ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

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K-Nearest Neighbor(KNN) Algorithm

K-Nearest Neighbors (KNN) is a supervised machine learning algorithm primarily used for classification tasks, though it can also be applied to regression. The algorithm works by identifying the "k" nearest data points (neighbors) to a given input and making predictions based on those neighbors. For classification, the predicted class is determined by the majority vote among the neighbors. For regression, the prediction is the average of the neighbors' values.

For example, consider the following table of data points containing two features:
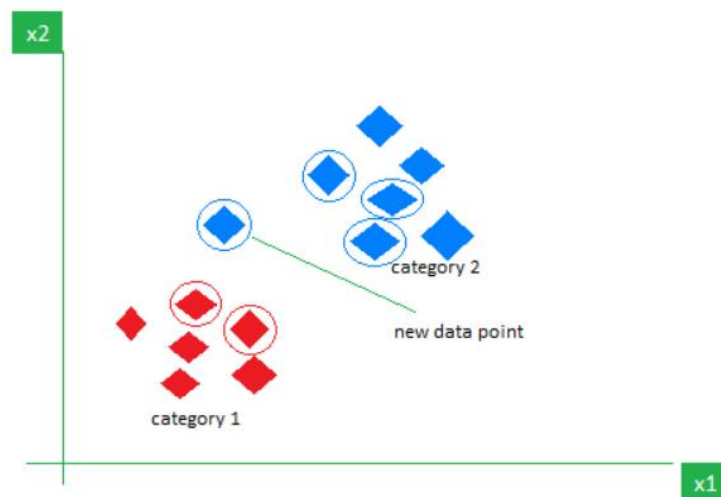
The new point is classified as Category 2 because most of its closest neighbors are blue squares. KNN assigns the category based on the majority of nearby points. The image shows how KNN predicts the category of a new data point based on its closest neighbours.

- The red diamonds represent Category 1 and the blue squares represent Category 2.

- The new data point checks its closest neighbors (circled points).

- Since the majority of its closest neighbors are blue squares (Category 2) KNN predicts the new data point belongs to Category 2.

KNN works by using proximity and majority voting to make predictions.

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What is 'K' in K-Nearest Neighbors?

In the K-Nearest Neighbors (KNN) algorithm, 'K' represents the number of nearest neighbors the algorithm considers when making a prediction.

Think of it like asking for advice—rather than relying on just one opinion, you ask K people nearby and go with the majority.

Example:

Imagine you're trying to identify a fruit based on its shape and size. You compare it to fruits you already know.

- If K = 3, the algorithm looks at the 3 closest known fruits.

- Suppose 2 of them are apples and 1 is a banana.

- Since the majority (2 out of 3) are apples, the algorithm classifies the new fruit as an apple.

Choosing the right value for K is important:

- A small K (like 1) can be sensitive to noise or outliers.

- A large K may smooth over distinctions and include points that are less relevant.

Convolutional Neural Network (CNN)

Convolutional Neural Networks are a class of deep learning models specifically designed to process data with a grid-like structure most commonly images.

Key Components of a Convolutional Neural Network

1. **Convolutional Layers**

   o Apply filters (also known as kernels) to the input to extract local features such as edges, textures, or patterns.

   o Preserve spatial relationships between pixels by learning features directly from the image.

2. **Pooling Layers**

   o Downsample the feature maps to reduce dimensionality and computation.

   o Common types include Max Pooling, which selects the maximum value from each region of the feature map.

3. **Activation Functions**

   o Introduce non-linearity into the model, enabling it to learn complex relationships.

   o Common activation: ReLU (Rectified Linear Unit).

4. **Fully Connected Layers**

   o Connect every neuron from one layer to every neuron in the next.

How CNNs Work?

1. **Input Image**

   o The image is preprocessed (resized, normalized) to ensure consistency in dimensions and pixel values.

2. **Convolutional + Activation Layers**

   o Filters slide over the image to generate feature maps that highlight important features.

3. **Pooling Layers**

   o Reduce the size of feature maps while retaining key information.

4. **Flattening & Fully Connected Layers**

   o The output from pooling layers is flattened and fed into dense layers to perform classification or regression.

5. **Output Layer**

   o Produces the final prediction, such as a label indicating the object in the image.

Evaluating CNN Models

CNN performance is typically measured using the following metrics:

- **Accuracy**: Proportion of correctly predicted images.

- **Precision**: How many of the predicted positives are actually positive.

- **Recall**: How many of the actual positives were correctly predicted.

- **F1 Score**: Harmonic mean of precision and recall—especially useful for imbalanced datasets.
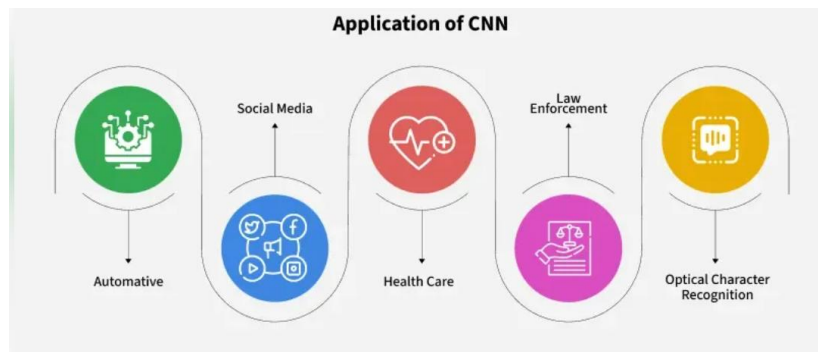
Application of CNN

LAMP Stack :

LAMP stack is a collection of Linux OS, Apache Server, MySQL Database, PHP. LAMP is basically a collection of software that you require to create a dynamic web application. LAMP is free and open-source.

- Linux -
  An open-source operating system. Has been around since the 1990s. It is one of the most secure and reliable OS available.

- Apache -
  This is a free, cross-platform, and open-source web server. Apache Web Server became the most popular web server after its development worldwide.

- MySQL -
  MySQL is an SQL-based database based on the relational model. In a relational model, data is stored in tabular form and is ideal for both large or small-scale applications.

- PHP -
  A server-side scripting language that communicates with server and database. PHP with MySQL is a powerful combination. PHP is used in back-end web development and also for Object-oriented programming.

As LAMP is the most popular stack the biggest advantage of LAMP is its community support, so any problem you might face as a developer someone might have already faced it and has its solution.

Working of LAMP Stack -

1. Apache : Web Server -
   This is the most used and most mature web server in the world right now. It processes user requests and responds to users with web assets.

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2. PHP : Scripting Language -
   PHP as mentioned is a server-side language which according to user request communicates with the database and presents apache with a result which in turn responds according to the request and code logic written.

3. MySQL : Database -
   All user data is stored, updated and fetched from here. Php communicates with My SQL and fetches or inserts data according to the user request.

4. Linux : Operating System -
   The most secure and reliable operating system. All of the architecture mentioned above is possible because of an operating system running on the base of this architecture in a server.

Install LAMP Stack on Ubuntu

1. Update Package Index

sudo apt update && sudo apt upgrade

2. Install Apache Web Server

sudo apt install apache2 -y

3. Install MySQL (or MariaDB)

sudo apt install mysql-server

4. Install PHP

sudo apt install php libapache2-mod-php php-mysql

5. One Command to Install PHP + Common Extensions

sudo apt install php php-curl php-json php-mbstring

Open Your Web Browser

In your browser, go to:

http://localhost/

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