Advanced machine learning

Assignment – 2

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Given, the assignment is provided with 2-layer code and our task is to play with the parameters and improve the overall accuracy.

We will focus on two important parameters validation accuracy and test accuracy to determine the performance.

Initially, we will discuss about the important parameters

Hidden Layers:

Hidden layer is a layer of neurons that receives inputs from the previous layer and produces outputs that are passed to the next layer. The term "hidden" refers to the fact that the layer's computations are not directly visible or accessible from outside the network.

Hidden Units:

A hidden unit is a single neuron in a hidden layer. A hidden unit receives input from the previous layer and produces an output that is passed on to the next layer.

The number of hidden units in a hidden layer is a hyperparameter that can be adjusted to optimize the performance of the neural network. Adding more hidden units can increase the model's capacity to learn complex patterns.

Activation function:

An activation function is a non-linear function that is applied to the output of a neuron in a neural network. The purpose of an activation function is to introduce non-linearity into the model, allowing it to capture more complex patterns in the data.

Some common activation functions include:

1. **Sigmoid**
2. **Tanh**
3. **ReLU**

Optimizer:

The goal of an optimizer is to find the set of parameters that result in the lowest possible value of the loss function, which indicates that the model is making accurate predictions on the training data.

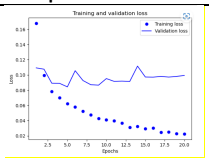
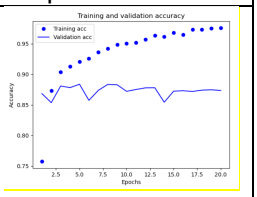
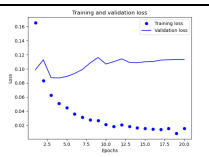
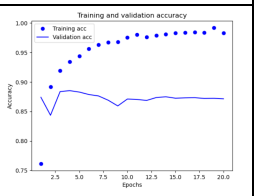
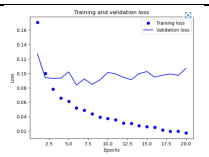
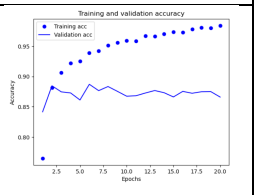
Regularizers:

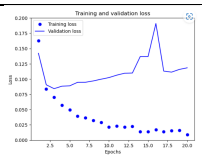
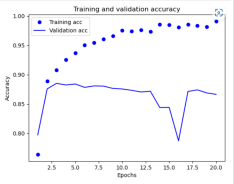
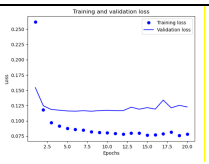
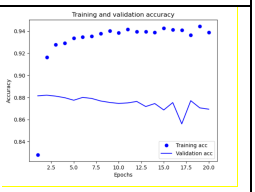
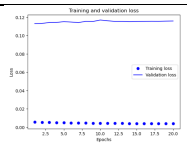
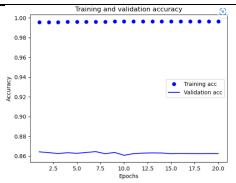
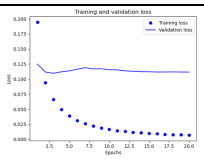
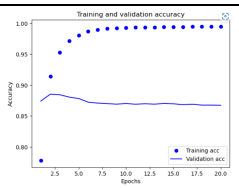
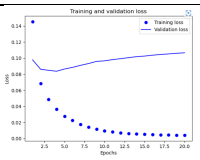
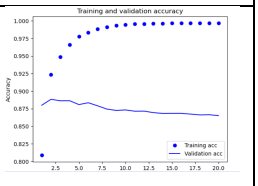
Regularizer is a technique used to prevent overfitting of a model. Overfitting occurs when a model is too complex and is able to fit the training data too closely, resulting in poor performance on new, unseen data.

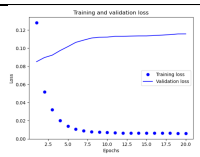
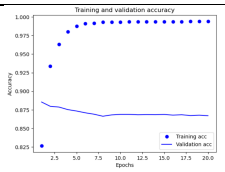
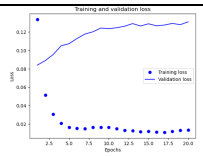
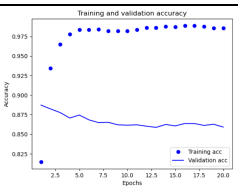
Dropouts:

Dropout is a widely used regularization technique in deep learning, and has been shown to improve the performance of neural networks on a variety of tasks.

Below is the brief description about the different cases that we are asked to play, and I tried with the various combinations, mentioned its training, validation and test accuracy with the graphs too.

Parameter	Training Accuracy	Validation Accuracy	Test Accuracy	Training & Validation loss Graph	Training & Validation Accuracy Graph
Hidden Layers – 1 Hidden Units – 128 Loss function – mse Activation Function – “Tanh” Regularization - NO Dropout – NO Optimizer – ‘rmsprop’ Metrics - “accuracy”	97.59	87.36	88.42		
Hidden Layers – 3 Hidden Units – 32 Loss function – mse Activation Function – “Tanh” Regularization - Dropout – NO Optimizer – “rmsprop” Metrics - “accuracy”	98.27	87.14	87.68		
Hidden Layers – 1 Hidden Units – 64 Loss function – mse Activation Function – “Tanh” Regularization - Dropout –	98.39	86.59	87.17		

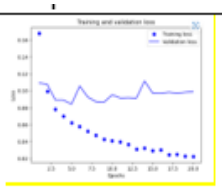
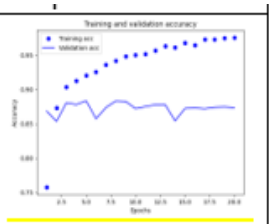
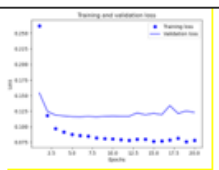
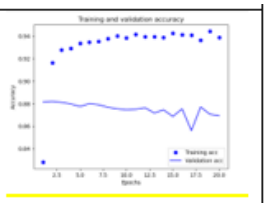
Optimizer – Metrics - “accuracy”					
Hidden Layers – 3 Hidden Units – 64 Loss function – mse Activation Function – “Tanh” Regularization - Dropout – Optimizer – Metrics - “accuracy”	99.10	86.64	87.47		
Hidden Layers – 1 Hidden Units – 128 Loss function – mse Activation Function – “Tanh” Regularization – L2 reg Dropout – NO Optimizer – ‘adam’ Metrics - “accuracy”	93.87	86.93	88.63		
Hidden Layers – 3 Hidden Units – 32 Loss function – mse Activation Function – “Tanh” Regularization – L2 reg Dropout – NO Optimizer – ‘adam’ Metrics - “accuracy”	99.55	86.31	85.79		
Hidden Layers – 3 Hidden Units – 32 Loss function – mse Activation Function – “Tanh” Regularization – L2 reg Dropout – yes Optimizer – ‘adam’ Metrics - “accuracy”	99.48	86.74	85.89		
Hidden Layers – 1 Hidden Units – 64 Loss function – mse Activation Function – “Tanh” Regularization – L2 reg Dropout – NO Optimizer – ‘adam’ Metrics - “accuracy”	99.67	86.51	86.73		

Hidden Layers – 2 Hidden Units – 64 Loss function – mse Activation Function – “Tanh” Regularization – L2 reg Dropout – NO Optimizer – ‘adam’ Metrics - “accuracy”	99.40	86.71	87.59		
Hidden Layers – 3 Hidden Units – 64 Loss function – mse Activation Function – “Tanh” Regularization – L2 reg Dropout – yes Optimizer – ‘adam’ Metrics - “accuracy”	98.57	85.91	87.30		

Conclusion:

All the combinations, produced the decent result, however the highlighted (yellow colored) are best.

So the final combination of parameters are:

Hidden Layers – 1 Hidden Units – 128 Loss function – mse Activation Function – “Tanh” Regularization - NO Dropout – NO Optimizer – ‘rmsprop’ Metrics - “accuracy”	97.59	87.36	88.42		
Hidden Layers – 1 Hidden Units – 128 Loss function – mse Activation Function – “Tanh” Regularization – L2 reg Dropout – NO Optimizer – ‘adam’ Metrics - “accuracy”	93.87	86.93	88.63