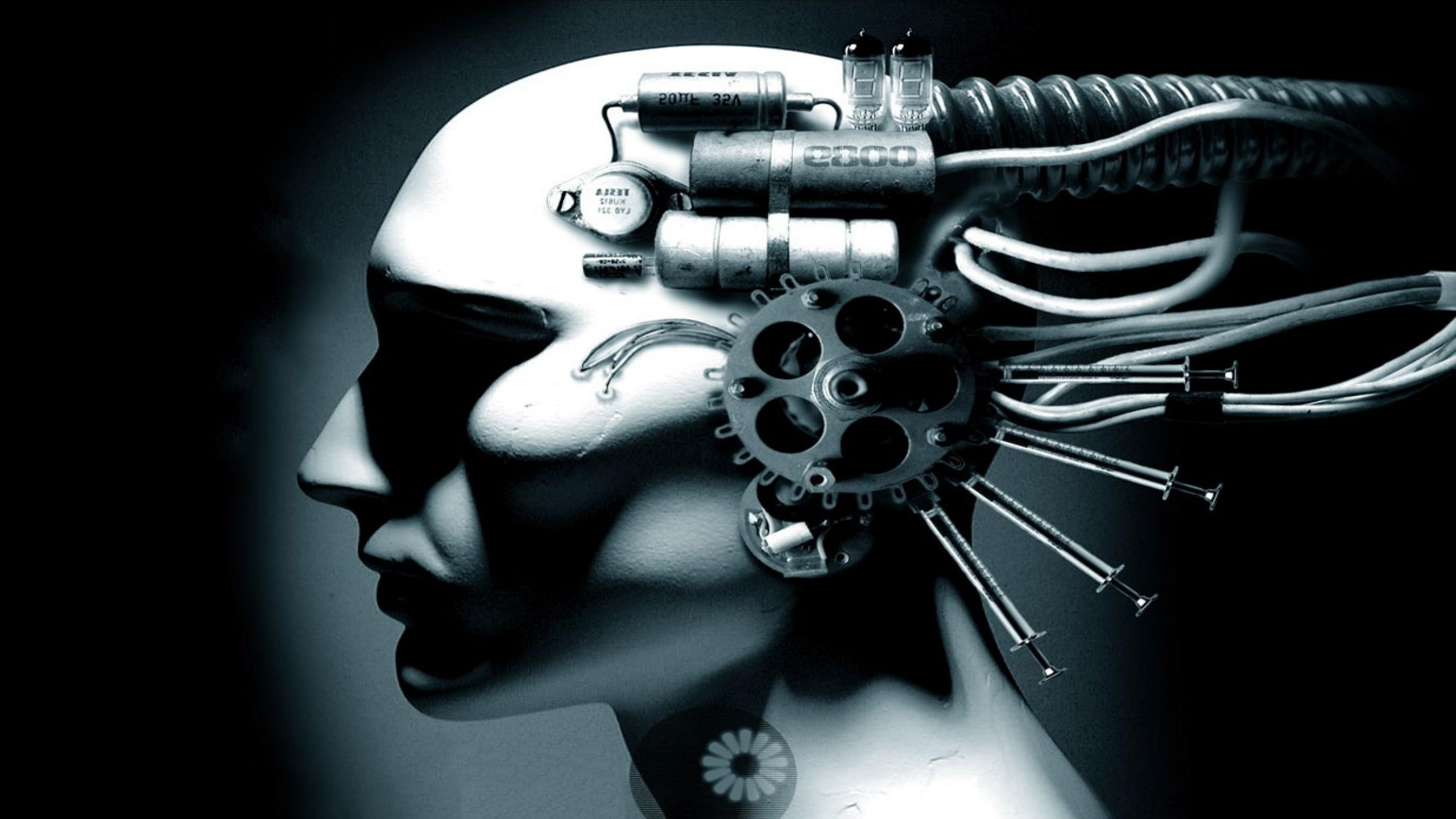


Agenda…

- Historical Events
- Mind Control your Computer
- The Neuroheadset
- Non-Invasive EEG
- EEG Data
- Reading Facial Expressions [Expressiv]
- Reading Emotions [Affectiv]
- Reading Conscious Thought [Cognitiv]
- Usages
- Large Scale EEG Processing with Hadoop
- Advantages of BCI

Historical Events

- 1924 ,Hans Berger, a German neurologist was the first to record human brain activity by means of EEG.
- 1970, Research on BCIs began at the University of California Los Angeles (UCLA).
- 1978, A prototype was implanted into a man blinded in adulthood.
- Following years of animal experimentation, the first neuroprosthetic devices implanted in humans appeared in the mid-1990s.
- 2005. Matthew Nagle was one of the first persons to use a BCI to restore functionality lost due to paralysis.
- 2013 Duke University researchers successfully connected the brains of two rats with electronic interfaces that allowed them to directly share information, in the first-ever direct brain-to-brain interface.

Mind Control Your Computer

Neuro Headset

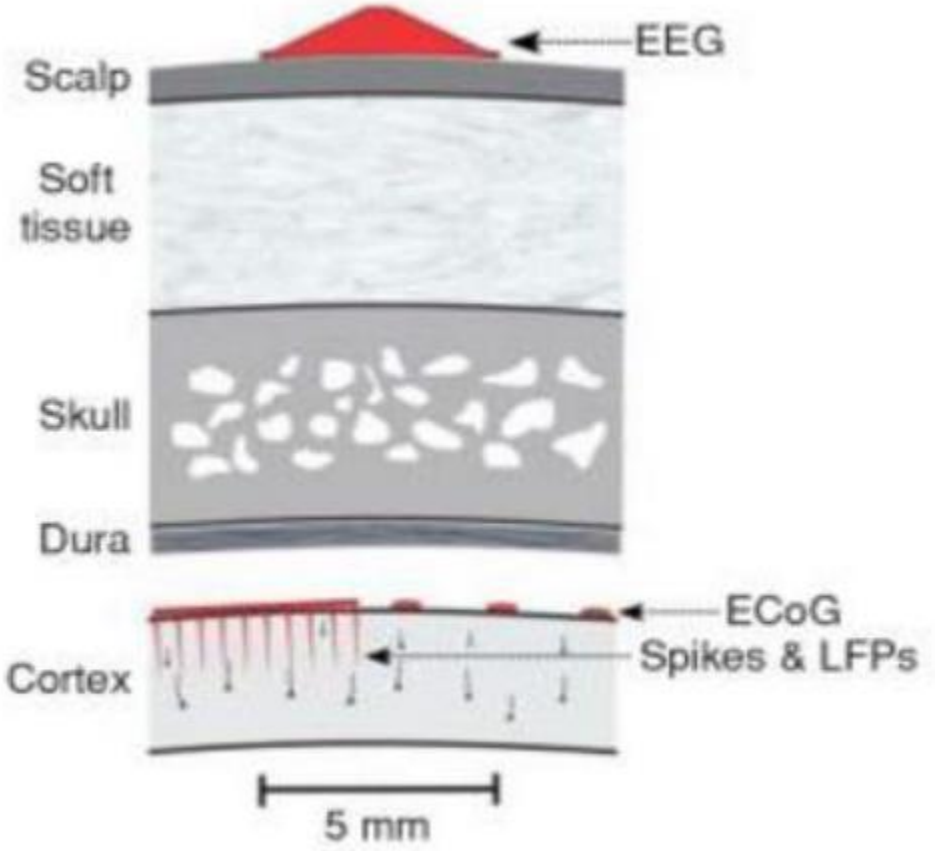
Non-Invasive EEG

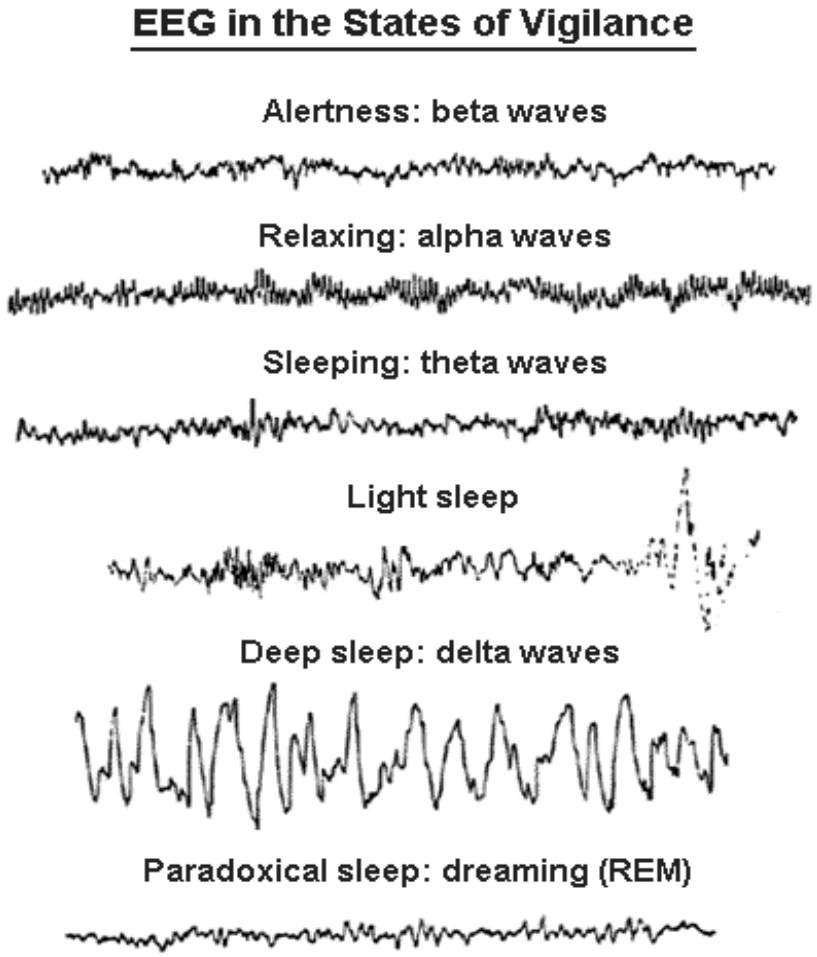
It is the most useful neuron signal imaging method which is applied to the outside of the skull, just applied on the scalp.

Techniques

- Electroencephalography [EEG]
- Magnetoencephalography [MEG]
- functional Magnetic Resonance Imaging [fMRI]

EEG Data


EEG
Scalp
Soft tissue
Skull
Dura
ECoG
Spikes & LFPs
Cortex
5 mm


EEG in the States of Vigilance
Alertness: beta waves
Relaxing: alpha waves
Sleeping: theta waves
Light sleep
Deep sleep: delta waves
Paradoxical sleep: dreaming (REM)

EEG Data

- Generally grouped by frequency: (amplitudes are about 100μV max)

Type	Frequency	Location	Use
Delta	<4 Hz	everywhere	occur during sleep, coma
Theta	4-7 Hz	temporal and parietal	correlated with emotional stress (frustration & disappointment)
Alpha	8-12 Hz	occipital and parietal	reduce amplitude with sensory stimulation or **mental imagery**
Beta	12-36 Hz	parietal and frontal	can increase amplitude during intense **mental activity**
Mu	9-11 Hz	frontal (motor cortex)	diminishes with movement or **intention of movement**
Lambda	sharp, jagged	occipital	correlated with visual attention
Vertex			higher incidence in patients with epilepsy or encephalopathy

Mind Control Your Computer

Reading Facial Expressions [Expressiv]

- Blink
- Right wink / Left wink
- Look Right / Left
- Raise Brow
- Smile
- Clench
- Laugh

Mind Control Your Computer

Reading Emotions [Affectiv]

- Real time changes in the subjective emotions experienced by the user.
- Affectiv Detections
  - Engagement
  - Instantaneous Excitement
  - Long-Term Excitement

Mind Control Your Computer

Reading Conscious Thought [Cognitiv]

- The cognitive detection suite evaluates a user's real time brainwave activity to discern the user's conscious intent.
- Includes Attention and Memory
- Information processing in a participant's or operators mind or brain.

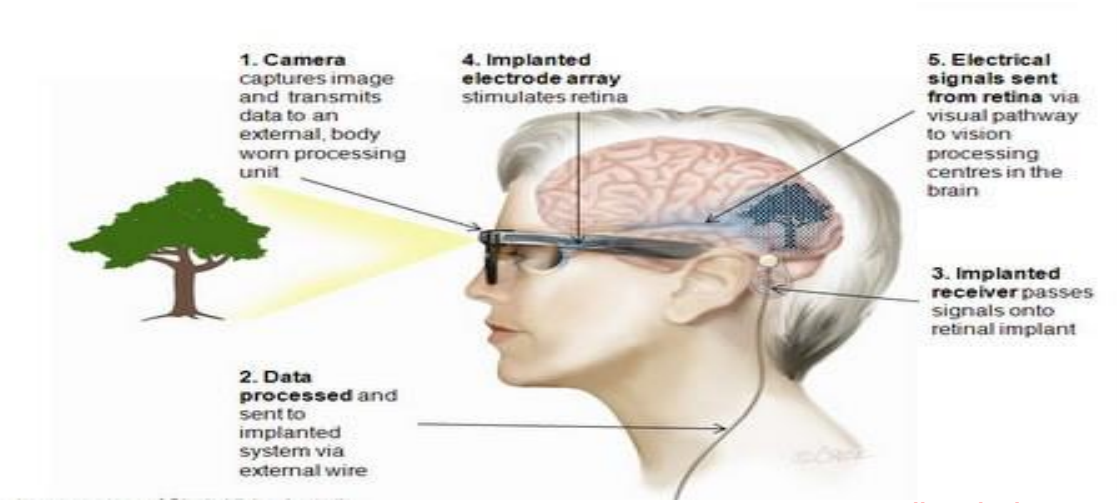
Mind Control Your Computer

- **Usages**
  - PTSD
  - Brain Fingerprinting
  - Gaming
  - Remote Control
  - Aiding the Impaired
  - Research

Mind Control Your Computer

- **P-300 Brain Wave**
  - Brain wave responses in the detection of concealed information
  - **Usages:**
    - Lie Detection
    - Dial an iPhone
    - Brain Hacking

Current Usages



Australian Bionic Eye

Brain Gate

Honda Asimo Control

BCI2000

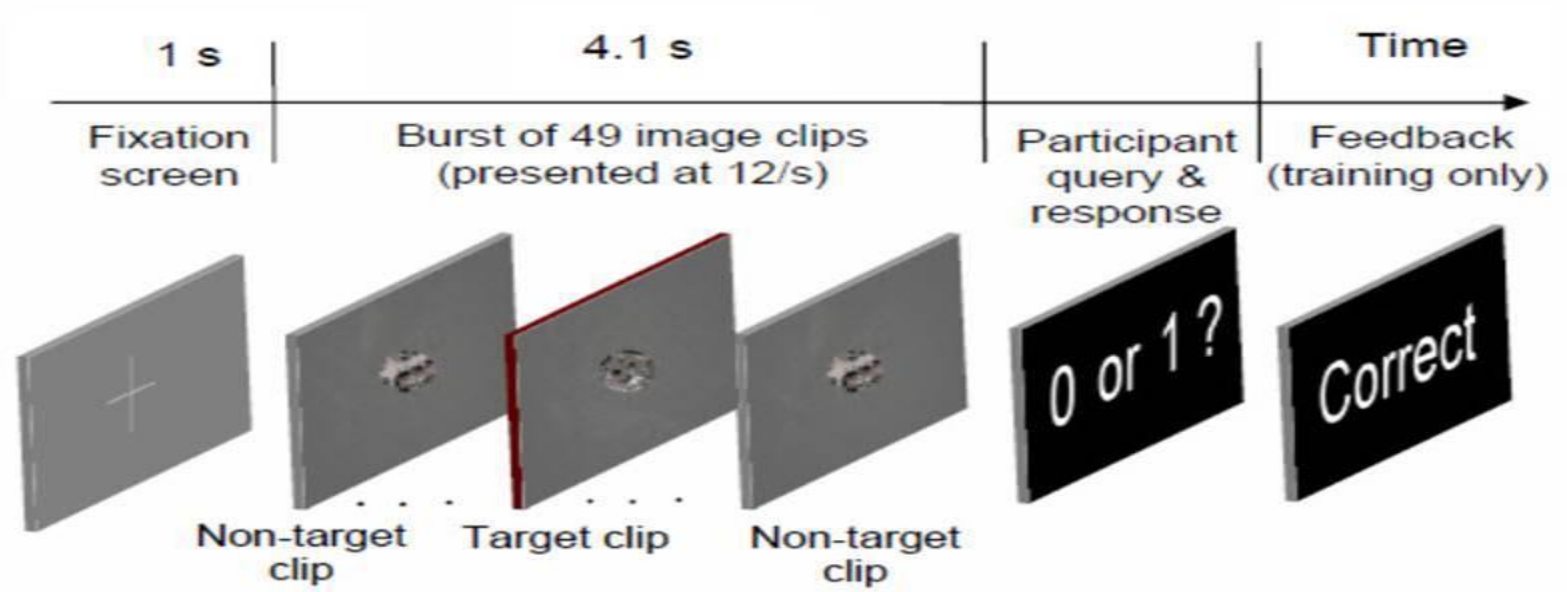
DEMO

Large Scale EEG Processing with Hadoop

- Hadoop
  - Runs on cheap hardware or cloud
  - Robust/mature scheduler and load balancer
  - Data-local task execution
  - Highly redundant / fault-tolerant architecture
  - Live tracking of cluster performance and job status

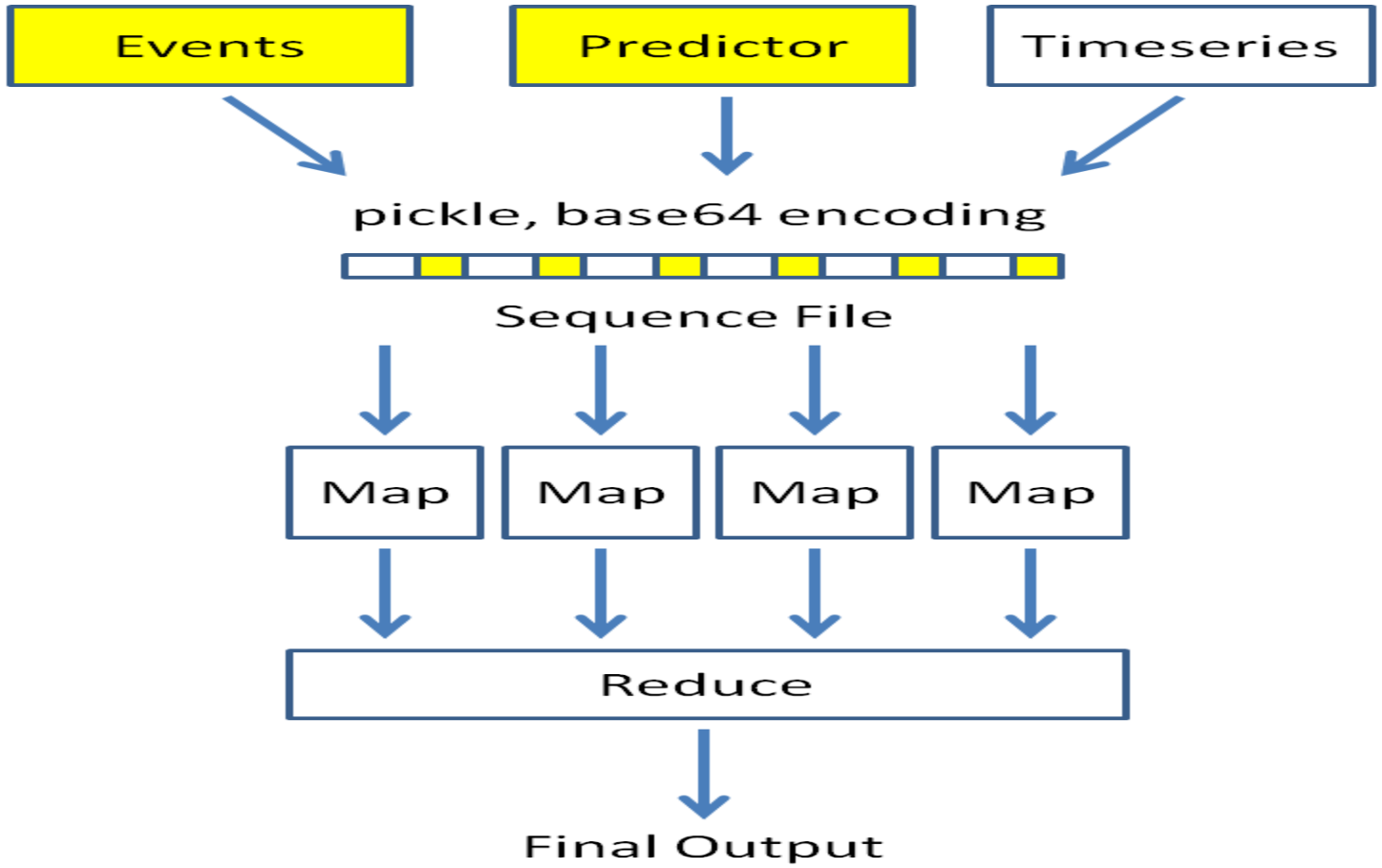
Large Scale EEG Processing with Hadoop

- To demonstrate how hadoop can be applied to EEG analysis, we implement an EEG experiment using the Hadoop Streaming interface.
  - Example Experiment / Problem



Large Scale EEG Processing with Hadoop

- Hadoop Implementation



Advantages of BCI

Eventually, this technology could:

- Allow paralyzed people to control prosthetic limbs with their mind.
- Transmit visual images to the mind of a blind person, allowing them to see.
- Transmit auditory data to the mind of a deaf person, allowing them to hear.
- Allow gamers to control video games with their minds.
- Allow a mute person to have their thoughts displayed and spoken by a computer.
- Deep Learning + Genomics

That's It!
Thank you for Listening

- Questions and Comments ?

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