ASSIGNMENT -3

1. The purpose of an activation function in a neural network is to introduce non-linearity, allowing the network to learn complex patterns. Common activation functions include ReLU, Sigmoid, Tanh, and Softmax.

2. Gradient descent is an optimization algorithm used to minimize the loss function by iteratively updating the weights and biases in the direction of the negative gradient. It is the core algorithm for training neural networks.

3. Backpropagation calculates the gradients of the loss function with respect to the weights and biases by applying the chain rule of differentiation from the output layer to the input layer. This process propagates the error gradients backward through the network.

4. A convolutional neural network (CNN) consists of convolutional layers, pooling layers, and fully connected layers. CNNs are designed to efficiently process grid-like data (e.g., images) by leveraging local connectivity, weight sharing, and spatial/temporal downsampling.

5. Convolutional layers in CNNs are advantageous for image recognition tasks because they can capture local spatial patterns, are equivariant to translations, and reduce the number of parameters compared to fully connected layers.

6. Pooling layers in CNNs downsample the spatial dimensions of feature maps, reducing the computational complexity and providing some degree of translation invariance. Common pooling operations are max pooling and average pooling.

7. Data augmentation helps prevent overfitting in CNN models by artificially increasing the diversity of the training data. Common techniques include random cropping, flipping, rotation, scaling, and adding noise.

8. The flatten layer in a CNN is used to convert the multi-dimensional output of the convolutional and pooling layers into a one-dimensional vector, which can then be fed into the fully connected layers for classification or regression tasks.

9. Fully connected layers in a CNN are typically used in the final stages to combine the high-level features extracted by the convolutional and pooling layers and output the final predictions.

10. Transfer learning involves using a pre-trained model (trained on a large dataset) as a starting point for a new task, rather than training from scratch. The pre-trained weights are fine-tuned on the new dataset, reducing training time and improving performance.

11. The VGG-16 model is a deep CNN with 16 weight layers, including 13 convolutional layers and 3 fully connected layers. Its depth and small convolutional filters were influential in improving performance on image recognition tasks.

12. Residual connections in ResNet models introduce skip connections that bypass layers, allowing the network to learn residual mappings. This helps address the vanishing gradient problem in very deep neural networks.

13. Advantages of transfer learning with models like Inception and Xception include improved performance, faster convergence, and the ability to work with smaller datasets. Disadvantages include the potential for negative transfer and the need for careful fine-tuning.

14. To fine-tune a pre-trained model, you typically freeze the earlier layers and fine-tune the later layers on the new dataset, gradually unfreezing more layers. Factors to consider include the size of the new dataset, the similarity to the original task, and the learning rate.

15. Common evaluation metrics for CNN models include accuracy (correctly classified instances), precision (true positives over predicted positives), recall (true positives over actual positives), and F1 score (harmonic mean of precision and recall).

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