Machine Learning and Deep Learning

Artificial intelligence through machine learning and deep learning. Introduces about key concepts, algorithms, and techniques for THU learning field.

June

What is Machine Learning

1 Definition

Machine learning is a subset of AI that enables systems to learn from data without the explicit programming.

2 Applications

It's used in various fields, including image recognition, natural language processing, and predictive analytics.

Learning from Data

Machine learning empowers computers to learn from data without explicit programming. Instead of relying on predefined rules, algorithms identify pattern and make predictions based on the information they are fed.

Continual Improvement

Machine learning algorithms are designed to improve their performance over time. As they encounter more data, they refine their models and enhance their ability , to make accurate predict ions.

What is Deep Learning

1

Definition

Deep learning is a subset of machine learning using multi-layered neural networks.

2

Advancements

It has revolutionized AI with breakthroughs in image and speech recognition.

3

Applications

Deep learning powers autonomous vehicles, virtual assistants, and advanced medical diagnostics.

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Neural Networks

Deep utilizes neural networks,
which are interconnected nodes organized in layers that process data through a series of computations.

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High Accuracy

Deep learning models have achieved state-of-the-art results in various tasks, such as image recognition, speech recognition,
and natural language understanding.

Fundamental Concepts in Machine Learning

Feature

Features are the attributes or characteristics of the data that are used to classify the instances. In the case of image recognition, features could include the color, shape, texture, or edges of objects.

Matplotlib

Matplotlib is a popular Python library for creating static, interactive, and animated visualizations. It's commonly used in machine learning for plotting data, visualizing model performance, and understanding patterns.

K-Nearest Neighbors Algorithm (KNN)

The KNN algorithm is a simple yet effective classification technique.
It classifies a new instance based on the majority class of its k nearest neighbors in the feature space.

Types of Machine Learning

Supervised Learning	Unsupervised Learning
Learning from labeled data with known outputs.	Learning from unlabeled data to discover patterns, structures
Examples: Classification and Regression	Examples: Clustering and Dimensionality Reduction

Data preprocessing is an essential step in preparing data for machine learning algorithms. It involves transforming raw data into a suitable format for training and evaluation.

1 Sampling Bias

Sampling bias occurs when the data used to train a model is not representative of the real-world population. This can lead to inaccurate predictions when the model is applied to new data.

2 Numpy

Numpy is a fundamental Python library for numerical computing. It provides powerful tools for creating, manipulating, and operating on arrays, which are essential for machine learning tasks.

3 Array Indexing and Broad casting

Array indexing allows you to access and manipulate specific elements within a Numpy array. Broadcasting extends operations between arrays of different shapes , simplifying calculations.

Regression

Regression is a type of supervised learning that aims to predict a continuous target variable based on input features. It's widely used for tasks like forecasting, pricing, and risk assessment.

1. ## Linear Regression

   Linear regression models the relationship between features and the target variable as a linear equation. It finds the best-fitting line that minimizes the difference between predicted and actual values.

2. ## Polynominal Regression

   Polynominal regression extends linear regression by using polynomial terms to model non-linear relationships between features and the target variable.

3. ## Multicultural Regression

   Multicultural regression is a generalization of linear regression that allows for multiple independent variables, enabling more complex models to capture intricate relationships in the data

4. ## Ridge Regression

   Ridge regression adds a regularization term to the cost function, which helps to prevent overfitting by shrinking the coefficients towards zero.

5. ## Lasso Regression

   Lasso regression also employs regularization, but instead of shrinking coefficients, it sets some of them to zero, resulting in a sparser model that can be more interpretable.

Key terms associated with regression include:

1. ## Coefficient of Determination

   Measures the proportion of variance in the target variable that is explained by the model.

2. ## Overfitting vs. Underfitting

   Overfitting occurs when the model learns the training data too well, leading to poor performance on unseen data. Underfitting occurs when the model is too simple and doesn't capture the underlying patterns in the data.

3. ## Weight (Coefficient)

   Represents the strength and direction of the relationship between a feature and the target variable.

4. ## Hyperparameter

   A parameter that is not learned by the model but is set before training, such as the regularization strength in Ridge or Lasso regression.

Multi-Class Classification

Multi-class classification extends binary classification to handle situations with more than two classes. This is commonly used in tasks like image recognition, sentiment analysis, and object detection.

1. ## Logistic Regression

   Logistic regression is a widely used technique for multi-class classification. It models the probability of an instance belonging to each class using a sigmoid function.

2. ## Softmax Function

   The softmax function transforms the output of a multi-class logistic regression model into a probability distribution over the classes, ensuring that the probabilities sum up to 1.

3. ## Stochastic Gradient Descent (SGD)

   SGD is an optimization algorithm used to train logistic regression and other machine learning models. It updates the model parameters based on the gradient of the loss function calculated on a small batch of data.

4. ## Loss Function

   The loss function measures the discrepancy between the model's predictions and the actual labels. Common loss functions for multi-class classification include cross-entropy loss and hinge loss.

Important terms in multi-class classification:

1. ## Sigmoid Function

   A mathematical function that squashes the output of a linear model to a range between 0 and 1, representing probabilities.

2. ## Boolean Indexing

   A technique used to select specific elements from an array based on a condition. It's helpful for filtering data and creating subsets.

3. ## Epoch

   A complete pass through the entire training dataset during the training process.

4. ## Minibatch Gradient Descent

   A variant of SGD that uses small batches of data to update the model parameters, balancing efficiency and stability.

5. ## Batch Gradient Descent

   An optimization algorithm that uses the entire training dataset to calculate the gradient and update model parameters.

6. ## Logistic Loss Function

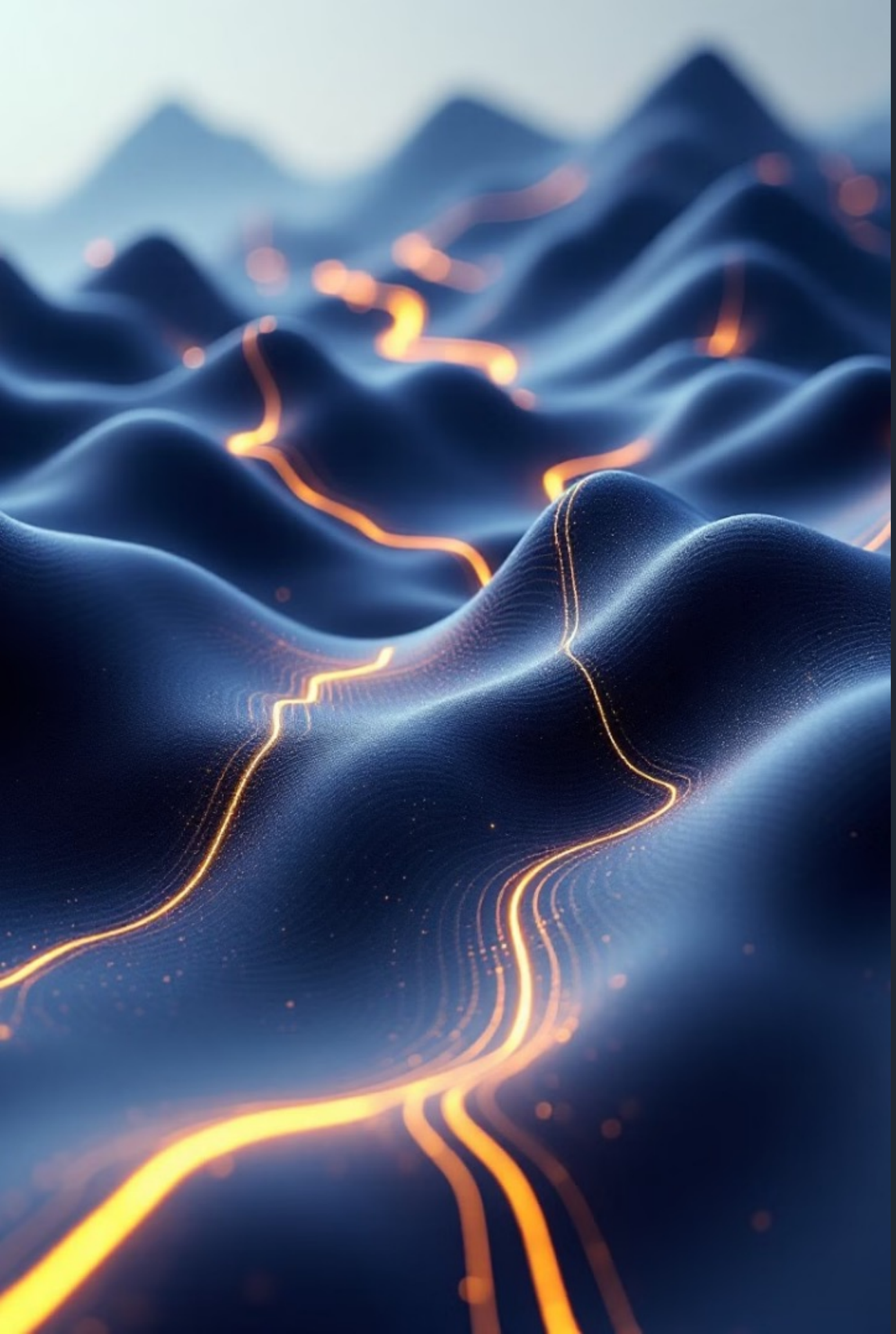
   A common loss function for logistic regression, which measures the difference between predicted and actual probabilities.

7. ## Cross-Entropy Loss Function

   A widely used loss function for multi-class classification, measuring the difference between the predicted and true probability distributions.

8. ## Hinge Loss

   A loss function commonly used in support vector machines (SVMs), which penalizes misclassified instances and encourages a large margin between classes.



Vielen

Dank !