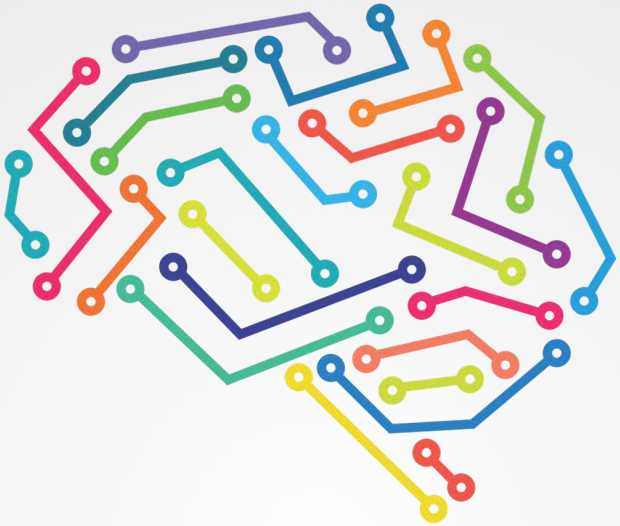

BRAIN

THE ULTIMATE HACK

Armagan Amcalar

International JavaScript Conference, London

April 11th, 2018

WHO AM I?

Armagan Amcalar

Head of Software Engineering @ unu GmbH

Founder @ Lonca Works

dashersw dashersw

AUTHORED ON GITHUB

erste

dovecote

cote

semaver

vieux

brain-bits

wits

brain-monitor

pedalboard.js

geneJS

jira-bot

WHAT IS

THE ULTIMATE HACK?

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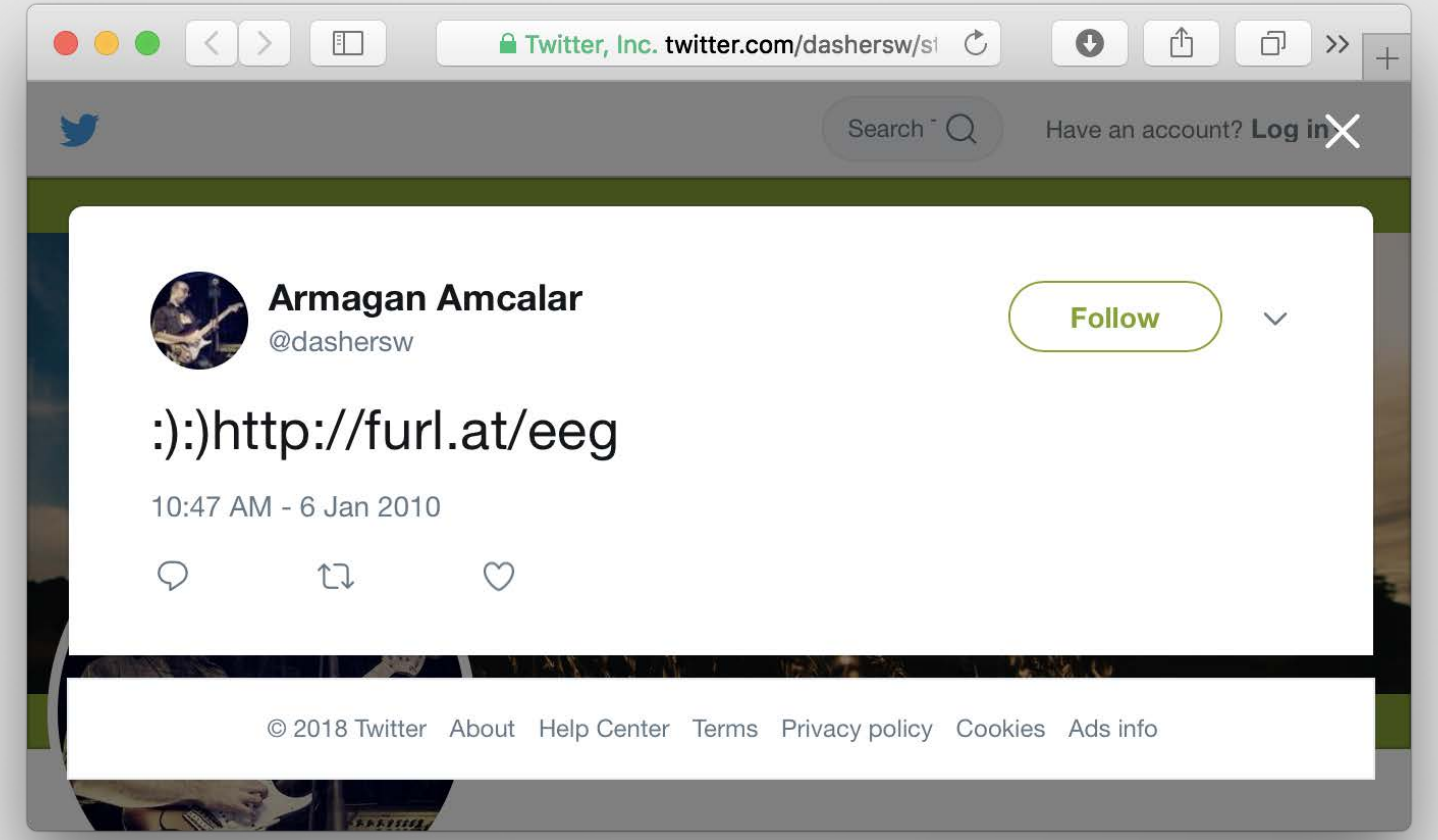
"I think we are about 8 to 10 years away from this being usable by people with no disability"
dashersw
The Summit 2013 - Picture by Dan Taylor / Heisenberg Media - www.heisenbergmedia.com

dashersw

Facebook VP of Engineering Regina Dugan F8 - Picture by Anthony Quintano


dashersw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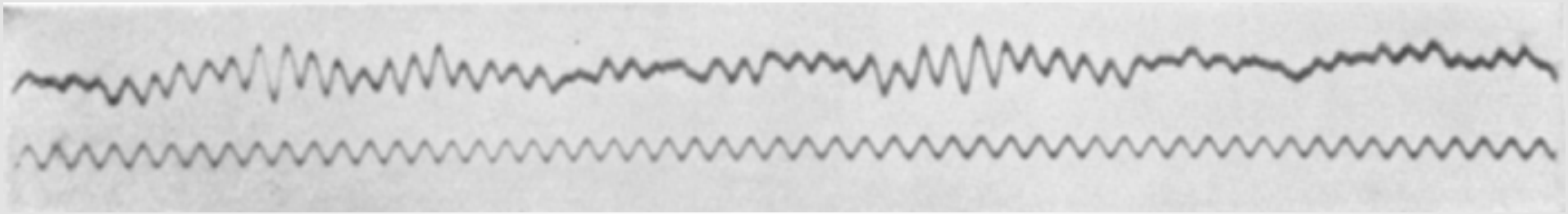
A PRIMER: THE WORLD'S FIRST EEG RECORDING



... in 1924, from experiments by Hans Berger

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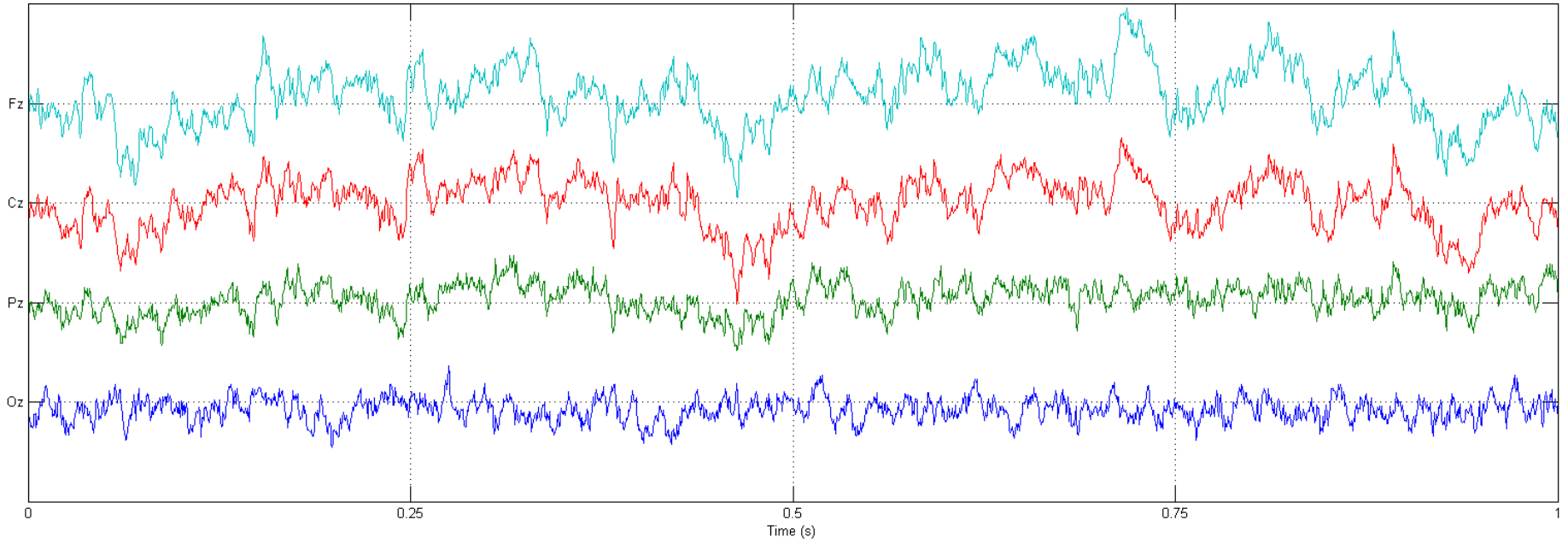
HOW IT LOOKS NOW



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ACTUALLY...

LET ME SHOW YOU.

HOW DOES THIS BLACK MAGIC WORK?

100 billion neurons

Chemical reactions of K & Na exchange produce potential difference > *"action potential"*

Up to 256 electrodes for non-invasive methods

Thousands of electrodes for invasive operations

... and we still don't know how it exactly works.

P300 — ODDBALL PARADIGM

First published by E. Donchin and L.A. Farwell in 1988

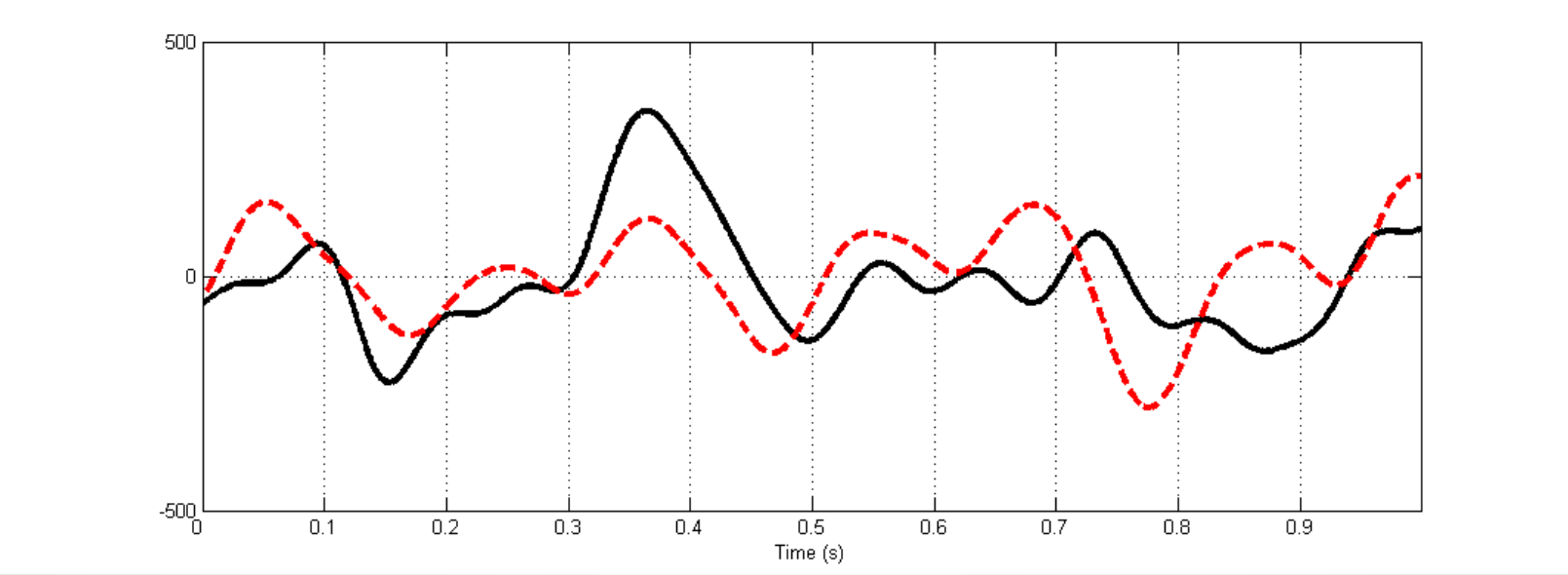
2.3 letters / min

Based on randomly flashing letters in a matrix

Rare positive, common negative flashes pique interest

Action potentials fire 300ms after stimulation

SEPARATE BLACK FROM RED



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WHERE DO I START?

Available on GitHub: https://github.com/dashersw/wits

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BRAIN-MONITOR

Available on GitHub: https://github.com/dashersw/brain-monitor

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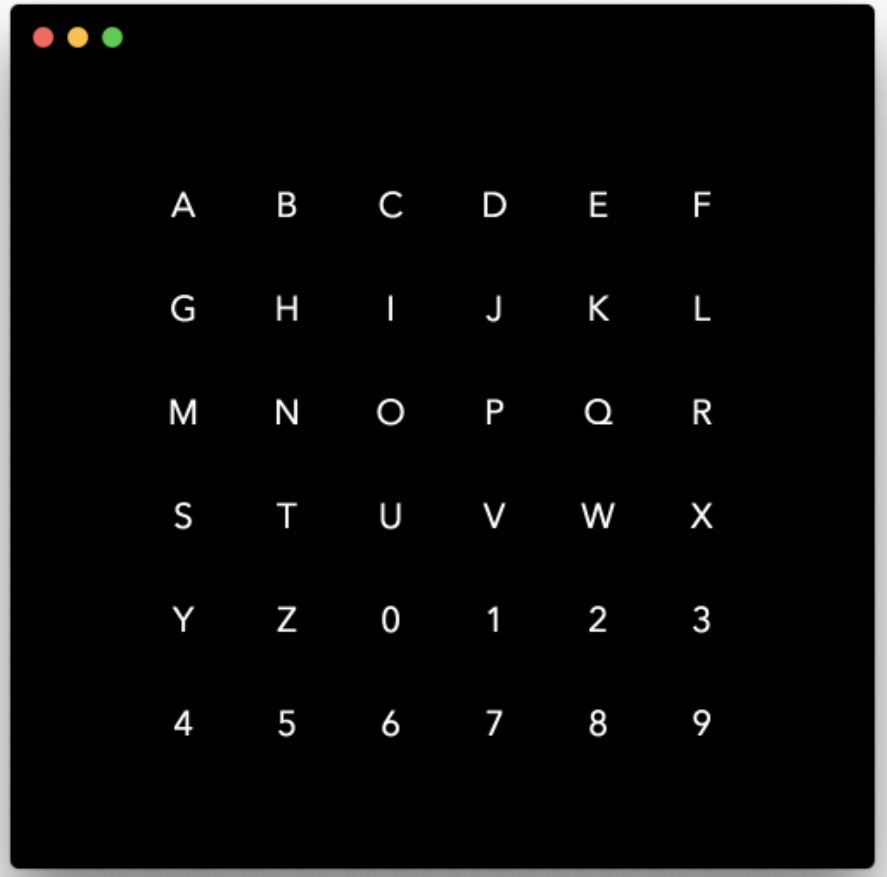
BRAIN-BITS

Available on GitHub: https://github.com/dashersw/brain-bits

Open-source P300 speller
that still needs some help!



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TECH STACK

JavaScript all the way up

Native C add-ons for the headset

Node.js for processing

Electron as the wrapper

Vue.js for front-end

brain.js for neural networks

Custom BLDA in JS as another classifier

...and, MATLAB as the server for **eig** function.

FORMATTING THE DATA FOR MACHINE LEARNING

1. Get raw electrode data
2. Group by each second to get epochs
3. Filter each epoc between 1-12Hz
4. Winsorize data
5. Zero-mean normalization
6. Decimate by 8
7. Apply machine learning
    1. Use brain.js for neural networks
    2. Use a custom algorithm for BLDA

CONCLUSION

“ JavaScript is powerful enough to read and parse not only JSON APIs, but also your brain’s API.

THANK YOU!

get these slides at:

https://slides.com/armaganamcalar/brain-the-ultimate-hack-ijs2018

LET'S KEEP IN TOUCH!

Armagan Amcalar

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