

# Convolutional Neural Networks

AUTHORS: Jed Pulley & Keshav Sharan Pachipala

---

**DO NOT POLLUTE!** AVOID PRINTING, OR PRINT 2-SIDED MULTIPAGE.

## 1 Introduction

In recent years, Convolutional Neural Networks (CNNs) have emerged as a cornerstone technology in the field of deep learning, particularly in the domain of computer vision. CNNs are adept at extracting intricate patterns and features from spatially structured data. Some fields that benefit from CNNs include:

1. Image Classification
2. Object Detection
3. Medical Image Analysis

In this paper, we won't go into the exact specifics of what a convolution is since it's slightly different in the discrete and continuous cases, as well as slightly different in a CNN context, but if you're really curious about it, 3Blue1Brown has some excellent videos visually explaining the mathematical concepts behind a convolution in his videos linked below [1] and [2].

## 2 NNs vs CNNs

## 3 Understanding the Architecture

### 3.1 Layers

### 3.2 Feature Hierarchy

## 4 Advanced CNN Architectures

- (a) VGGNet
- (b) ResNet
- (c) Inception Network

## 5 Future Directions and Trends

- (a) TO-DO
- (b) TO-DO
- (c) TO-DO

## 6 Resources

[1] 3Blue1Brown - But What is a Convolution?

<https://www.youtube.com/watch?v=KuXjwB4LzSA&t=1s>

[2] 3Blue1Brown - Convolutions — Why  $X+Y$  in probability is a beautiful mess

<https://www.youtube.com/watch?v=IaSGqQa50-M>

[3] far1din - Convolutional Neural Networks from Scratch — In Depth

<https://www.youtube.com/watch?v=jDe5BAst2-Y>

[4] Younesi, A., Ansari, M., Fazli, M. A., Ejlali, A., Shafique, M., & Henkel, J. (2024). A Comprehensive Survey of Convolutions in Deep Learning: Applications, Challenges, and Future Trends. arXiv preprint arXiv:2402.15490

<https://arxiv.org/abs/2402.15490>