DLP lab3 EEG classfication

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tags: `class`

Introduction

The EEG classification is one important part of the brain computer interface (BCI) - user interface which allows to work with computer and thus to communicate even for the disabled person. And it verifying physiology hypotheses about the brain can be also found in the field of physiology

This lab is to implement simple EEG classification models which are EEGNet and DeepConvNet

Experiment set up

A. The detail of your model

- hyperparameter:
    - Batch size= 256
    - Learning rate = 0.001
    - Epochs = 300
    - Weight decay = 0.001
    - Optimizer: Adam
    - Loss function: torch.nn.CrossEntropyLoss()

B. Explain the activation function (ReLU, Leaky ReLU, ELU)

- ReLU: when meet negative values, it sets them zero. But it may have dead ReLU probelm. The dead ReLU probelm is that neuron will not activate forever because ReLU is not differentiable compeletely

$$\text{ReLU} = \max(0, x)$$
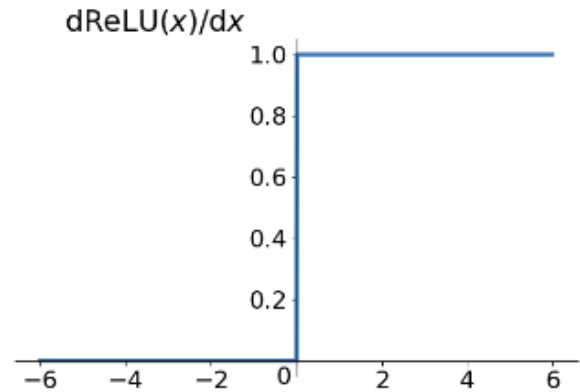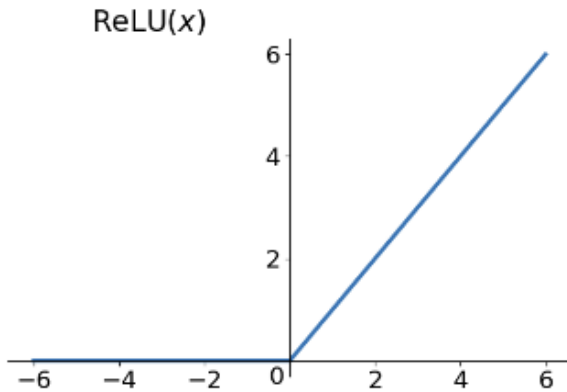
- Leaky ReLU: is the other form of ReLU. It is is designed to improve ReLU. ReLU set negative values to zero. In Leaky ReLU, it sets a negative slope to negative values and doesn't meet dead ReLU problem. But the computation cost is more higher than ReLU.

$$\text{LeakyRELU}(x) = \begin{cases} x, & \text{if } x \geq 0 \\ \text{negative\_slope} \times x, & \text{otherwise} \end{cases}$$
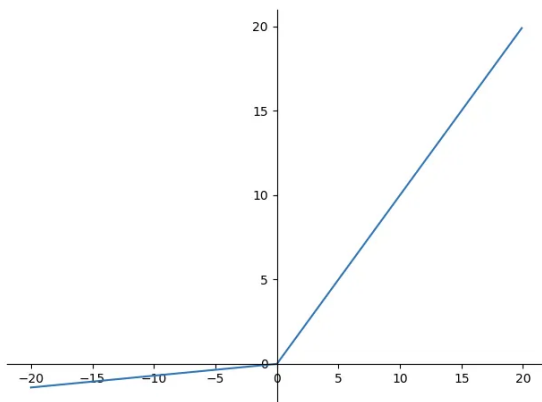
- ELU: is designed to improve ReLU too. When meeting negative values, it set a exponential function to them. Its average output value is close to zero. It doesn't meet dead ReLU problem but. But the computation cost is more higher than ReLU like Leaky ReLU

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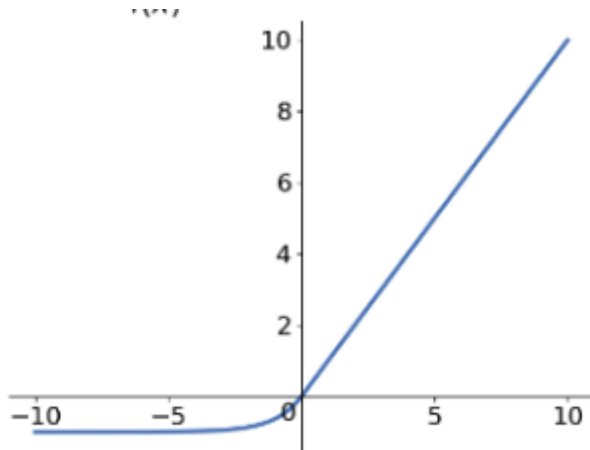
Experimental results

A. The highest testing accuracy
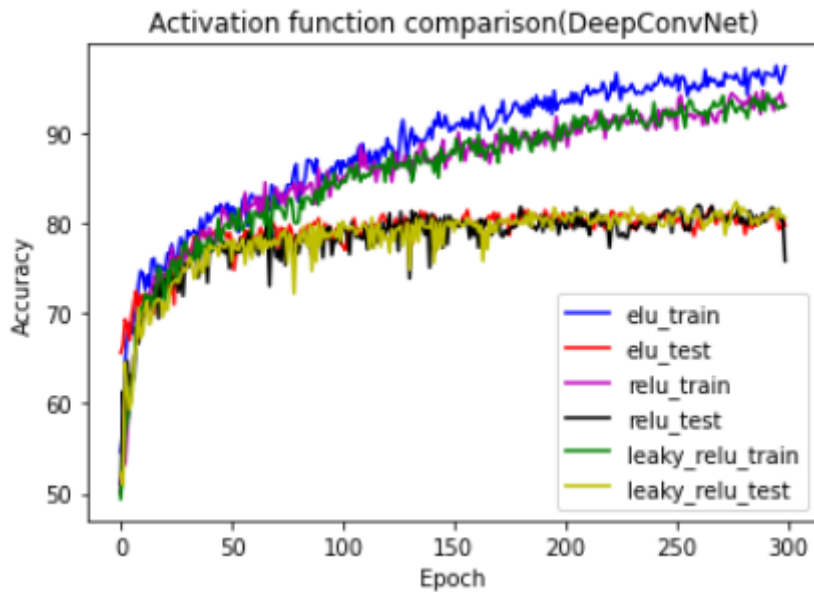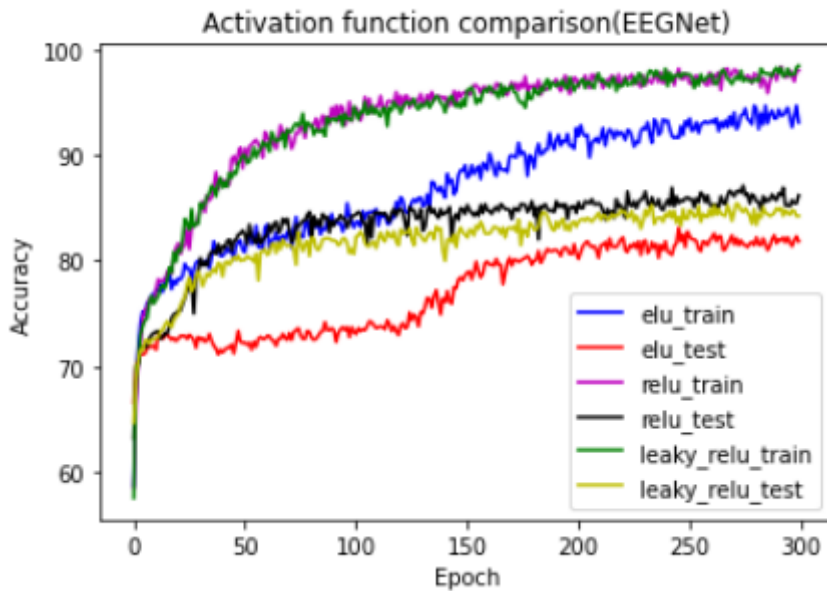
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EGGNet
Relu :87.13%
Leaky Relu :85.46%
Elu :83.15%

DeepConvNet
Relu :82.04%
Leaky Relu :82.41%
Elu :81.67%
```

B. Comparison figures

Activation function comparison(EEGNet)

Activation function comparison(DeepConvNet)

Discussion

Idealy the performance of Leaky ReLU and ELU shold be better than ReLU. But the performance of ReLU is the best. So some improvements of ReLU are better than in theorey. But they are not uncertain in practice. It still needs to do some experiment to find the best choice.