Module 4 - Neural Networks and Deep Learning for Image Classification

Neural Networks

A neural network is a type of machine learning model that's inspired by the structure of the human brain. It's made up of layers of interconnected nodes (also called neurons) that process data and learn patterns from it.

Simple Neural Network for XOR

Completed Lab; attached to Module

Fully Connected Neural Network Architecture

- Deals with how to arrange the different number of hidden layers and neurons

- We can make multiclass predictions using neural networks, just by adding more neurons to the output layer

- A neural network with mroe than one hidden layer is known as a deep neural network

    - More neurons or more layers may lead to overfitting

    - The output or activation of each layer is the same dimension as the number of neurons

Neural Network Rectified Linear Unit (ReLU) vs Sigmoid

Completed Lab; attached to module

Training a Neural Network with Momentum

Completed Lab; attached to module

Convolutional Neural Networks (CNNs)

A CNN is a neural network with special layers - A CNN looks at small parts of an image, finds important features, reduces complexity, and then uses those features to figure out what the image is.

- Convolution and pooling layers are the first layers used to extract features from an input these can be thought of as the feature learning layers, the fully connected layers are simply a neural network

Convolutional Neural Network Lab

Completed Lab; attached to module

Data Augmentation

Completed Lab; attached to module

CNN Architectures

Popular Architectures include:

- LeNet-5

  - One of the first CNNs.

  - Used on MNIST (handwritten digits dataset).

- AlexNet

  - Deep network with large kernels (e.g., 11×11) and many parameters

  - Needs lots of data to train

  - Sparked the revival of CNNs in image classification

- VGGNet

  - Known for being deeper and simpler.

- VGG-16 and VGG-19 are most common
- Uses stacked 3×3 convolutions instead of larger ones
  - Same effect (receptive field) but fewer parameters and faster training
- Resnet
  - As networks got deeper, vanishing gradients became an issue
  - ResNet solves this using skip connections
  - Allows for very deep networks (e.g., 32+ layers) to be trained effectively

Practice Assessment

Practice Assessment

Assignment details

Submitted
May 5, 8:38 PM PDT

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Unlimited

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To pass you need at least 50%. We keep your highest score.

60%

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1. Data augmentation techniques   `1 point`

☐ Add extra layers to the neural network

☑ Randomly change the training data

☑ Prevent overfitting

2. What is the problem that occurs when a network gets deeper, resulting in a smaller gradient?   `1 point`

◯ Validation

◉ Gradient descent

◯ Vanishing gradient

3. Usually, the more input dimensions there are in a neural network, the...   `1 point`

◉ More neurons are required

◯ Less neurons are required

◯ The number of required neurons remains the same

4. Which of the following are activation functions? Check all that apply.   `1 point`

☑ ReLU

☑ Sigmoid

☐ Logistic function

5. For a given input in a neural network, we obtain an output for each neuron for the last layer. The class chosen is according to the index of the neuron with the...   `1 point`

◉ Largest value

◯ Smallest value

◯ Randomly selected value

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