**Assignment 3 – AML**

**Student Name**: Aksa Taniya

**Instructor**: CJ Wu

**Topic:** Cats Vs Dogs Classification using Deep Learning

For this task, I have classified the following into following cases as per the instructions provided.

I categorized the use cases into the following,

1. Basic Convolution network from the scratch
2. Convolution network with optimization techniques
3. Using pre-trained network

And then sub categorized depending on the training samples.

**Dataset: I used the official dataset from the Kaggle which contains 25000 training samples and roughly around 5000 testing sample and below is the link for the dataset.**

**https://www.kaggle.com/datasets/biaiscience/dogs-vs-cats**

I used **ResNet50** architecture as my pretrained network and a brief detail provided below

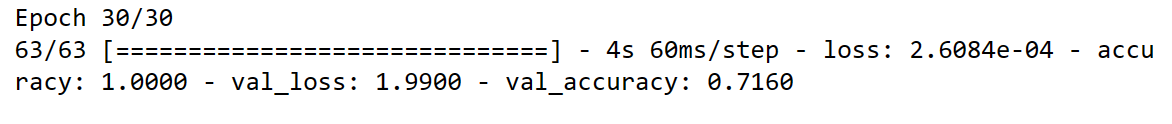
ResNet50 is a convolutional neural network architecture that was proposed by Microsoft Research in 2015. It is one of the variants of the ResNet (Residual Network) family, which introduced the concept of residual learning to improve the training of very deep neural networks.

ResNet50 consists of 50 layers, including a convolutional layer, followed by four stages, each containing multiple residual blocks. Each residual block consists of two convolutional layers and a shortcut connection that bypasses the convolutional layers. The shortcut connection allows for the gradient to flow directly through the network without being affected by the convolutional layers, which can help to mitigate the vanishing gradient problem and improve the training of very deep neural networks.

ResNet50 also includes a global average pooling layer and a fully connected layer at the end of the network, which outputs the class scores for the input image. The architecture has been pre-trained on a large dataset such as ImageNet and can be fine-tuned for specific tasks such as image classification, object detection, and segmentation

And the results are displayed below.

**Case: 1 - Convnet from Scratch with 1000 sample data and 500 validation and testing data**

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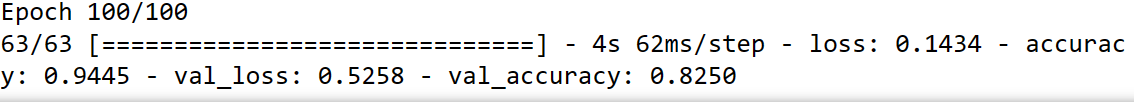
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**Case: 2 - Convnet from scratch with 1000 sample data and 500 validation and testing data also with Dropout and Data Augmentation – (optimization Techniques)**

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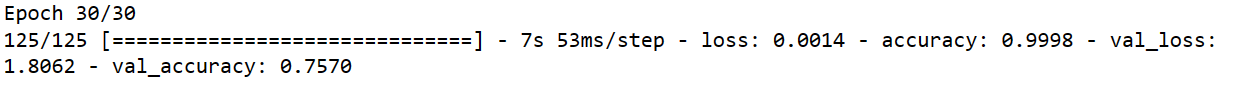
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**Case: 3 - Convnet from Scratch with 2000 training samples and 500 validation and testing data.**

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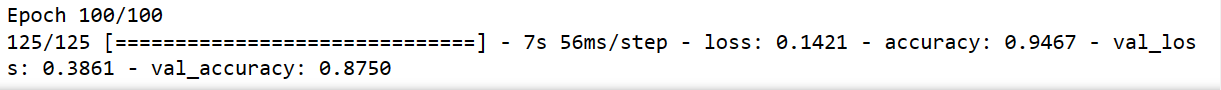
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**Case: 4 - Convnet with Dropout and Data Augmentation with 2000 training samples and 500 validation and testing data – (optimization Techniques)**

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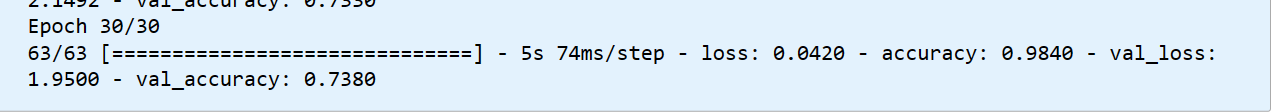
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**Case: 5- Convnet from Scratch with 5000 training samples and 500 validation and testing data**

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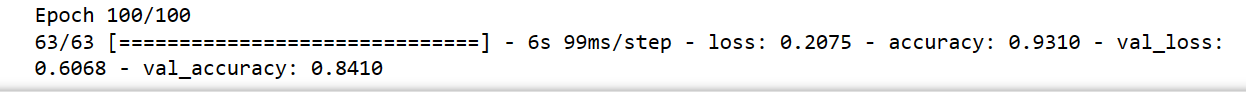
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**Case: 6 - Convnet with Dropout and Data Augmentation with 5000 training samples and 500 validation and testing data – (optimization Techniques)**

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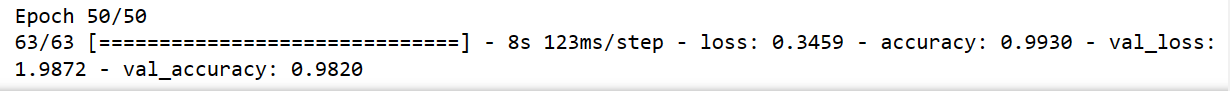
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**Case: 7 - Using pre-trained ResNet50 architecture with 1000 sample data and 500 validation and testing data**

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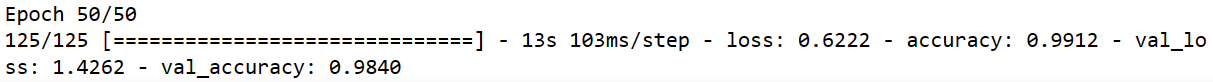
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**Case: 8 - Using pre-trained ResNet50 architecture with 2000 sample data and 500 validation and testing data**

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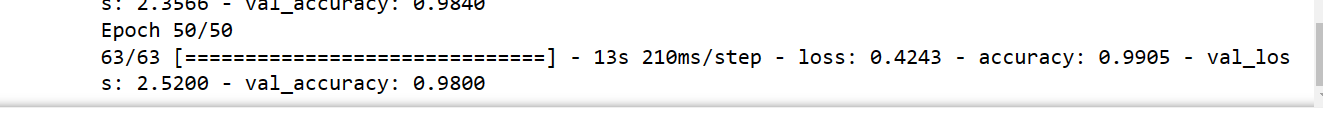
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**Case: 9 - Using pre-trained ResNet50 architecture with 5000 sample data and 500 validation and testing data**

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**Case: 10 - Using pre-trained ResNet50 architecture with 5000 sample data and 500 validation and testing data along with optimization techniques.**

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**Summary of Results:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Cases | Training Accuracy | Validation Accuracy | Training Loss | Validation Loss | Test accuracy |
| Case - 1 | 1.00 | 0.716 | 2.608 | 1.990 | 0.772 |
| Case - 2 | 0.9445 | 0.9445 | 0.1434 | 0.5258 | 0.813 |
| Case - 3 | 0.9998 | 0.7570 | 0.0014 | 0.0014 | 0.721 |
| Case - 4 | 0.9467 | 0.8750 | 0.1421 | 0.3861 | 0.838 |
| Case - 5 | 0.9848 | 0.7380 | 0.0420 | 1.9500 | 0.782 |
| Case -6 | 0.9310 | 0.8410 | 0.2075 | 0.6068 | 0.834 |
| Case -7 | 0.9930 | 0.9820 | 0.3459 | 1.9872 | 0.978 |
| Case-8 | 0.991 | 0.9840 | 0.622 | 1.426 | 0.980 |
| Case -9 | 0.9990 | 0.9760 | 0.1155 | 5.5881 | 0.9765 |
| Case -10 | 0.9905 | 0.9800 | 0.4243 | 2.5200 | 0.9790 |

**Conclusion:**

Using a basic convolution, the accuracy of the model is normal, and it touches around 70 percent, As we performed the optimizations techniques and increases the sample size, it varied a lot and increased, thus proving the fact that these techniques really worked in practical. In later stage I used pretrained Resnet50 architecture which gives a pretty decent result and great improvement in the performance.

Also, an highlight of this task is as we increase the sample size, the accuracy is getting increased and decent when using the pretrained architecture, but when I use convnet that is basically designed with no optimizations it around 75-80 percent. Considering the above two points using the pretrained architecture is best for this scenario.

Overall, the highest performance was achieved is 98 percent, Thus the model can predict the classification task with 98 percent accuracy.