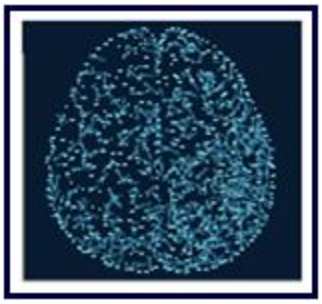
***EEGHUB.GE***



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***EEGHUB.GE***

# Contents

# 1. Introduction

**Overall description and scope of the service**: studying the nature of alteration of basic characteristics of EEG (Electroencephalogram-Brain Electrical Activity) in healthy subjects and patients with different disorders of nervous system (NS) is important for understanding both normal and pathological brain condition. In addition, the accumulation the comparison of EEG in healthy subjects and patients with different disorders of central nervous system (CNS) helps to develop criteria for more adequate assessment of the degree of brain dysfunction.

**Target user community and value provided for it**: identifying EEG predictors during pharmacotherapy and finding EEG biomarkers in patients with CNS disorder (ADHD, epilepsy and etc.) in clinical settings. It will be especially useful in children for the assessment of brain maturation processes; it is particularly informative in psychiatry, neurology for diagnosis of different functional disorders (e.g. ADHD). We have collected large volumes of EEG data http://eeghub.ge/ (normal and pathological) in Georgia and share data with international partners at KTH Royal Institute of Technology (KTH), Stockholm, Sweden and Lesya Ukrainka Eastern European National University (EENU), Lutsk, Ukraine.

The service is free for European (or national) researchers following the FAIR (Findable, Accessible, Interoperable, and Reusable) principles. Service has convenient search engine, which allows users to identify any recordings that correspond to specific requirements. The recordings are easily accessible and can be downloaded for further exploitation. The target users are open-source groups of researchers/practitioners, lecturer/students, Scientific Organization, Hospitals, Universities, etc. It is envisaged that EEG collection http://eeghub.ge/ will support researchers in the field of neuroscience, psychophysiology, medicine, psychology, neurophysiology, cognitive and social science.

This work was initiated as part of the international collaborative project “Computational infrastructure for high-throughput analysis of large volumes of brain signal data”, funded by the Swedish Research Council (Vetenskapsrådet, VR) within the framework of the Swedish Research Links (VR SRL) program.

EEG is informative both in the study of mental processes and in determining the mechanisms of various psychiatric/neurological disorders. The accumulation and comparison of EEG in healthy subjects and patients with different disorders of nervous system (NS) helps to develop criteria for more adequate assessment of the degree of brain dysfunction. The EEG collection allows us to comprehensively evaluate children for brain maturation processes. This can be particularly informative in pediatrics and neurology for the study of the processes of brain maturation. Comparison of the obtained EEG data before, during and after pharmacotherapy will allow to adequately assessing the quality of dysfunction of the brain's regulatory systems. Also in the diagnosis of various cognitive (functional, behavioral) disorders in the field of clinical psychology and in child neurodevelopmental disorders there is an opportunity to evaluate the effectiveness of monitoring of current treatment. The identification of EEG data and key EEG biomarkers for different disorders support effective implementation of therapeutic methodologies at the early stage. This facilitates the validation and potentially the correction of diagnoses and paves the

way for further development of therapeutic strategies increasing the quality of treatment. In addition, it is particularly useful in psychiatry, neurology for diagnosis of different functional disorders.

## 2. Methodology

This database includes EEG data, which has been collected for 15 years at Ivane Beritashvili Center of Experimental Biomedicine and David Tatishvili Medical Center, Tbilisi, Georgia. The data was recorded from healthy subjects (typically developed children, adolescences, adults and elder people) and subjects with different disorders of nervous system, 4087 subjects in total, from both men and women and varying age groups, ranging from 3 months to 75 years. Ethical aspects and privacy rights are protected in agreement with fundamental ethical standards in accordance with the ethical standards of research of the Helsinki Declaration. The identities of participants are anonymized and pseudorandomized. Personal information is removed to ensure full anonymization, there are no names, surnames or data births of the patients, instead pseudorandom numerical identifiers have been used.

The current EEG recordings in the database were performed at the same time of the day, in the morning. The mean duration of an EEG recording was 25-30 minutes including the resting-state-background EEG activity, followed by functional samples (photo stimulation and hyperventilation). The background EEG was recorded with eyes closed (4 minutes), with eyes open (4 minutes), and once again with the eyes closed (4 minutes). Functional trials were performed with rhythmic photostimulation, at frequencies 3-5-10-15-20Hz; hyperventilation (three minutes) - with open, closed eyes and the breath hold (15-25sec) recording was finished with closed eyes. Besides the standard EEG scenario, there are sleep EEG recordings of children under the three year's old. The database consists also of the normal and pathological recording of humans EEG with different dysfunction of NS (for example: headaches, epilepsy, encephalopathy, stroke, ADHD, cerebral palsy and so on).

The ENCEPHALAN 131-03 software MEDICOM was used for digital recording 19 scalp electrodes according to the International 10-20 system. The bandpass of the amplifiers was 0.5-100Hz, and the notch filter was 50Hz. The signals from each input electrode were digitized with at a sampling rate of 256Hz with a resolution of 16 bits. Electrode (Ag/AgCl) impedance will be under 5kΩ.

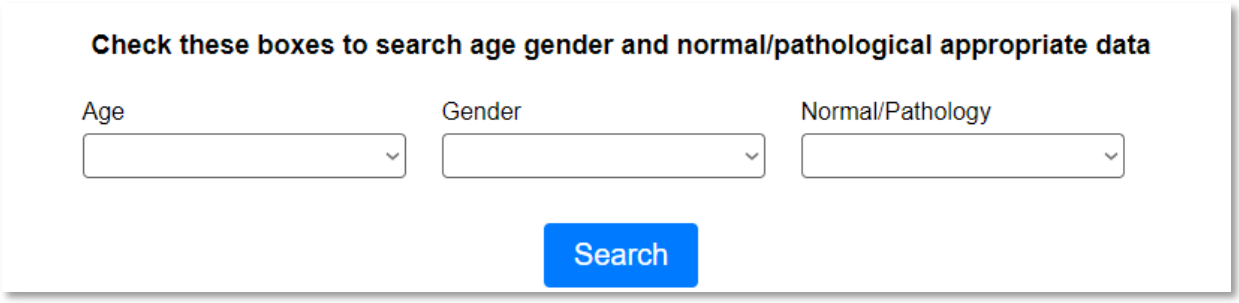
A quantitative analysis of the EEG epochs is conducted using a fast Fourier transformation (FFT) algorithm. The Spectral analysis methods of brain functional activity are used, based on quantitative EEG spectral analysis paradigm and frequency-amplitude characteristics. The spectral analysis is used to calculate absolute value of power (AVP, μV^2s) within 6 frequency bands: Delta (0.5 - 4.0 Hz), Theta-1 (4.0 - 6.0 Hz), Theta-2 (6.0 - 8.0 Hz), Alpha (8 - 13 Hz), Beta (13 - 30 Hz) Gama (30 >- Hz).

The collected EEG data was systematized, curated and stored in an online database in EDF format.

# 3. Description of the Program

## 3.1 Input

a. To search for data, first select filters of age, gender and normal/pathology. The user can also use each filter separately to search for data.




b. After selecting appropriate filters, user should press the **"Search"** button.

## 3.2 Output

a. After pressing "**Search**" button the following database will appear.

The database involves EEG recordings with selected categories: age, gender, normal/pathology, number of visits, pharmacotherapy and recording date.

| Patient code | Age | Gender | Normal Pathology | Number of visits | Pharmacotherapy | Recording date |
|---|---|---|---|---|---|---|
| 55 | 4-6 | Female | Pathology | 1 | Sonapax+Phenibut | 2004-07-27 |
| 13 | 4-6 | Female | Pathology | 1 | Depakine | 2004-08-02 |
| 12 | 4-6 | Female | Pathology | 1 | | 2004-08-03 |
| 140 | 4-6 | Female | | 1 | | 2005-01-13 |
| 146 | 4-6 | Female | | 1 | | 2005-01-17 |
| 152 | 4-6 | Female | Pathology | 1 | | 2005-01-26 |
| 100 | 4-6 | Female | | 1 | | 2005-01-31 |
| 681 | 4-6 | Female | Pathology | 1 | | 2005-02-02 |
| 697 | 4-6 | Female | Pathology | 1 | Depakine+Finlepsin | 2005-02-22 |
| 737 | 4-6 | Female | Pathology | 1 | | 2005-02-26 |
| 715 | 4-6 | Female | Pathology | 1 | | 2005-02-28 |
| 731 | 4-6 | Female | Pathology | 1 | Luminal+Finlepsin | 2005-02-28 |
| 461 | 4-6 | Female | | 3 | | 2005-04-07 |
| 215 | 4-6 | Female | | 1 | | 2005-05-05 |
| 179 | 4-6 | Female | Pathology | 1 | | 2005-05-05 |
| 213 | 4-6 | Female | | 2 | | 2005-05-06 |
| 190 | 4-6 | Female | Pathology | 2 | Depakine | 2005-05-13 |

**Note:** Empty cells under the section of **"Normal/Pathology"** means EEG data of healthy subjects.

### b. Number of visits

The section "Number of visits" indicates number of EEG recordings for each patient, with a specific numerical indicator (1 – for one EEG recording, 2 – for two and so on).

| Patient code | Age | Gender | Normal Pathology | Number of visits | Pharmacotherapy | Recording date |
|---|---|---|---|---|---|---|
| 55 | 4-6 | Female | Pathology | 1 | Sonapax+Phenibut | 2004-07-27 |
| 13 | 4-6 | Female | Pathology | 1 | Depakine | 2004-08-02 |
| 12 | 4-6 | Female | Pathology | 1 | | 2004-08-03 |
| 140 | 4-6 | Female | | 1 | | 2005-01-13 |
| 146 | 4-6 | Female | | 1 | | 2005-01-17 |
| 152 | 4-6 | Female | Pathology | 1 | | 2005-01-26 |
| 100 | 4-6 | Female | | 1 | | 2005-01-31 |
| 681 | 4-6 | Female | Pathology | 1 | | 2005-02-02 |
| 697 | 4-6 | Female | Pathology | 1 | Depakine+Finlepsin | 2005-02-22 |
| 737 | 4-6 | Female | Pathology | 1 | | 2005-02-26 |
| 715 | 4-6 | Female | Pathology | 1 | | 2005-02-28 |
| 731 | 4-6 | Female | Pathology | 1 | Luminal+Finlepsin | 2005-02-28 |
| 461 | 4-6 | Female | | 3 | | 2005-04-07 |
| 215 | 4-6 | Female | | 1 | | 2005-05-05 |
| 179 | 4-6 | Female | Pathology | 1 | | 2005-05-05 |
| 213 | 4-6 | Female | | 2 | | 2005-05-06 |

### c. Pharmacotherapy

This section provides information about pharmacotherapy. Below is shown what type medication the patient was taking. Blank cell means the patient without pharmacotherapy.

| Patient code | Age | Gender | Normal Pathology | Number of visits | Pharmacotherapy | Recording date |
|---|---|---|---|---|---|---|
| 55 | 4-6 | Female | Pathology | 1 | Sonapax+Phenibut | 2004-07-27 |
| 13 | 4-6 | Female | Pathology | 1 | Depakine | 2004-08-02 |
| 12 | 4-6 | Female | Pathology | 1 | | 2004-08-03 |
| 140 | 4-6 | Female | | 1 | | 2005-01-13 |
| 146 | 4-6 | Female | | 1 | | 2005-01-17 |
| 152 | 4-6 | Female | Pathology | 1 | | 2005-01-26 |
| 100 | 4-6 | Female | | 1 | | 2005-01-31 |
| 681 | 4-6 | Female | Pathology | 1 | | 2005-02-02 |
| 697 | 4-6 | Female | Pathology | 1 | Depakine+Finlepsin | 2005-02-22 |
| 737 | 4-6 | Female | Pathology | 1 | | 2005-02-26 |
| 715 | 4-6 | Female | Pathology | 1 | | 2005-02-28 |
| 731 | 4-6 | Female | Pathology | 1 | Luminal+Finlepsin | 2005-02-28 |
| 461 | 4-6 | Female | | 3 | | 2005-04-07 |
| 215 | 4-6 | Female | | 1 | | 2005-05-05 |
| 179 | 4-6 | Female | Pathology | 1 | | 2005-05-05 |
| 213 | 4-6 | Female | | 2 | | 2005-05-06 |

## 3.3 Download Recordings

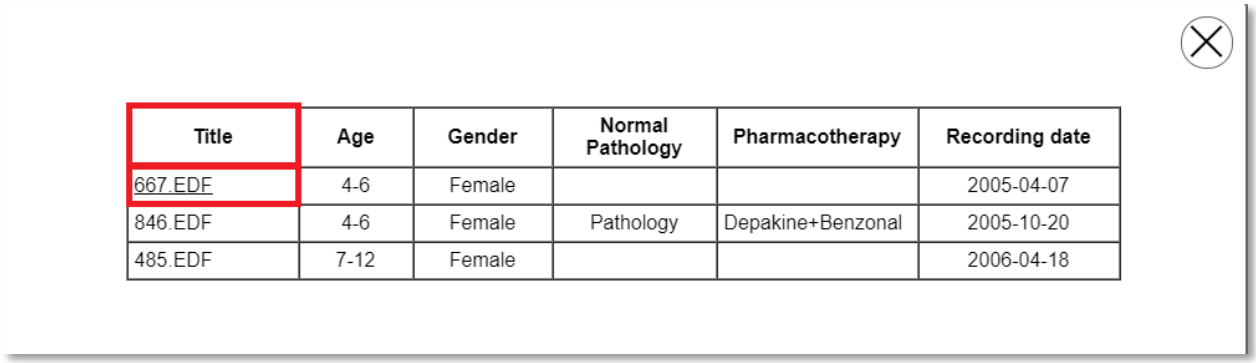
a. After pressing on the number of "Patient code", a new window is provided specifically for one particular patient data.

| Patient code | Age | Gender | Normal Pathology | Number of visits | Pharmacotherapy | Recording date |
|---|---|---|---|---|---|---|
| 55 | 4-6 | Female | Pathology | 1 | Sonapax+Phenibut | 2004-07-27 |
| 13 | 4-6 | Female | Pathology | 1 | Depakine | 2004-08-02 |
| 12 | 4-6 | Female | Pathology | 1 | | 2004-08-03 |
| 140 | 4-6 | Female | | 1 | | 2005-01-13 |
| 146 | 4-6 | Female | | 1 | | 2005-01-17 |
| 152 | 4-6 | Female | Pathology | 1 | | 2005-01-26 |
| 100 | 4-6 | Female | | 1 | | 2005-01-31 |
| 681 | 4-6 | Female | Pathology | 1 | | 2005-02-02 |
| 697 | 4-6 | Female | Pathology | 1 | Depakine+Finlepsin | 2005-02-22 |
| 737 | 4-6 | Female | Pathology | 1 | | 2005-02-26 |
| 715 | 4-6 | Female | Pathology | 1 | | 2005-02-28 |
| 731 | 4-6 | Female | Pathology | 1 | Luminal+Finlepsin | 2005-02-28 |
| 461 | 4-6 | Female | | 3 | | 2005-04-07 |
| 215 | 4-6 | Female | | 1 | | 2005-05-05 |
| 179 | 4-6 | Female | Pathology | 1 | | 2005-05-05 |
| 213 | 4-6 | Female | | 2 | | 2005-05-06 |

**Note**: "**Number of Visits**" section indicates that each particular patient has got more than one EEG recording. The program automatically appear all the recordings in sequence according to number of visit and recording date (year, month, and day).

**Example**: *Patient Code – 461 , age - 4-6, gender – female, number of visits – 3, without pharmacotherapy, recording date – 2005-04-07.*

b. To see EEG recording of a particular patient, the recording needs to be downloaded separately. Download requires pressing on the number of EDF file under the column of "Title".

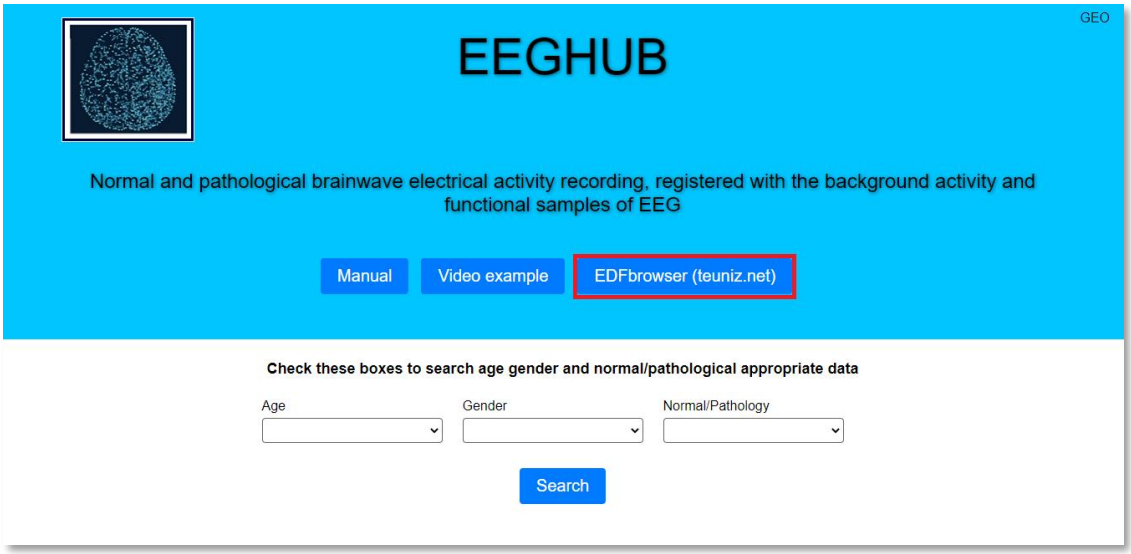


| Title | Age | Gender | Normal Pathology | Pharmacotherapy | Recording date |
|---|---|---|---|---|---|
| 667.EDF | 4-6 | Female | | | 2005-04-07 |
| 846.EDF | 4-6 | Female | Pathology | Depakine+Benzonal | 2005-10-20 |
| 485.EDF | 7-12 | Female | | | 2006-04-18 |

## 3.4 Opening of EEG recording

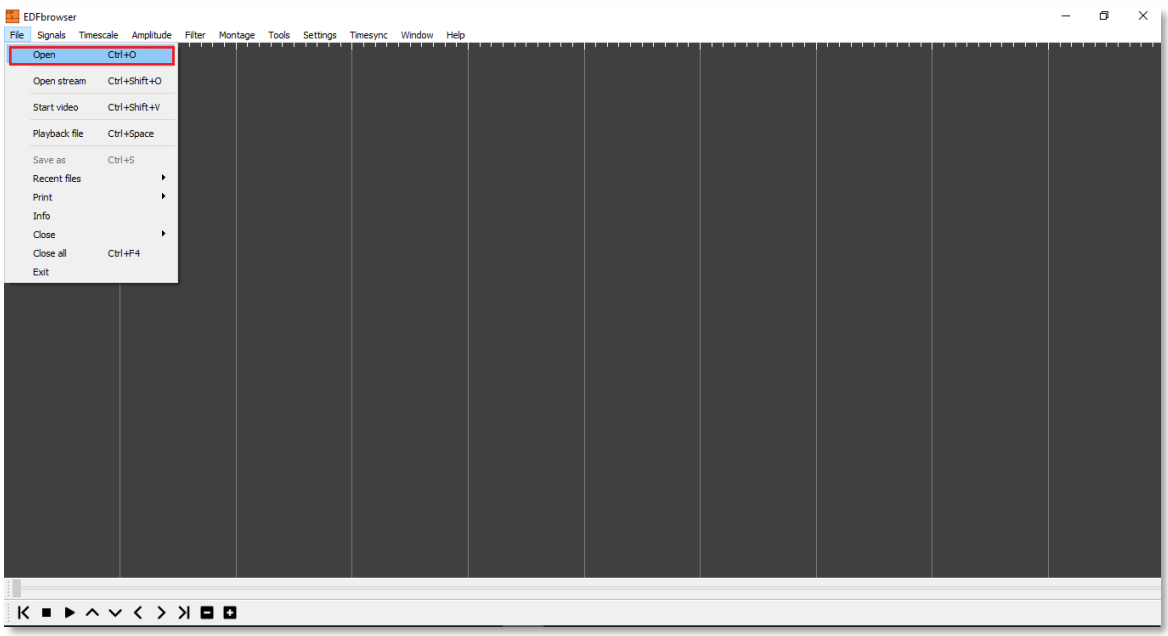
a. For opening the EDF file use program **"EDFbrowser"**

**Link for downloading EDFbrowser can be found on** [EEGHUB](EEGHUB).

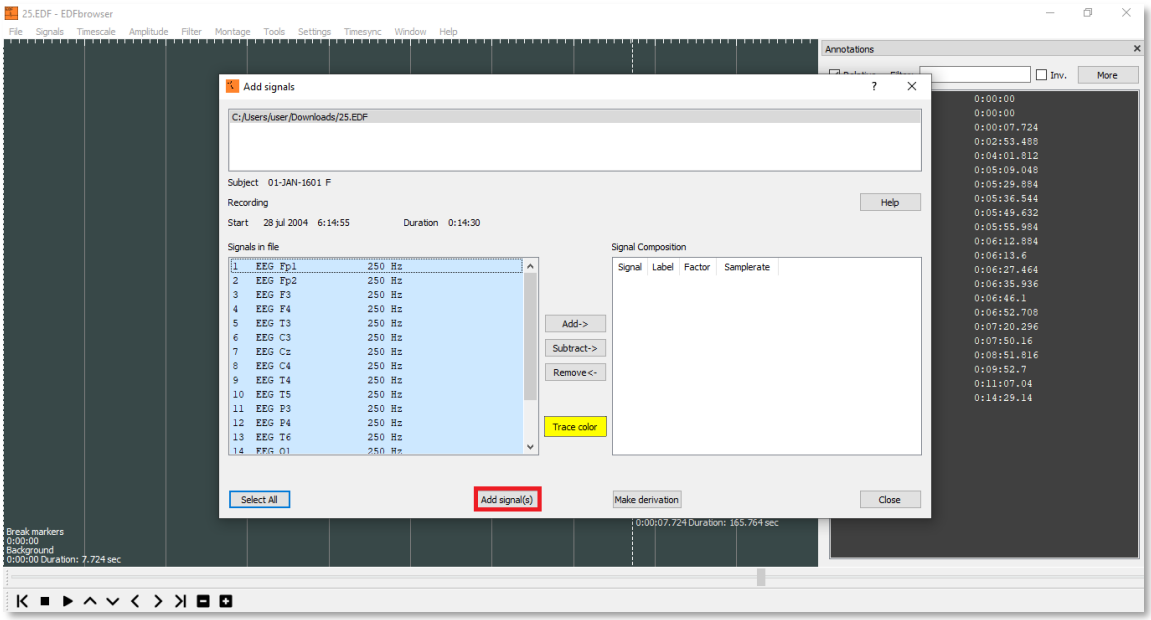



b. Steps for opening downloaded EEG data in EDFbrowser

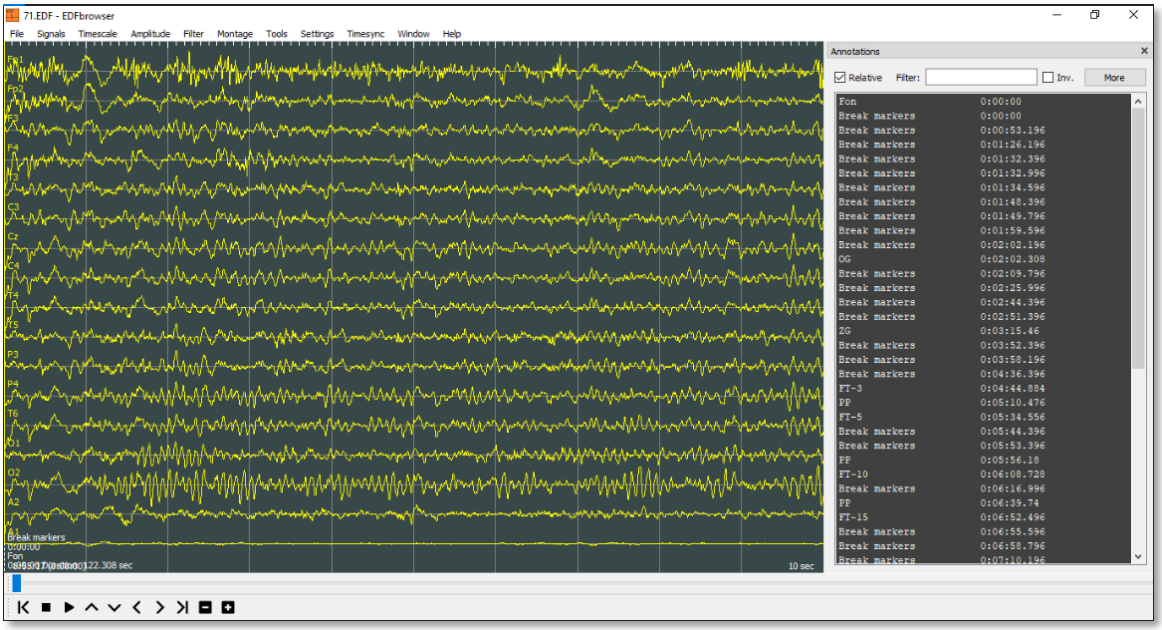
- File → open
- Select downloaded file



- When the browser opens the file, press **Add signal(s)**




c. EDFbrowser opens EDF file




*If you encounter problems, please feel free to contact us at: eeghub@gmail.com*

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