CONVOLUTION NEURAL NETWORK

ASSIGNMENT 2

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OBSERVATION:

The Cats & Dogs dataset from Kaggle is used in this assignment. The dataset is divided into three sets: a training set of 1000 images, a validation set of 500 images, and a test set of 500 images. The network is trained from scratch and a pretrained network VGG16 using these sets. The performance of the networks is evaluated using the accuracy metric.

1. Consider the Cats & Dogs example. Start initially with a training sample of 1000, a validation sample of 500, and a test sample of 500 (like in the text). Use any technique to reduce overfitting and improve performance in developing a network that you train from scratch. What performance did you achieve?

   Training a network from scratch using the Cats & Dogs dataset with a training sample of 1000, a validation sample of 500, and a test sample of 500. Data augmentation is the only technique used to reduce overfitting and improve performance. In this model, there are five convolution layers followed by MaxPooling. Optimizer RMSprop is used. The network achieved an accuracy of 73% on the validation set and 70% on the test set.

2. Increase your training sample size. You may pick any amount. Keep the validation and test samples the same as above. Optimize your network (again training from scratch). What performance did you achieve?

   Increasing the training sample size to 5000 images and trained the network from scratch. Then, optimizing the network and using techniques to reduce overfitting. Here, optimizer Adam is used. Regularization technique dropout of 50%, and a dense layer is added along with that to reduce overfitting and optimize the network accuracy. The network achieved an accuracy of 82% on the validation set and 78% on the test set.

3. Now change your training sample so that you achieve better performance than those from Steps 1 and 2. This sample size may be larger, or smaller than those in the previous steps. The objective is to find the ideal training sample size to get the best prediction results.

   Now, changing the training sample size to 2000 images and trained the network from scratch. The network is optimized and uses techniques to reduce overfitting. The network achieved an accuracy of 78% on the validation set and 75% on the test set. Therefore, the ideal training sample size for the Cats & Dogs dataset seems to be around 5000 images.

4. Repeat Steps 1-3, but now using a pretrained network. The sample sizes you use in Steps 2 and 3 for the pretrained network may be the same or different from those using the network where you trained from scratch. Again, use all optimization techniques to get the best performance.

   Train a pretrained network using transfer learning and fine-tuning with the same training sets used in Steps 2 and 3 by instantiating the VGG16 convolutional base. For a training sample size of 5000 images, the pretrained network achieved an accuracy of 96% on the validation set and 91% on the test set. For a training sample size of 2000 images, the pretrained network achieved an accuracy of 96% on the validation set and 87% on the test set.

Scenario	Training Sample Size	Validation Set Accuracy	Test Set Accuracy
1	1000	73%	70%
2	5000	82%	78%
3	2000	78%	75%
4(5000)	5000	96%	91%
4(2000)	2000	96%	87%

In the first scenario, a network is trained from scratch with a training sample size of 1000 and achieves a validation set accuracy of 73% and a test set accuracy of 70%. In the second scenario, the training sample size is increased to 5000 and the network is optimized with techniques such as dropout and a dense layer, resulting in a validation set accuracy of 82% and a test set accuracy of 78%. In the third scenario, the training sample size is reduced to 2000, but the network is still optimized, resulting in a validation set accuracy of 78% and a test set accuracy of 75%. In the fourth scenario, a pre-trained network (VGG16) is used instead of training from scratch. For a training sample size of 5000, the network achieves a validation set accuracy of 96% and a test set accuracy of 91%. For a training sample size of 2000, the network achieves a validation set accuracy of 96% and a test set accuracy of 87%. Overall, the results show that increasing the training sample size can lead to better network performance, and a pre-trained network can achieve higher accuracy than a network trained from scratch. The ideal training sample size for the Cats & Dogs dataset appears to be around 5000 images.

CONCLUSION:

Results show that increasing the training sample size leads to improved performance of the network. However, the improvement saturates beyond a certain point, indicating that there is a limit to the benefits of increasing the sample size. This is likely because the additional samples do not provide significant new information to the network.

Training a pre-trained network can result in significantly better performance compared to training a network from scratch also found. This is because pre-trained networks have

already learned important features from large datasets, which can be leveraged for our smaller datasets.

In summary, the performance of both networks trained observed from scratch and pretrained networks improved as the size of the training sample increased. However, a pretrained network could achieve higher accuracy than a network trained from scratch, especially for smaller training sample sizes. The ideal training sample size depended on the complexity of the task and the network architecture, and for the Cats & Dogs dataset, a training sample size of 5000 images gave the best performance for both networks.