Image Processing Basics

Pixels

The smallest unit of an image, pixels are tiny squares that form the grid of a digital image. Each pixel contains color information typically represented in RGB (Red, Green, Blue) values.

RGB to Grayscale Conversion

To convert a color image to grayscale, the RGB values of each pixel are transformed into a single intensity value. A common method is to use a weighted sum:

$$\text{Grayscale} = 0.299R + 0.587G + 0.114B$$

This formula accounts for the human eye's sensitivity to different colors.

Neural Network Diagram

Structure

A neural network consists of layers of nodes (neurons). The basic layers include the input layer, hidden layers, and the output layer.

Connections

Each node in a layer is connected to nodes in the next layer, with weights assigned to each connection. These weights are adjusted during training to minimize error.

Activation Functions

Nodes use activation functions to determine their output based on the input sum. A commonly used activation function is the sigmoid function.

Sigmoid Function

Formula

The sigmoid function is defined as:

$$\sigma(x) = \frac{1}{1 + e^{-x}}$$

Properties

It maps any input value to a range between 0 and 1, making it useful for binary classification tasks and providing smooth gradient changes for backpropagation during neural network training.

Equation $a_{ij+1} = w_{ij}a_{ij} + c_{ij}$

Explanation

This equation describes the computation in a neural network, where:

- a_{ij+1}: The activation of the neuron in the $(j+1)$-th layer.
- w_{ij}: The weight between the i-th neuron in the j-th layer and the corresponding neuron in the $(j+1)$-th layer.
- a_{ij}: The activation of the neuron in the j-th layer.
- c_{ij}: The bias term for the neuron in the $(j+1)$-th layer.

Purpose

The equation calculates the weighted sum of inputs from the previous layer, adding a bias term to determine the input for the activation function in the next layer.

In a neural network, the output of one layer becomes the input to the next layer. The weights and biases are adjusted during training through algorithms like backpropagation, aiming to minimize the error between the predicted output and the actual target values.