SEB4233
Biomedical Signal Processing

EEG Processing

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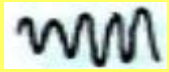
Electroencephalogram (EEG)

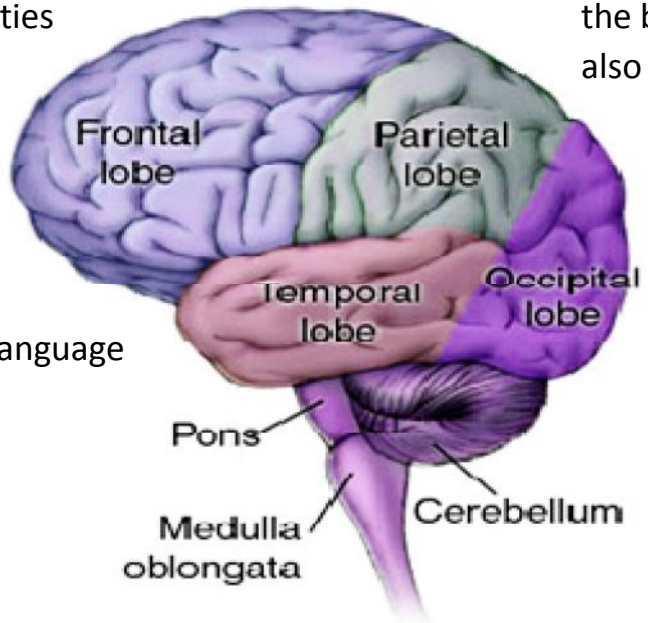
- The electroencephalogram (EEG) is a recording of electrical activity originating from the brain
- Analyzed in four frequency bands associated to certain activities as follows

Type of Wave	Shape	Frequency per second	Amplitude in pV	Physiologic variations of potential		
				In waking EEG		In Sleeping EEG
				Ault	Child	All ages
beta		14-30	5-50	Frontal and precentral prominent, in clusters	Seldom prominent	Beta-activity ("spindles") sign of light sheep
alpha		8-13	20-120	Predominant activity	Predominant activity, age 5 and above	Not a sign of sleep
theta		4-7	20-100	Constant, not prominent	Predominant activity, from 18 mos. To 5 years	Normal sign of sleep
delta		0.5-3	5-250	Not prominent	Predominant activity until 18 mos.	Concomitant sign of deep sleep
gamma		31-60	-10	Laws governing predominance and localization not fully known		

Brain Lobes

Frontal lobe
control skilled muscle movements, mood, planning for the future, setting goals and judging priorities

Parietal lobe
receives and processes information about temperature, taste, touch, and movement coming from the rest of the body. Reading and arithmetic are also processed in this region



Occipital lobe
process visual information

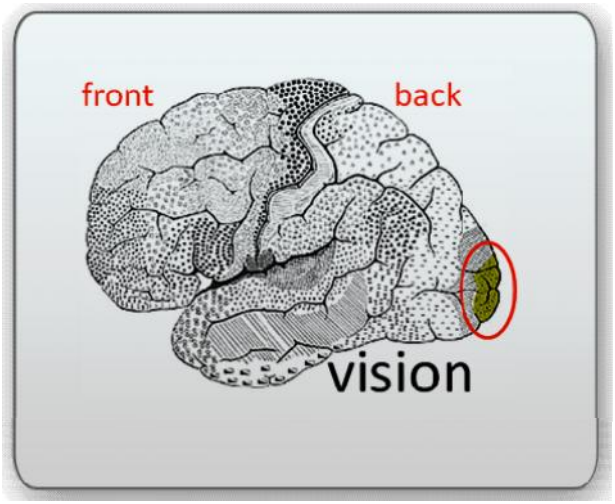
Temporal lobe
hearing, memory and language functions

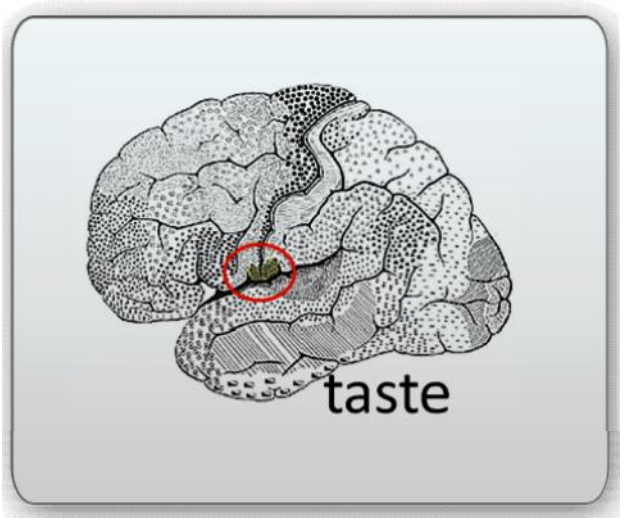
Cerebellum
coined as the "little brain", it governs movement, postural adjustments and stores memories for simple learned motor responses

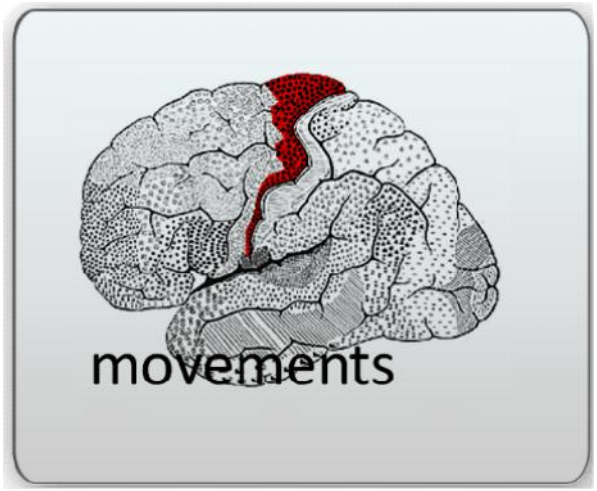
Pons
contains centres for the control of respiration and cardiovascular functions. It is also involved in the coordination of eye movements and balance

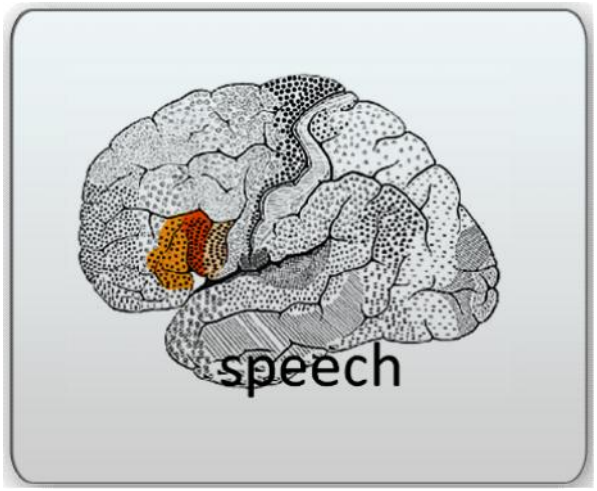
Medulla oblongata
contains centres for the control of heart rate, respiration, blood pressure and swallowing

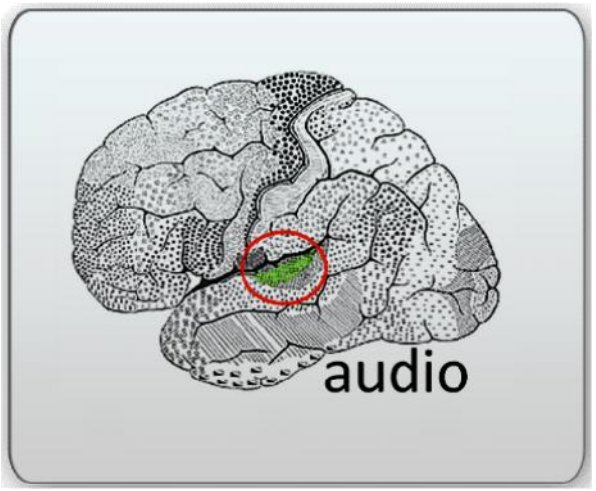
Brain Lobes











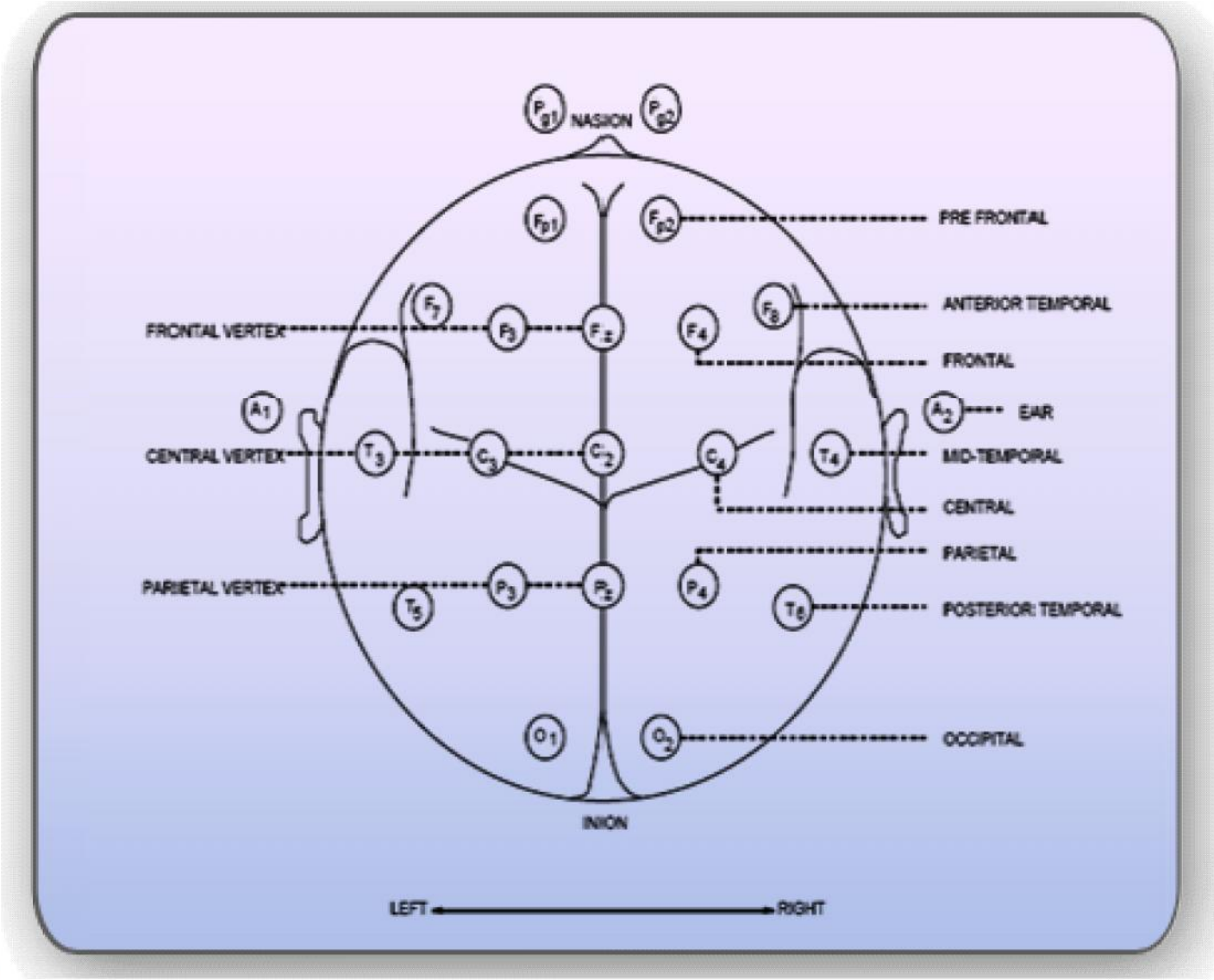
Recording of EEG

- The recording can be performed non-invasively (scalp EEG), directly on the brain cortex (cortical EEG) or within the brain (depth EEG).

- The placement of EEG electrodes on the scalp usually follows a standard arrangement known as the 10-20 system.

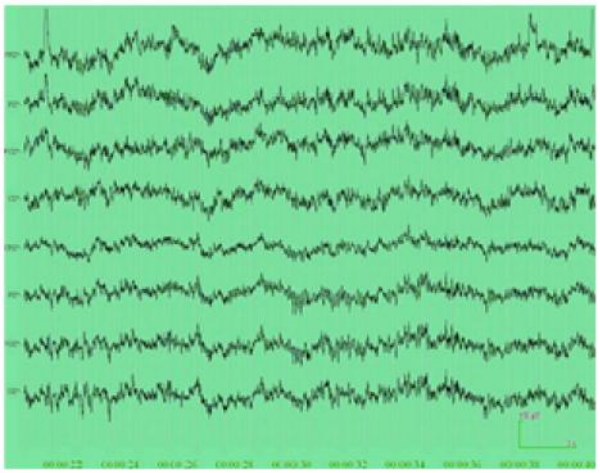
- This system was devised by the International Federation of Societies for Electroencephalography and Clinical Neurophysiology.

10-20 system

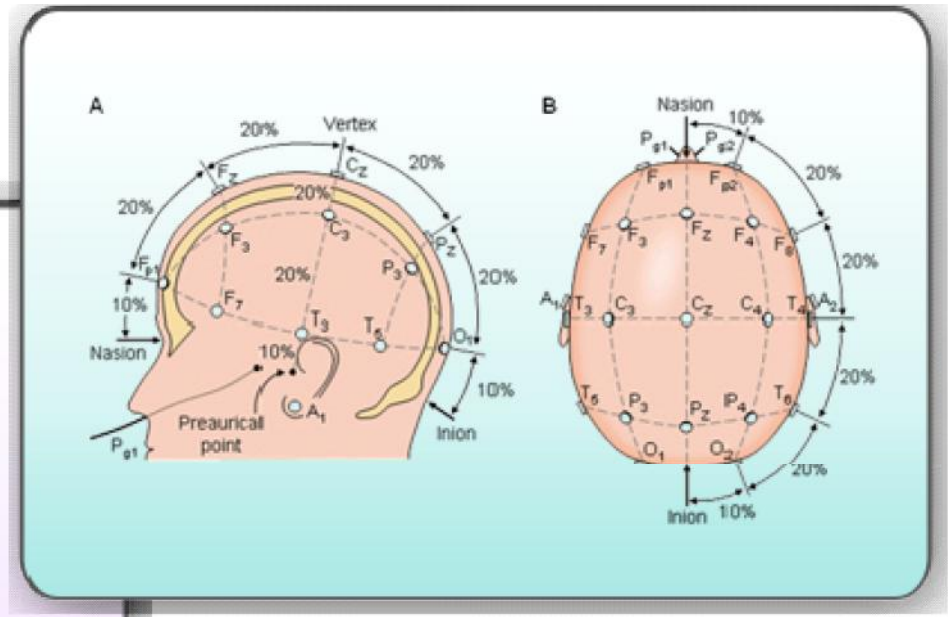

NASION
PRE FRONTAL
ANTERIOR TEMPORAL
FRONTAL VERTEX
FRONTAL
EAR
CENTRAL VERTEX
MID-TEMPORAL
CENTRAL
PARIETAL
PARIETAL VERTEX
POSTERIOR TEMPORAL
OCCIPITAL
INION
LEFT
RIGHT

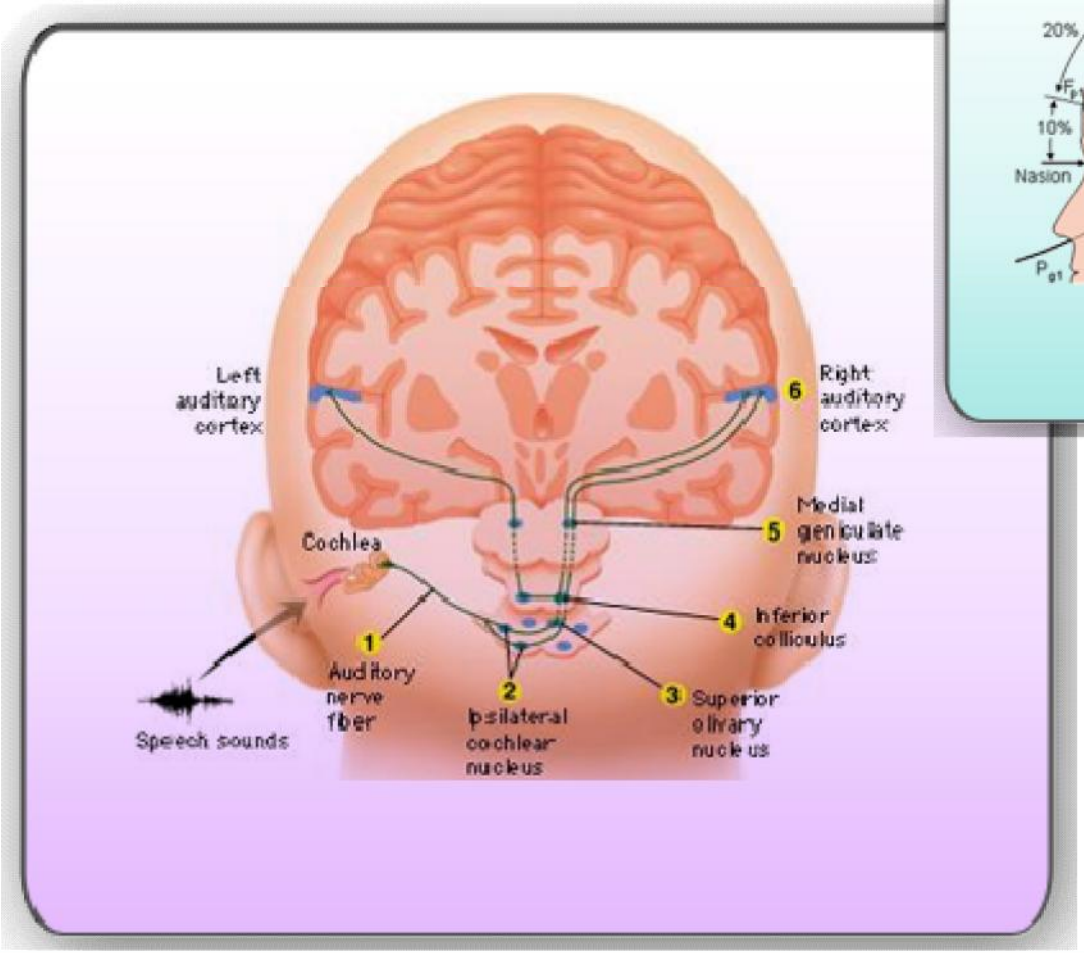
10-20 system

- Even numbered electrodes are placed on the right side of the head, and odd are placed on the left.
- The electrodes in this arrangement are placed along a bisecting line drawn from the nose (nasion) to the back of the head (inion), first at the position 10% of the distance along the line, then at 20% intervals.
- The notation F stands for frontal lobe, C for central sulcus, P for parietal lobe, and O for occipital lobe, Pg is the nasopharyngeal point (nose) and A is on the ear lobe.



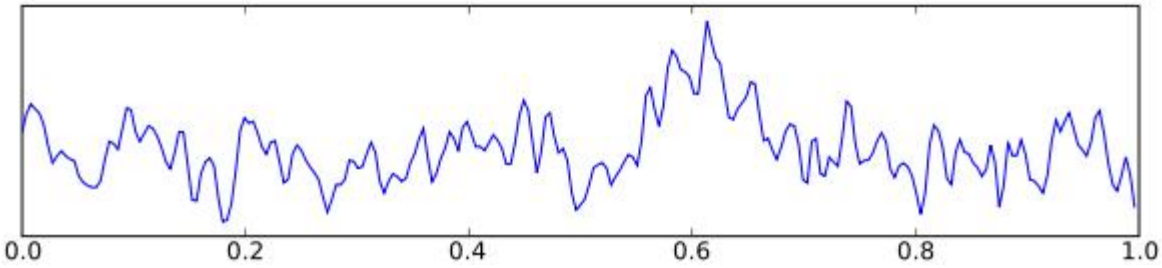
Sensor Placement : EEG



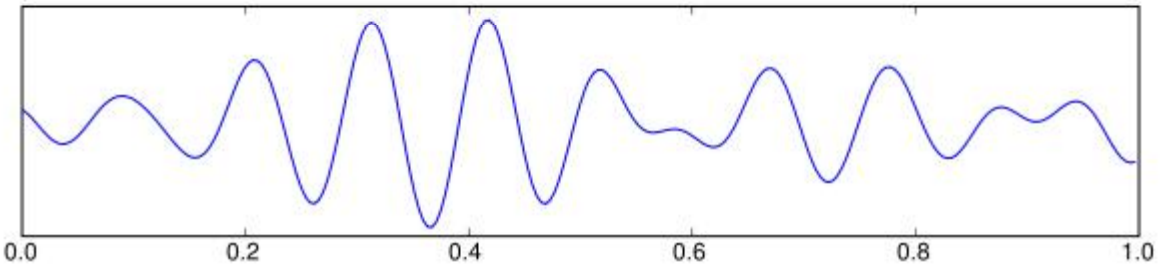


EEG Signal

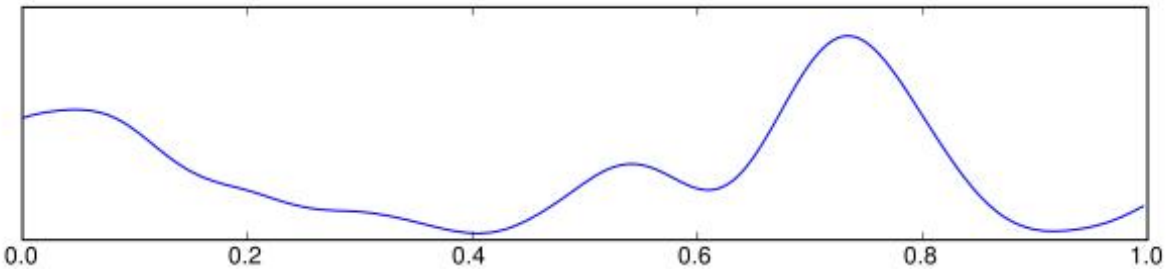
- EEG Signal



- Alpha waves

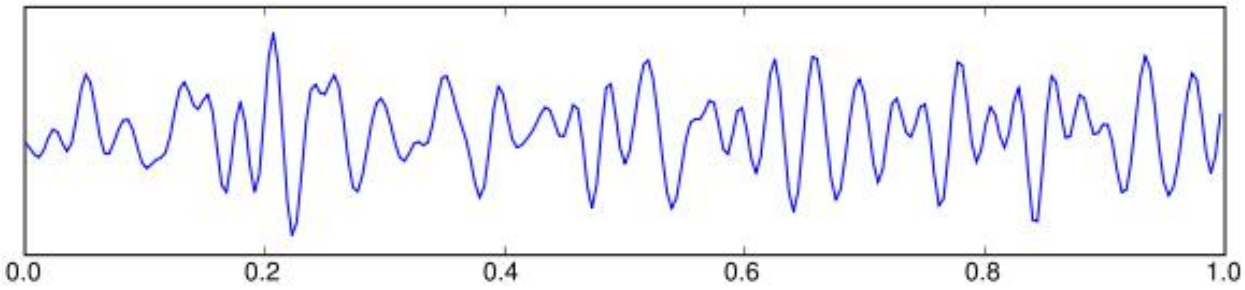


- Delta waves

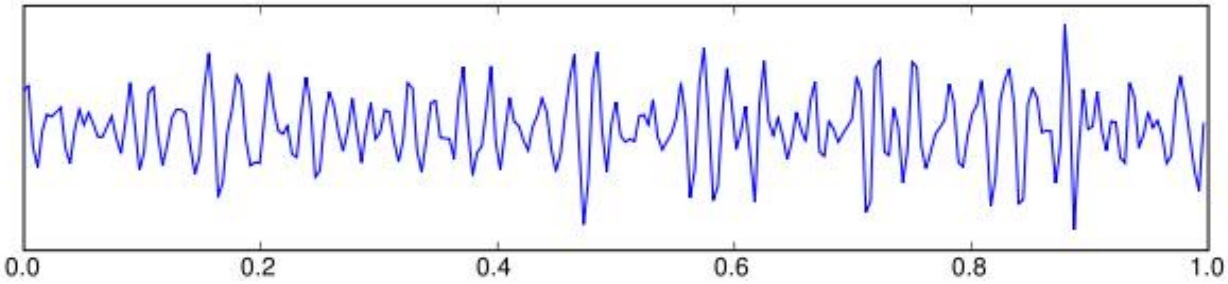


EEG Signal

- Beta waves



- Gamma waves



- Theta waves