

Dataset Description - Mental Effort Monitoring in Code Comprehension

The purpose of this study was to explore the measurement of mental effort during the reading and comprehension of programs with varying complexity. To achieve this, a group of programmers (subjects) participated in an experiment where sensors were placed on their bodies to monitor various physiological signals. The experimental setup utilized a comprehensive set of sensors, including a 64-channel EEG cap, ECG, EDA, and eye tracking with pupillography. All signals from these sensors were synchronized in a common time base, enabling consistent cross-analysis.

A total of 27 participants, all with experience in the Java programming language, were included in the study. Each participant's Java programming skill level (Ordinary or Proficient) was determined through an interview during the screening process. The study was conducted following ethical guidelines and regulations, with approval from our organization's Ethics Committee. Informed consent was obtained from all participants. Upon request, the anonymized data collected during this research will be made available by the authors.

To maintain consistency in programming style and ensure that additional difficulties unrelated to code complexity, such as math or algorithmic challenges, were avoided, three small Java programs were carefully designed. These programs have different levels of complexity, but the algorithms were implemented in a way that minimizes extraneous difficulties. Program C1 and C3 contain the algorithm within a single function, while program C2 spreads the algorithm across two functions. Despite having a comparable number of lines of code, this structure may make C2 easier to read compared to C3.

Program	Expected complexity	V(g)	LoC	No. units	Goal
C1	Easy	5+1	15	2	Counts the number of elements in an array that fall within a given interval.
C2	Medium	4+7+1	45	3	Computes multiplication using classic weighted digit algorithm.
C3	Difficult	22	43	1	Searches 3 dimensional objects in a 3 dimensions space

The dataset consists of recordings obtained during the experiments conducted in a controlled environment with the participants. The experiments took place in the same room, ensuring a distraction-free and noise-free environment with no presence of unrelated individuals. The protocol followed during the experiments involved specific steps performed on the screen of a laptop.

Baseline Phase: The participant was presented with an empty grey screen containing a black cross at its center for a duration of 30 seconds. This phase served as a baseline, where no specific activity was performed.

Reference Activity: The screen displayed a text in natural language to be read by the participant. The maximum duration for this step was 60 seconds. This reference activity was different from code understanding and was included for the purpose of data analysis.

Baseline Phase: Similar to the first step, the participant was shown an empty grey screen with a black cross for 30 seconds.

Code Comprehension: The screen displayed Java code of the program to be analyzed for code comprehension. The participants were given a maximum of 10 minutes to comprehend and analyze the code. Three programs, denoted as C1, C2, and C3, were used for this purpose.

The experimental protocol is summarized as follows:

Baseline Phase (30 seconds)

Reference Activity (up to 60 seconds)

Baseline Phase (30 seconds)

Code Comprehension (up to 10 minutes) - Programs C1, C2, and C3

The dataset includes various parameters and data types collected during the experiments:

Time Series:

EDA (Electrodermal Activity)

ECG (Electrocardiogram)

PPG (Photoplethysmogram)

ICG (Impedance Cardiogram)

EEG (Electroencephalogram) - 64 channels

Eye Tracking Data:

Raw data position

Pupil diameter (left and right eye)

Cornea reflex position (left and right eye)

Point of regard (gaze data / left and right eye)

Head position / Rotation