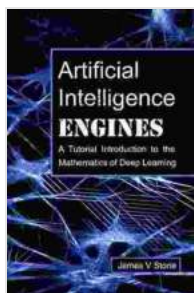# Tutorial Introduction To The Mathematics Of Deep Learning

Deep learning is a subfield of machine learning that uses artificial neural networks to learn from data. Artificial neural networks are inspired by the human brain and are composed of layers of interconnected nodes. Each node takes in a vector of input values and produces a vector of output values. The output values of one layer are then fed into the input values of the next layer.

Deep learning has been used to achieve state-of-the-art results on a wide range of tasks, including image recognition, natural language processing, and speech recognition. However, deep learning models can be complex and difficult to understand. This tutorial provides an to the mathematics of deep learning, with a focus on the most important concepts.

Linear algebra is a branch of mathematics that deals with vectors, matrices, and linear transformations. Linear algebra is essential for understanding deep learning because artificial neural networks are composed of layers of linear transformations.

Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep Learning

★★★★☆ 4.4 out of 5

Language   : German
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A vector is a collection of numbers that are arranged in a column. A matrix is a collection of numbers that are arranged in a rectangular grid. A linear transformation is a function that maps a vector to another vector.

The most important linear transformations in deep learning are:

- **Matrix multiplication:** Matrix multiplication is used to combine two matrices into a single matrix.

- **Vector addition:** Vector addition is used to add two vectors together.

- **Scalar multiplication:** Scalar multiplication is used to multiply a vector by a scalar.

Calculus is a branch of mathematics that deals with rates of change. Calculus is essential for understanding deep learning because artificial neural networks are trained using a technique called backpropagation. Backpropagation involves calculating the gradients of the cost function with respect to the weights and biases of the neural network.

The most important concepts in calculus for deep learning are:

- **Derivatives:** Derivatives are used to calculate the rate of change of a function.

- **Integrals:** Integrals are used to calculate the area under a curve.

- **Optimization:** Optimization is used to find the minimum or maximum of a function.

Probability and statistics are branches of mathematics that deal with uncertainty. Probability and statistics are essential for understanding deep learning because artificial neural networks are probabilistic models.

The most important concepts in probability and statistics for deep learning are:

- **Probability distributions:** Probability distributions are used to represent the probability of different outcomes.

- **Statistical inference:** Statistical inference is used to make inferences about a population from a sample.

- **Bayesian inference:** Bayesian inference is a method of statistical inference that uses Bayes' theorem to update beliefs in light of new evidence.

The most common deep learning models are:

- **Convolutional neural networks (CNNs):** CNNs are used for image recognition. CNNs are composed of layers of convolutional filters, which are used to extract features from images.

- **Recurrent neural networks (RNNs):** RNNs are used for natural language processing and speech recognition. RNNs are composed of layers of recurrent units, which are able to process sequences of data.

- **Generative adversarial networks (GANs):** GANs are used to generate new data. GANs are composed of two networks, a generator and a discriminator. The generator creates new data, and the discriminator tries to distinguish the new data from real data.

This tutorial has provided an to the mathematics of deep learning. The most important concepts in deep learning are linear algebra, calculus, probability and statistics, and deep learning models. Understanding these concepts is essential for understanding deep learning and for developing deep learning models.
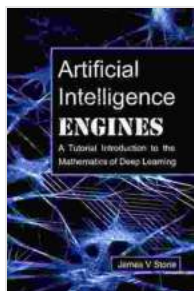
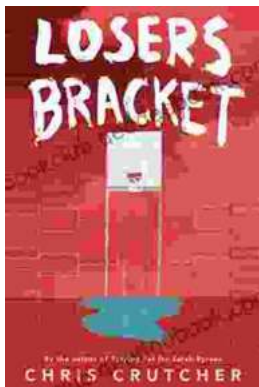### Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep Learning

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