ASSIGNMENT 4

1. Activation functions introduce non-linearity to the neural network, enabling it to learn complex patterns. Commonly used activation functions include ReLU (Rectified Linear Unit), sigmoid, and tanh.
2. Gradient descent is an optimization algorithm used to minimize the loss function by adjusting the parameters of the neural network in the direction of the steepest descent of the gradient. It calculates the gradient of the loss function with respect to each parameter and updates them iteratively.
3. Backpropagation calculates the gradients of the loss function with respect to the parameters of a neural network using the chain rule of calculus. It propagates the error backward from the output layer to the input layer, updating the weights and biases accordingly.
4. A convolutional neural network (CNN) consists of convolutional layers, pooling layers, and fully connected layers. Unlike fully connected neural networks, CNNs leverage convolutional and pooling operations to extract spatial hierarchies of features from input data, making them particularly effective for tasks like image recognition.
5. Convolutional layers in CNNs exploit spatial hierarchies of features by using shared weights and local connections. This allows CNNs to efficiently capture patterns in images, leading to better performance in tasks like image recognition compared to fully connected networks.
6. Pooling layers in CNNs reduce the spatial dimensions of feature maps by downsampling, which helps in controlling overfitting and reducing computational complexity. They aggregate the information within local regions, preserving the most relevant features.
7. Data augmentation helps prevent overfitting in CNN models by increasing the diversity of the training data. Common techniques include random rotations, flips, translations, and scaling of images, which introduce variations to the training data without changing the underlying labels.
8. The flatten layer in a CNN transforms the output of convolutional layers into a one-dimensional vector, which can be input into fully connected layers. It preserves the spatial structure of features while converting them into a format suitable for traditional neural network layers.
9. Fully connected layers in a CNN are densely connected layers where each neuron is connected to every neuron in the previous layer. They are typically used in the final stages of a CNN architecture to perform classification or regression tasks based on the extracted features.
10. Transfer learning involves leveraging knowledge from pre-trained models on similar tasks to improve the performance of a model on a new task. Pre-trained models are adapted for new tasks by fine-tuning their parameters or using them as feature extractors.
11. The VGG-16 model consists of 16 layers, including 13 convolutional layers and 3 fully connected layers. Its depth and convolutional layers enable it to learn intricate features at different levels of abstraction, making it effective for a wide range of image recognition tasks.
12. Residual connections in a ResNet model allow for the direct flow of gradients during training, mitigating the vanishing gradient problem. They enable the network to learn residual mappings, making it easier to train deeper networks by facilitating the flow of information.

ASSIGNMENT 4

13. Transfer learning with pre-trained models like Inception and Xception offers advantages such as faster training and better performance on limited data. However, they may suffer from domain mismatch if the pre-trained model's data is substantially different from the target task.

14. Fine-tuning a pre-trained model involves updating its parameters on a new task while preserving the learned representations. Factors to consider in the fine-tuning process include the similarity between the pre-trained model's task and the target task, the amount of available data, and the computational resources.

15. Common evaluation metrics for CNN models include accuracy, precision, recall, and F1 score. Accuracy measures the proportion of correctly classified instances, precision measures the proportion of true positive predictions among all positive predictions, recall measures the proportion of true positive predictions among all actual positive instances, and the F1 score is the harmonic mean of precision and recall, providing a balanced measure of a model's performance.