

What is a Convolutional Neural Network (CNN)?

A **Convolutional Neural Network** is a type of deep learning model specifically designed to process **grid-like data**, such as **images**, by learning spatial hierarchies of features through layers.

□ Key Concepts:

1. Input Layer

- Takes in raw data (e.g., image pixels: height × width × channels).

2. Convolutional Layer

- Applies **filters (kernels)** that slide over the input to detect **features** like edges, corners, or textures.
- Outputs **feature maps**.
- Learns **local patterns**.

3. Activation Function (usually ReLU)

- Introduces non-linearity.
- Helps model learn complex patterns.

4. Pooling Layer (e.g., Max Pooling)

- **Downsamples** feature maps.
- Reduces dimensionality and computation.
- Helps with **spatial invariance** (e.g., recognizing a feature regardless of position).

5. Flatten Layer

- Converts the 2D feature maps into a 1D vector before feeding into fully connected layers.

6. Fully Connected (Dense) Layer

- Traditional neural network layer.
- Makes **final predictions** based on extracted features.

7. Output Layer

- Uses **softmax** for multi-class classification, or **sigmoid** for binary.
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□ CNN Structure Summary:

```
text
CopierModifier
[Input Image]
  ↓
[Convolution → ReLU → Pooling] × N
  ↓
[Flatten]
  ↓
[Dense → Output]
```

□ What CNNs are good at:

- **Image classification** (e.g., cat vs. dog)
 - **Object detection** (e.g., YOLO, Faster R-CNN)
 - **Face recognition**
 - **Medical image analysis**
 - **Text classification** (1D CNNs)
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TP : IMAGE CLASSIFICATION

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اختيار مشروع واحد فقط وتطبيقه

1. fashion-mnist classification:

Link:

<https://github.com/guilhermedom/cnn-fashion-mnist/blob/main/notebooks/1.0-gdfs-cnn-fashion-mnist.ipynb>

2. Cats and Dogs Sample Dataset

Dataset link :

https://zenodo.org/records/5226945?utm_source=chatgpt.com

3. Cifar classification

<https://www.geeksforgeeks.org/cifar-10-image-classification-in-tensorflow/>

<https://lopezyse.medium.com/computer-vision-image-classification-using-python-913cf7156812>

4. MNIST CLASSIFICATION الارقام

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