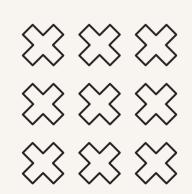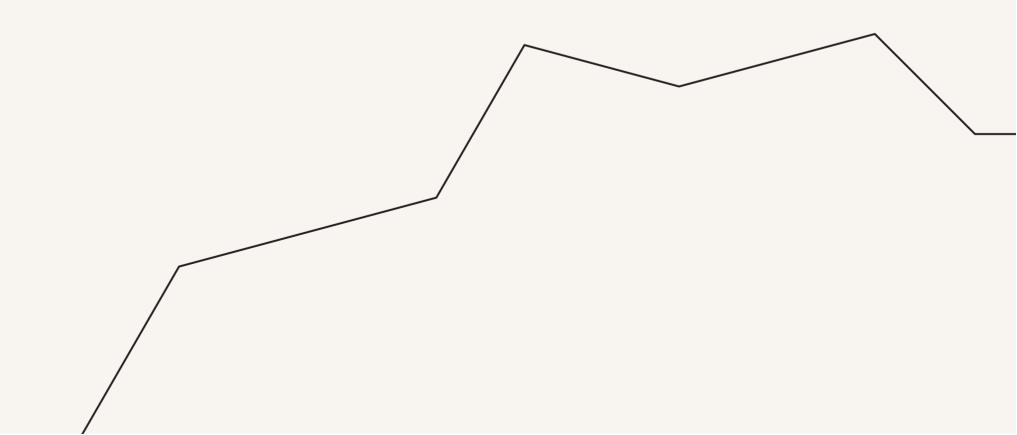# Understanding the Basics of Convolutional Neural Networks (CNNs)

Introduction to CNNs
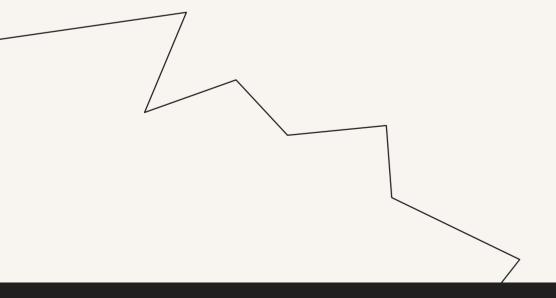
In this presentation, we will explore the **fundamentals** of **Convolutional Neural Networks (CNNs)**. CNNs are a class of deep learning algorithms primarily used for **image processing** and **computer vision** tasks. We will cover their architecture, functioning, and applications.
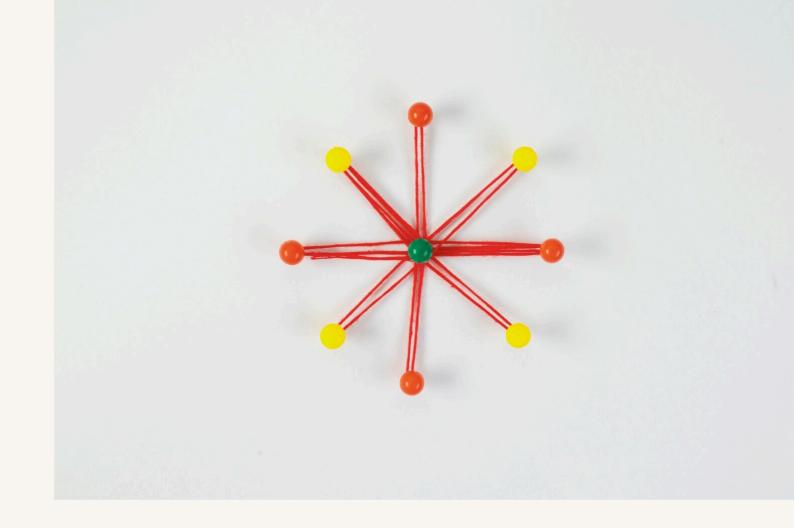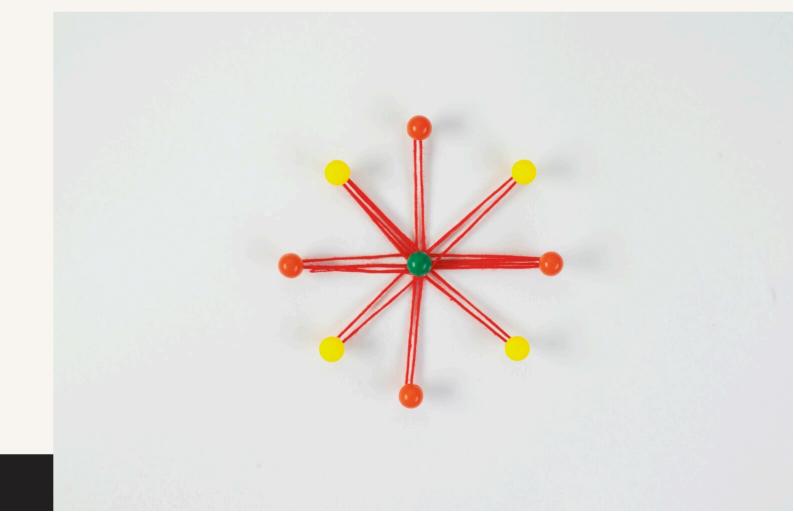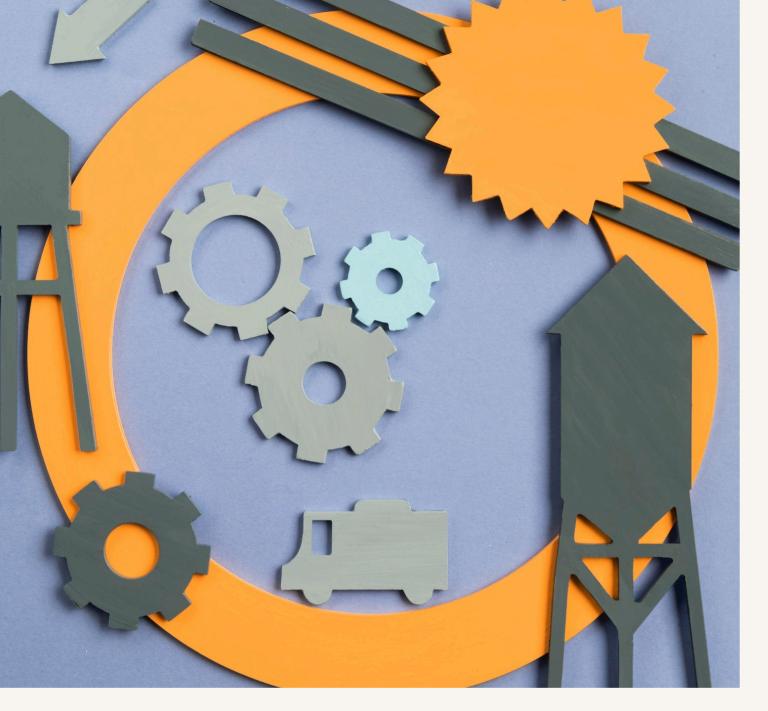
What are CNNs?

CNNs are specialized **neural networks** designed to process **grid-like data**, such as images. They are inspired by the **visual cortex** of animals and are particularly effective in recognizing patterns and features in images due to their hierarchical structure.
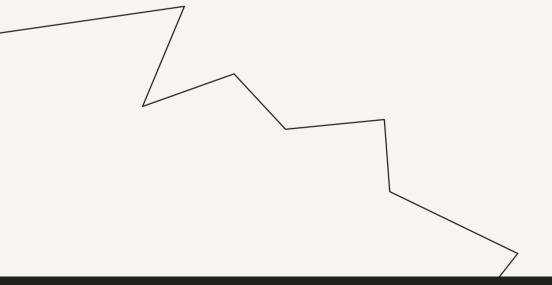
Key Components

The main components of CNNs include **convolutional layers**, **pooling layers**, and **fully connected layers**. Each component plays a crucial role in extracting features, reducing dimensionality, and making predictions, contributing to the network's overall performance.
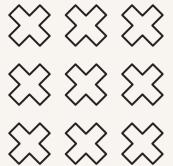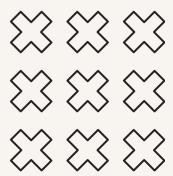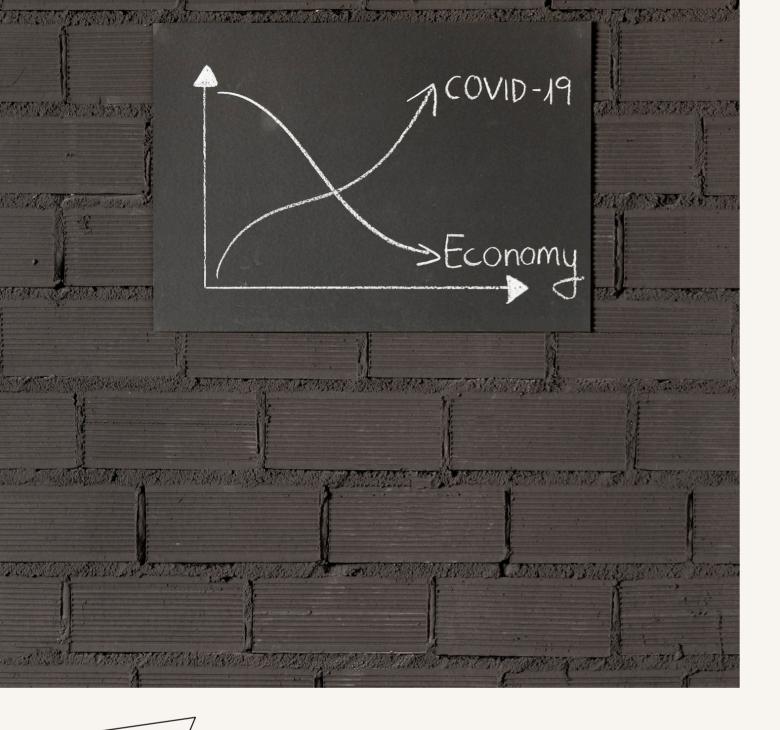
Convolutional Layers

The **convolutional layer** applies filters to the input data, allowing the network to learn **feature maps**. These filters slide over the input and perform a mathematical operation called **convolution**, which helps in detecting patterns like edges and textures.

Activation Functions

After convolution, **activation functions** like **ReLU** (Rectified Linear Unit) are applied to introduce **non-linearity**. This helps the network learn complex patterns and relationships within the data, enhancing its ability to generalize.
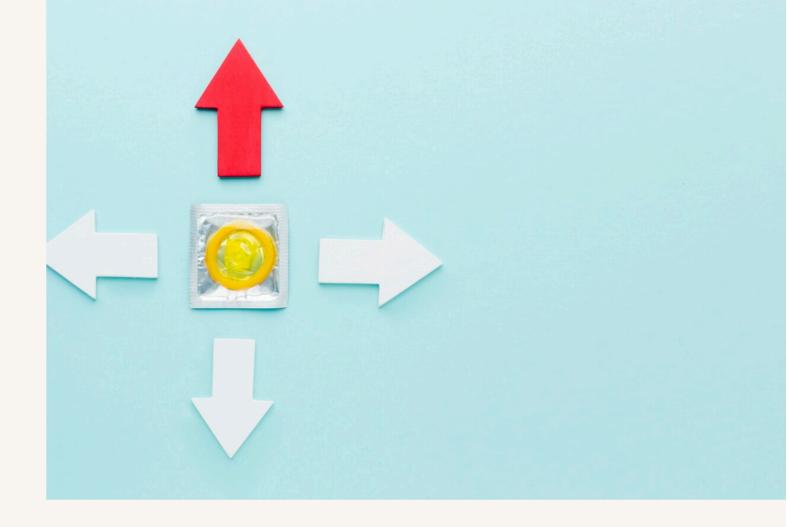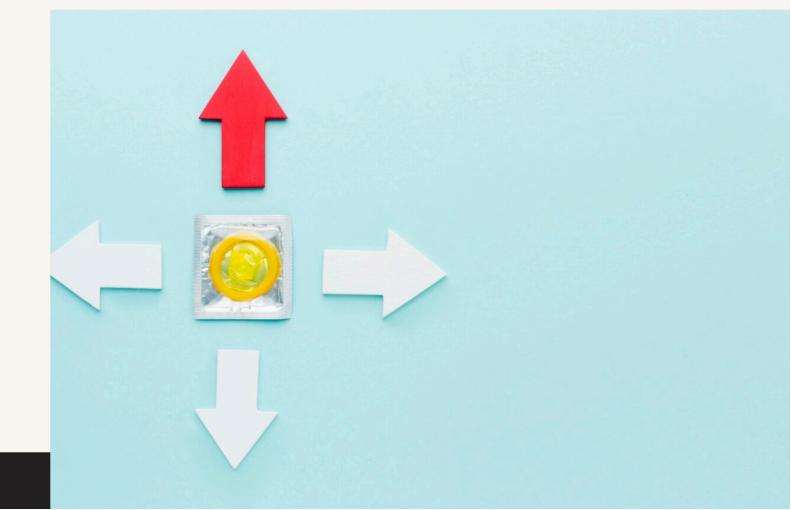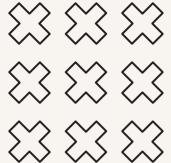
Pooling Layers

Pooling layers are used to reduce the spatial dimensions of the feature maps, which helps in decreasing the computational load. **Max pooling** is a common technique that selects the maximum value from a set of values, preserving important features.
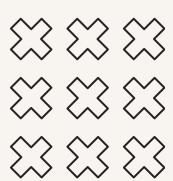
Fully Connected Layers

In the final stages of a CNN, **fully connected layers** connect every neuron from the previous layer to every neuron in the current layer. This structure helps in making the final **classification** or **regression** decisions based on the learned features.
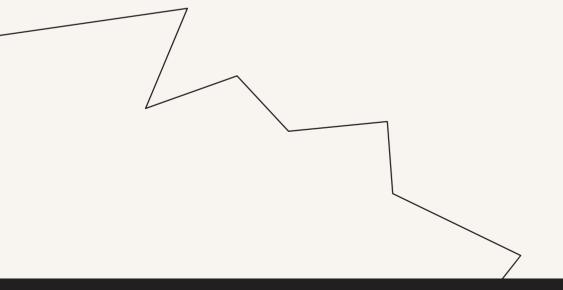
Training CNNs

Training a CNN involves using a large dataset to adjust the weights of the filters through a process called **backpropagation**. The network learns to minimize the **loss function**, improving its accuracy over time through multiple iterations.

Applications of CNNs

CNNs have a wide range of applications including **image recognition**, **object detection**, and **medical image analysis**. They are also used in **self-driving cars** and **facial recognition systems**, showcasing their versatility and effectiveness.
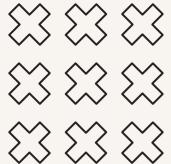
Challenges in CNNs

Despite their advantages, CNNs face challenges such as **overfitting**, **computational intensity**, and the need for large labeled datasets. Addressing these issues is crucial for improving the performance and efficiency of CNN models.
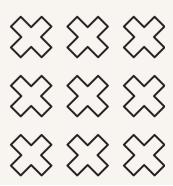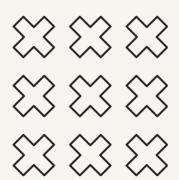
Future of CNNs

The future of CNNs looks promising with advancements in **transfer learning, automated machine learning**, and **neural architecture search**. These innovations aim to enhance the efficiency and effectiveness of CNNs in various domains.
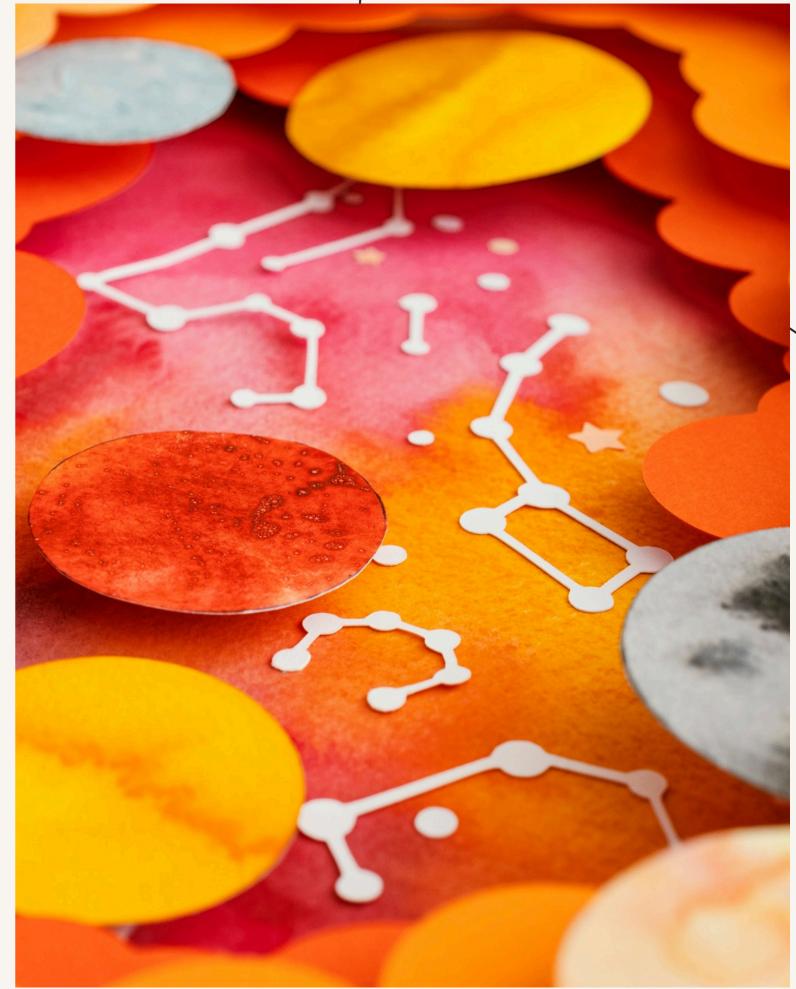
Conclusion

In conclusion, **Convolutional Neural Networks** are a powerful tool for understanding and processing visual data. Their unique architecture and ability to learn from data make them essential in many modern applications, paving the way for future innovations.

Thanks!