# EEG data analysis and AI/ML methods for brain conditions

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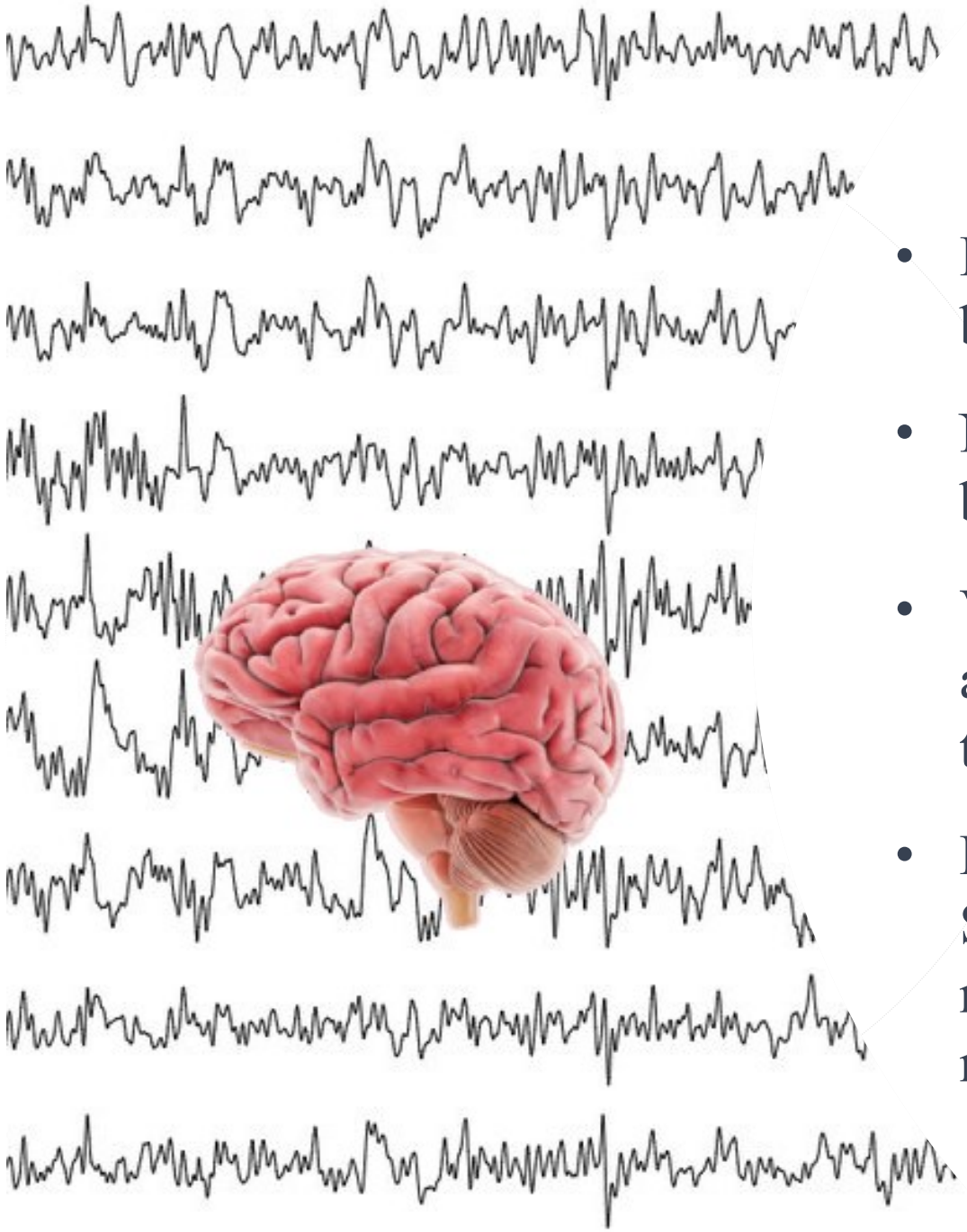
Motivation

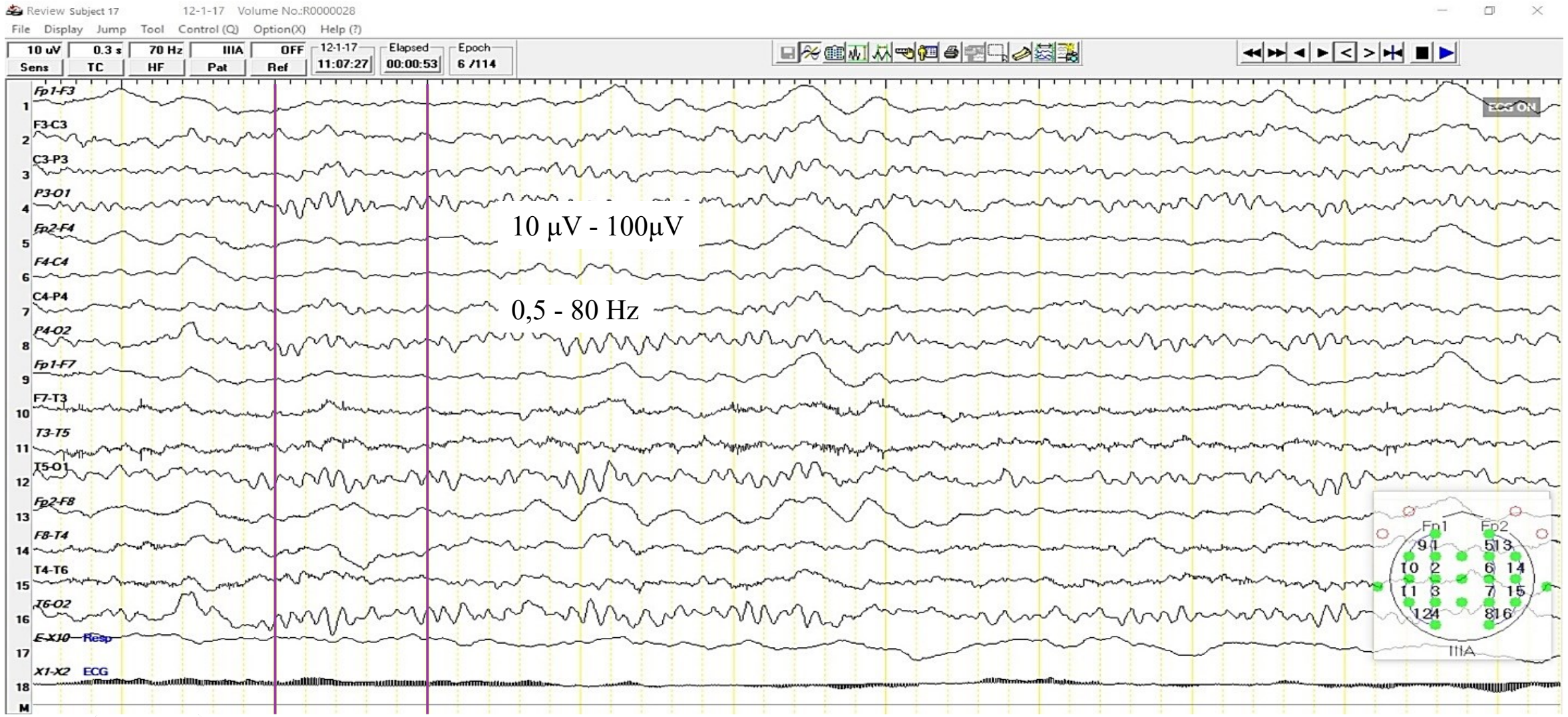

# Christina – Zoe



# The Electroencephalogram

- EEG measures the electrical activity of the brain
- Non-invasive way to capture and record the brain's electrical signals
- Various techniques and algorithms can be applied to extract meaningful information from the EEG data.
- Mainly used to detect epilepsy and monitor Sleep disorders Alzheimer’s Disease, neurological and development disorders and many other brain conditions.

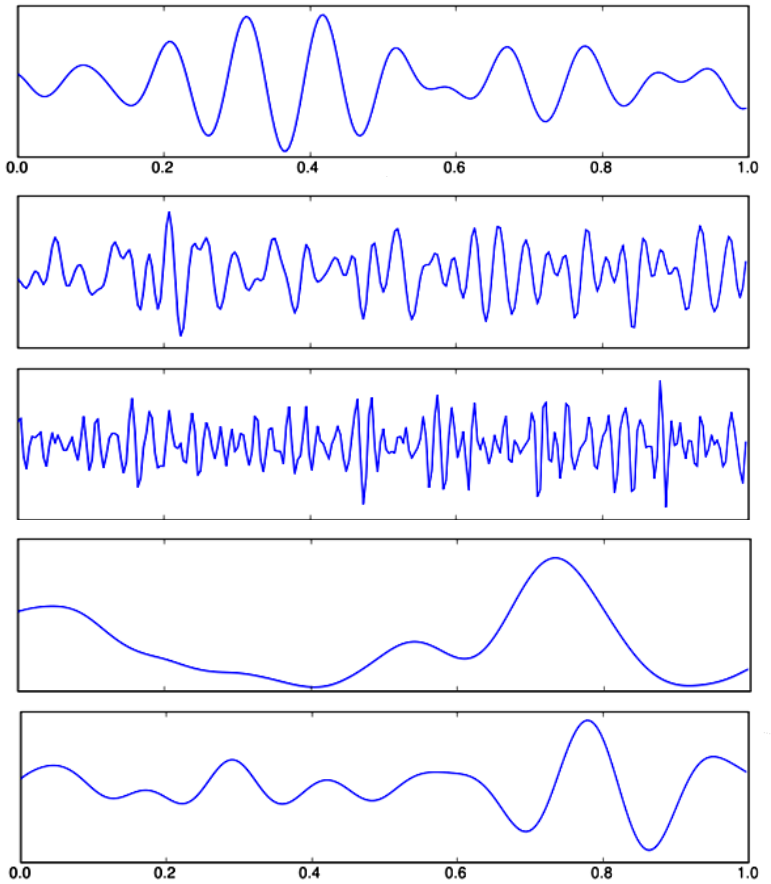
# The Electroencephalogram



# Brain Activity

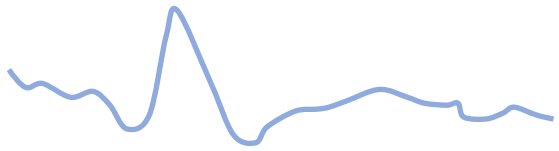


| Rhythm | Frequency (Hz) | Amplitude (μV) |
|---|---|---|
| alpha | 8-13 | 30-50 |
| beta | 13-30 | <20 |
| gamma | 30-50 | 10-100 |
| delta | 0.5-4 | 100-300 |
| theta | 4-8 | <30 |

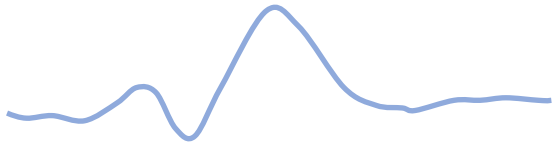


# Abnormal EEG patterns

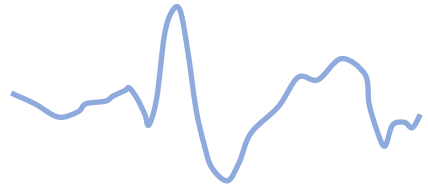




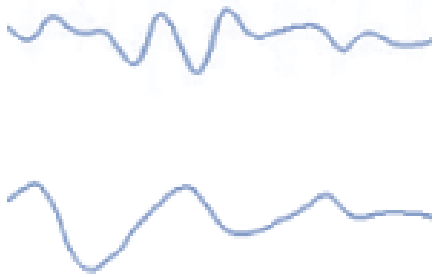
Spike



Sharp wave



Spike-wave complex



Frequency changes in waveforms

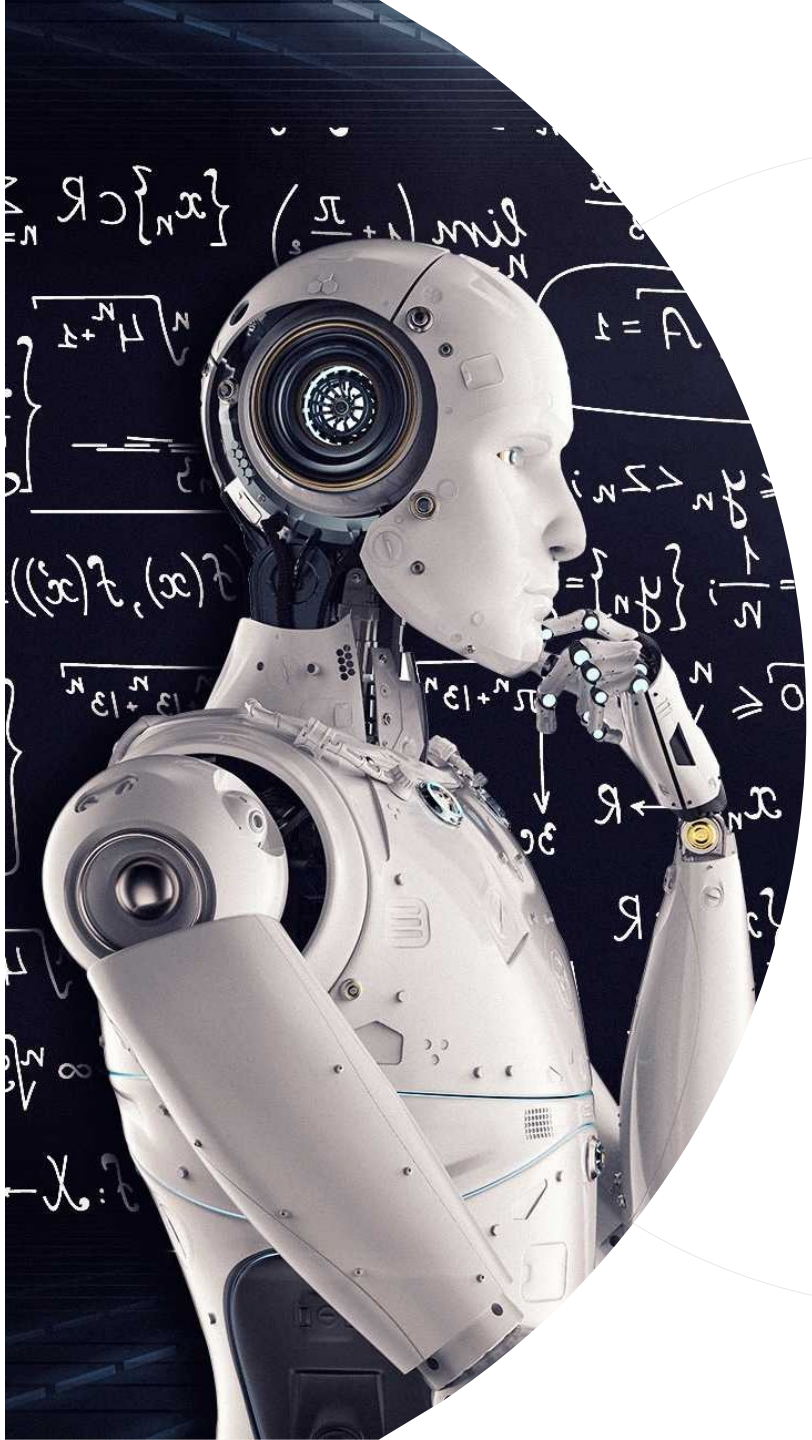
polyspike-wave complex

# Abnormal EEG recordings



The Electroencephalogram

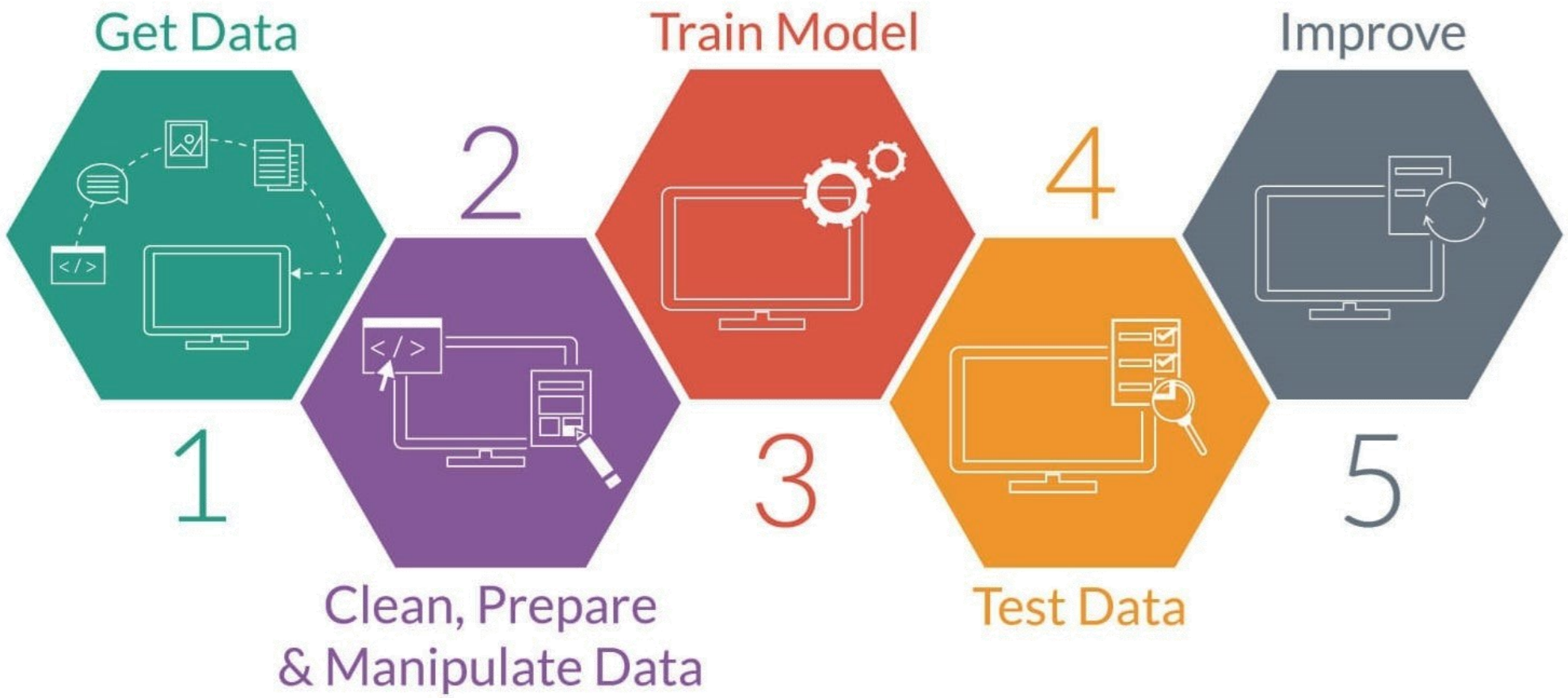
# Machine Learning



- Machine learning (ML) is a subfield of artificial intelligence (AI) that focuses on the development of algorithms and models that enable computers to learn and make predictions or decisions without being explicitly programmed.
- ML algorithms learn from data, identify patterns, and make informed predictions or decisions based on that data.

# Machine Learning Process

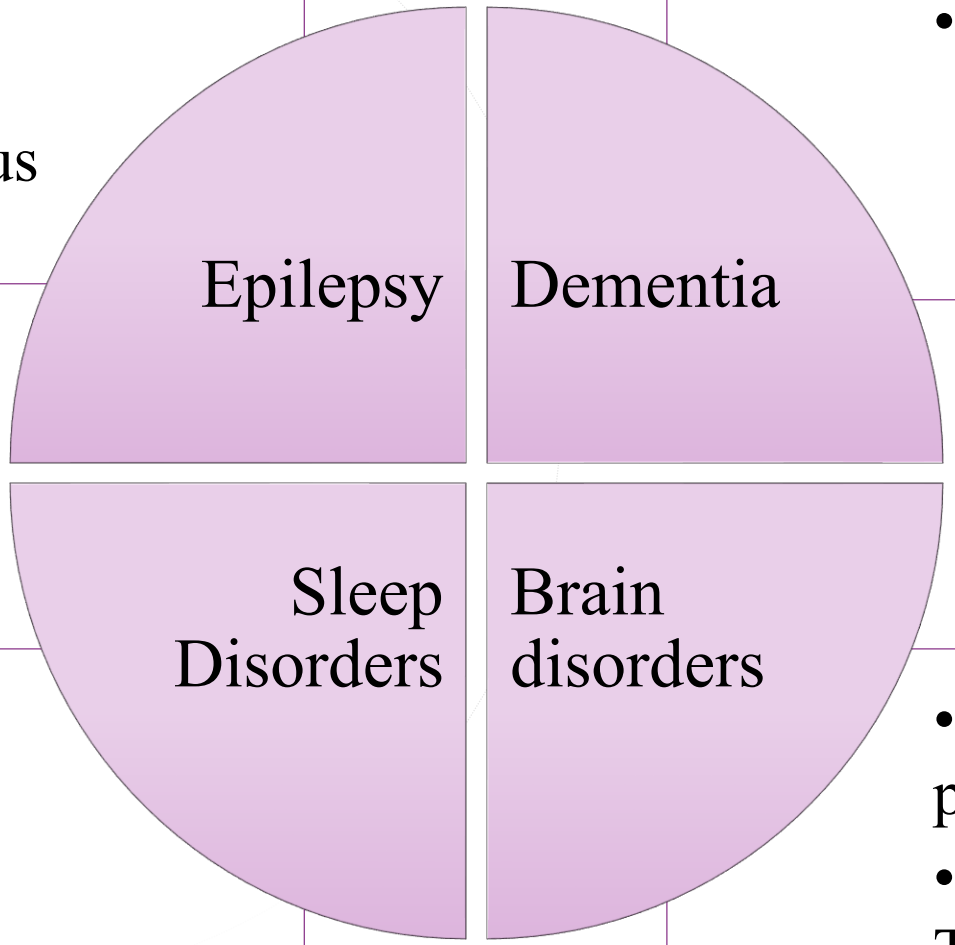




# EEG Analysis with Machine Learning techniques



- Seizure Detection
- Seizure Prediction
- Epileptogenic Focus Localization




- Quantitative EEG biomarkers for cognitive decline

- Sleep patterns and abnormalities identification

- Monitor disease progression
- Personalized Treatment Planning

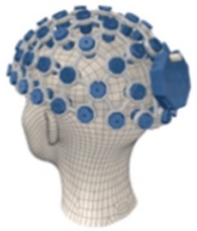

EMOTIV
*Insight, Epoc x, Flex*

*NextMind*

*g.Nautilus PRO*

Neurosky
*Mindwave*

InteraXon
*Muse*



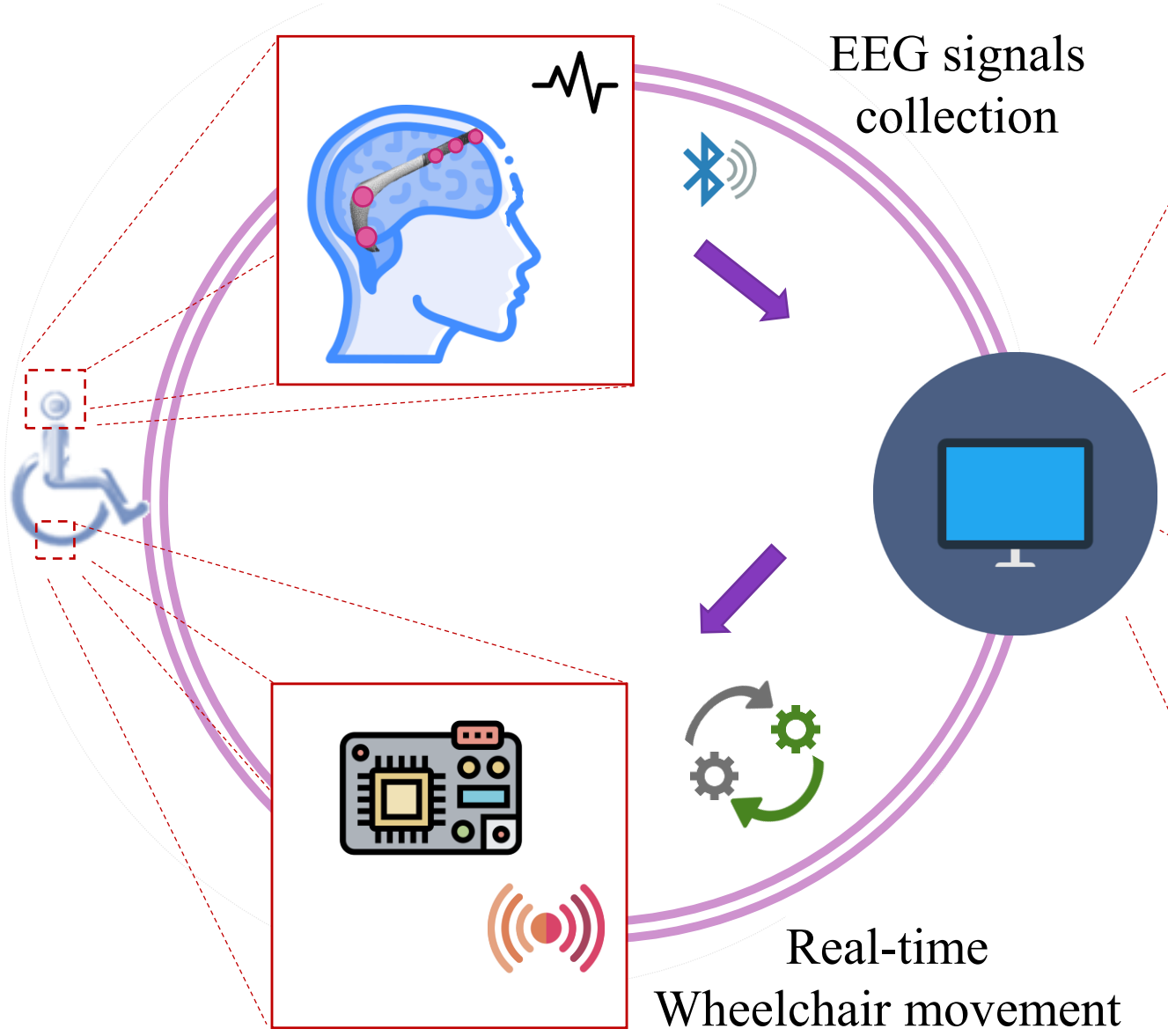
*OpenBCI*

*Unicorn Hybrid Black*

# Brain Computer Interfaces

- It is a technology that enables direct communication between the human brain and an external device, such as a computer or a prosthetic device, without using traditional means like muscles or peripheral nerves.
- BCIs are designed to interpret brain activity and convert it into actionable commands or information.

# Intelligent EEG-based Wheelchair control System




## Offline training

- EEG signal Preprocessing
- Feature extraction
- Mental commands classification

## Online testing

- Feature extraction
- Mental commands classification
- Wheel drive command

# Symptoms

- Seizures
- Sleep disorders
- Intellectual disability
- Developmental delay
- Speech and language impairments
- Behavioral issues
- Wide, short skull (brachycephaly)
- Hypotonia

KLEEFSTRA SYNDROME

*How can EEG machine learning research help individuals with Kleefstra syndrome?*

## RESEARCH

Gain insights into specific patterns of brain activity

## MONITOR

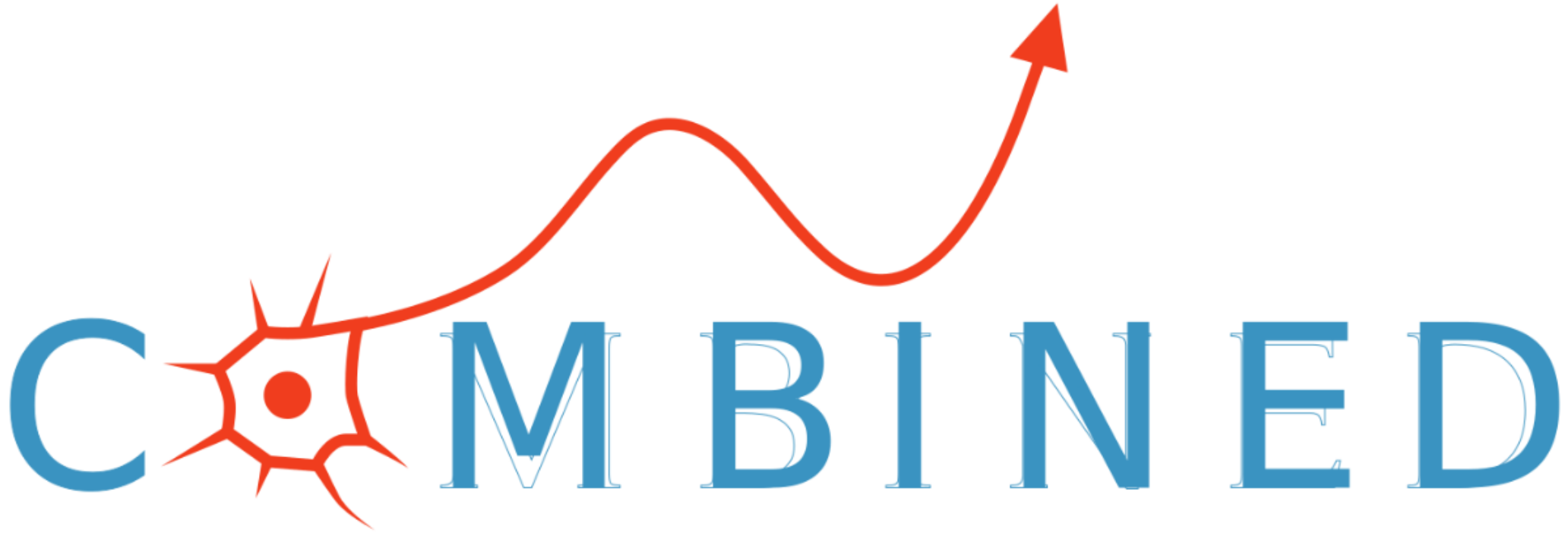
Monitor brain condition and assess treatment efficacy

## KNOWLEDGE

Understand the underlying mechanisms of Kleefstra Syndrome

# Opportunity to establish KS biorepository






IDEFINE
Unlock the Potential

# Thank you!

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