# BRAINATHON-25

# EEG Attention Multiclassification Challenge

Welcome to **Brainathon-2025**! This event is designed to challenge your analytical skills and creativity by working with real-world EEG data collected during various attention-related tasks. Whether you are new to EEG or a data enthusiast, this competition will provide an exciting opportunity to explore how the human brain processes attention.

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## *Overview of EEG and Attention*

Electroencephalography (EEG) is a powerful tool used to measure the brain's electrical activity. By placing electrodes on the scalp, we can record brain signals that reflect cognitive processes, such as attention.

Attention, a key cognitive function, helps us focus on relevant information while ignoring distractions. Different types of attention—focused, selective, alternating, and divided—are measured using specific experimental paradigms, each designed to probe unique aspects of attention processing.

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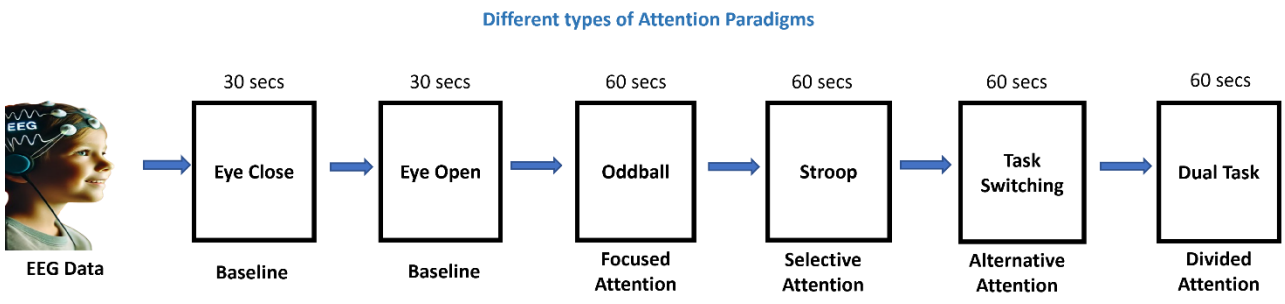
## *About the Dataset*

The dataset contains EEG recordings collected from **24 healthy subjects** aged **20 to 50 years**, using an **8-channel dry EEG system (Brain Product)**. Data was sampled at **250 Hz**, providing detailed temporal resolution.

Each subject's data includes baseline recordings and four attention paradigms: Oddball, Stroop Task, Task Switching, and Dual-Task, designed to assess different types of attention.

- EEG signals and event markers are provided for every paradigm.
- Each paradigm comprises **100 trials**, with each trial lasting **1 minute**.

The EEG channels used in this study are **Fp1, Fp2, F3, Fz, F4, Cz, Pz, and Oz.**




**Flow chart: Data collection on attention paradigms**

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Baseline EEG recordings provide reference brain activity when the subject is at rest. Two conditions are included:

1. **Eyes Open**: The subject sits quietly with their eyes open, focusing on a fixed point for **30 seconds**.
2. **Eyes Closed**: The subject sits with their eyes closed, maintaining a relaxed state for **30 seconds**.

These baseline recordings are crucial for analyzing task-related changes in brain activity and serve as a reference for noise removal and normalization.

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### *Attention Paradigms and Tasks*

**1. Oddball Paradigm**

The Oddball Paradigm is a task designed to measure focused attention and neural responses to rare or target stimuli. Participants are instructed to press the SPACE key when they see a red circle while ignoring blue circles. This paradigm evaluates the brain's ability to differentiate between frequent and infrequent stimuli, typically reflected in enhanced event-related potentials like the P300. The focus here is to measure attention through neural markers such as alpha suppression, which indicates reduced background activity, and gamma oscillations, associated with sensory processing and cognitive engagement.

**2. Stroop Task**

The Stroop Task is a classic paradigm for assessing selective attention and cognitive control. Participants respond by pressing SPACE only when the word displayed matches its color (e.g., "RED" shown in red) while ignoring mismatched conditions (e.g., "RED" shown in blue). This task creates a conflict between automatic and controlled processes, allowing researchers to study neural components like the N2, which is linked to conflict detection, and the P300, which reflects attentional resource allocation and decision-making processes.

**3. Task-Switching Paradigm**

The Task-Switching Paradigm evaluates the cognitive flexibility required to switch between two rules. Participants alternate between pressing SPACE for even numbers and numbers greater than five. This paradigm is ideal for studying alternating attention, as it engages executive control processes needed to shift mental sets. Neural activity during this task is often characterized by theta oscillations, associated with cognitive control, and P3b amplitudes, reflecting the updating of task-relevant information in working memory.

**4. Dual-Task Paradigm**

The Dual-Task Paradigm explores divided attention, where participants respond to two simultaneous tasks: pressing SPACE when a circle turns red or when a target sound is heard. This setup tests the brain's capacity to manage multiple streams of information and allocate resources efficiently. The paradigm focuses on beta activity, which is associated with task engagement and sensorimotor control, and reduced P300 responses, which indicate the cognitive cost of managing dual demands on attention.

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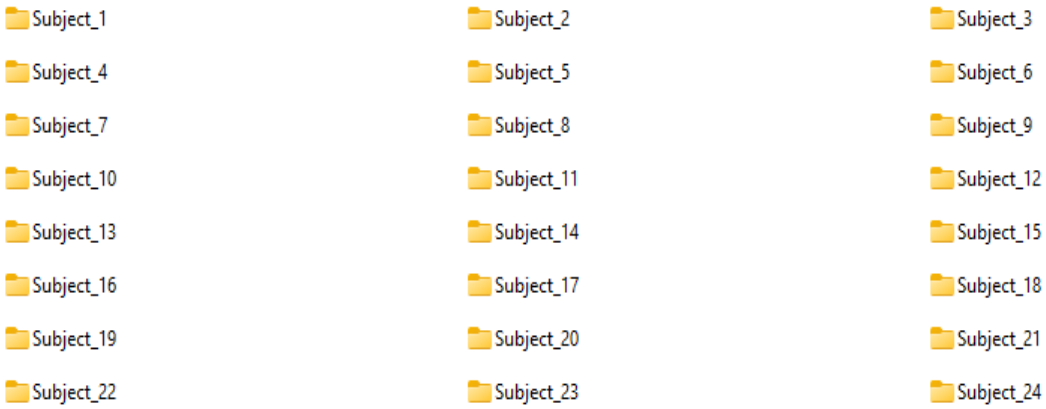
## *Data Organization*

Each subject has a dedicated folder containing EEG and marker files for all paradigms. Here's how the folder is structured:

- **Subject_Folders**: Subject_1, Subject_2, ..., Subject_24.
- **File Naming Convention**: Each file includes the subject number, baseline, paradigm, and type of data (e.g., Subject_1_oddball_paradigm_eeg.xlsx).




**File Types**:

1. **EEG Files**: Contain the raw brain signals recorded during the task.
2. **Marker Files**: Include timestamps for task-specific events (e.g., when a red circle appears).

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- Subject_1_baseline_eyesclosed_eeg
- Subject_1_baseline_eyesclosed_markers
- Subject_1_baseline_eyesopen_eeg
- Subject_1_baseline_eyesopen_markers
- Subject_1_dual-task_paradigm_eeg
- Subject_1_dual-task_paradigm_markers
- Subject_1_oddball_paradigm_eeg
- Subject_1_oddball_paradigm_markers
- Subject_1_stroop_task_eeg
- Subject_1_stroop_task_markers
- Subject_1_task-switching_paradigm_eeg
- Subject_1_task-switching_paradigm_markers

Each file includes raw EEG signals or markers, ensuring all task events are logged for accurate analysis in .csv format.

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Dive into the dataset, uncover the secrets of the brain, and showcase your findings. Best of luck in **Brainathon-2025**!