Quiz3

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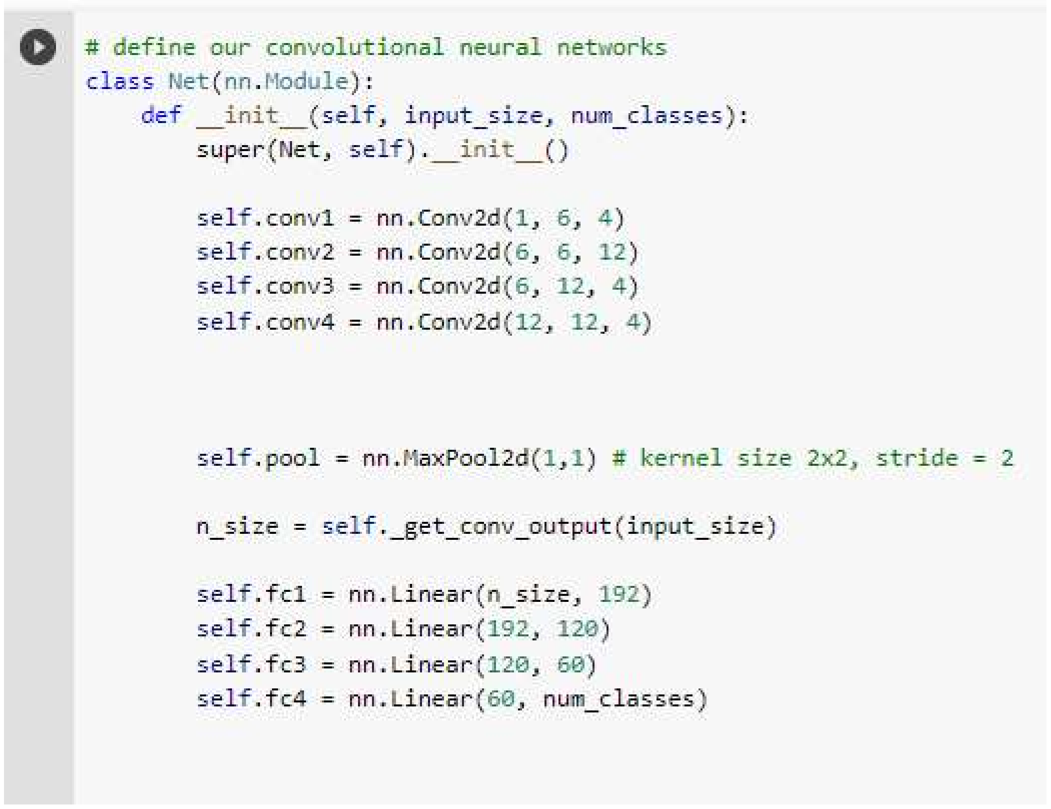
Question1:

After research the best suited loss function for this Connvolutional Neural Network is **Crossentropyloss** The reason why this loss function compare to other loss functions that are available in pytorch is that:

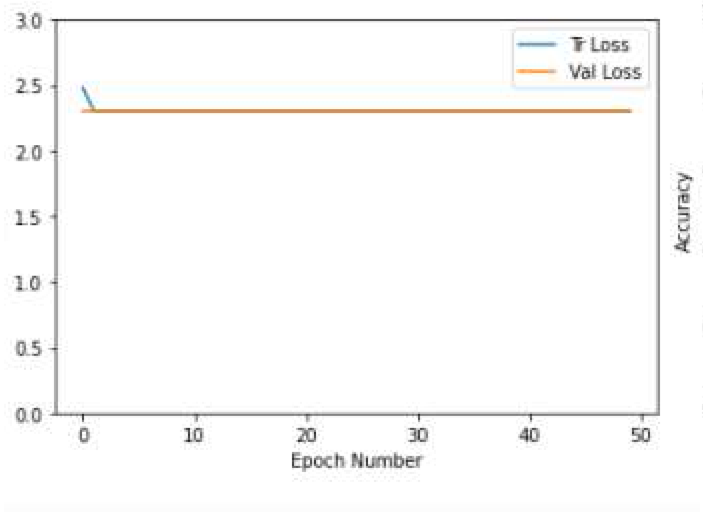
- Its one the most common loss function that is mostly used in training networks
- Using log-probabilities has the additional effect of keeping gradients from varying too widely
- Its more faster than others as its very uses log to get the data which is a simple algorithm
- Formula: $\text{loss}(x,class)=weight[class](-x[class]+\log(j\sum\exp(x[j])))$

Question2:



```
# define our convolutional neural networks
class Net(nn.Module):
    def __init__(self, input_size, num_classes):
        super(Net, self).__init__()

        self.conv1 = nn.Conv2d(1, 6, 4)
        self.conv2 = nn.Conv2d(6, 6, 12)
        self.conv3 = nn.Conv2d(6, 12, 4)
        self.conv4 = nn.Conv2d(12, 12, 4)



        self.pool = nn.MaxPool2d(1,1) # kernel size 2x2, stride = 2

        n_size = self._get_conv_output(input_size)

        self.fc1 = nn.Linear(n_size, 192)
        self.fc2 = nn.Linear(192, 120)
        self.fc3 = nn.Linear(120, 60)
        self.fc4 = nn.Linear(60, num_classes)
```

Figure 1: ConvNet Architecture



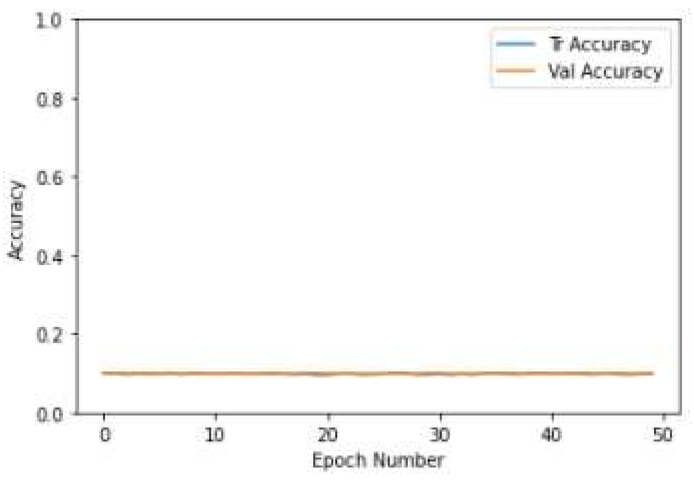


Figure 2: Loss plots of train and test data(Right),Accuracy plots of train and test data

- Optimizer=SGD optimizer
- Activation function=Relu
- Learning rate=0.1

Question3:

Activation Function	Accuracy	Loss
Tanh	`Training Accuracy: 86.2029%, Test Accuracy: 85.6705%`	`Training: Loss: 0.3646 Test Loss : 0.4055`
Sigmoid	`Train Accuracy: 9.9502% Test Accuracy: 9.9585%`	`Training: Loss: 2.3042 Test Loss : 2.3036`
Elu	`Train Accuracy: 9.9974% Test Accuracy: 9.8892%`	`Training: Loss: nan Test Loss : nan`

B)Keepin ReLU Function and testing with different Learning Rate:

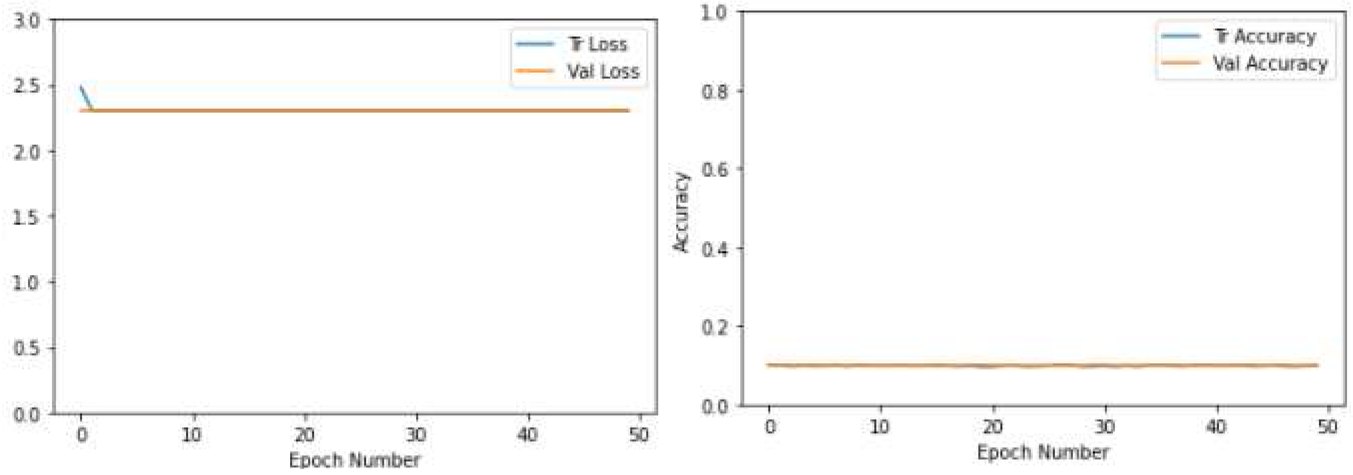


Figure 4: ReLU with Learning Rate=0.1

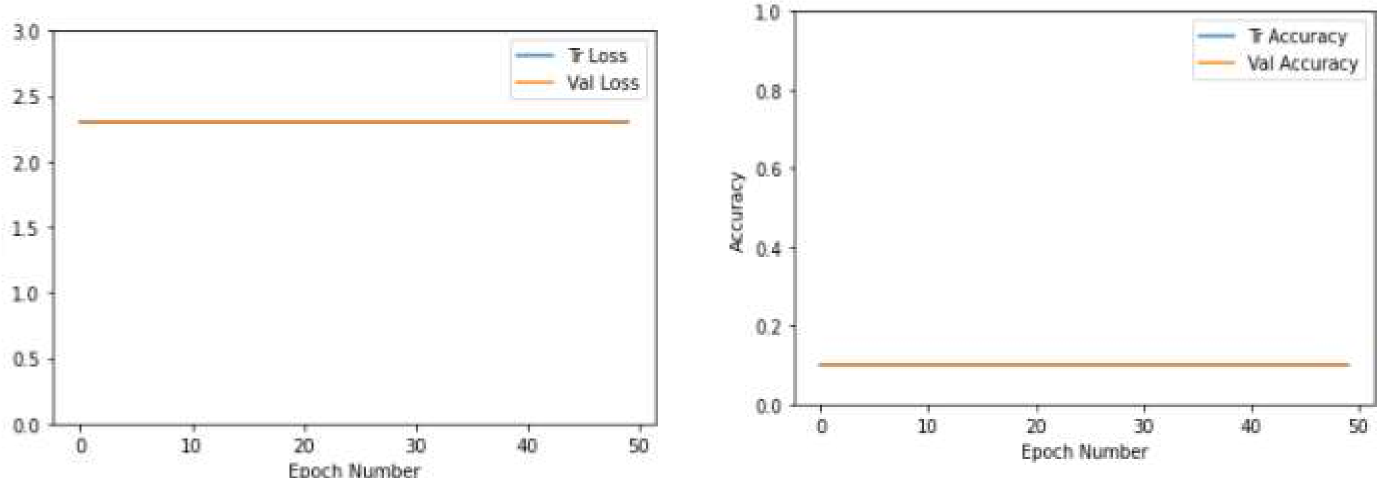


Figure 3: ReLU with Learning Rate=0.01

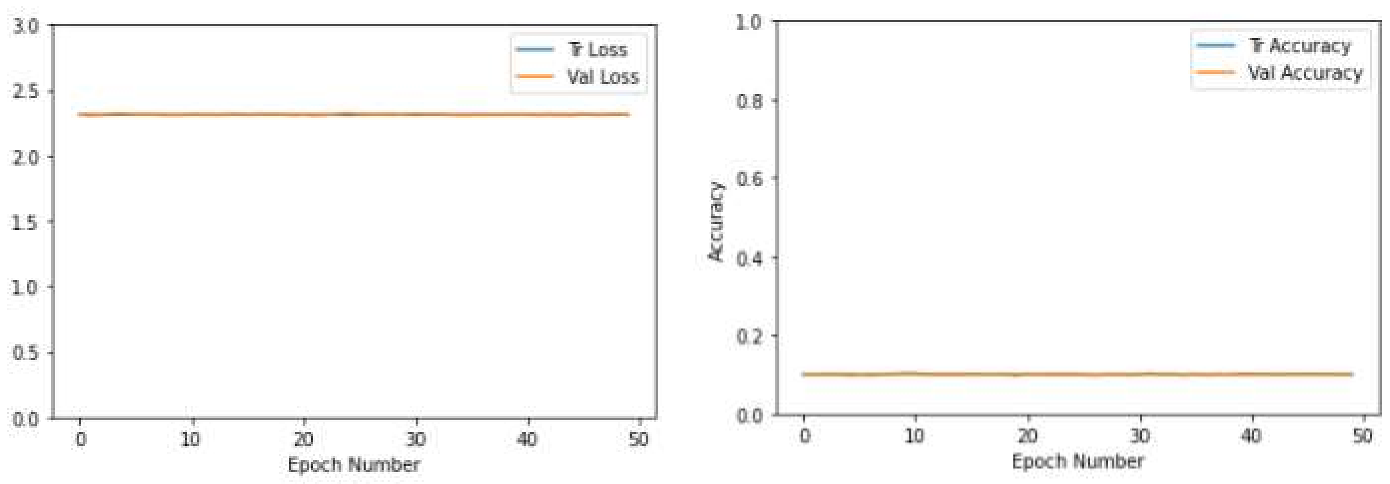


Figure 5:ReLU with learning Rate=0.5

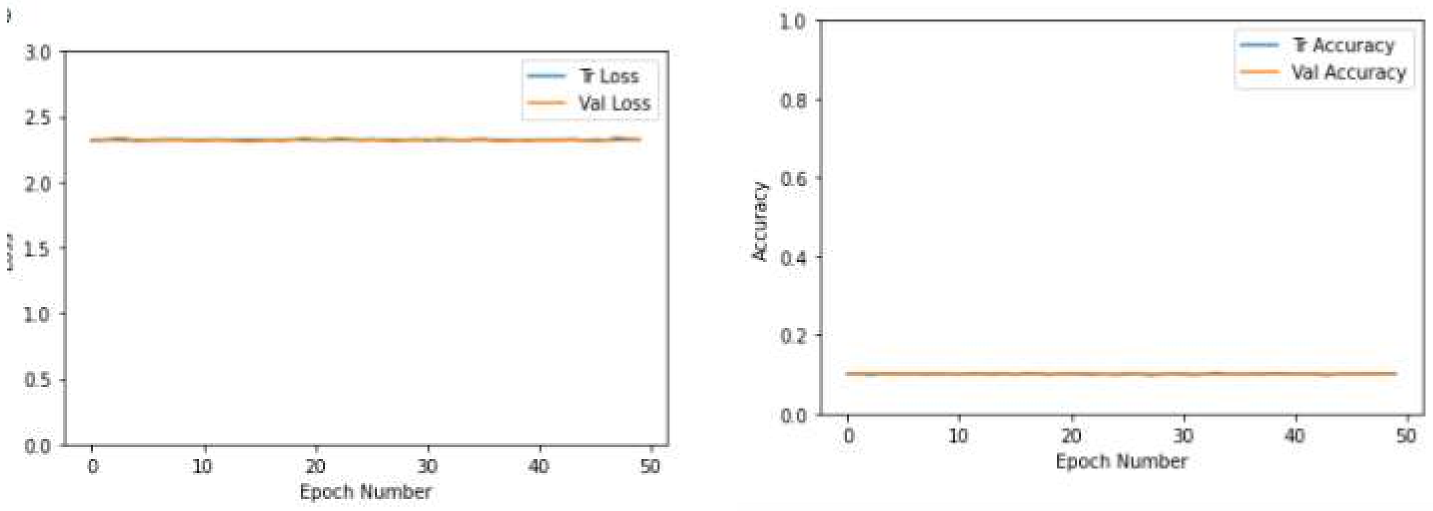


Figure 6:Relu with Learning rate=1

Conclusion:

As shown above diagram it looks the learning rate 0.001 is still low as the accuracy is very low and the loss is very high, But we can also observe that as the learning rate reaches 10 is start to randomly gong up and down as the higher learning rate causes high change in the weights during back progression.

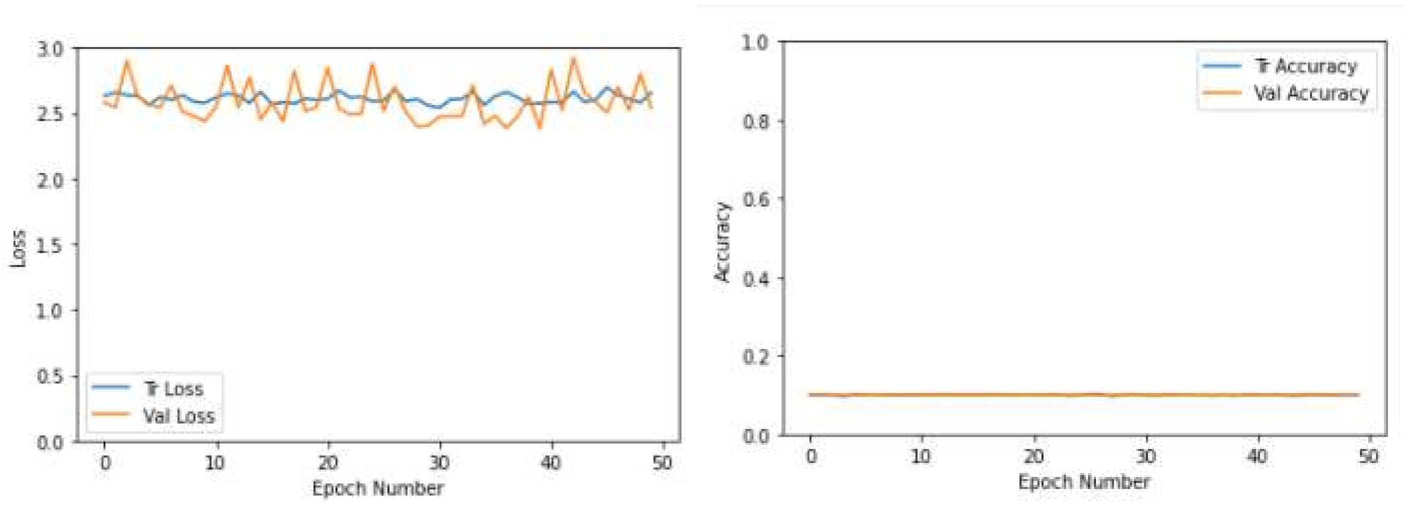
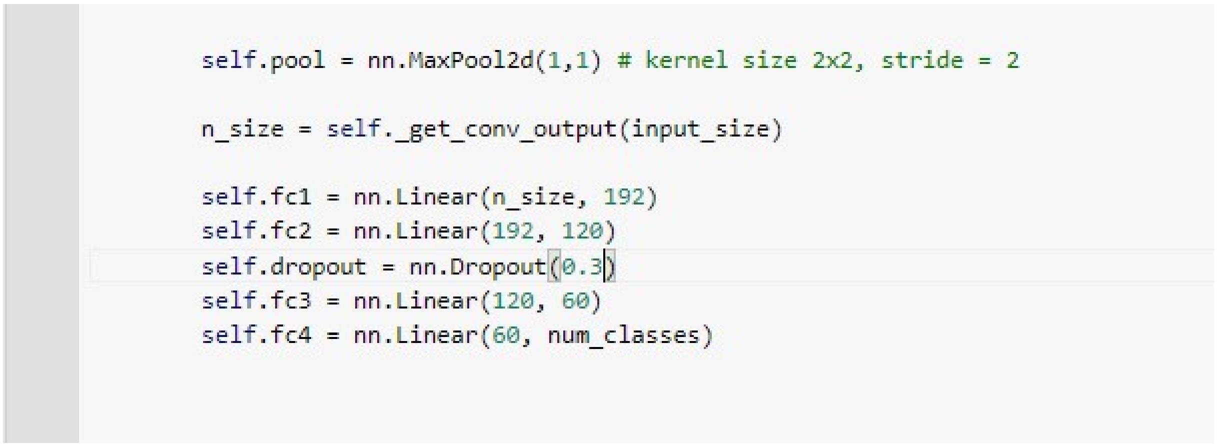


Figure 7:ReLU with Learning Rate=10

```
Epoch: 50/50
Epoch : 049, Training: Loss: 2.6563, Accuracy: 9.9336%,
               Validation : Loss : 2.5374, Accuracy: 10.0969%, Time: 6.8818s
```

Question4:

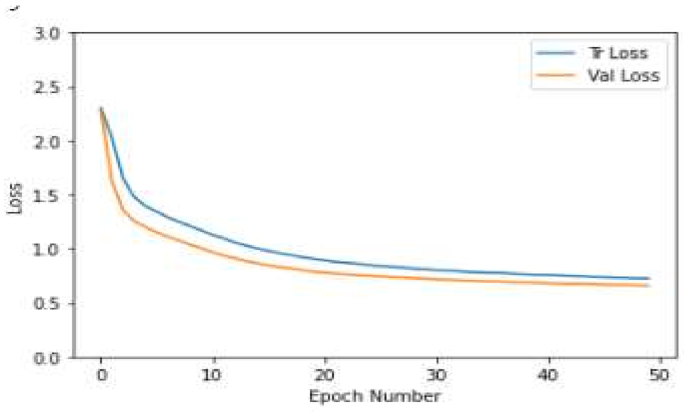
```
We add a dropout of 0.3 in the second fully connected layer
```

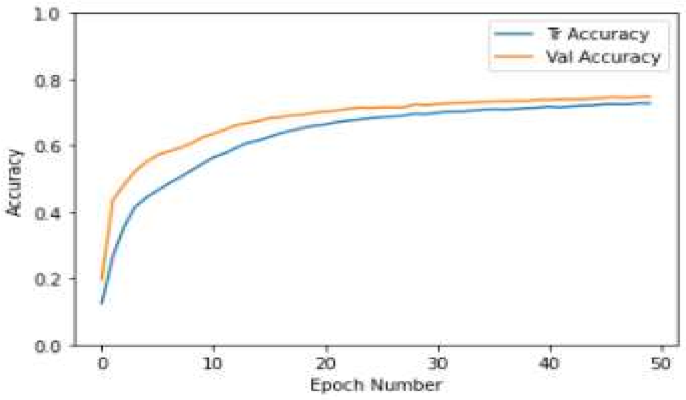


```
self.pool = nn.MaxPool2d(1,1) # kernel size 2x2, stride = 2

n_size = self._get_conv_output(input_size)

self.fc1 = nn.Linear(n_size, 192)
self.fc2 = nn.Linear(192, 120)
self.dropout = nn.Dropout(0.3)
self.fc3 = nn.Linear(120, 60)
self.fc4 = nn.Linear(60, num_classes)
```

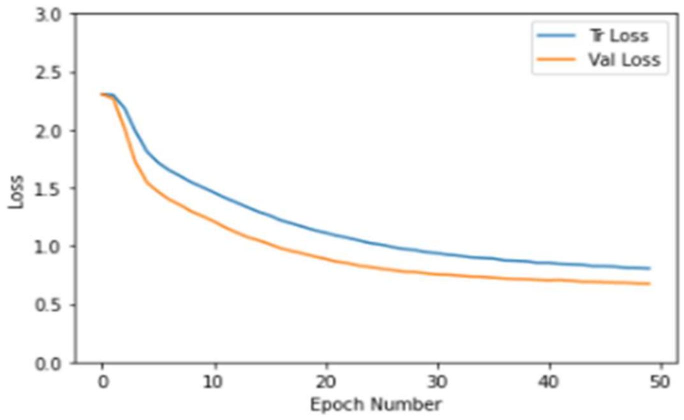
In the fellowing classification I used a different Optimizer (**optim.Adam)** and very low learning Rate so that we can visually see the effect of different dropout value.

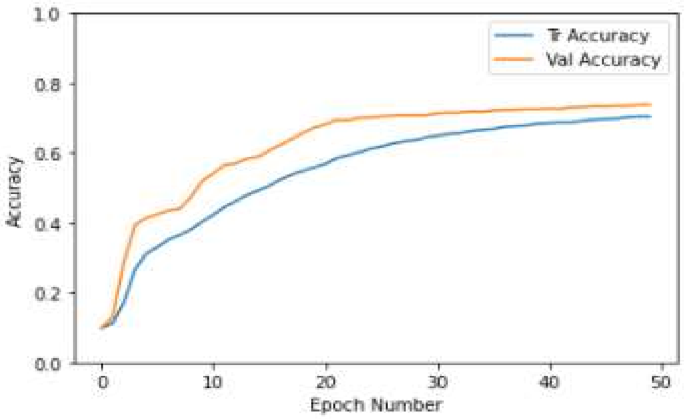
- Dropout=0.3



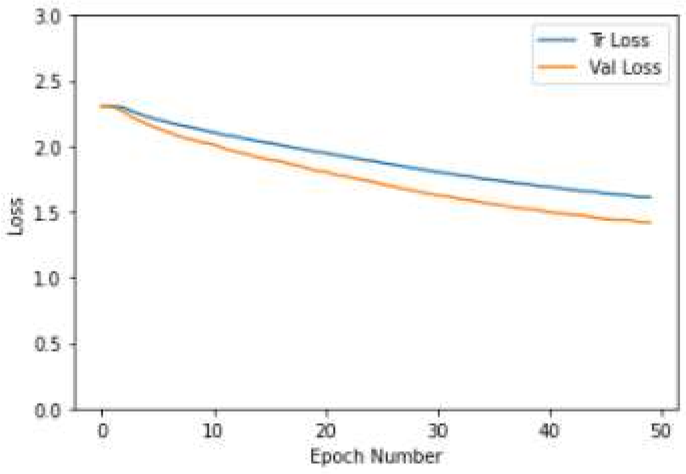


- DropOut=0.1





- Dropout=0.8



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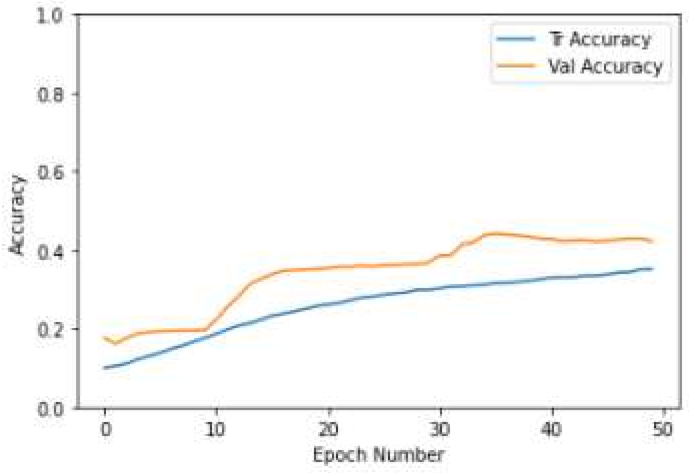

As shown in the above results, if the dropout is low the gap between the training data and the test data is bigger compare when the dropout =0.3.

And if the dropout is too high it effect the accuracy and the loss as it make the accuracy low and the rate of loss degrading is very low.