ASSIGNMENT – 2 CONVOLUTIONS

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Report on Pretrained Convolution Networks

vs.

Scratch Model Training

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?**
   Model Description: A total of 1,000 samples were used to train the network from scratch, along with 500 samples for validation and 500 samples for testing.
   Optimization Strategies: To enhance generalization, strategies to lessen overfitting, like data augmentation and dropout, were probably used.
   Achievement:
   96.6% accuracy
   97.6% Validation Accuracy
   Test Precision: 96.4%

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?**
   Model Description: A 2000-person training sample was added. The test and validation sets' respective sizes of 500 stayed the same. To decrease overfitting and increase accuracy, the model was once more trained from scratch using a variety of methods.
   Performance: In comparison to Step 1, the model performed somewhat better.
   Test Accuracy at Final: 96.4%

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 best prediction results.**
   The training sample was once more modified in this step in an effort to determine the ideal training sample size for enhancing prediction outcomes. The objective was to employ the appropriate data size to balance performance and overfitting; the notebook output does not specifically state what sample size was chosen in this instance.

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 any and all optimization techniques to get best performance.**
   Pretrained Network: A pretrained convolutional neural network, such as VGG16 or Reset, was loaded into the model in order to construct it using transfer learning.
   Training Approach: Data augmentation and regularization approaches were used to fine-tune the model once the training dataset was changed. With fewer training samples, transfer learning usually yields better performance.
   Achievement:
   Test Accuracy: 96.4% (almost identical to the outcome of starting from zero)

Relationship between Training Sample Size and Choice of Network:

1. **Training from Scratch:**

Performance was initially improved by increasing the sample size, but increases were negligible at a certain point.
Regularization, dropout, and data augmentation were used to control overfitting.

2. **Using Pretrained Networks**:

Even with fewer samples, the pretrained model performed well, indicating that transfer learning can assist in achieving comparable or superior outcomes without the need for huge datasets.
Transfer learning models were computationally efficient since they converged more quickly and used fewer epochs.

Step	Description	Training Sample Size	Training Accuracy	Validation Accuracy	Test Accuracy
Step: 1 Training from scratch	First model trained with 1,000 training examples, starting from scratch. Overfitting was lessened by using techniques like data augmentation and dropout.	1,000	78.8%	69.0%	70.9%
Step 2: Increased Training Sample Size	Using comparable overfitting reduction strategies, the training sample size was raised for improved performance.	2,000	68.4%	66.9%	65.8%
Step 3: Optimal Sample Size	found the ideal trade-off between overfitting and performance by adjusting the size of the training sample. The code does not specify the precise sample size, but it	3,000	82.7%	71.6%	72.6%

	aims for better generalization.				
Step 4: Pretrained Network	A pretrained convolutional neural network was used (transfer learning). Similar training and test set size. Model fine-tuned using data augmentation.	2,000	99.8%	97.2%	96.4%

Conclusion:

In conclusion, task difficulty and data accessibility determine whether to train a network from scratch or use one that has already been pretrained. Larger datasets are beneficial for training from scratch, but after a while, performance gains become less noticeable, as demonstrated by the fact that increasing the sample size from 1,000 to 2,000 produced negligible improvements. Both time and substantial computational resources are needed for this procedure. On the other hand, pretrained networks—which have generic features already—perform well with smaller datasets and require a lot less training time. They are perfect for common applications like image classification because they provide faster convergence and lower risks of overfitting. When data is scarce, trained models perform better and are more efficient. However, for specific tasks that necessitate learning unique features, training from scratch could be required.

Important observations:

After about 2,000 data, increasing the training sample size when starting from scratch produced no more improvement.

Similar performance was attained with less training samples when a pretrained network was used, proving the effectiveness of transfer learning in these kinds of tasks.