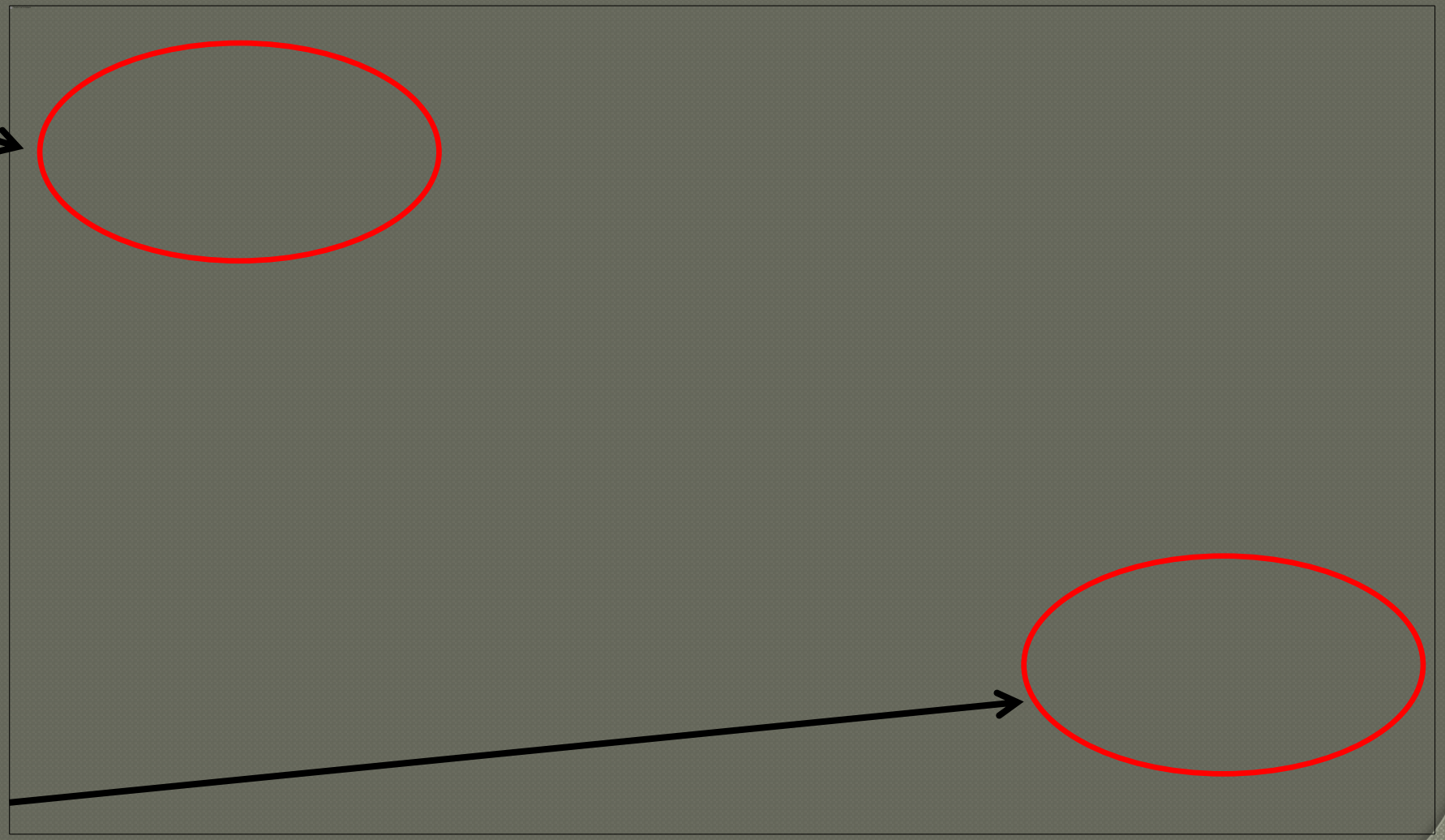
Neural Interfacing with Keyboard

Adam Kacmarsky
Tyler Brutsman
Thomas Glade

Background

- How does the brain work?

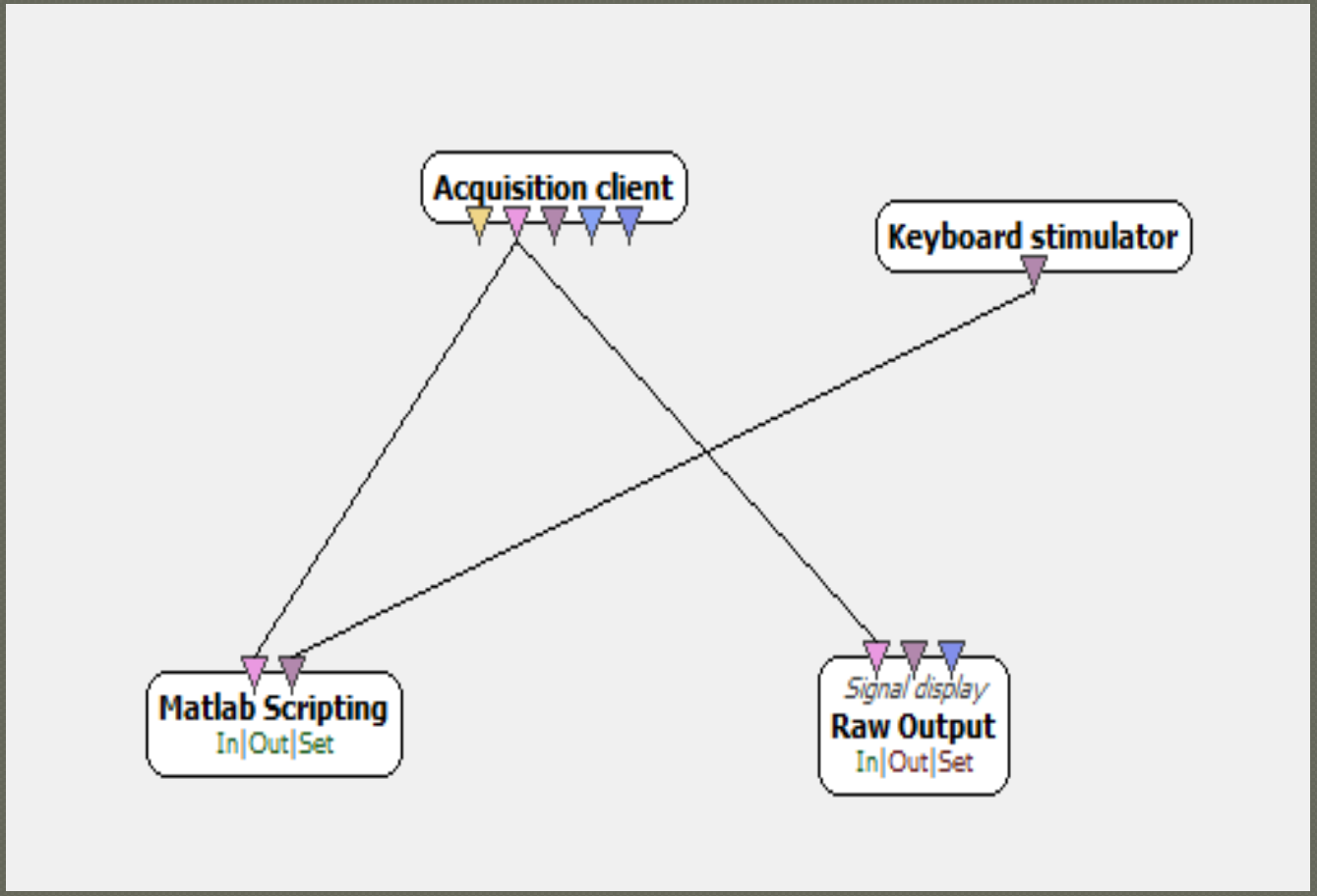


Goals

- Provide an interface from neural signals to keyboard output
  - Provide a method for training new signals quickly
  - Provide a framework that is easily modified and extend

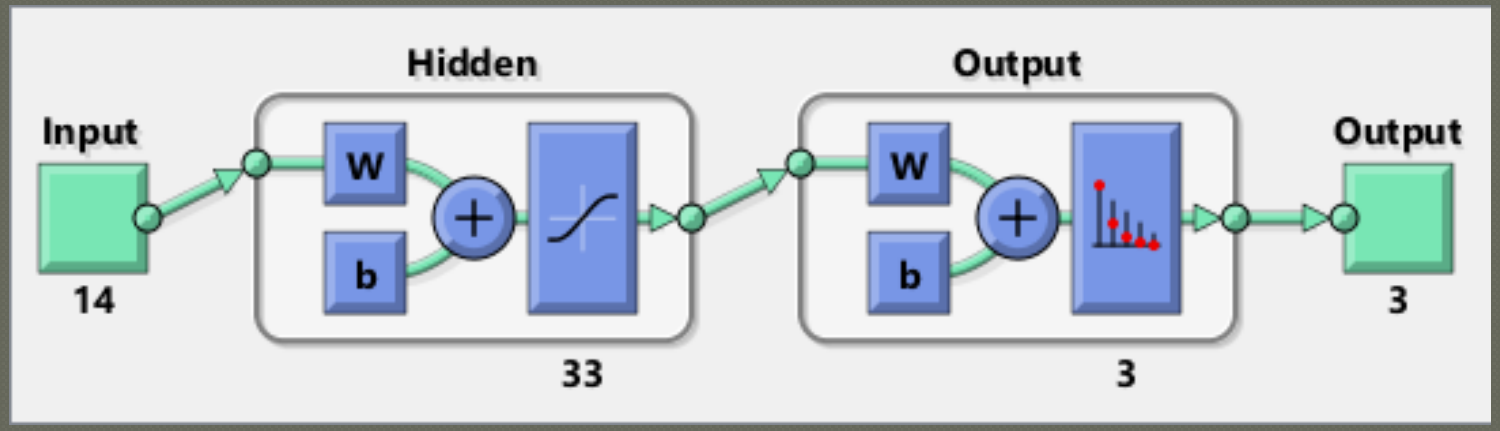
Technical Information

- Brain-Computer Interface (BCI)
  - Emotiv EPOC
    - 14 Sensors
    - 128 Samples/second
    - (picture: either headset or someone wearing headset)

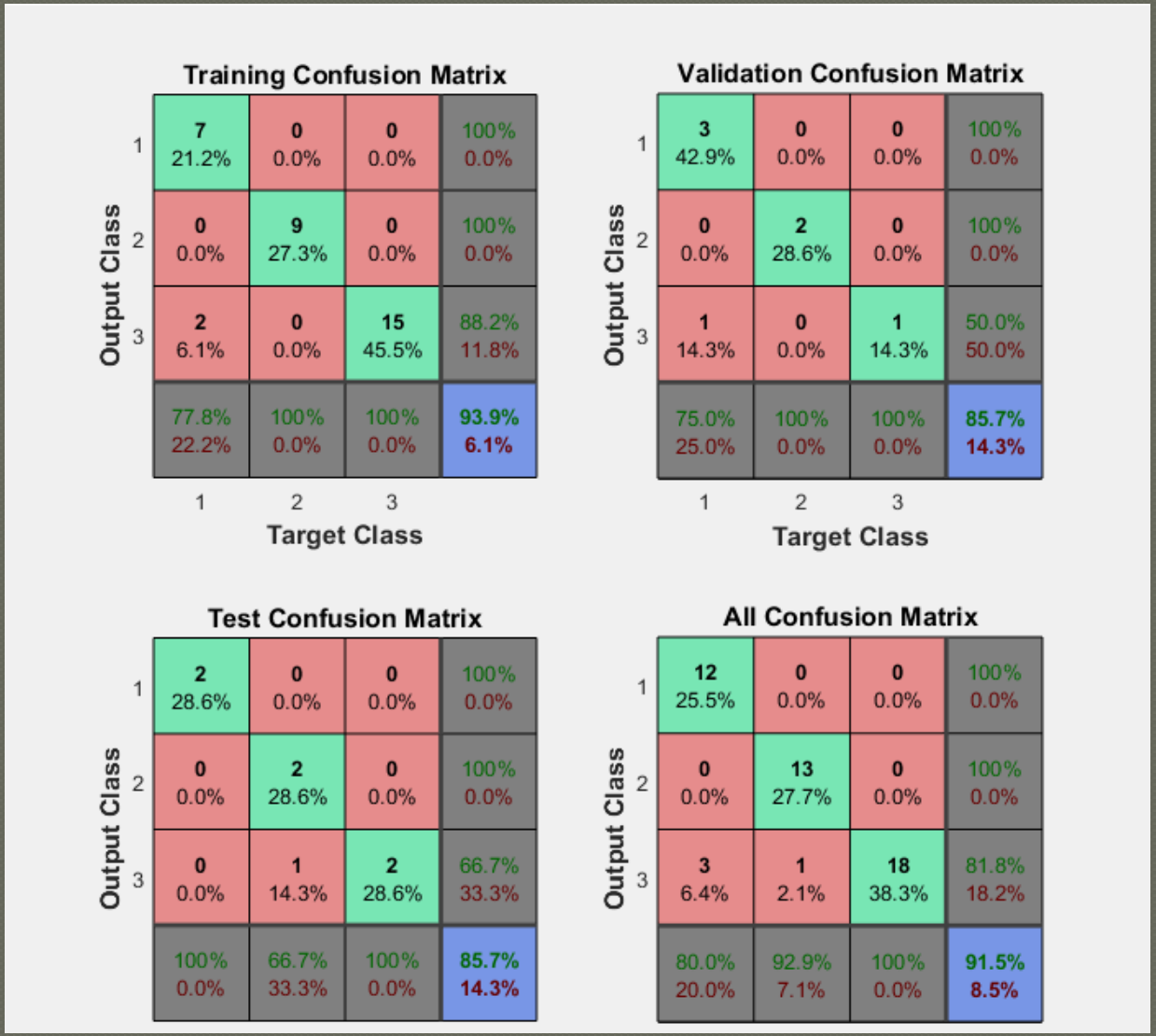


- Software
  - OpenViBE
  - MATLAB
    - Toolboxes
      - Digital Signal Processing
      - Statistics and Machine Learning
      - Data Analytics
- Building training sets

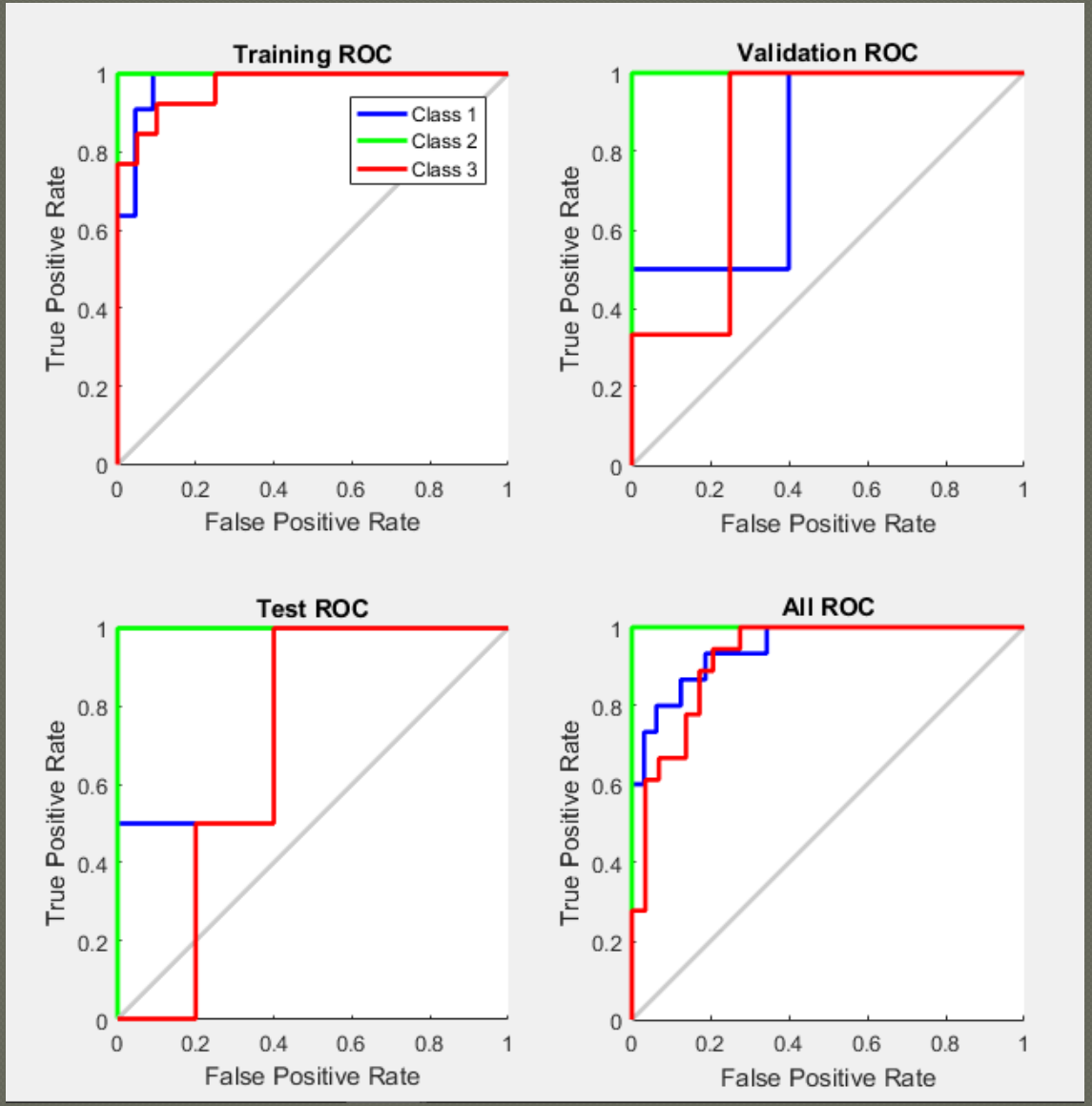
- Neural Networks
  - Good at pattern matching
  - Quick, and can be implemented with built in MATLAB functions

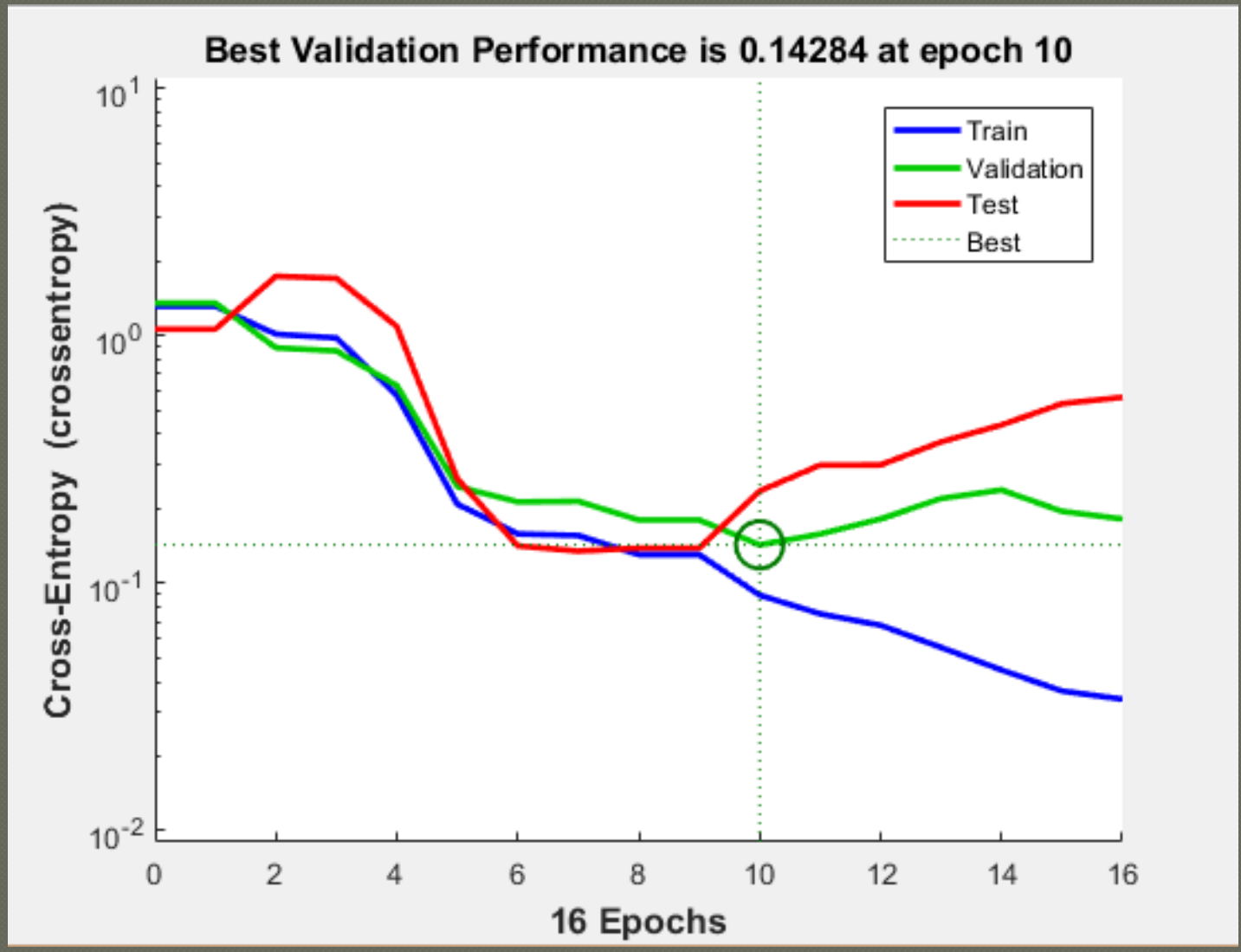


Performance



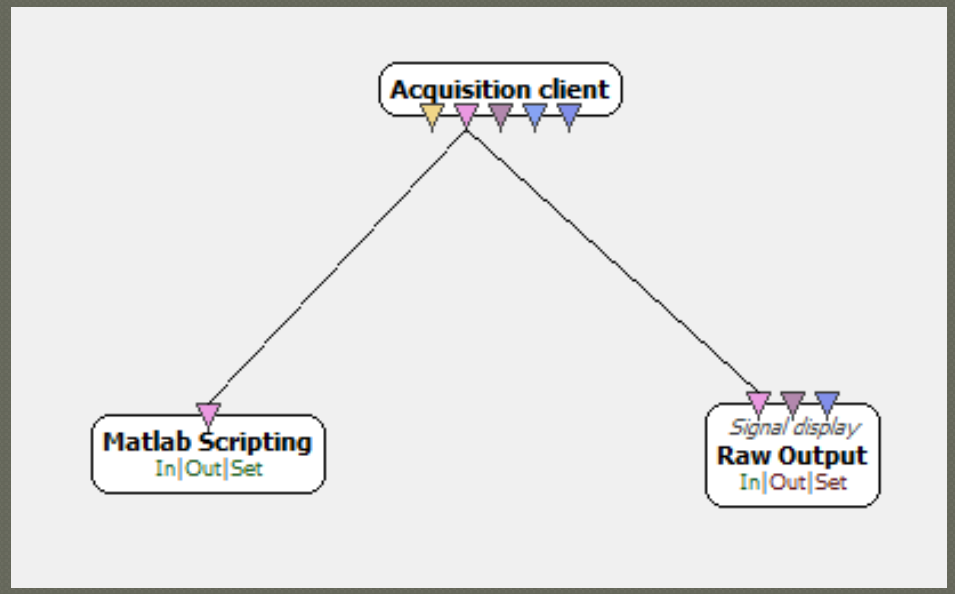
Receiver Operating Characteristic

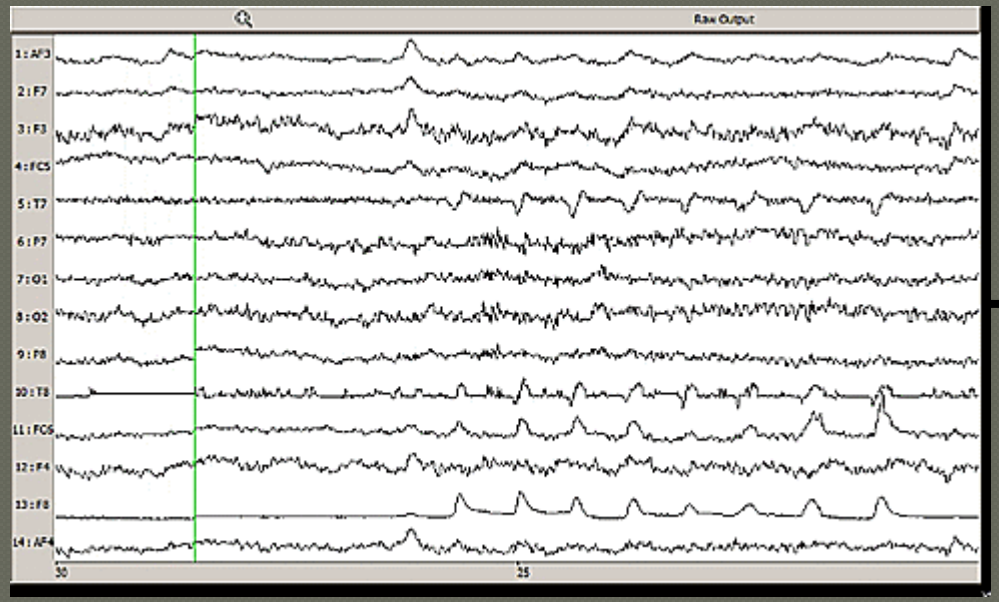



Best Validation Performance is 0.14284 at epoch 10
Train
Validation
Test
Best
Cross-Entropy (crossentropy)
16 Epochs
10^{1}
10^{0}
10^{-1}
10^{-2}
0
2
4
6
8
10
12
14
16

Classifier

- Output is Nx1 matrix where $N = (number\ of\ keys) + 1$
- Each point in the matrix is the certainty the net has of that output
- The highest is selected, and transformed to keyboard output.





Demo

Conclusion

- Costs

Emotiv EPOC:	$400 - $500
MATLAB:	$100 - $200
Total Cost:	$500 - $700

- Applications
  - Low – Mobility Patients
  - Gesture Recognition
- Future Work
  - Include external application to set variables/create keyboard stimulation file

Special Thanks

- Dr. Amy Banic
- Angela ???
- Dr. Ruben Gamboa

Q&A