Deep Learning Assignment

Deadline : 11th November 2020

1 Tutorials

Some relevant tutorials to familiarise yourself with pytorch :

- `https://pytorch.org/tutorials/beginner/pytorch_with_examples.html`
- `https://pytorch.org/tutorials/beginner/blitz/cifar10_tutorial.html`
- `https://youtu.be/6SlgtELqOWc?t=3077`
- `https://github.com/kuangliu/pytorch-cifar` (Not a tutorial but repo might help)
- Pytorch Documentation : `https://pytorch.org/docs/stable/index.html`

Jargon you should be comfortable with : Tensors, Optimiser, Models, Autograd or Backward Pass, Activations, ...

2 XOR

2.1 Data Generation

Firstly generate 10K points in $[-1, 1] \times [-1, 1]$ using

```
np.random.seed(0)
data = 2*np.random.uniform(size=(10000,2)) - 1
```

Label points according to their quadrant. First and Third quadrant being labeled 0 and Second and Fourth quadrant being labeled 1

2.2 Exercises

1. Write a Dataset module for the XOR data (3 sets train, validation and test,70:15:15 respectively)
   - Inherit from `torch.utils.data.Dataset`
   - Define `__init__,__getitem__,__len__`
2. Define the Dataloader with batchsize of 16
   - Go through all the arguments of dataloader like `drop_last,shuffle,batch_size`
3. Define the Dataloader with batchsize of 16
4. Define the Neural Network Model
   - Inherit from : `torch.nn.Module`
   - 2 Linear layers, ReLU activation after first layer, single numeric output
   - Variable hidden layer size as input to model (4 as default hidden layer size)
5. Loss function define as `torch.nn.CrossEntropyLoss`
   - Explore other possible loss functions like `LogSoftmax + NLLLoss` vs `CrossEntropyLoss` and `MSELoss`
6. Optimizer : Use SGD optimizer with learning rate of 1e-3
   - See `zero_grad(), step()`
7. Write the main training loop and validation loops for n epochs
   - See `loss.backward(), model.forward()`
   - Use `model.train(), model.eval(),torch.no_grad()`
   - Validate for each epoch, run for 100 epochs
8. Plot the following :
   (a) Training and Validation loss vs epoch in a single plot
   (b) Training and Validation accuracy vs epoch in a single plot
   (c) Best Validation loss vs Hidden Layer size (use hidden size to be (2,4,6,8,10))
   (d) Best Validation loss vs learning rate used (use learning rates in (1e-5,1e-4,1e-3,1e-2,1e-1)) for max number of 20 epochs
   (e) Plot test set predicted labels for best validation model. Report accuracy and loss for the same.