Assignment 5
Brain Signal Classification

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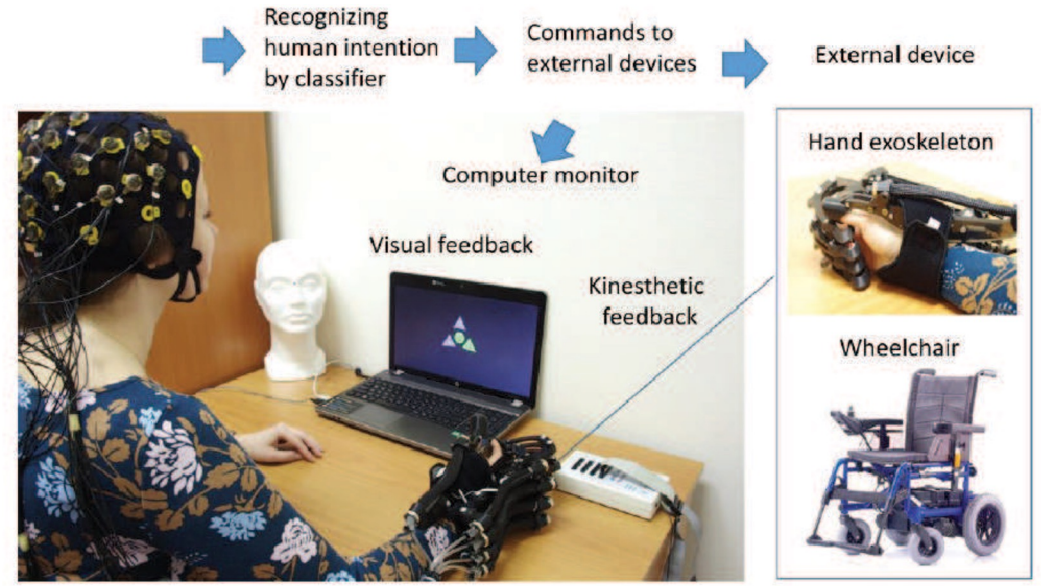
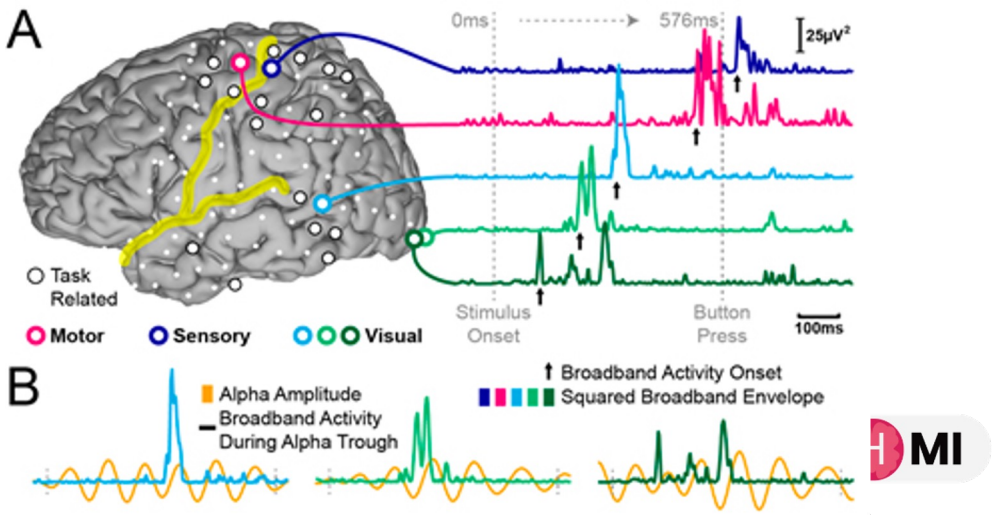
Introduction

- Motor imagery describes the mental process in which a person merely imagines performing a certain action, such as extending or retracting the left or right hand without performing the left or right hand in actuality.
- For patients with reduced mobility, motor imagery may be used to assist in communication and control some external instruments.



Introduction

- EEG is a method to record an electrogram of the spontaneous electrical activity of the brain.
- Motor imagery can be monitored by EEG signal via the electrodes placed above the motor areas.
- In this assignment, we use the recorded EEG data in a motor imagery experiment to train models.



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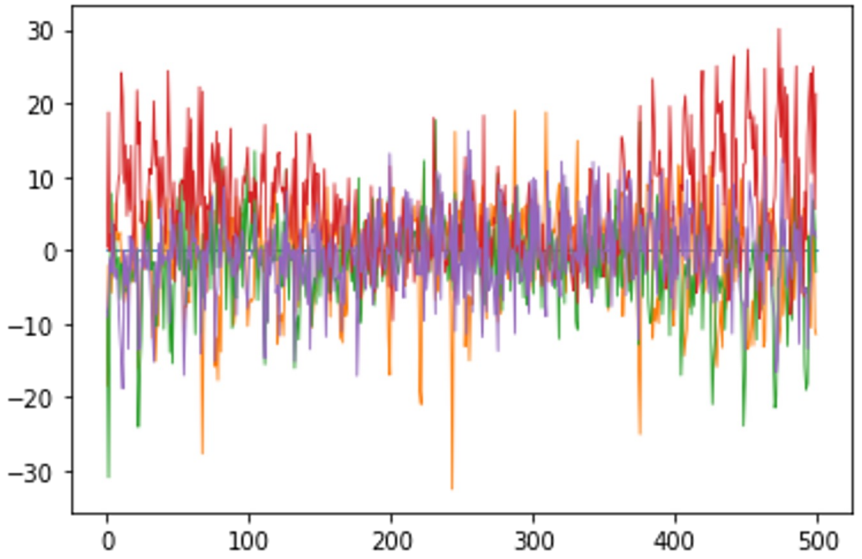


Introduction

- There are six classes of motor imagery class in our dataset, including left/right-hand movement, left/right leg movement, tongue movement and passive imagery.
- Predict motor imagery class based on the given EEG data.
- Use RNN-based and CNN-based models to model time series data and compare the different performance between them.

Grading Policy

Item	Score
Model Implementation	70%
Model competition	20%
Report	10%

Model Implementation (70%)

Design two models in **TensorFlow or Pytorch** to predict the class:

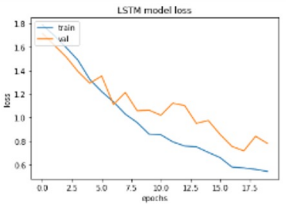
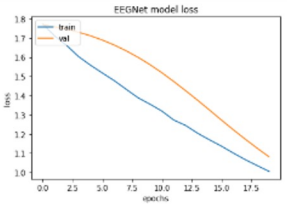
1. (35%) LSTM:
   Build your own LSTM model to reach a baseline.
   If your test accuracy reaches **0.6**, you will get all 35%
2. (35%) EEGNet:
   Build a model reproducing EEGNet architecture in the attached paper (hw5_paper.pdf) to reach a baseline.
   If your test accuracy reaches **0.6**, you will get all 35%.
3. You can import any packages.

Model competition (20%)

1. Ranking (20%) : We will use your test accuracy to compete with others.
2. You can redesign a new model with any state-of-the-art architecture or directly use one of the predictions in the model implementation part!
3. There is no any limitation!

Report (10%)

- Below are some elements you need to address in the **Model Implementation Part**:
  - epochs(2%)
  - training time (1%)
  - accuracy (training and valid) (1%)
  - number of parameters (2%)
  - training loss curve (2%)
  - others (optional)

	LSTM	EEGNet
epochs	20	20
training time	10 min	10 min
accuracy	0.6	0.8
number of parameters	100	100
training loss curve		
others		

- For the **Model Competition Part** : Describe which model you use in competition. If you use other model architecture, explain how you design or choose the model. (2%)
- Do not exceed 2 pages!

Dataset

1. You will get 604 samples as training data, 152 samples as validation data and 190 samples as testing data.
2. Each sample data contains 22 channels x 200 time points
3. The corresponding label is as below:
   0 : left hand, 1 : right hand, 2 : passive, 3 : left leg, 4 : tongue, 5 : right leg
4. Use the training data and validation data to train and tune your model.
5. Predict the class of each samples in test data. The shape of the prediction of X_test is **(190, 1).**
6. The shape of the given data:
   X_train : (604, 22, 200) Y_train : (604, 1)
   X_val : (152, 22, 200) Y_val : (152, 1)
   X_test : (190, 22, 200)
6. The output format of your prediction should be the same as the **sample_output.csv** file.

Files for you

- Template: **hw5_template.ipynb**
- Training, validation and testing data: **data.npz**, **label.npz**
- Sample output: **sample_output.csv**
- Paper: **hw5_paper.pdf**

Remember to save the code file to **hw5_template.ipynb!**
We recommend you use google colab to do your homework.
Reference:
https://www.tensorflow.org/api_docs/python/tf/keras/layers/LSTM

Requirement

- Do it individually! Not as a team! (team is for final project)
- Announce date: 2022/12/22
- Deadline: **2023/1/9 23:59** (Late submission is not allowed!)
- Hand in your files in the following format (Do not zip the files!)
  - hw5_template.ipynb (Please keep your execution output)
  - lstm_output.csv
  - eegnet_output.csv
  - competition_output.csv
  - hw5_report.pdf

Penalty

0 points if any of the following conditions:

- Plagiarism
- Late submission
- Incorrect prediction format
- Incorrect submission format

Questions?

- TA: Chia-Yun Lee (ss111062529@gapp.nthu.edu.tw)
- **Do not ask for debugging!**