Lab2 : CNN Classifier

Lab Objective:

In this lab, you will need to implement simple EEG classification models which are DeepConvNet, EEGNet with BCI competition dataset. Additionally, you need to try different kinds of activation function including ReLU, Leaky ReLU and ELU.

Important Date:

1. Experiment Report Submission Deadline: 9/16 (Wed) 11:59 a.m.
2. Demo date: 9/16 (Wed)

Turn in:

1. Experiment Report (.pdf)
2. Source code (.py)

zip all files in one file and name it like「DLP_LAB2_yourID_name.zip」
email to 92242@saes.tc.edu.tw with subject MTK_ DLP_LAB2_yourID_name

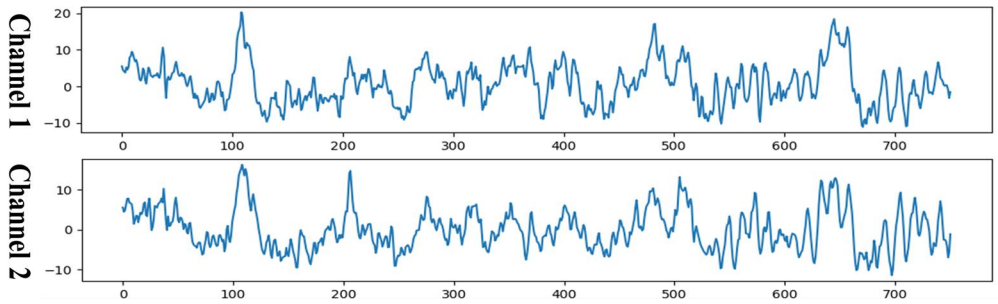
Requirements:

1. Implement the EEGNet, DeepConvNet with three kinds of activation function including ReLU, Leaky ReLU, ELU
2. In the experiment results, you have to show the highest accuracy (not loss) of two architectures with three kinds of activation functions.
3. To visualize the accuracy trend, you need to plot each epoch accuracy (not loss) during training phase and testing phase.

Dataset:

BCI Competition III - IIIb Cued motor imagery with online feedback (non- stationary classifier) with 2 classes (left hand, right hand) from 3 subjects [2 classes, 2 bipolar EEG channels]

Reference: *http://www.bbci.de/competition/iii/desc_IIIb.pdf*



Implementation Details:

- **Model Architecture**

  You cannot modify the architecture of DeepConvNet

  You must have at least one depthwise separable convolution layer in EEGNet

DeepConvNet:

Layer	# filters	size	Activation	Options
Input		(C, T)		
Reshape		(1, C, T)		
Conv2D	25	(1, 5)		mode = valid
Conv2D	25	(C, 1)		mode = valid
BatchNorm				epsilon = 1e-05, momentum = 0.1
Activation			ELU	
MaxPool2D		(1, 2)		
Dropout				p = 0.5
Conv2D	50	(1, 5)		mode = valid
BatchNorm				epsilon = 1e-05, momentum = 0.1
Activation			ELU	
MaxPool2D		(1, 2)		
Dropout				p = 0.5
Conv2D	100	(1, 5)		mode = valid
BatchNorm				epsilon = 1e-05, momentum = 0.1
Activation			ELU	
MaxPool2D		(1, 2)		
Dropout				p = 0.5
Conv2D	200	(1, 5)		mode = valid, max norm = 2
BatchNorm				epsilon = 1e-05, momentum = 0.1
Activation			ELU	
MaxPool2D		(1, 2)		
Dropout				p = 0.5
Flatten				
Dense	N		?	

EEGNet:

Block	Layer	# filters	size	Output	Activation	Options
1	Input			(C, T)		
	Reshape			(1, C, T)		
	Conv2D	F_1	(1, 51)	(F_1, C, T)		mode = same
	BatchNorm			(F_1, C, T)		
	DepthwiseConv2D	D * F_1	(C, 1)	(D * F_1, 1, T)		mode = valid, depth = D
	BatchNorm			(D * F_1, 1, T)		
	Activation			(D * F_1, 1, T)	ELU	
	AveragePool2D		(1, 4)	(D * F_1, 1, T // 4)		
	Dropout*			(D * F_1, 1, T // 4)		$p = 0.25$
2	SeparableConv2D	F_2	(1, 15)	(F_2, 1, T // 4)		mode = same
	BatchNorm			(F_2, 1, T // 4)		
	Activation			(F_2, 1, T // 4)	ELU	
	AveragePool2D		(1, 8)	(F_2, 1, T // 32)		
	Dropout*			(F_2, 1, T // 32)		$p = 0.25$
	Flatten			(F_2 * (T // 32))		
Classifier	Dense			N	?	

Reference: Depthwise Separable Convolution

https://towardsdatascience.com/a-basic-introduction-to-separable- convolutionsb99ec310272

- **Activation Functions**

  ELU (Exponential Linear Units)

  $$f(x) = \begin{cases} x, & \text{if } x > 0 \\ \alpha(e^x - 1), & \text{otherwise} \end{cases}$$

  ReLU

  $$\text{ReLU} = \max(0, x)$$

  Leaky ReLU

  $$f(x) = \max(0.01x, x)$$

- **Result comparison**
  1. show the highest accuracy (not loss) of two architectures with three kinds of activation functions
  2. plot each epoch accuracy (not loss) during training phase and testing phase

- **Report Spec**
  1. Introduction (10%)
  2. Experiment set up (35%)
     - The detail of your model
     - Explain the activation function (ReLU, LeakyReLU, ELU)
     - Explain the output layer activation function and loss function
  3. Experiment result (30%)
     - The highest testing accuracy
       - Two models with three activation functions
       - Anything you want to present
     - Comparison figures
       - Accuracy curve for two models
  4. Discussion (25%)
     - Depthwise separable convolution improve what issue in normal convolution
     - Your training strategy
     - Anything you want to share

- **Experimental results**
  - Accuracy > = 87% = 100 pts
  - Accuracy 85~87% = 90 pts
  - Accuracy 80~85% = 80 pts
  - Accuracy 75~80% = 70 pts
  - Accuracy < 75% = 60 pts