Machine Learning for Cognitive Load Inference from Physiological Signals

Veljko Pejović[1] & Martin Gjoreski[2]

[1] *Faculty of Computer and Information Science, University of Ljubljana, Slovenia*
[2] *Faculty of Informatics, Università della Svizzera italiana, Lugano, Switzerland*

Automatic cognitive load inference would enable a range of applications in areas spanning from education to traffic safety. The integration of physiological sensors in off-the-shelf wearable devices (e.g., smartwatches), opens the opportunity for cheap and ubiquitous cognitive load inference, as a user's cognitive engagement gets reflected in the physiological changes detectable by these sensors. The inference, however, is not straightforward, as the sensors' properties, placement, and a user's movement can all affect the quality of the recorded signal. In this tutorial we will examine the potential of **in-the-wild cognitive load inference from wearable devices.** Working on a dataset of smart wristband sensor data collected from 23 individuals who were subject to tasks designed to elicit different levels of cognitive load, using Python programming language we will: 1) identify the most promising sensing modalities and extract the most informative features for cognitive load modelling; 2) experiment with both traditional machine learning algorithms as well as deep learning for cognitive load inference; and, finally, 3) share lessons learnt from our own five-year experience with cognitive load modelling and discuss the results of a recent open challenge in mining physiological signals from cognitive load modelling.

Keywords

Cognitive load inference, Wearables, Ubiquitous computing, Python, Machine learning

Prerequisites

The tutorial will be held online via Zoom platform. We suggest installing a Zoom desktop app beforehand.

The tutorial will be given both as a guided exercise and as a demonstrational project. We encourage attendees to <u>actively participate</u>, in which case they should:

- Be familiar with Python programming language.
- Open a Google Colab account.

No other prerequisites are needed for attending the tutorial as a viewer only.

Course Schedule (September 11th, 14:00h – 18:00 CET)

Saturday, Sep 11th	
14:00	Lecture: Cognitive load inference with ubiquitous computing
15:00	Break

15:15	Hands-on: Inferring cognitive load from physiological signals captured by consumer wearable devices
17:00	Discussion and meta-analysis of Cognitive Load Machine Learning Challenge 2020

Maximum Intake

The number of participants is not limited.

[Recommended Reading, if any]

1. Gjoreski, M., Kolenik, T., Knez, T., Luštrek, M., Gams, M., Gjoreski, H., & Pejović, V. (2020). Datasets for Cognitive Load Inference Using Wearable Sensors and Psychological Traits. Applied Sciences, 10(11), 3843.
2. Gjoreski, M., Luštrek, M., & Pejović, V. (2018, October). My watch says I'm busy: Inferring cognitive load with low-cost wearables. In Proceedings of the 2018 ACM International Joint Conference and 2018 International Symposium on Pervasive and Ubiquitous Computing and Wearable Computers (pp. 1234-1240).
3. Pejović, V., Gjoreski, M., Anderson, C., David, K., & Luštrek, M. (2020). Toward Cognitive Load Inference for Attention Management in Ubiquitous Systems. IEEE Pervasive Computing, 19(2), 35-45.