

Assignment 4

1. What is the primary difference between a traditional computer program and a neural network in terms of problem-solving?
2. You have a neural network with three layers: an input layer with 100 neurons, a hidden layer with 50 neurons, and an output layer with 10 neurons. If each neuron in the hidden layer is connected to each neuron in the input and output layers, calculate the total number of weights in the network.
3. Suppose you are training a neural network for image classification with a batch size of 32, and you have 10,000 training images. How many weight updates will occur during one epoch (one pass through the entire training dataset)?
4. What is backpropagation, and why is it important in training neural networks?
5. Given an image with dimensions 100x100 pixels and a convolutional layer with a 3x3 filter and no padding, calculate the dimensions of the feature map produced.
6. What are filters (kernels) in a convolutional layer, and how are they used to extract features from images?

Programming Assignment: MNIST Image Classification with a Simple Neural Network

Build and train a basic neural network to classify handwritten digits from the MNIST dataset. Experiment with different hyperparameters to observe their impact on model performance.

Hyperparameters to Experiment With:

- Number of Hidden Layers
- Number of Neurons in Hidden Layers
- Activation Function (e.g., ReLU or Sigmoid)
- Learning Rate
- Batch Size
- Number of Epochs

Training and Evaluation:

- Train the model on the training data with chosen hyperparameters.
- Monitor training metrics.
- Evaluate the model on the test data.

Experimentation:

- Change hyperparameters systematically and observe their effects on model performance.
- For instance, test different learning rates, layer configurations, or batch sizes.

Reporting:

- Summarize results with tables or charts.
- Discuss how changing hyperparameters impacted the model's performance.