# 685.621 Algorithms for Data Science

Neural Networks

Module Learning Objectives

➢ 11.1 Explain the architecture and functioning of artificial neural networks, including perceptrons and multi-layer perceptrons.

➢ 11.2 Differentiate between linear and nonlinear activation functions and their implications for learning capacity in neural networks.

➢ 11.3 Illustrate how forward propagation and backpropagation operate to update weights and biases in a neural network.

➢ 11.4 Analyze the role of gradient descent and its variants in optimizing neural network parameters.

➢ 11.5 Evaluate the vanishing gradient problem and strategies used to address it in deep learning architectures.

➢ 11.6 Compare shallow and deep learning models with respect to expressiveness, training complexity, and generalization.
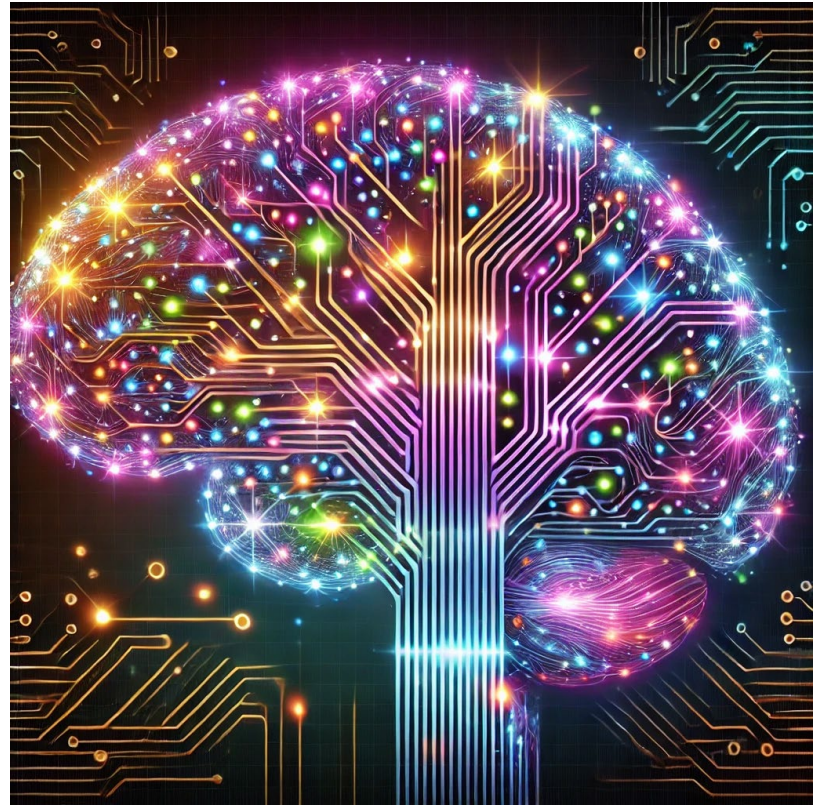
DALL-E, 2025

Neural Networks: An Overview

Neural networks are computational models composed of layers of interconnected nodes (neurons) designed to recognize complex patterns through learning from data.

Key Features

Complex Pattern Recognition

Self-Learning and Adaptation

Applications

Image and Speech Recognition

Natural Language Processing

Forecasting

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