

Understanding Convolutional Neural Networks (CNNs)

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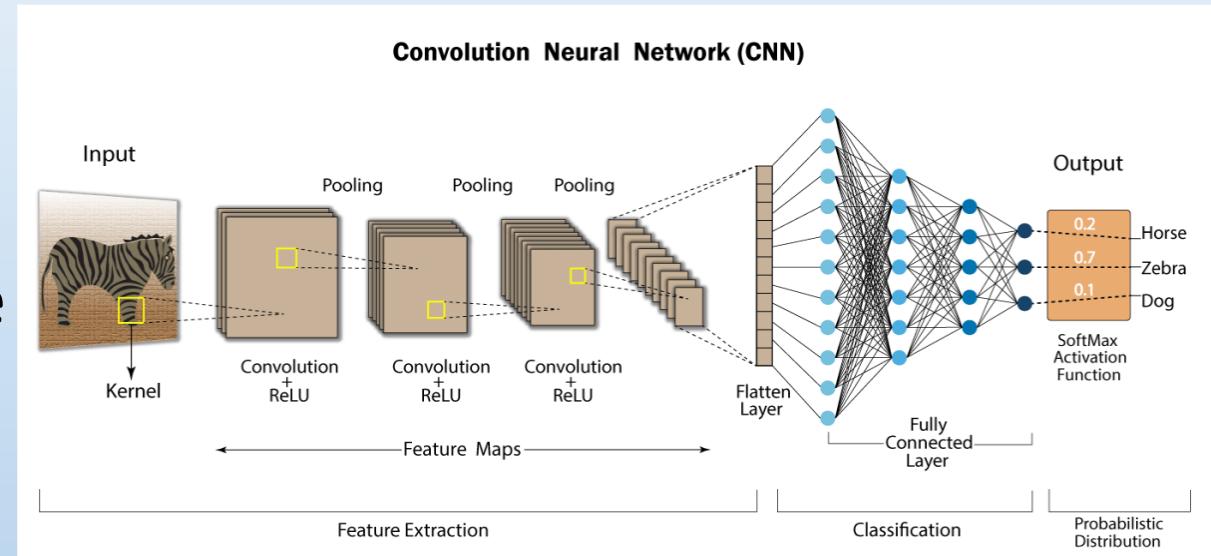
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What is a CNN?

- **CNNs** are deep learning models built to analyse visual data or images.
- **Convolution layers** identify simple visual patterns such as edges and textures.
- **Pooling layers** reduce data size while keeping key information.
- **Fully connected layers** turn those features into predictions.

CNN structure diagram



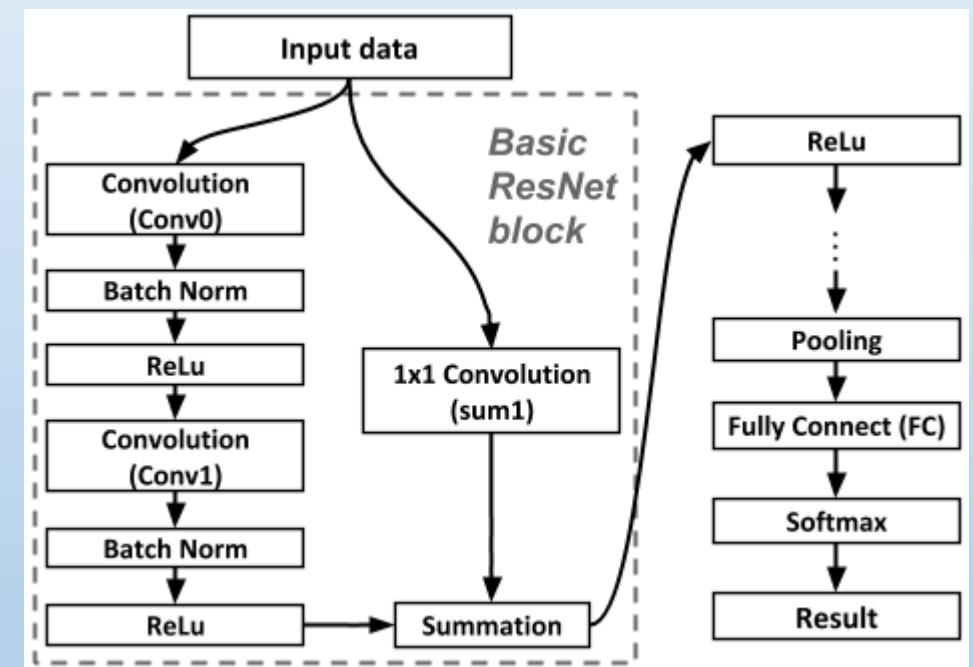
Case Study: Deep Residual Learning

Paper: He, K., Zhang, X., Ren, S., & Sun, J.
(2015)

Deep Residual Learning for Image Recognition.
Available at: <https://go.exlibris.link/1hvjCCTL>

- **Goal:** Make deep CNNs easier to train.
- **Dataset:** ImageNet (over 1 million images).
- **Model:** ResNet (Residual Network).
- **Result:** Achieved top performance with 96% top-5 accuracy.

ResNet block diagram)



Why CNNs Were Suitable

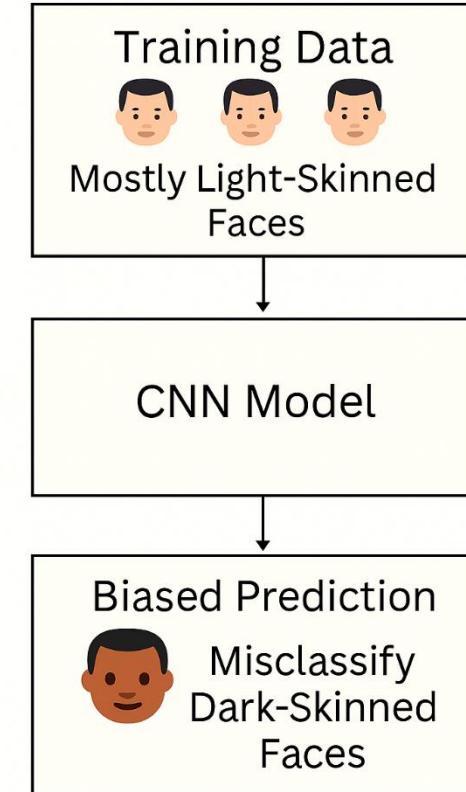
- Automatically extract image features.
- Efficient with large datasets.
- Reduce need for manual feature selection.

Ethical Issue: Bias in CNNs

Ethical Concern: Bias in facial recognition

- Training data may not include all demographic groups equally.
- Could result in unfair predictions.
- **Solution:** Use diverse datasets and evaluate fairness.

bias concept diagram



Reflection

My CNN Experience

- **What?** Built a CNN to classify MNIST digits.
- **How?** Used Keras and experimented with layers.
- **Why?** To understand how CNNs learn image patterns.
- **Outcome:** Accuracy improved after tuning.
- **Next Step:** Try more complex datasets.

Summary & References

Summary:

- CNNs learn features from images using convolution and pooling layers.
- ResNet helps train very deep networks using residual connections.
- Ethical concern: bias in training data.
- Reflection: practical experience improved understanding.

References:

He, K., Zhang, X., Ren, S. and Sun, J., 2015. *Deep Residual Learning for Image Recognition*. arXiv preprint arXiv:1512.03385. Available at: <https://go.exlibris.link/1hvjCCTL> [Accessed 13 October 2025].

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He, K., Zhang, X., Ren, S. & Sun, J. (2015) “A building block of Residual Learning” [figure]. In: *Deep Residual Learning for Image Recognition*. Available at: <https://www.researchgate.net/publication/328091629/figure/fig1/AS:678212644401153@1538709903556/Basic-block-diagram-of-ResNet.ppm> (Accessed: 24 October 2025).