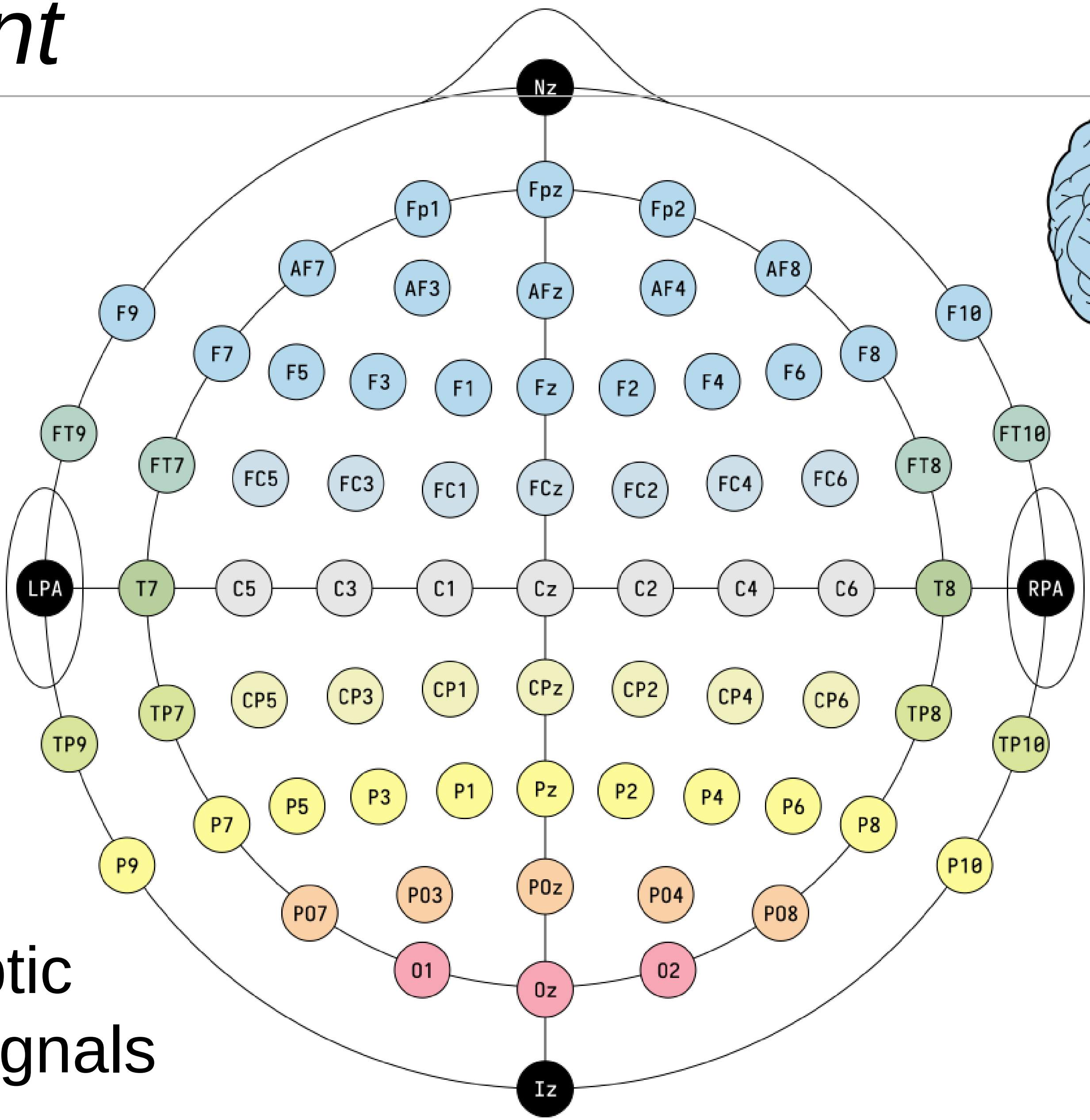
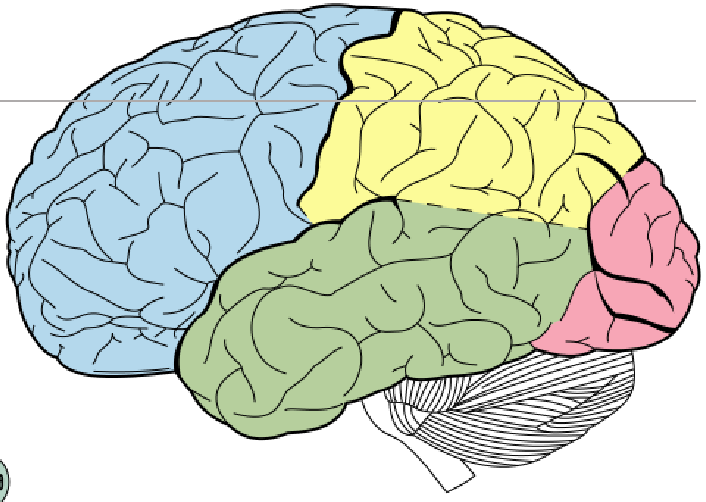
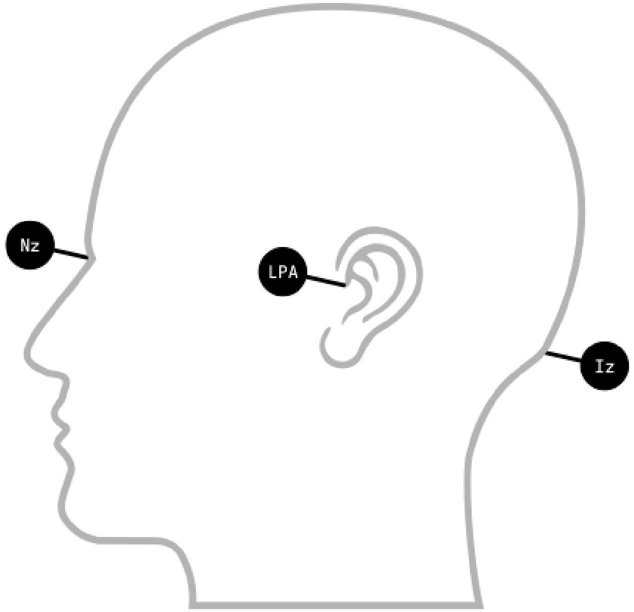
CHALLENGE 4. TEMPORAL SIGNALS

Debora Gil

Starting Point

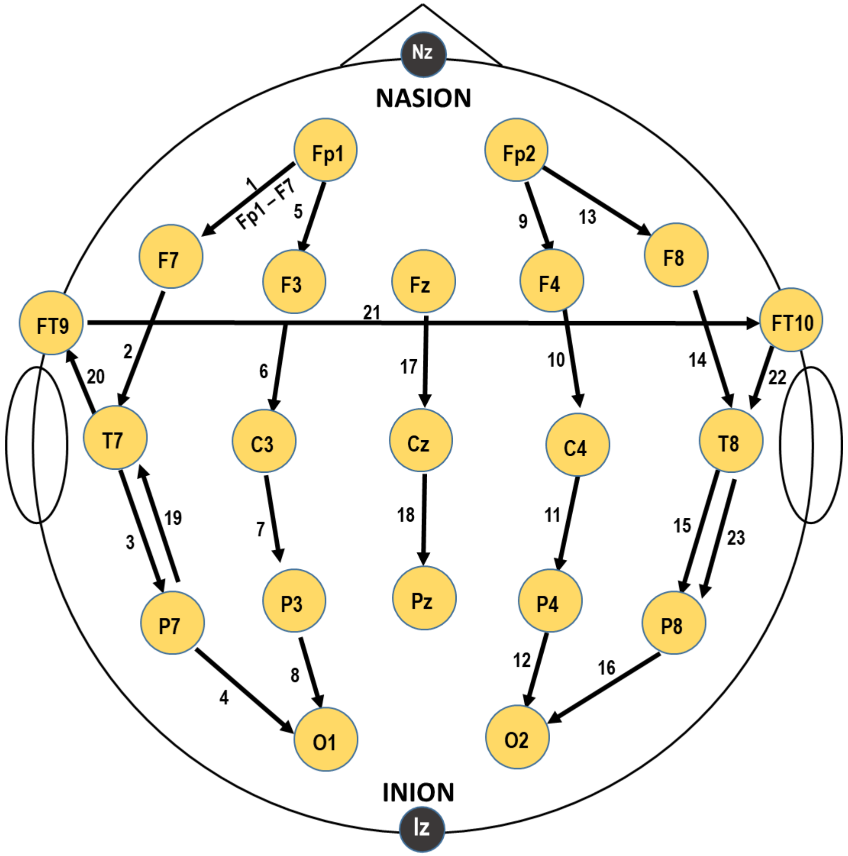




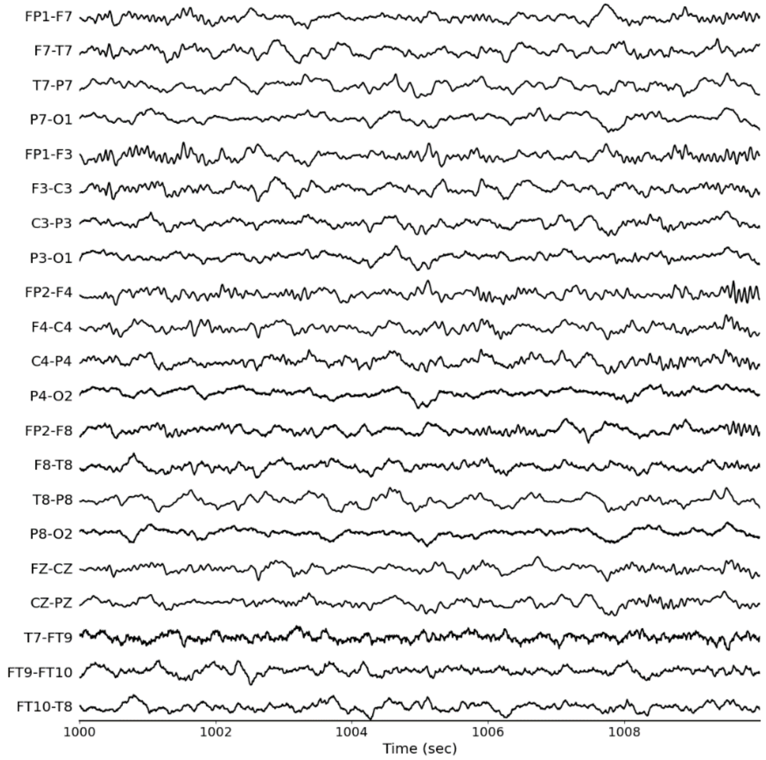


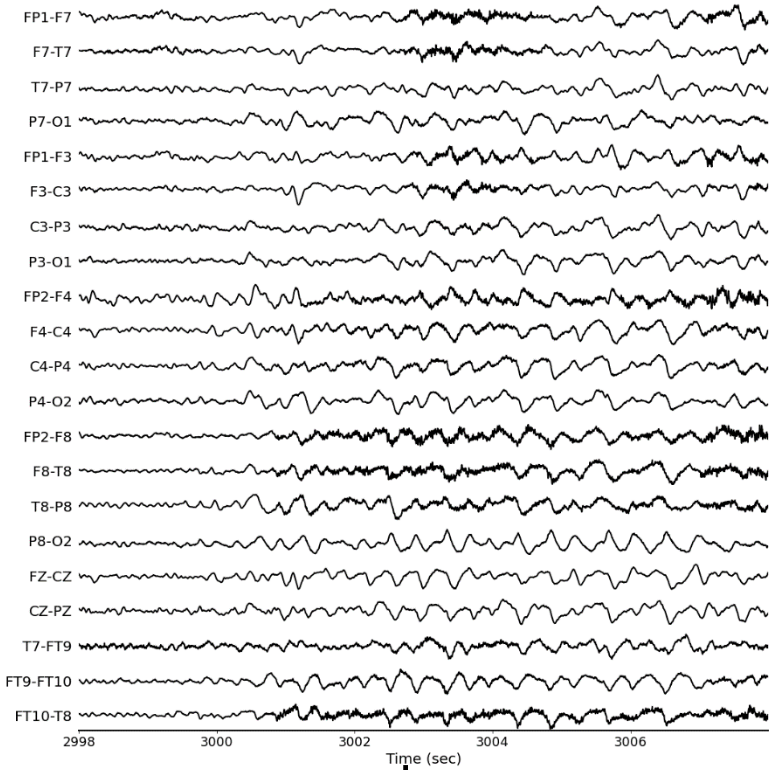
Detection of epileptic
seizures in EEG signals

Seizure Patterns in EEG

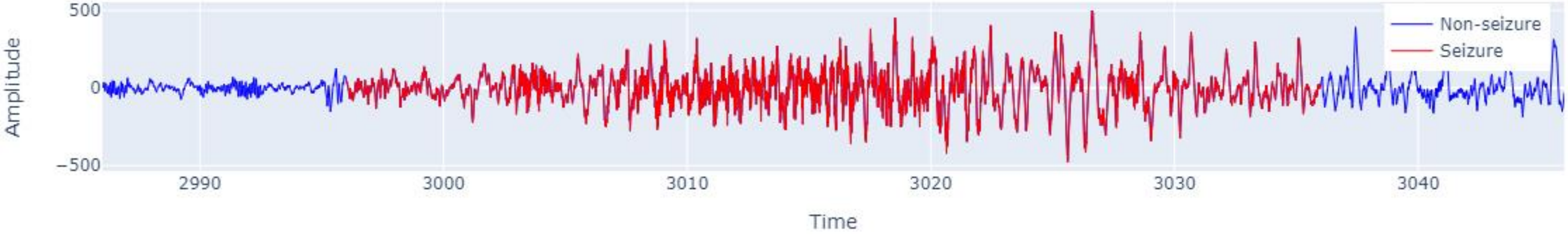


normal

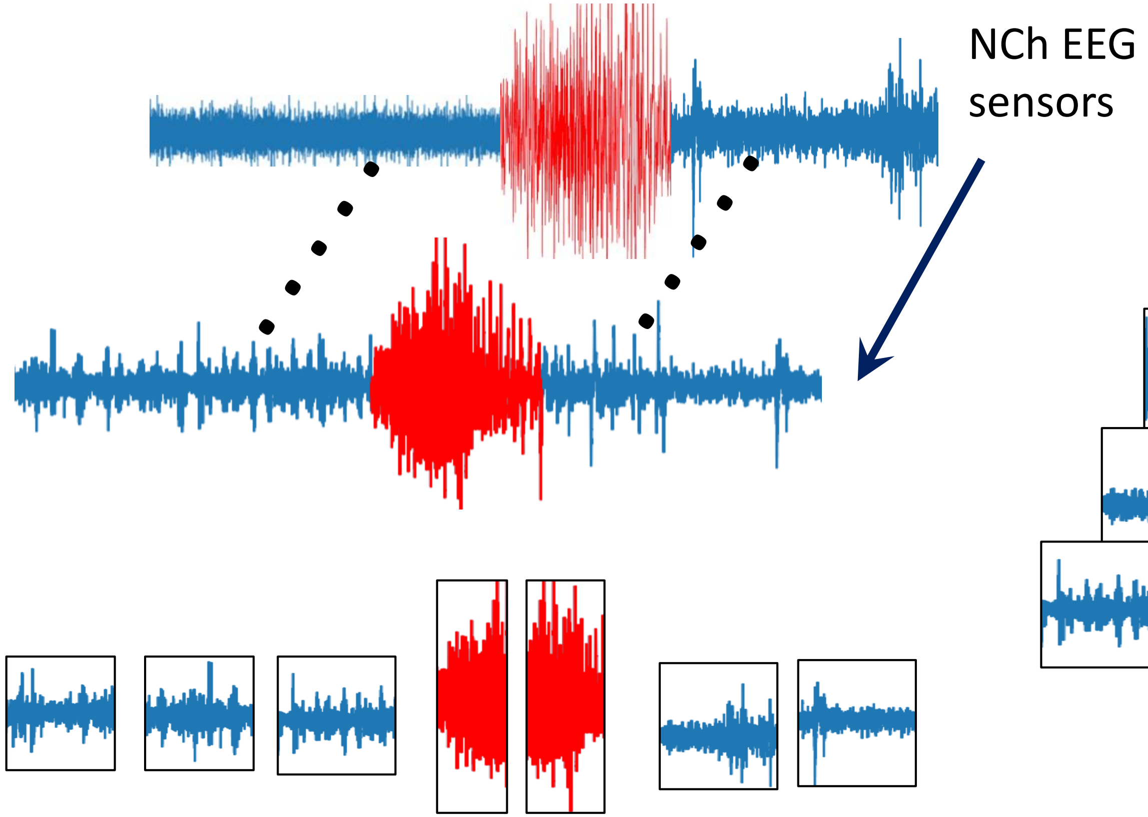




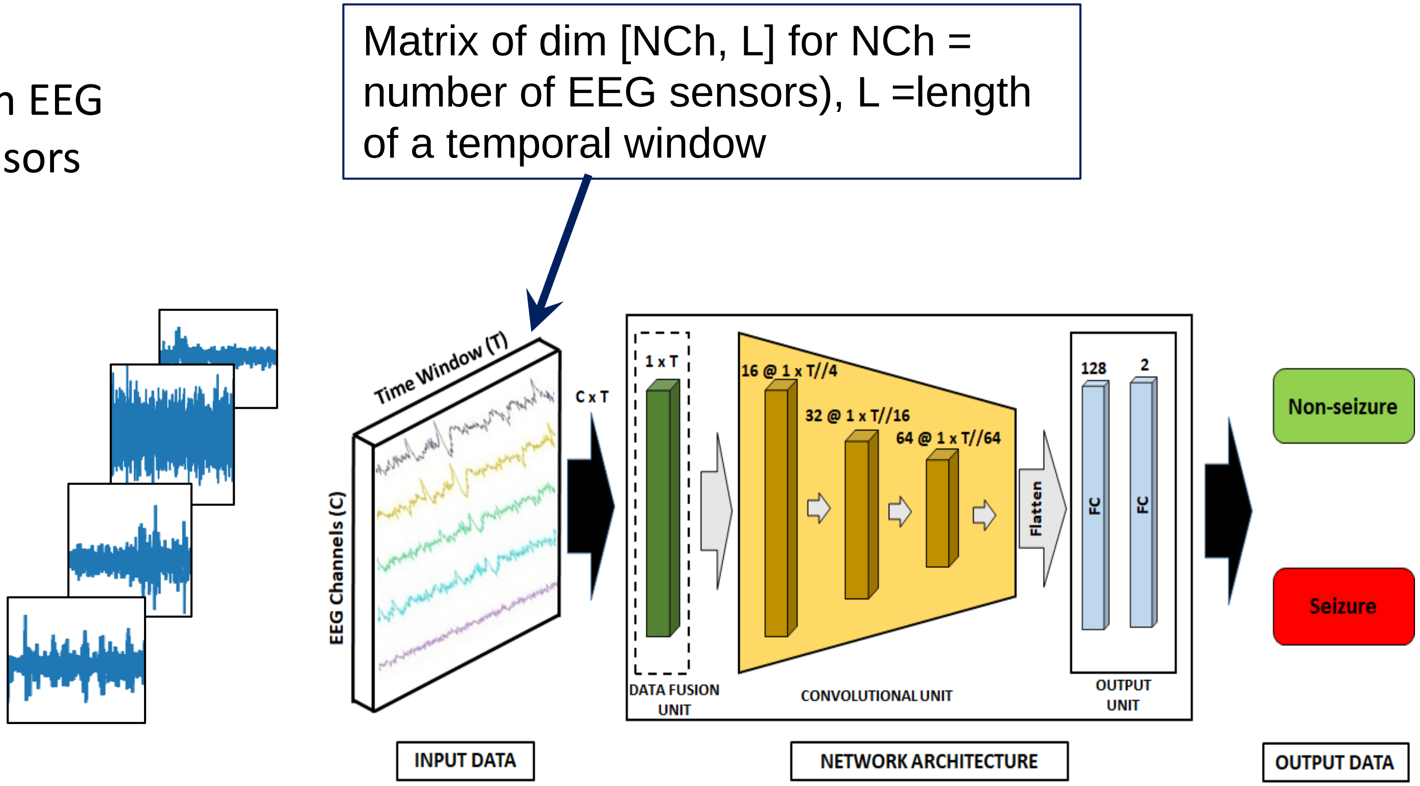
seizure



System Pipeline

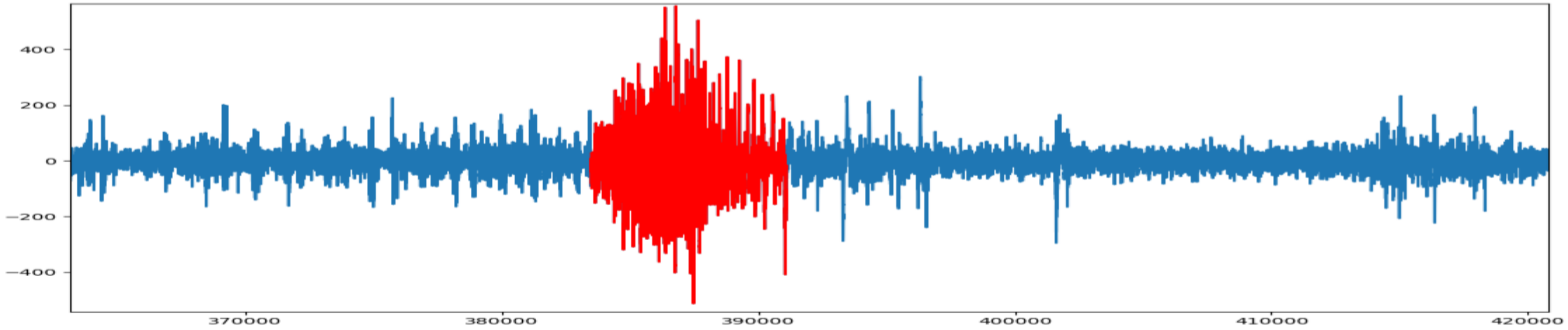


Data Preparation. Extract temporal windows from EEG signals

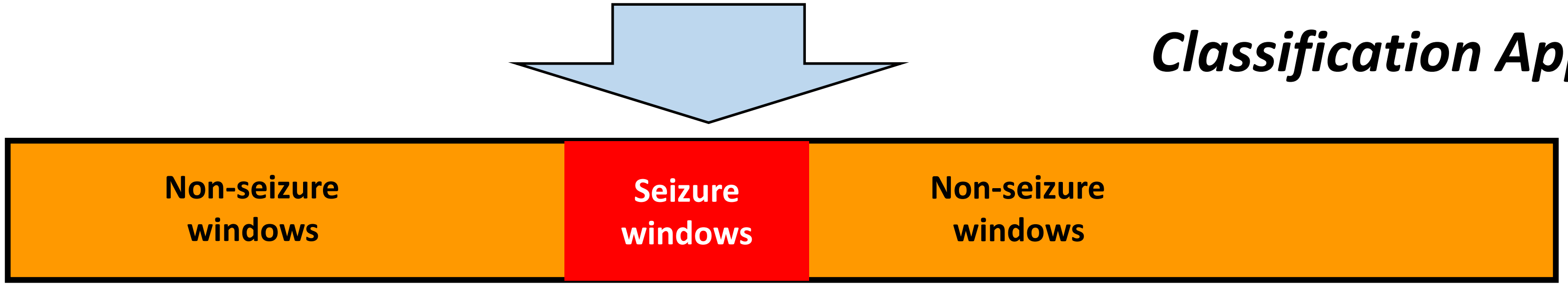


Window Seizure Detection. Identify seizure presence in Windows from the analysis of NCh EEG signals

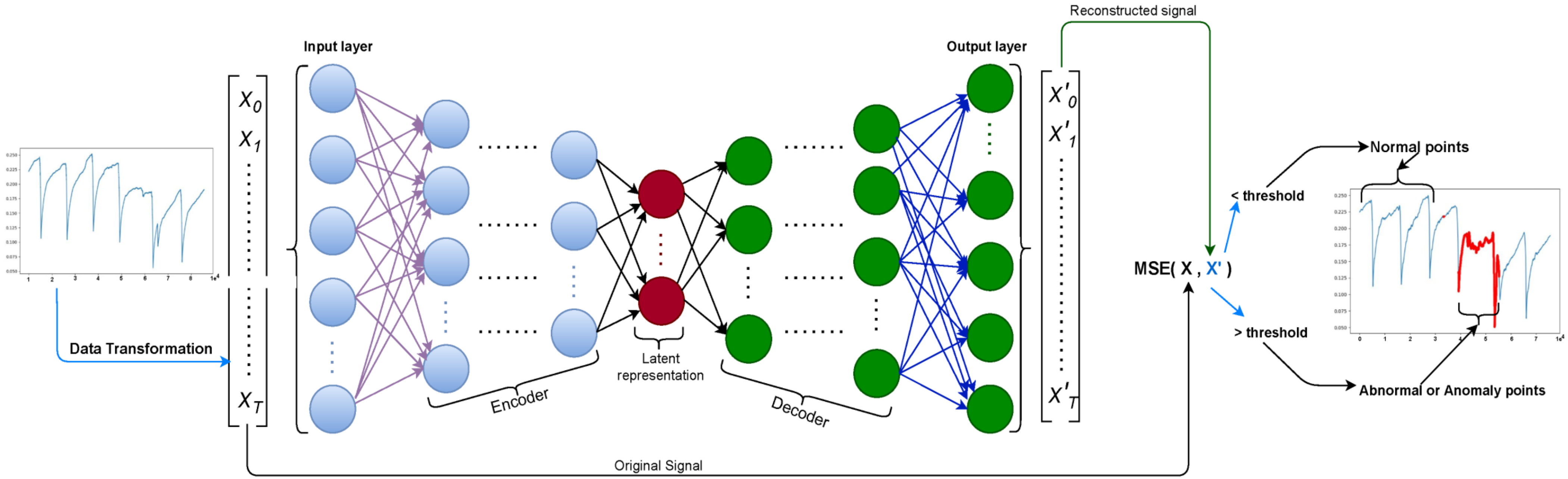
Window Seizure Detection



Classification Approach



Anomaly Detector

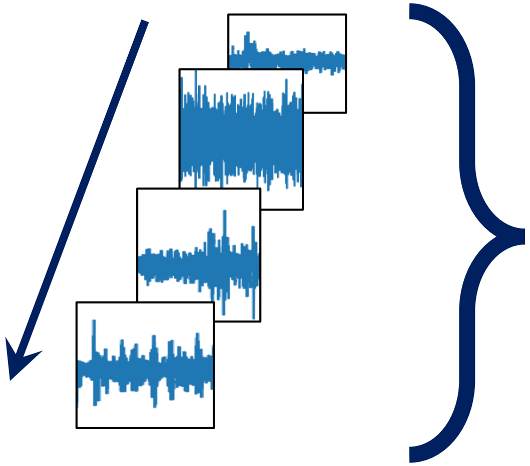


AI Challenges

1. How to combine EEG electrode signals (Channel Fusion)

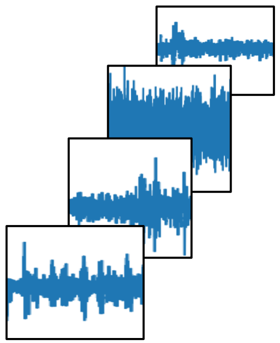
NCh EEG sensors

EEG Windows at time T



Representation space of a single window taking into account the information of all NCh EEG channels

2. How to include temporal information of EEG signals



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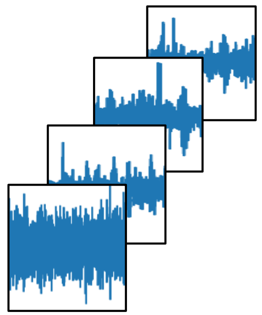


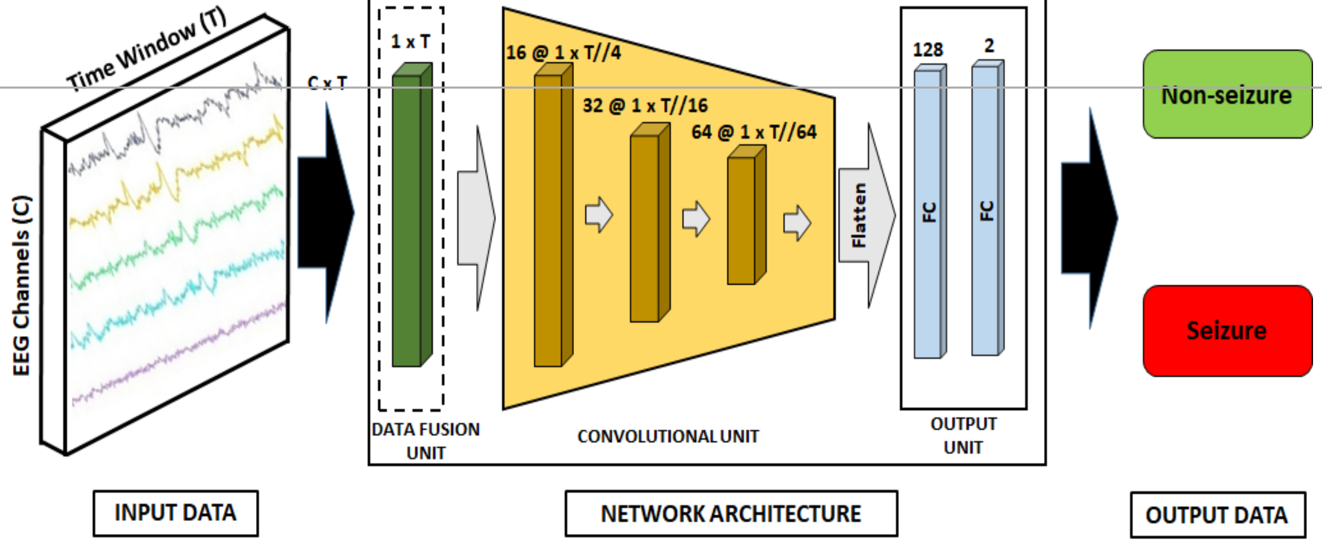
EEG Windows at time T

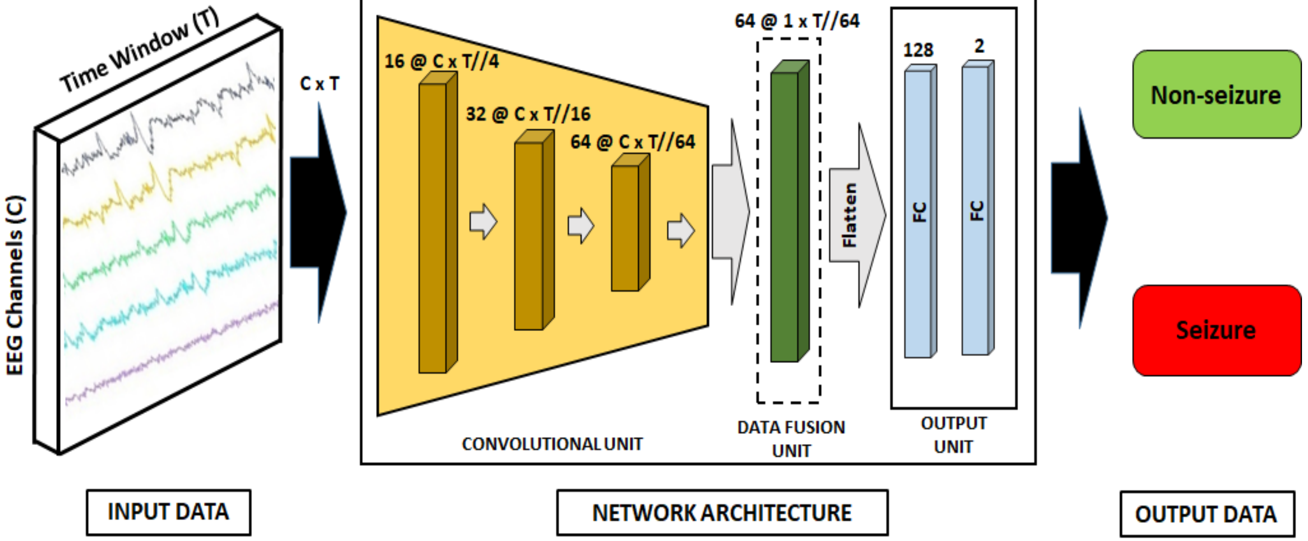
EEG Windows at time T+K

Representation space of a single window taking into account previous Windows in a K-length sequence

Channel Fusion

Fusion of EEG channels at input level (like image CNNs)





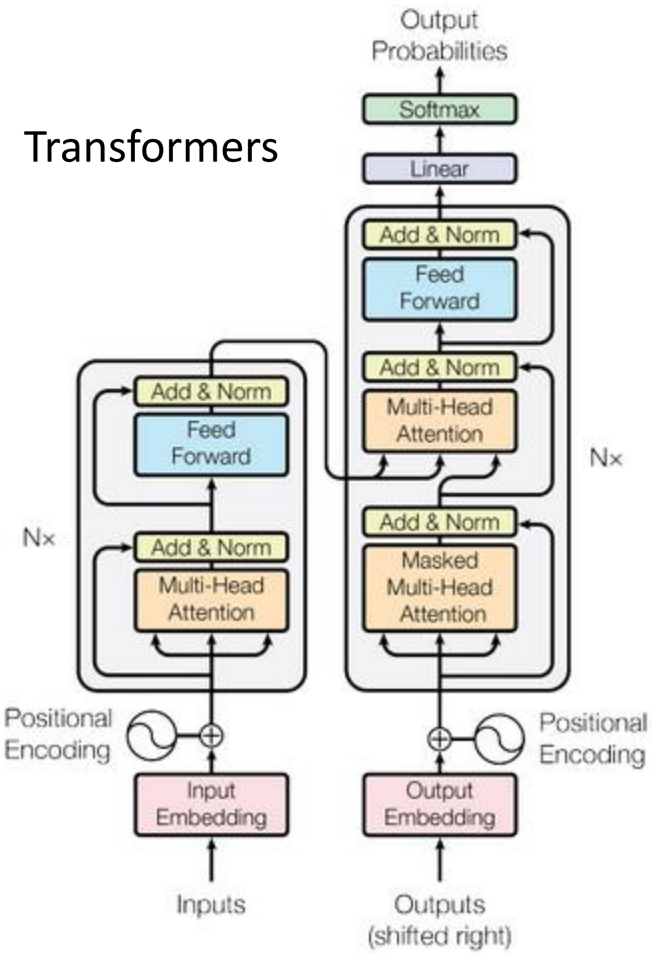
Fusion of EEG channels at feature level (after extracting relevant features for each sensor)

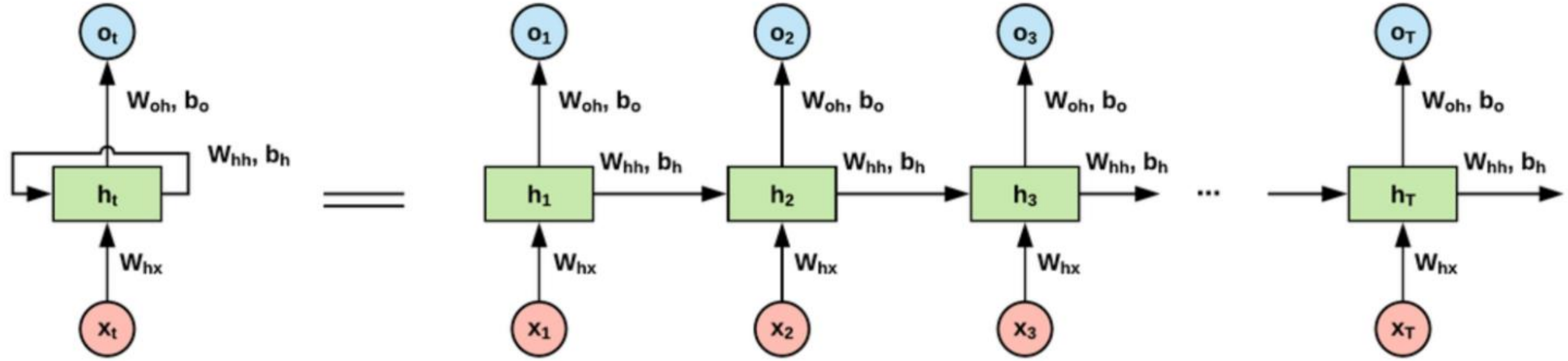
[Recognition of the Mental Workloads of Pilots in the Cockpit Using EEG Signals (mdpi.com)]

Temporal Information

2. How to include temporal information of EEG signals

Transformers

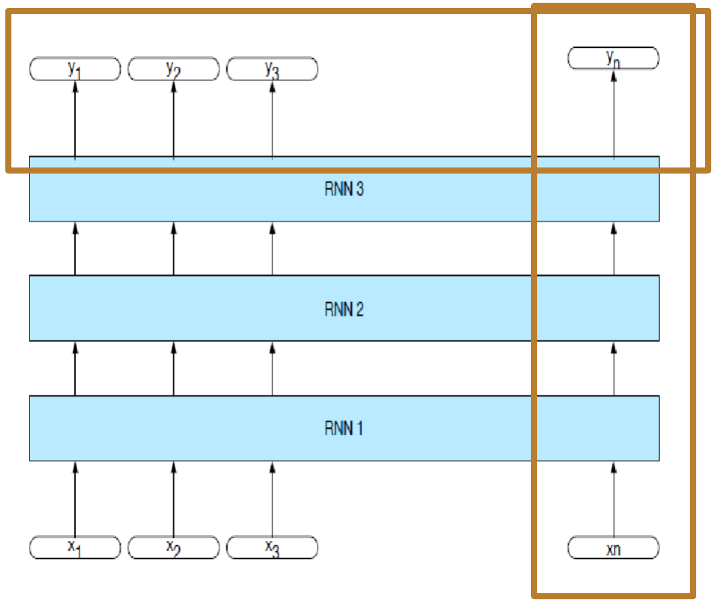


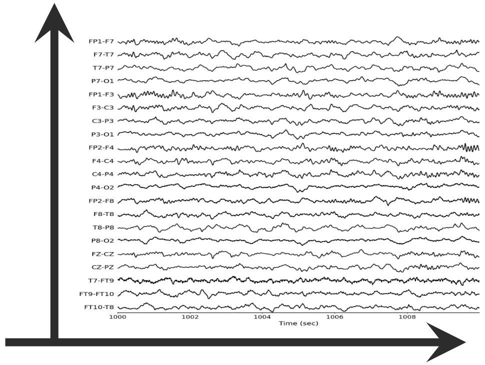


Recurrent Networks (LSTM)

Temporal Information

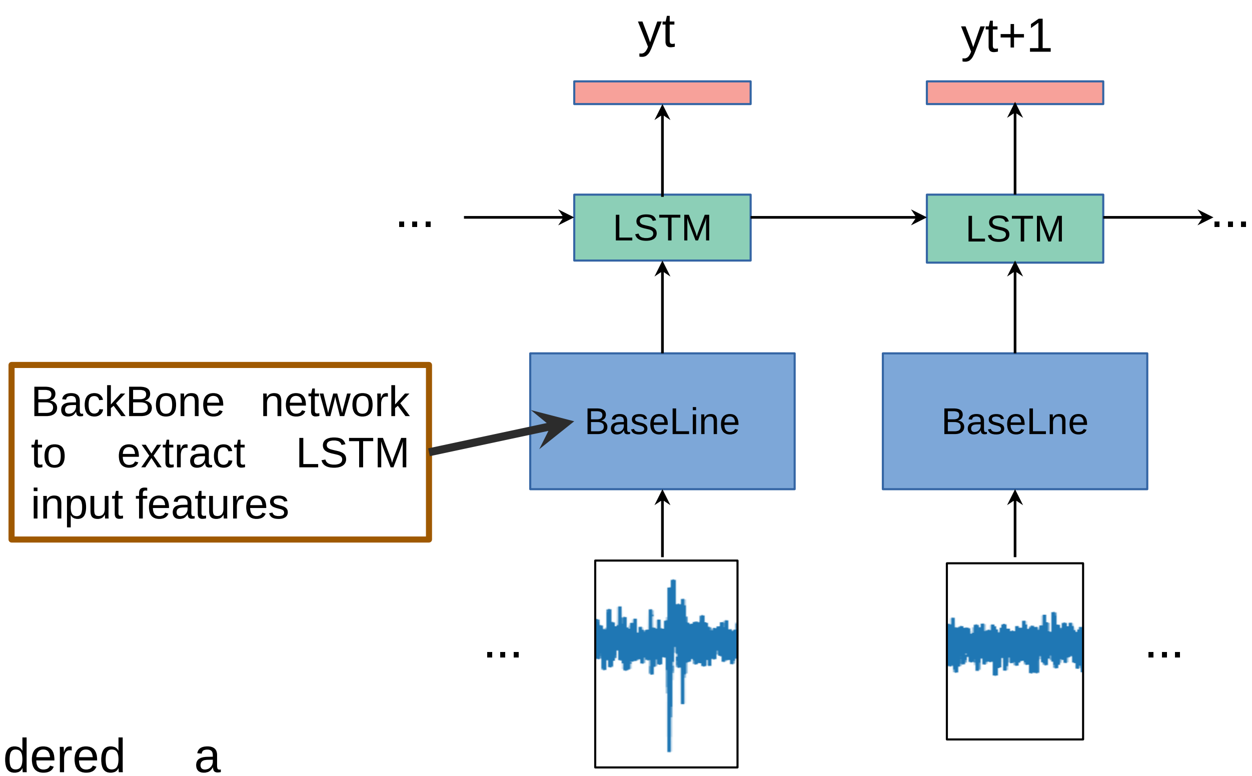
Combine channels using temporal information





X=[21,T] is considered a temporal signal of length T=128 represented by the 21 channels

Process consecutive temporal windows to classify the last one



Computer Methods and Programs in Biomedicine, 2021, available al VC

AI Challenges

3. Personalization level of models

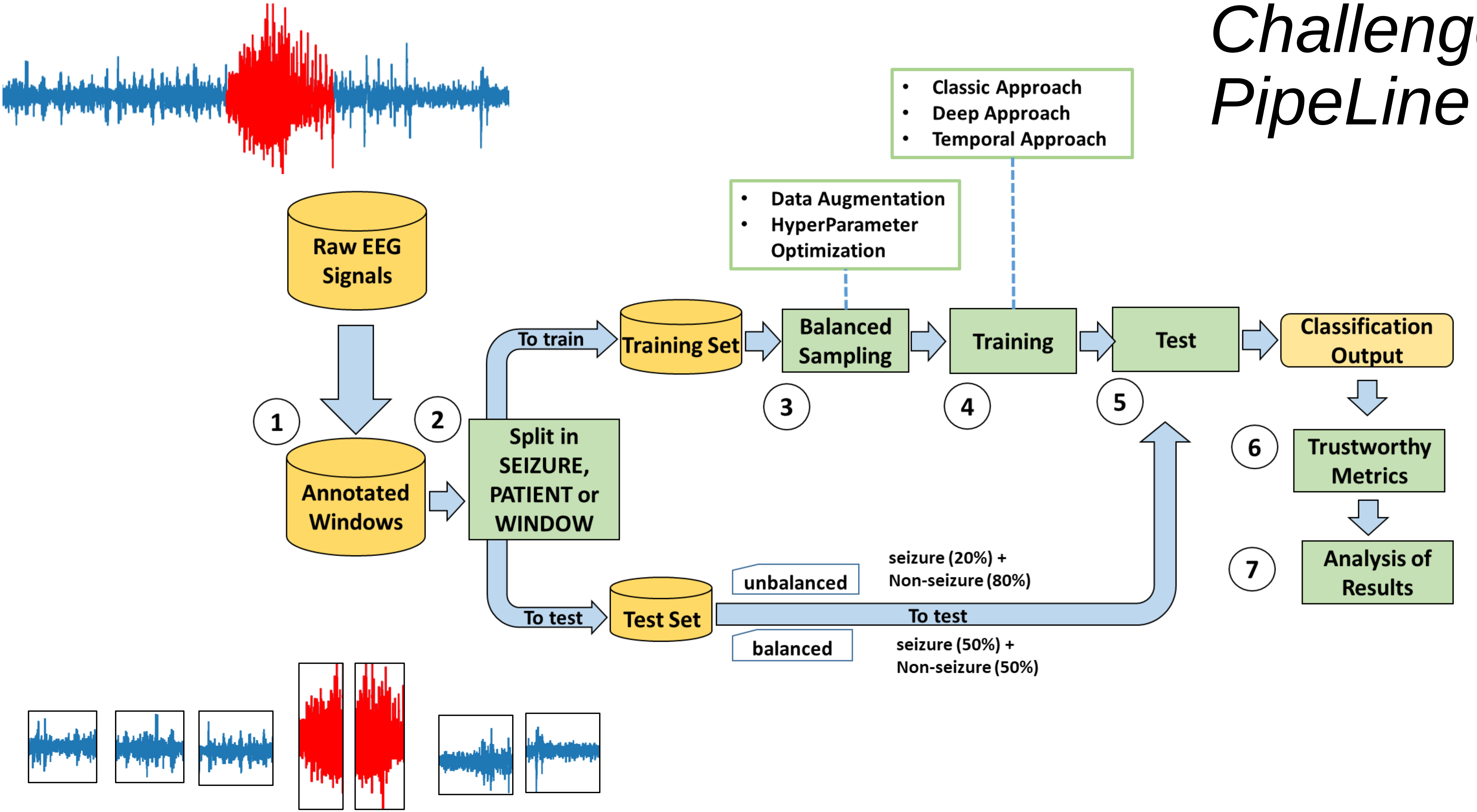
Population Approach.

Test: unseen subjects

Personalized Approach.

Test: unseen event of same set of subjects

Challenge PipeLine



Specific Objectives

1. Implement two systems:

    1.1 Baseline single window classifier with Channel fusion

    1.2 Temporal approach using LSTM

2. Compare performance at different generalization levels:

    2.1 Personalized Model

    2.2 Poblational Model

Session Schedulle

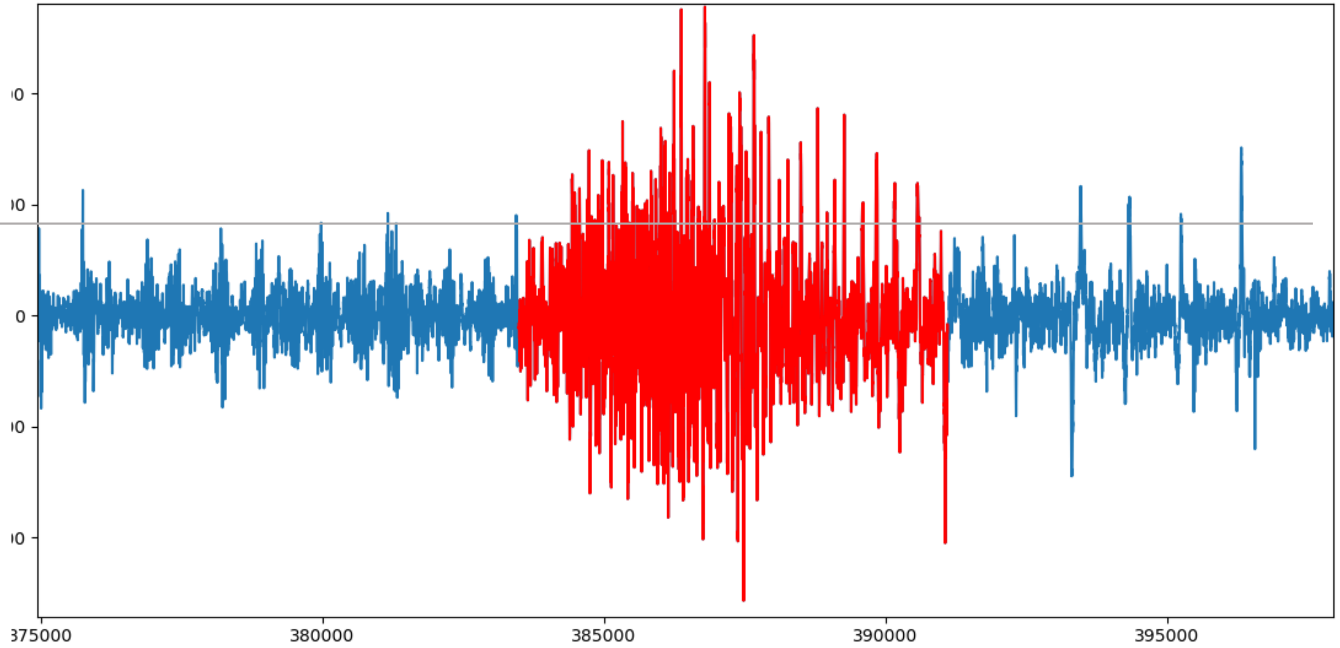
desembre	dimarts 2	Challenge 4: Detection of Epileptic Seizure in EEG. Challenge presentation. Data Base Exploring Materials in VC: Challenge Presentation. CHB-MIT Dataset.
	divendres 5	Base Line Architecture for Channel Fusion. Materials in VC: Architectures.Channel Fusion
	dimarts 9	Base Line Architecture for Channel Fusion. Follow-up Materials in VC: Architectures.Channel Fusion
	divendres 12	Experimental Design. Train and Test of Base Line Architecture at two different generalization levels. Materials in VC: Validation&Verification
	dimarts 16	Recurrent Architecture for Processing of Temporal Information. Materials in VC: Architectures. Processing Temporal Data
	divendres 19	Recurrent Architecture for Processing of Temporal Information. Follow-up Materials in VC: Architectures.Processing Temporal Data
		Gener-Febrer
		Defense of the Challenge (Check Calendar of Exams on the Web Site)

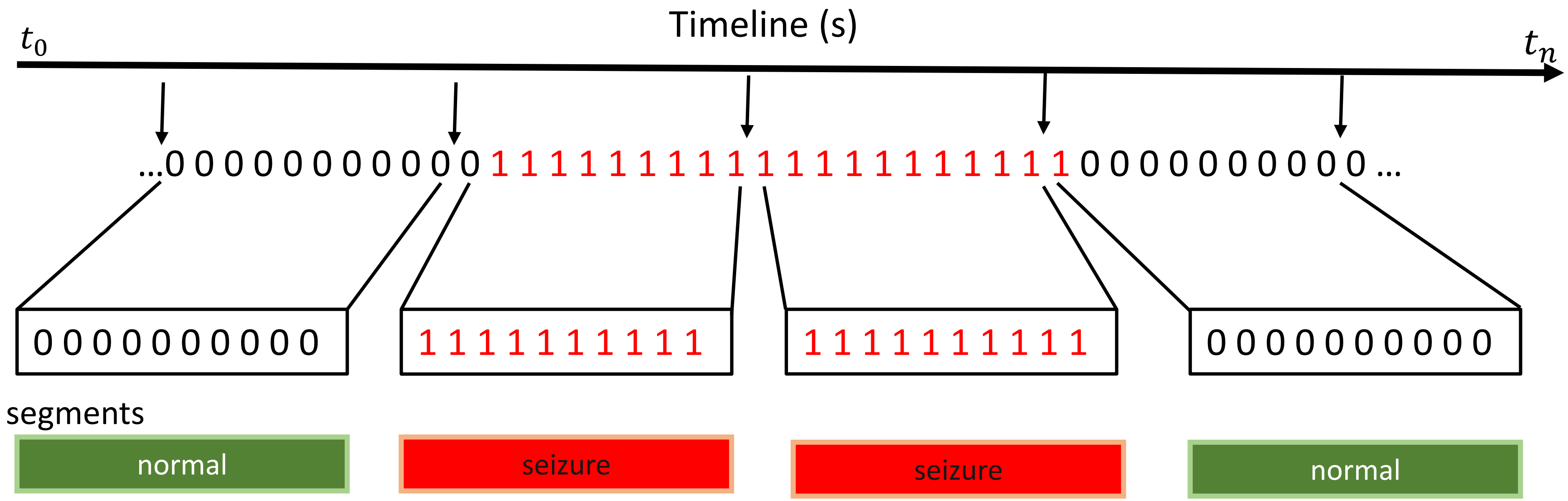
Dataset

CHB-MIT DataSet

Recordings at 256 MHz from 24 subjects with several seizures. Seizure start-end time is annotated.

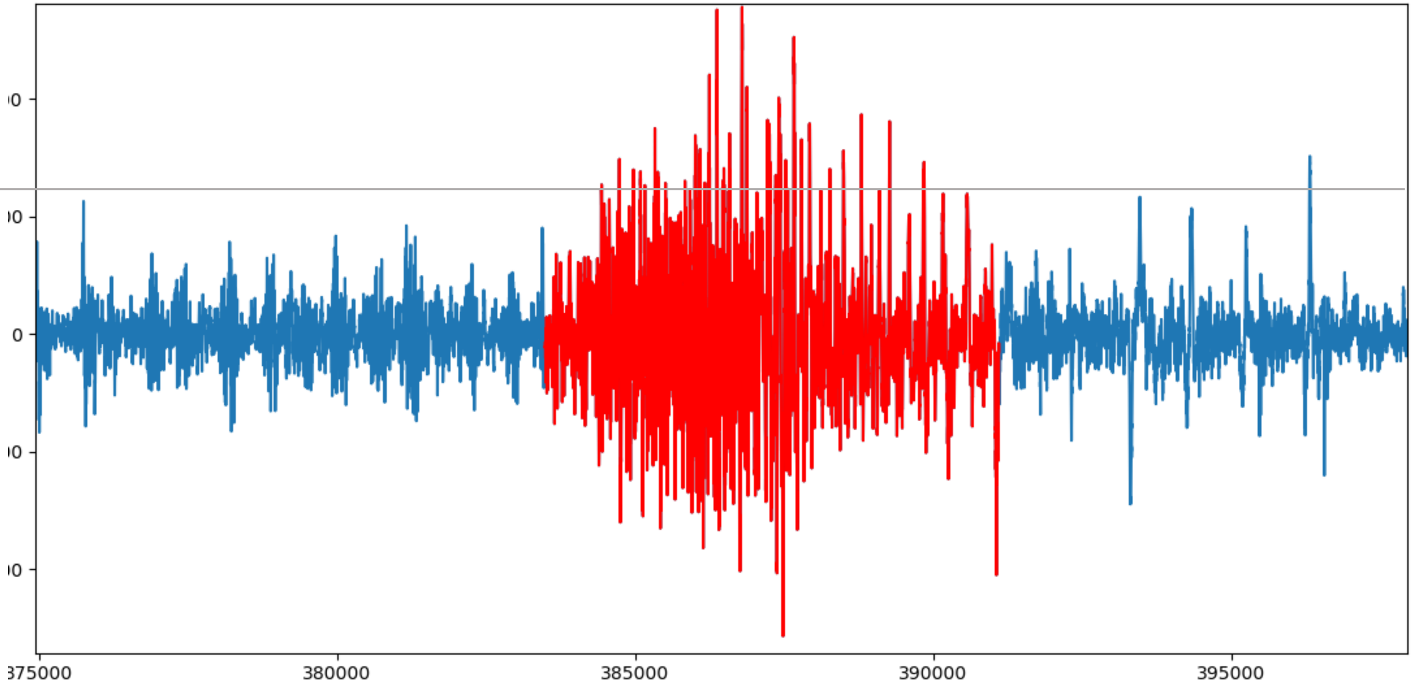
EEG device with 21 electrodes

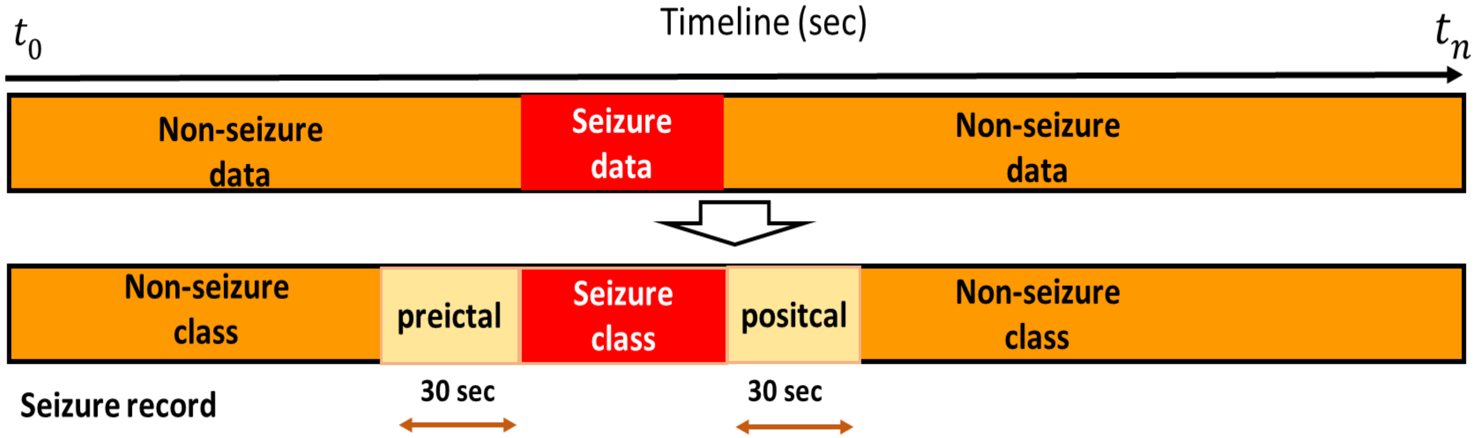




Annotated windows

Signals resampled at 128 MHz and cropped in 1sec temporal windows



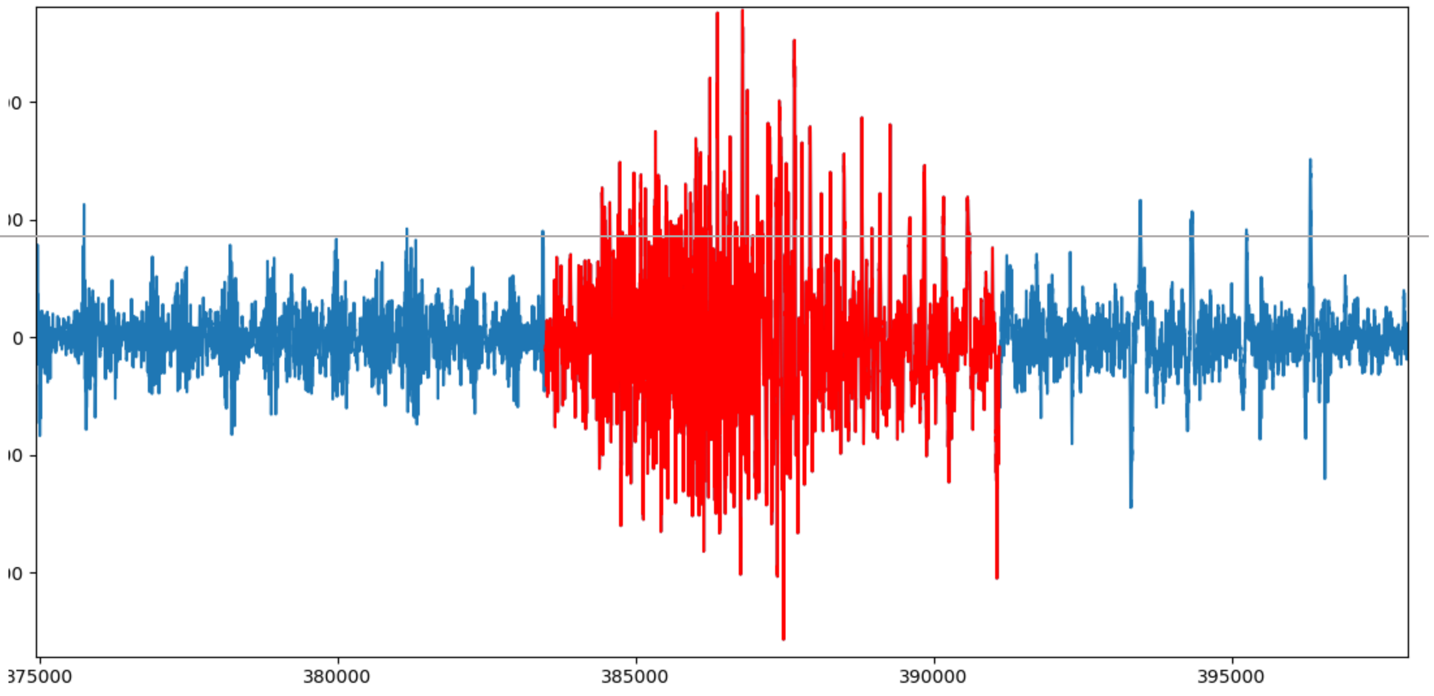


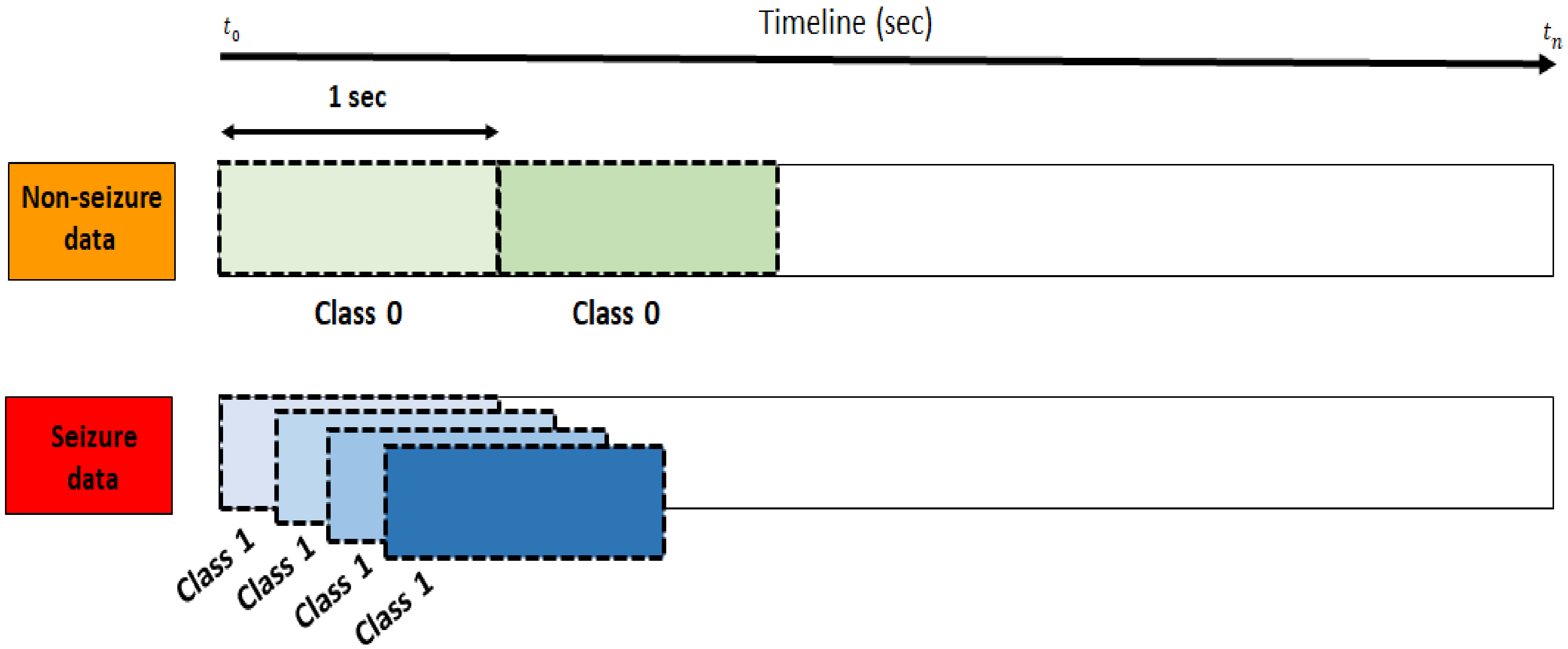
Windows annotations:
0-normal
1-ictal

pre and post ictal intervals have to be discarded

Annotated windows

Ictal windows with 80% overlap for ictal data augmentation





Annotated windows files

1. npz files with EEG Windows signals:

PatID_seizure_EEGwindow_1.npz
PatID ={chb_01, …., chb24}
EEG_win is ndarray of size [NWinPatID, 21, 128]

Number of annotated windows

Length of the 1 sec. window

Number of EEG Channels

Annotated windows files

2. parquet with EEG Windows Metadata: PatID_seizure_metadata_1.parquet

Dataframe with class, recording identifier (.edf), normal/ictal Interval identifiers of each window

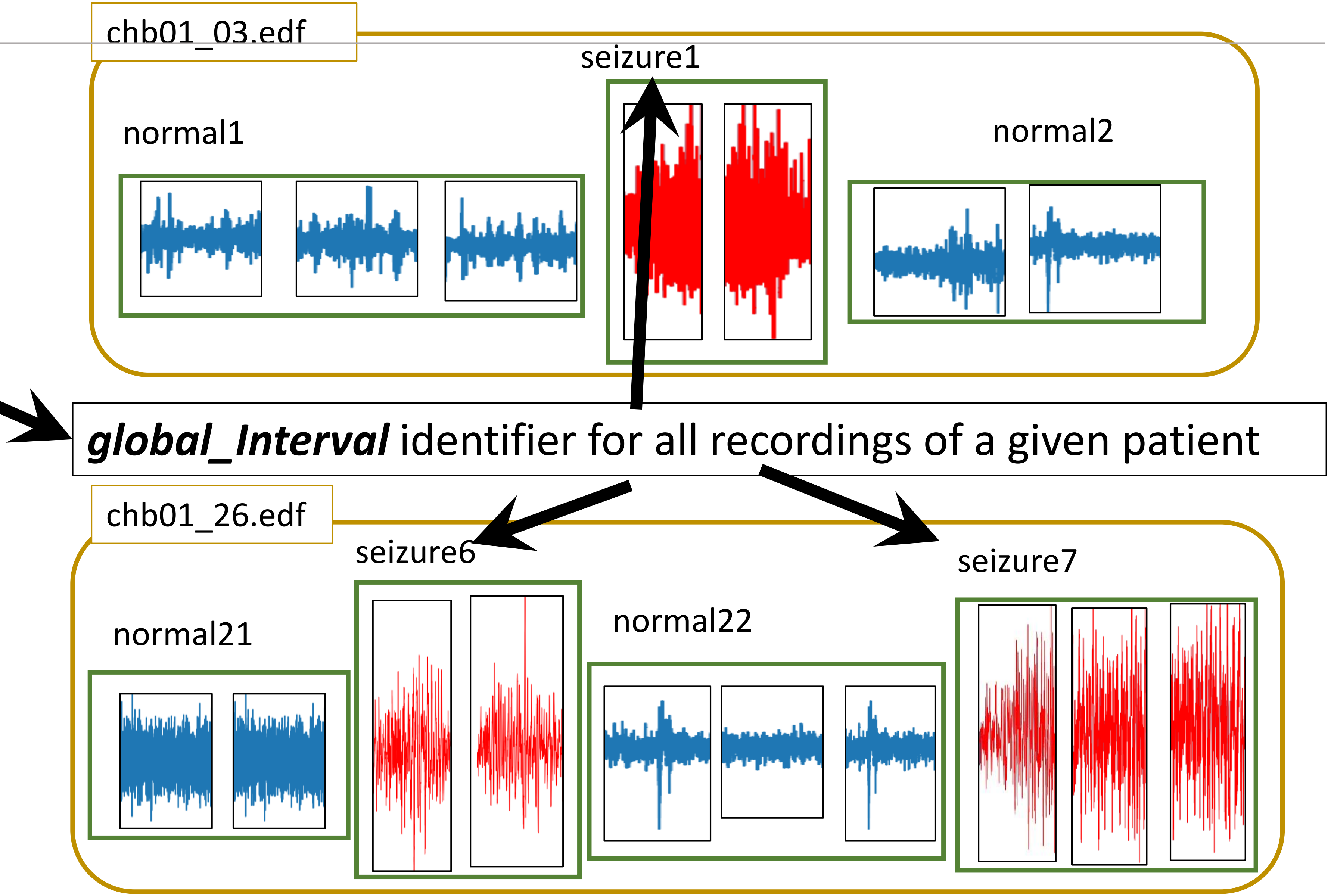
	class	filename_interval	global_interval	filename
0	0	1	1	chb01_03.edf
1	0	1	1	chb01_03.edf
2	0	1	1	chb01_03.edf
…	…	…	…	
26525	1	2	7	chb01_26.edf
26526	1	2	7	chb01_26.edf
26527	1	2	7	chb01_26.edf
26528	1	2	7	chb01_26.edf

Usefull for data split at the two levels of personalization

```
metadata=pd.read_parquet(
file,engine='fastparquet')
```

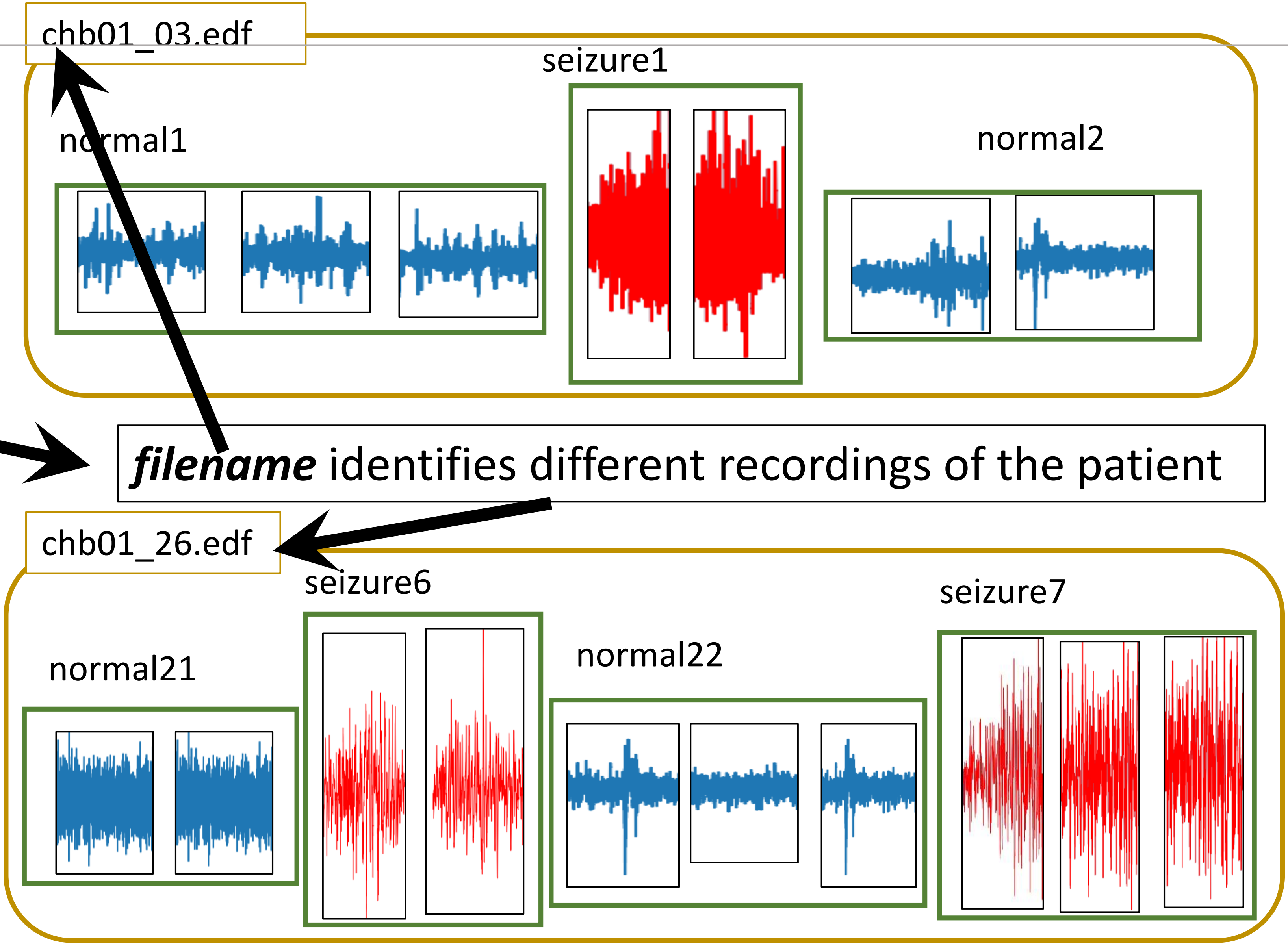
Annotated windows metadata

Personalized model using seizure Interval split



Annotated windows metadata

Personalized model using patient recording split



Annotated windows metadata

Population model using patient split (leave-one-out)

filename.Split('_')[0] identifies the patient

	class	filename_interval	global_interval	filename
0	0	1	1	chb01_03.edf
1	0	1	1	chb01_03.edf
2	0	1	1	chb01_03.edf
...	...	...	...	
26525	1	2	7	chb01_26.edf
26526	1	2	7	chb01_26.edf
26527	1	2	7	chb01_26.edf
26528	1	2	7	chb01_26.edf

CHALLENGE 4. TEMPORAL SIGNALS

Debora Gil