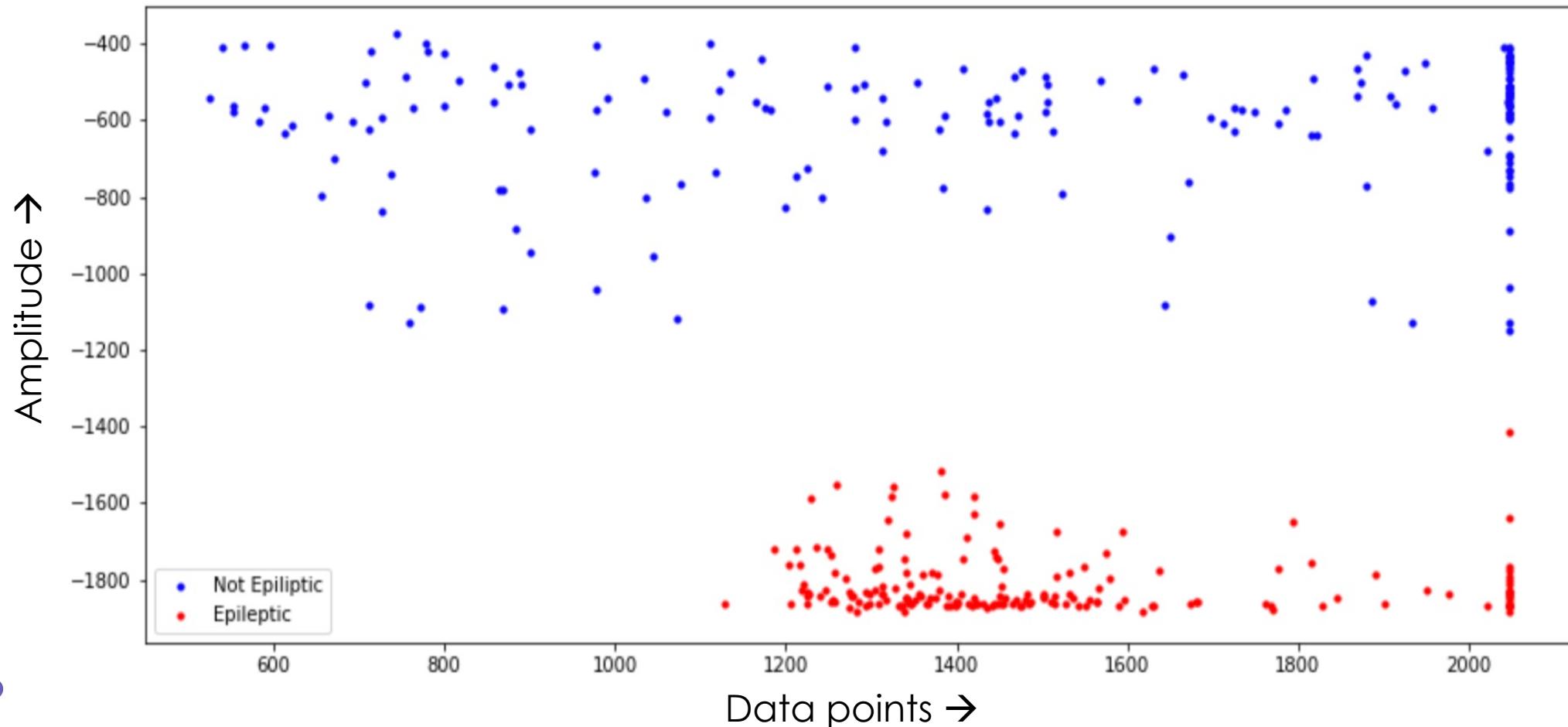
A Comparison



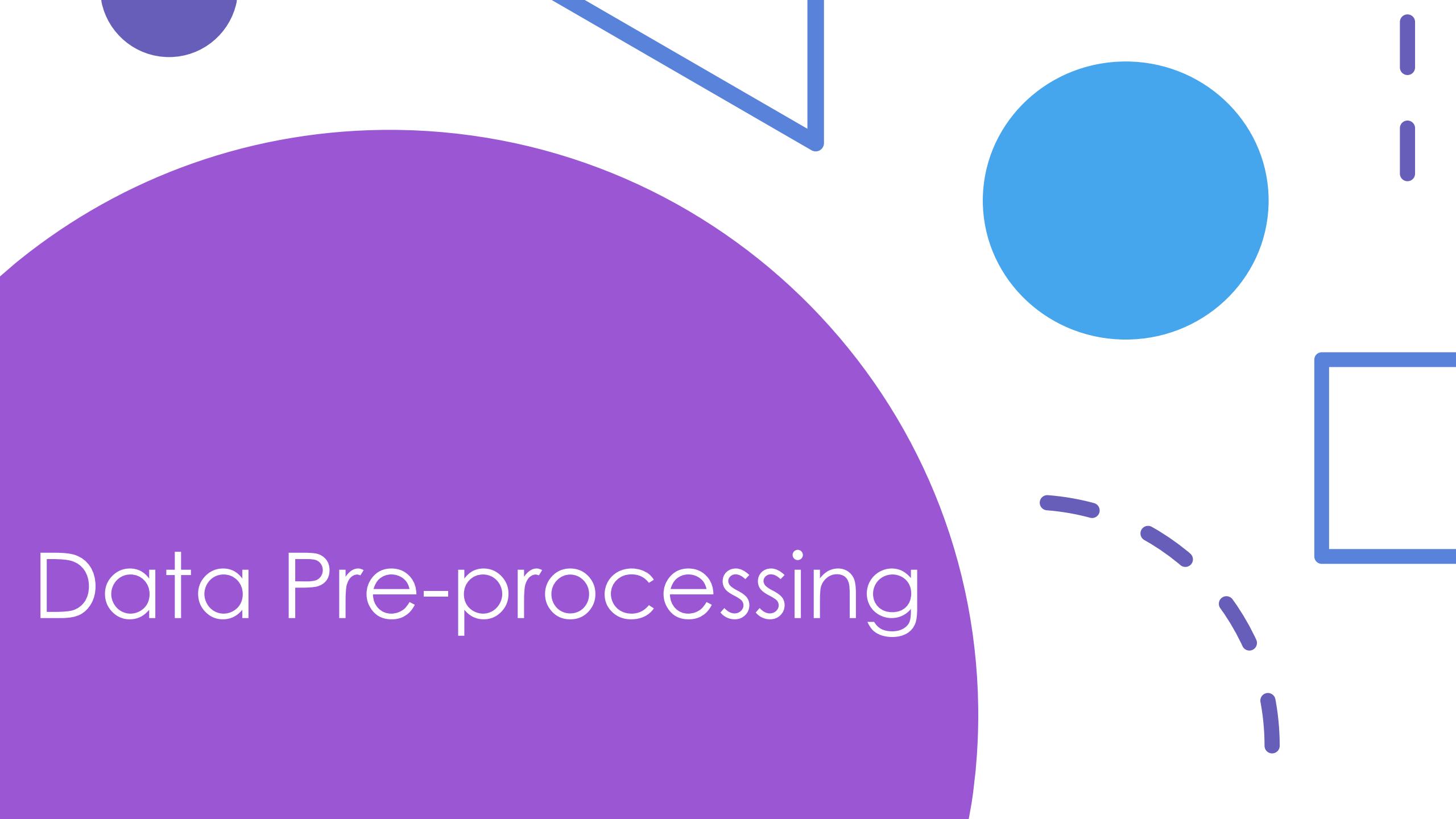
V/S



Scatter plot of epileptic and non-epileptic signals



Data Pre-processing



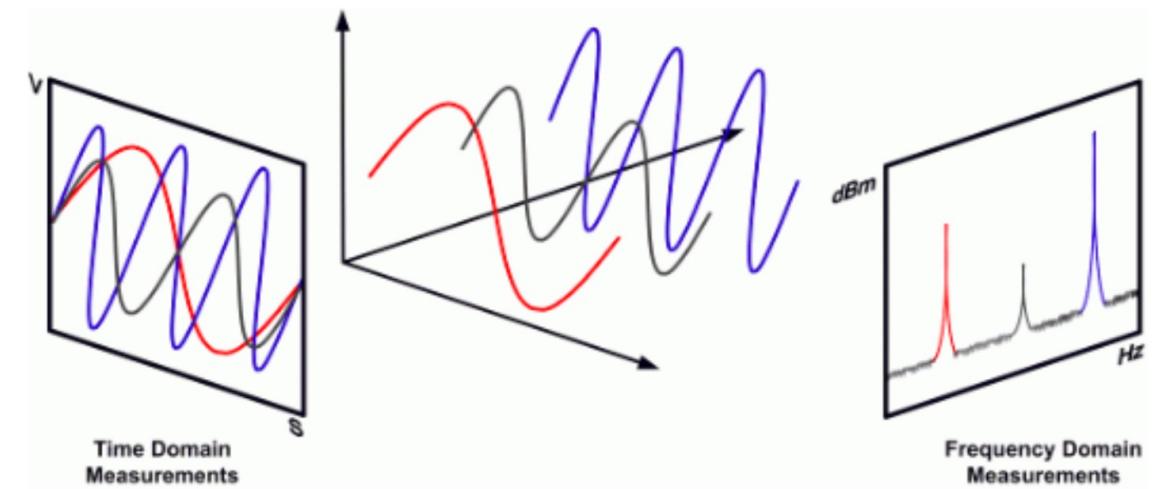
Feature scaling and Feature transformation

Normalization and standardization

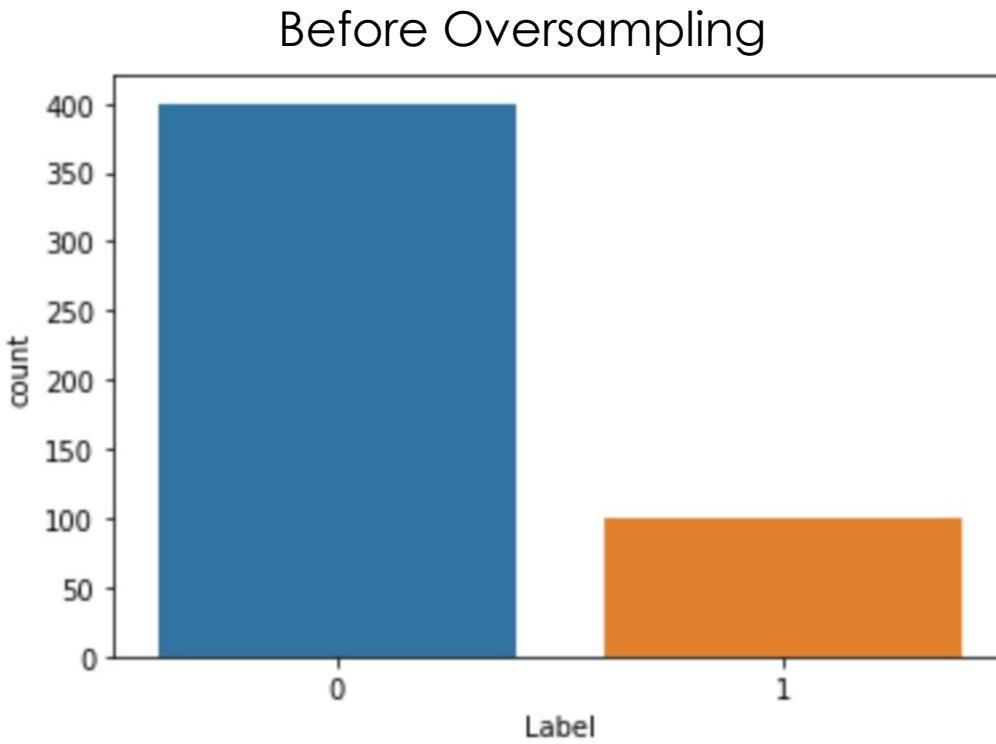
- Used the scikit-learn object → StandardScaler

Fourier transformation

- Which converts time domain to frequency domain



Class imbalance



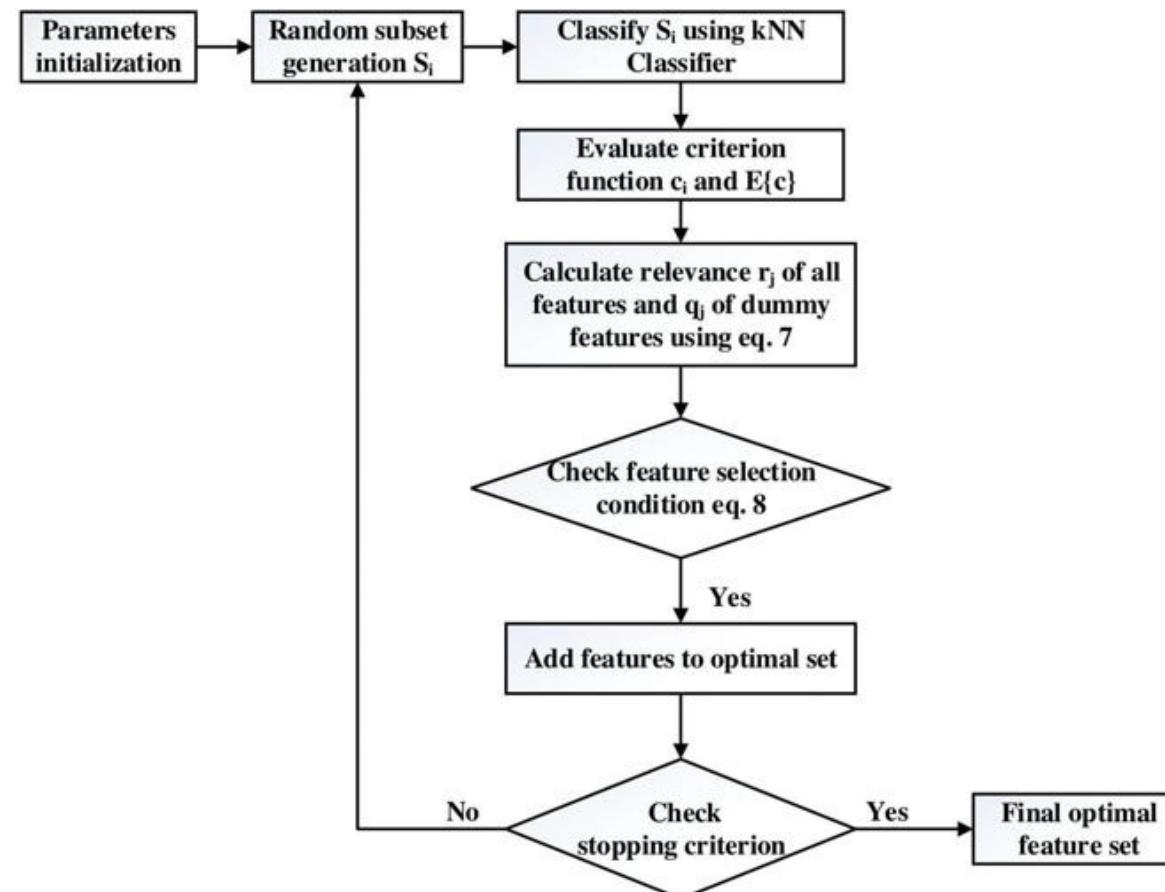
Before OverSampling, counts of label '1': 68
Before OverSampling, counts of label '0': 282

After OverSampling, the shape of train_X: (564, 4097)
After OverSampling, the shape of train_y: (564,)

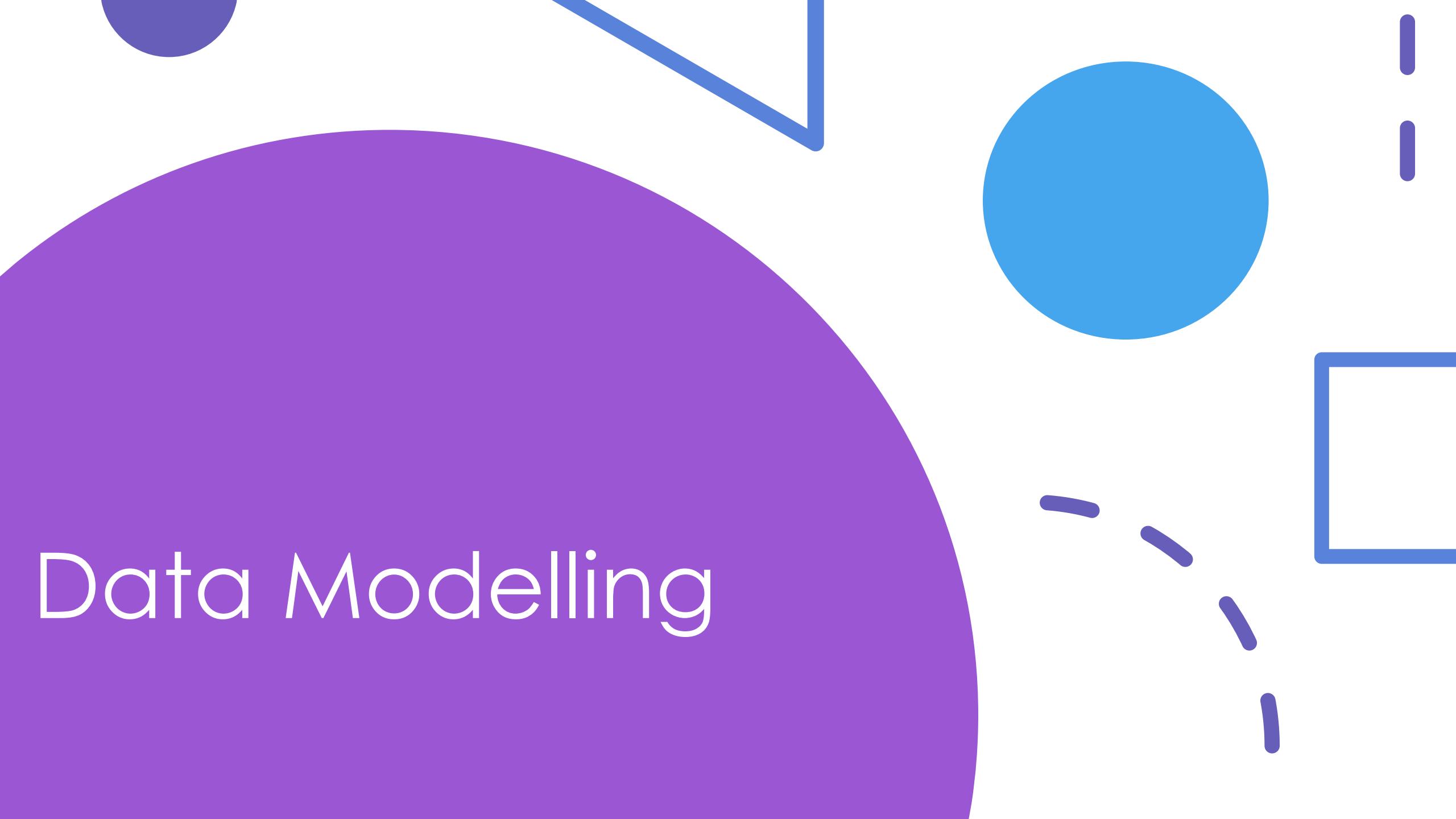
After OverSampling, counts of label '1': 282
After OverSampling, counts of label '0': 282

Attribute selection

RSFS



Data Modelling



Feature extraction

```
Xrsfs['Label'] = y  
Xrsfs
```

	0	22	79	103	110	113	136	152	154	196	...	3841	3862
0	-15.979399	-61.590045	-35.612190	-36.049572	6.126970	3.519763	13.753745	-46.246450	-47.470310	5.451132	...	-9.123440	5.332
1	-9.449462	34.156805	-37.387783	-18.621420	-10.157801	-29.569994	15.401767	14.014285	7.188024	28.976996	...	-12.963881	-55.5
2	-19.111807	-92.940752	37.815851	26.006295	10.386153	46.450210	-11.703717	1.498500	34.042303	-26.606372	...	74.340675	-9.50
3	-15.947554	29.944793	6.161303	-62.401662	-3.486773	31.939308	20.628554	81.533730	58.783770	-15.528215	...	8.274328	-29.7
4	7.772188	-48.241527	1.528408	8.691027	12.134514	-26.473751	9.396993	-44.467833	-63.806612	-41.131723	...	49.344957	61.13
...
495	39.651971	59.622565	-31.294614	-28.510627	1.615939	125.170891	-49.450404	-84.772783	-53.217639	126.662751	...	-130.865673	165.7
496	-0.730217	-221.236986	-337.340827	32.745909	74.800733	46.394351	-178.430476	75.691799	106.844601	-19.569266	...	262.301512	8.839
497	75.046048	-127.467261	-429.883846	-380.023695	411.644522	626.608323	-420.421130	371.290032	286.556547	-325.899369	...	-159.563122	83.58
498	619.260498	387.608333	-138.976485	1168.003415	7.069898	-149.680306	901.807382	-252.445198	-283.156232	-590.869159	...	-823.067307	-80.5
499	-83.947354	-111.163092	-745.075167	259.728863	16.220884	26.910022	-1446.059903	991.081335	944.503086	-323.504478	...	-1323.995755	142.1

500 rows × 263 columns

The reduced features

Models used

KNN

SVM

ADAB

Decision
Tree

LSTM

Naive
Bayes

Modelling



USED THOSE MODELS
ON THE DATASET

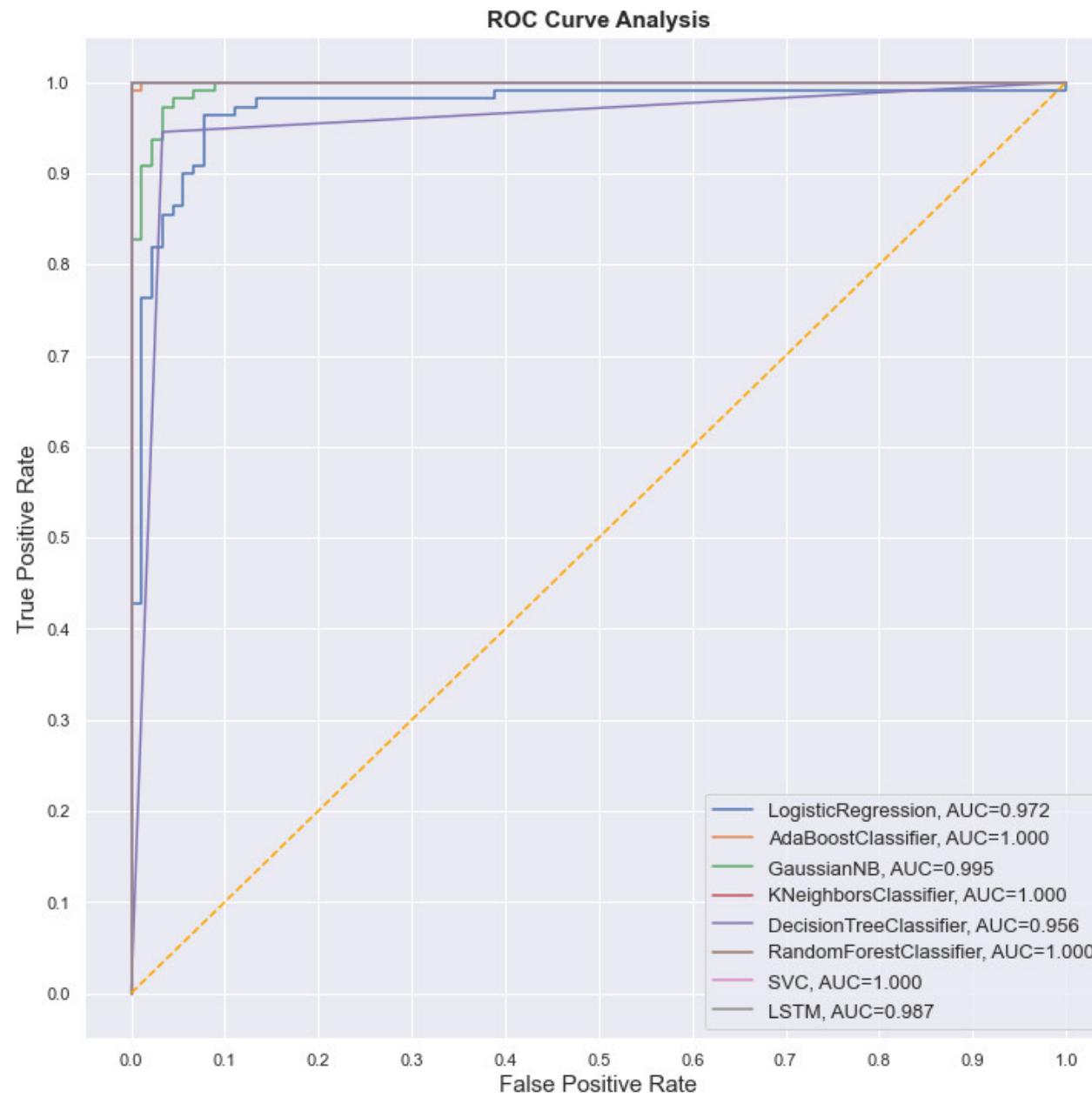


THEN COMPARED THE
RESULTS

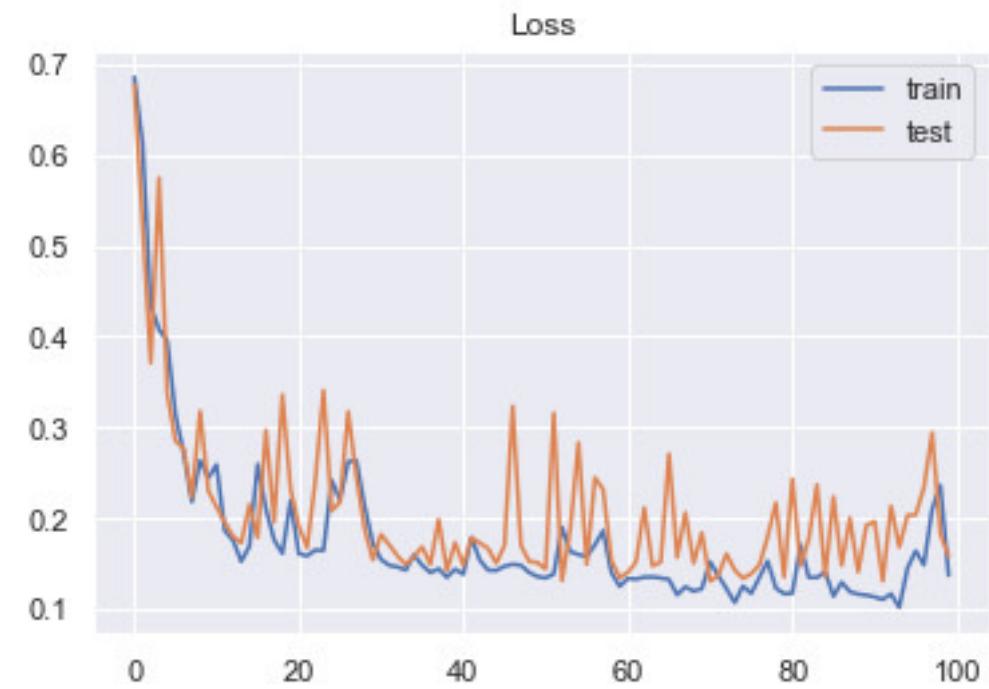


Evaluation

ROC curve



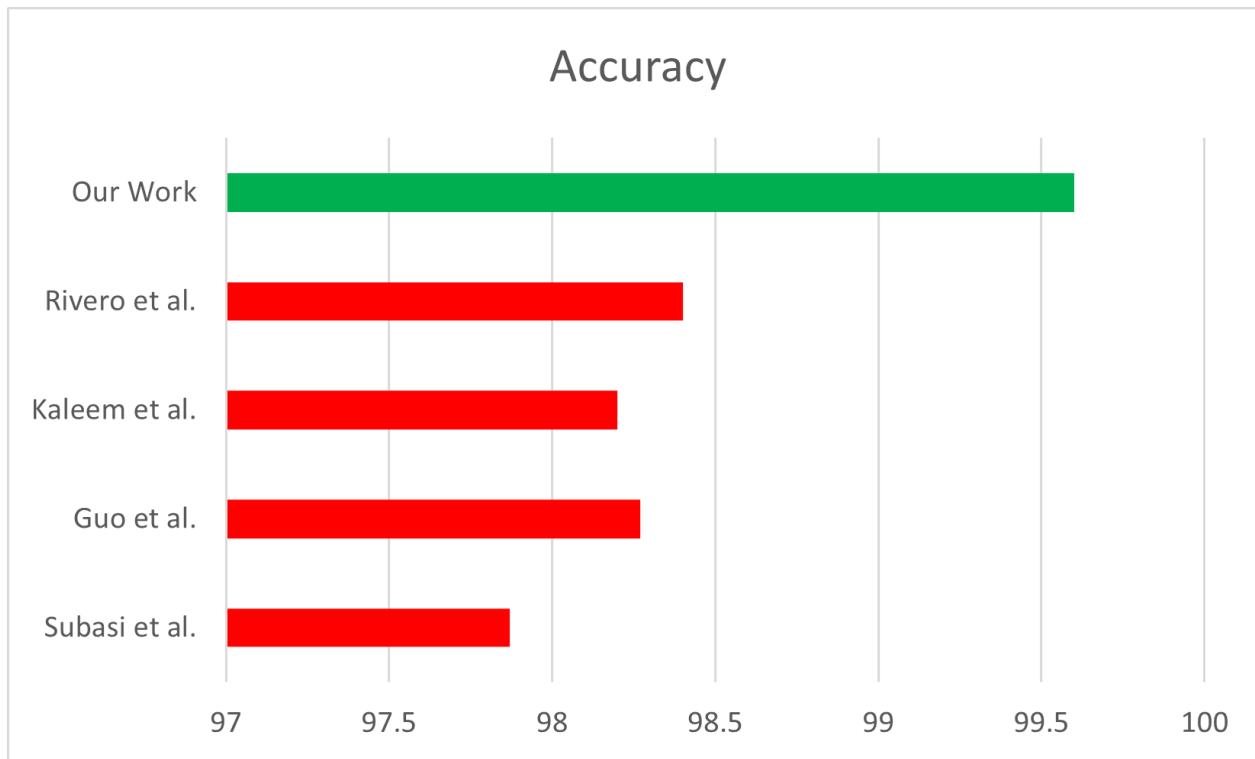
Accuracy and Loss V/S Epochs

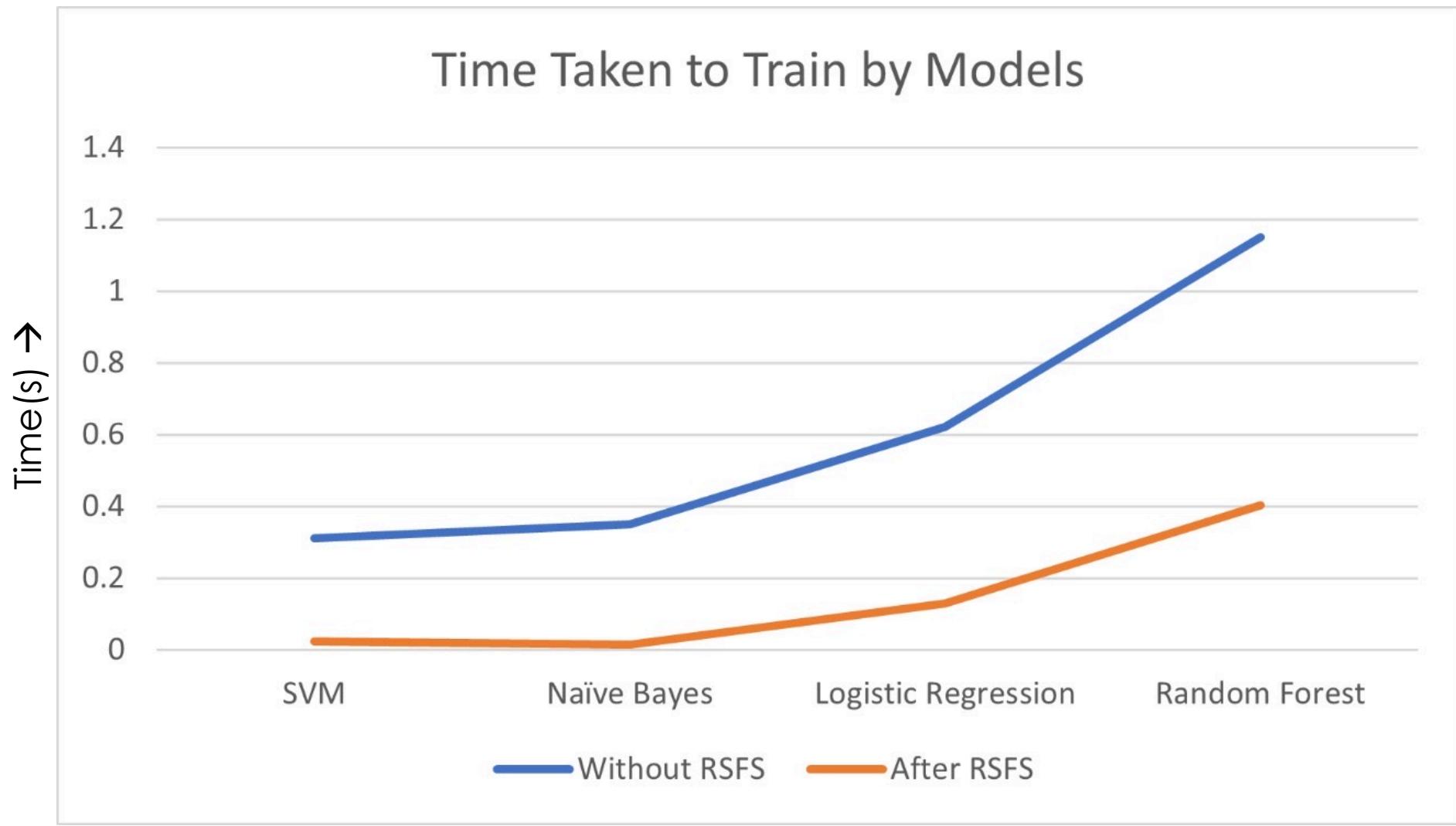


Metrics

Model	F1 score	Precision	Recall	Accuracy
KNN	0.87	0.9	0.85	96
SVM	0.99	0.99	0.99	99.25
ADAB	0.99	0.99	0.99	98.75
Decision Tree	0.91	0.91	0.91	94.2
LSTM	0.94	0.95	0.92	96.71
Naïve Bayes	0.94	0.94	0.94	98.8

Comparison with state of the art work

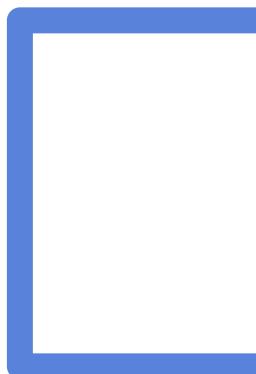
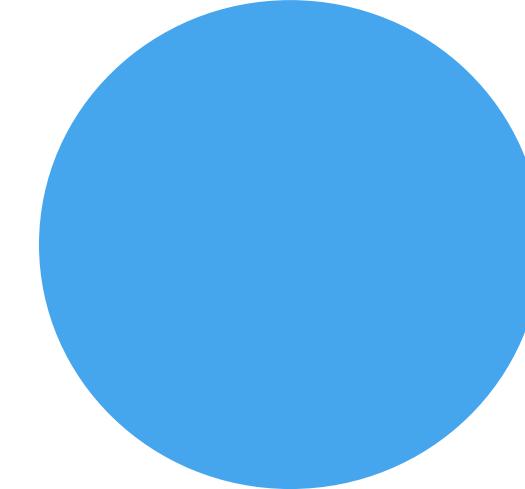




Time(s)	Ada Boost	SVM	Naïve Bayes	Logistic Regression	Random Forest
Without RSFS	114.6	0.311	0.35	0.622	1.15
After RSFS	6.68	0.024	0.015	0.129	0.403



Deployment



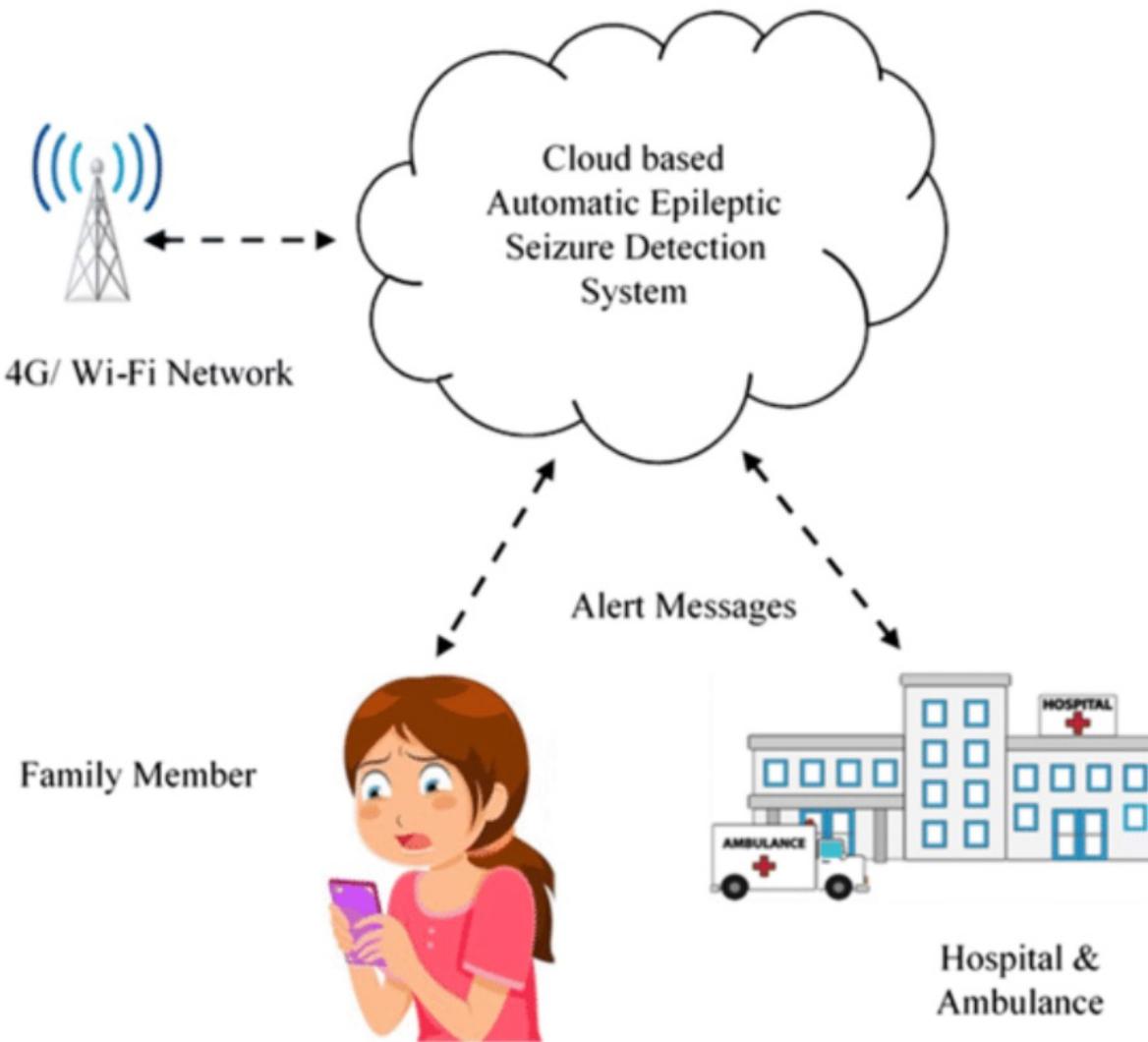
Device Layer

Sensed EEG signal Acquisition & Transmission
through Mobile phone to Cloud



Cloud Layer

Cloud Storage and Computing Services



References

- <https://www.researchgate.net/publication/324863472> RANDOM SUBSET FEATURE SELECTION FOR CLASSIFICATION
- <https://www.ukbonn.org/epileptologie/ag-lehnertz-downloads/>
- <https://www.kaggle.com/maximkumundzhiev/epileptic-seizure-recognition/data>
- <https://journals.aps.org/pre/abstract/10.1103/PhysRevE.64.061907>
- <https://www.researchgate.net/publication/11620616>
- <https://www.kdnuggets.com/2020/02/fourier-transformation-data-scientist.html>
- <http://www.dradvaitkulkarni.com/latest-update/epilepsy-what-are-s/7>



Thank You

