Lecture 07 – CNN Applications and Tricks

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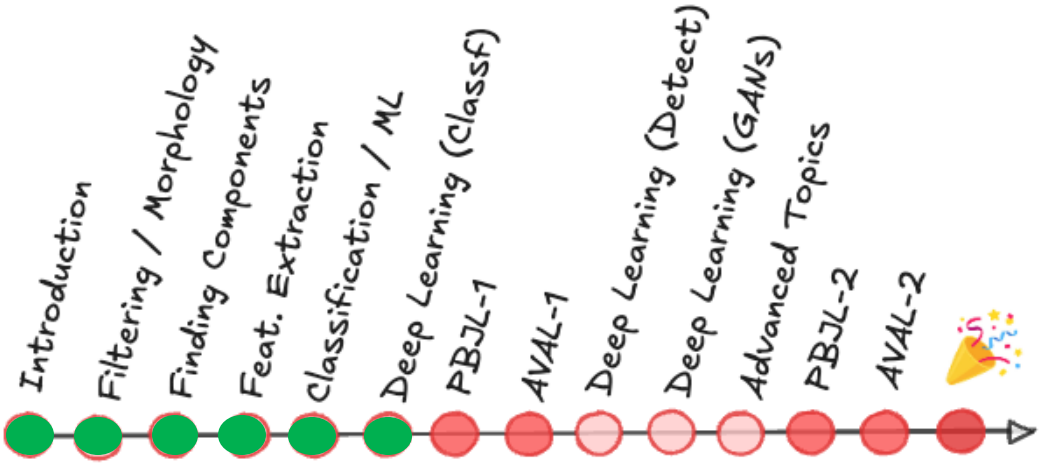
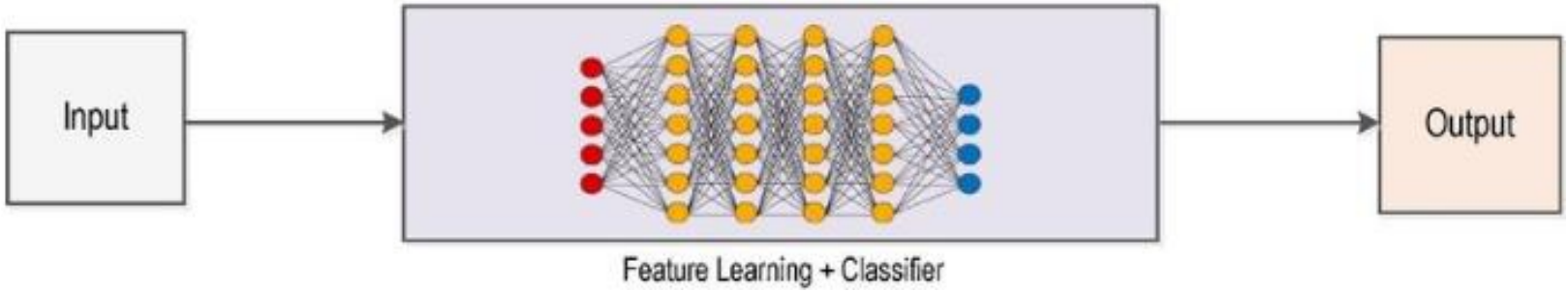
Topics

- Convolutional Neural Network
  - Basic Concepts
  - Archicteture and Hiper Parameters
  - Data Augmentation
  - Transfer-Learning
  - Applications
- Practice

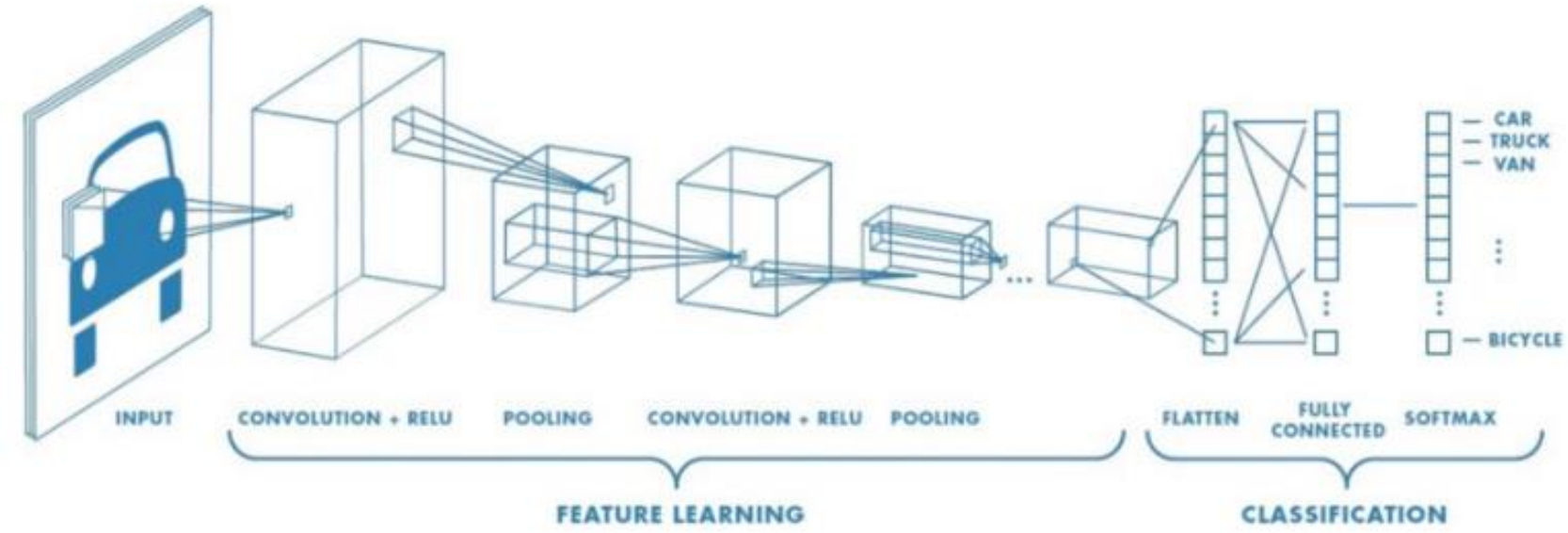


Deep Learning Pipeline



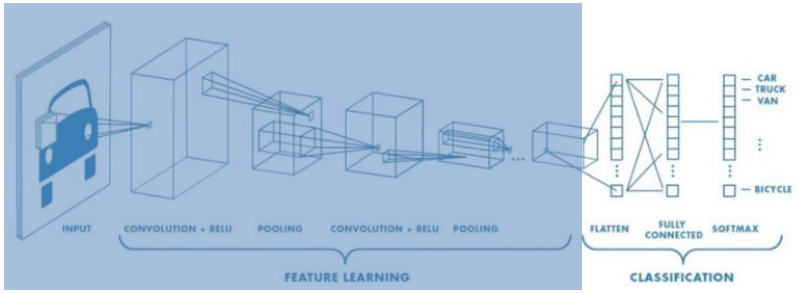
Convolutional Neural Network

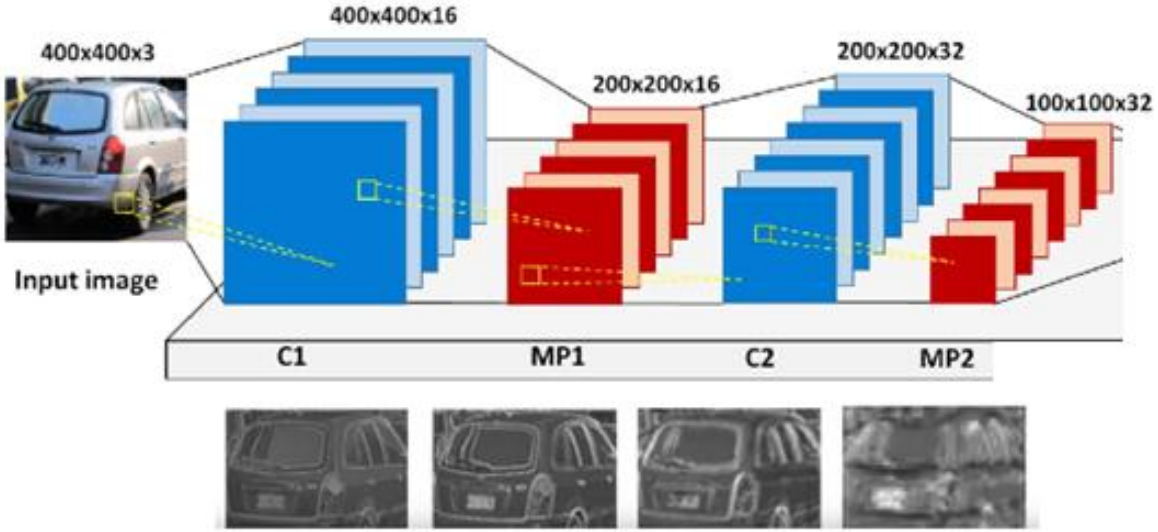
- CNN



Convolutional Neural Network

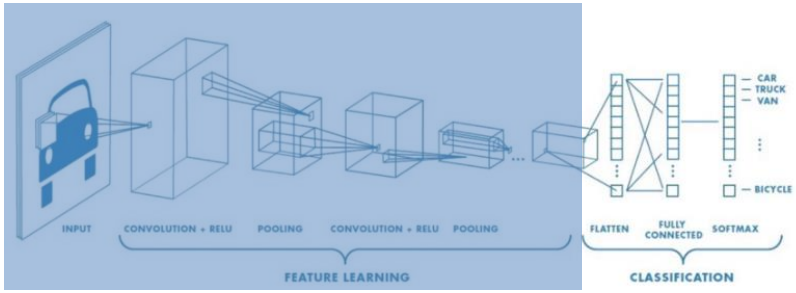
- Feature Extraction

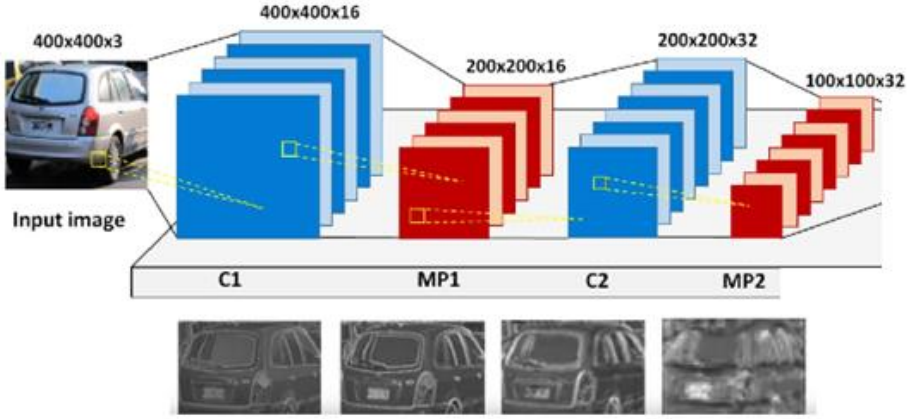


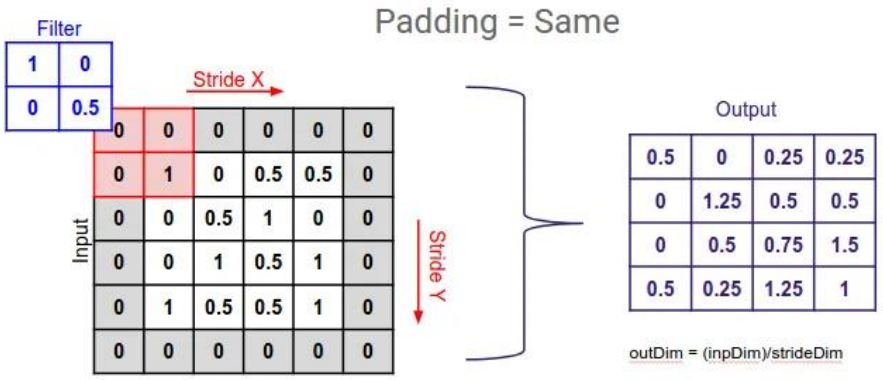


Convolutional Neural Network

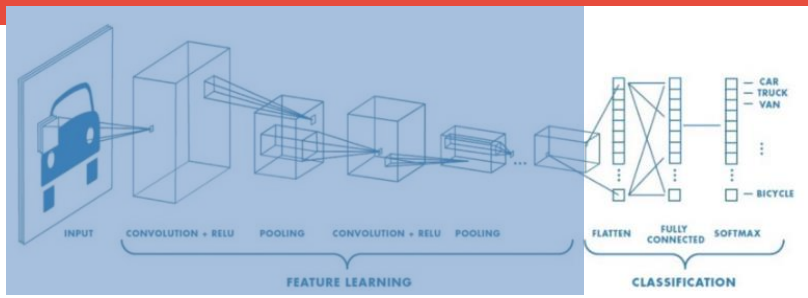
- Convolutional Layer (Learnable Filters)
  - Padding
  - Stride
  - Kernel Size
  - Number of Filters



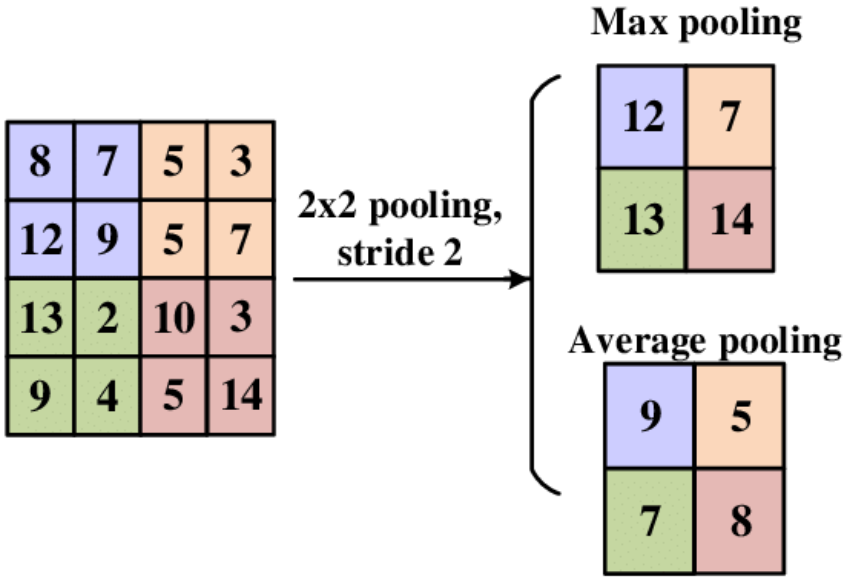




Convolutional Neural Network

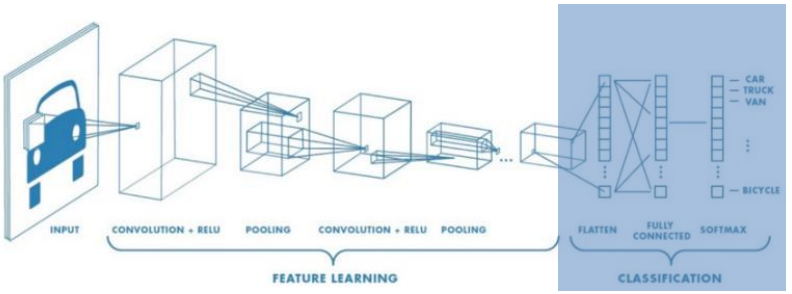


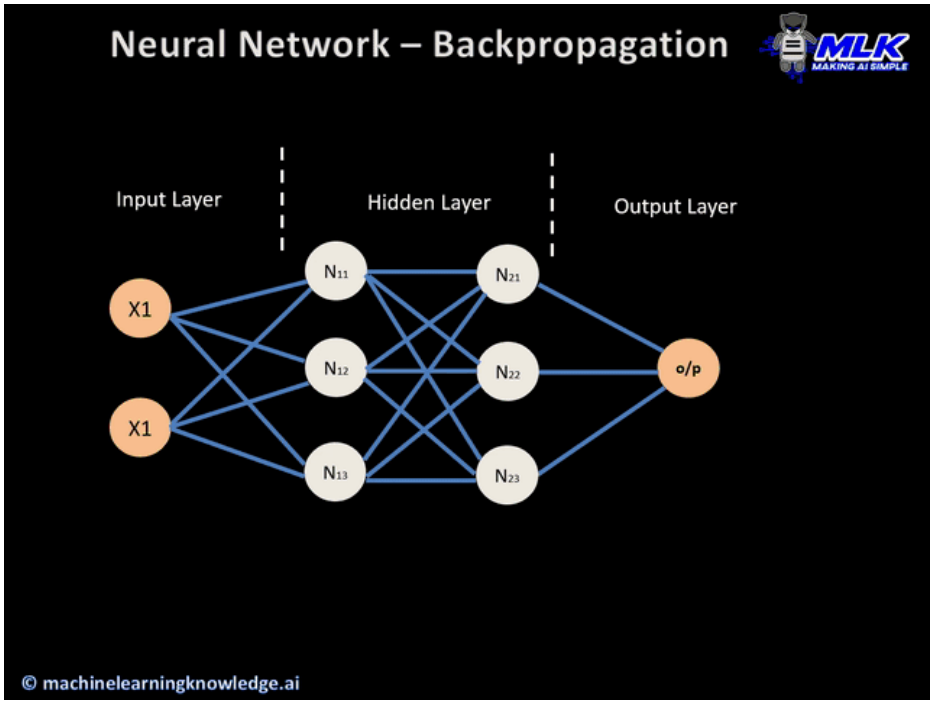
- Pooling Layer
  - Reduce Spatial Dimensions
  - Translation-Invariant
  - Common Filter
    - Max: Preserve the “strongest” features
    - Average: Smooth features, preserves general representations



Convolutional Neural Network

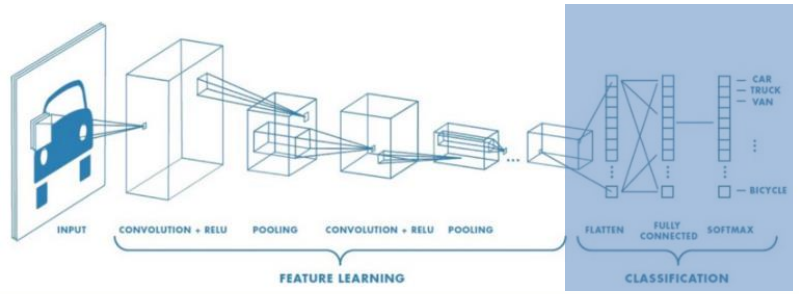
- Classification
  - Forward and Back Propagation

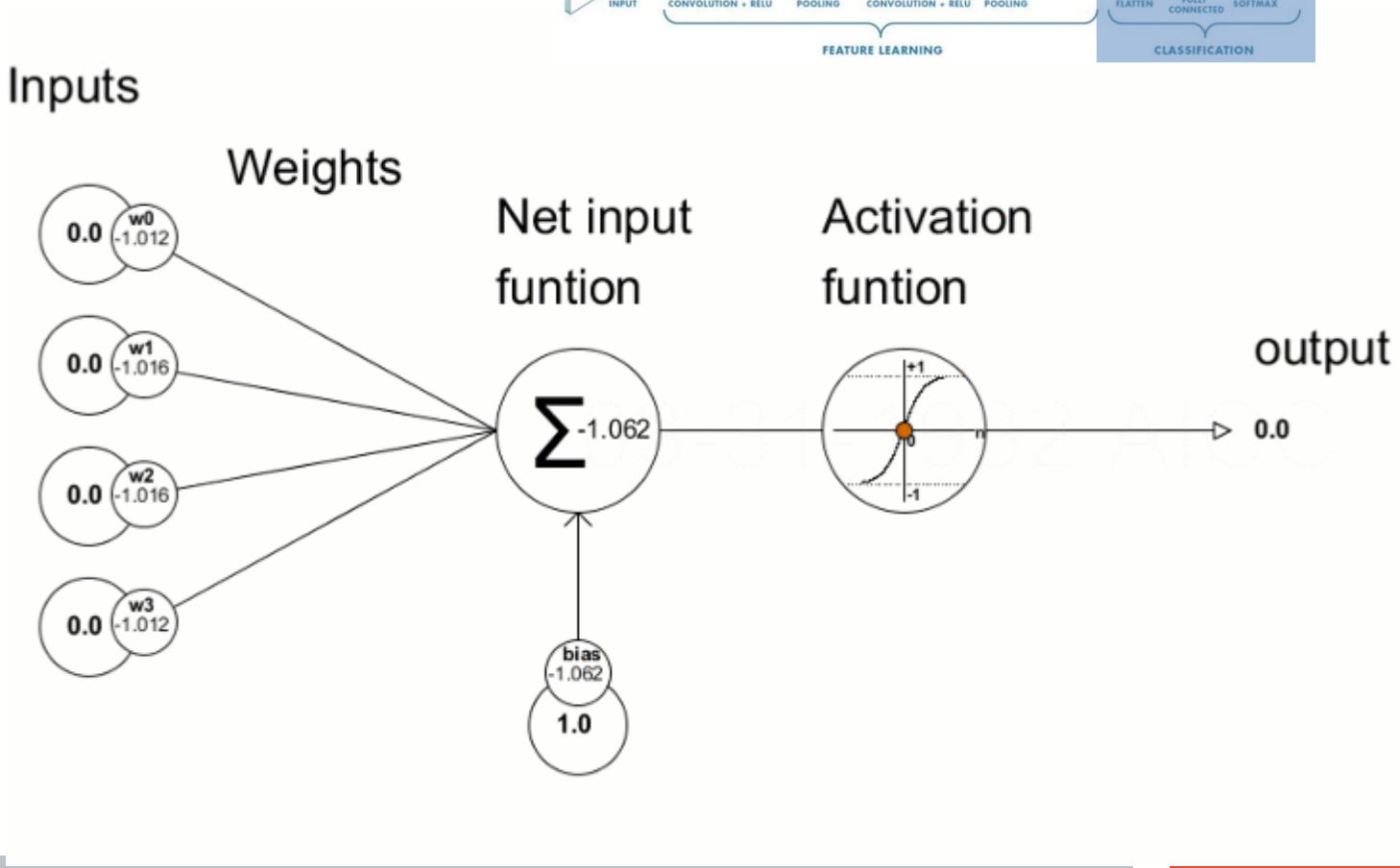




Convolutional Neural Network

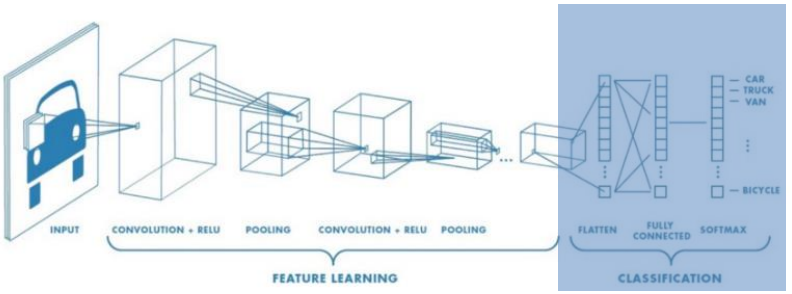
- Forward and Back Propagation

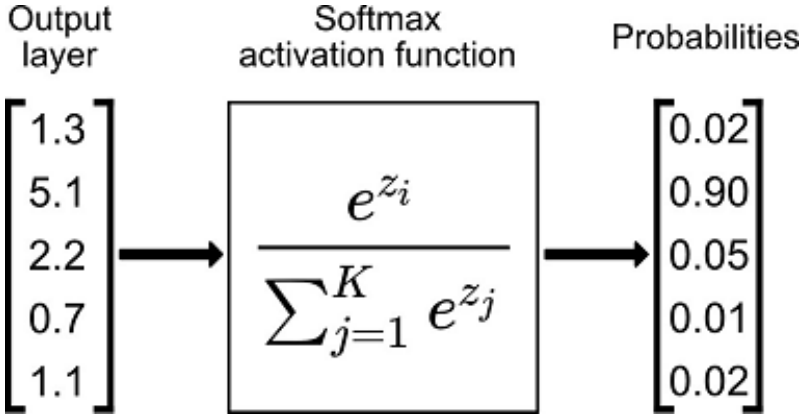


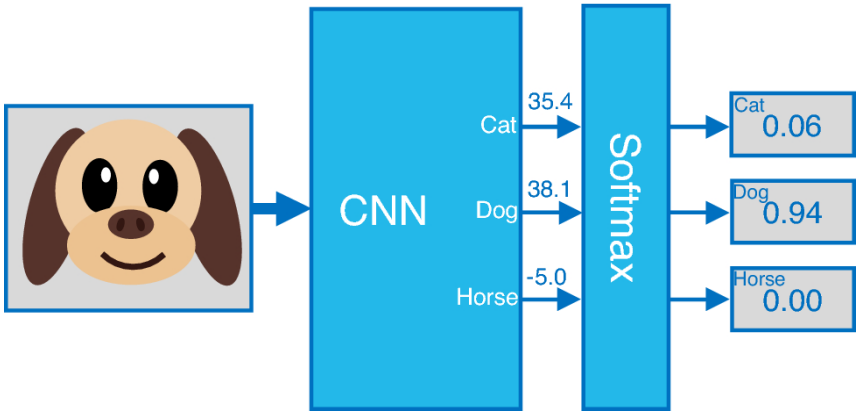


Convolutional Neural Network

- Softmax







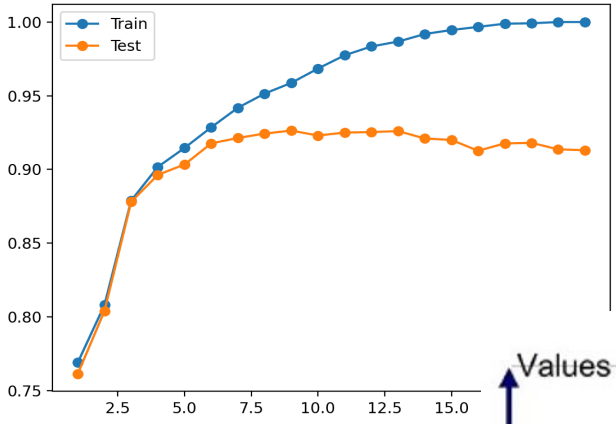
Convolutional Neural Network

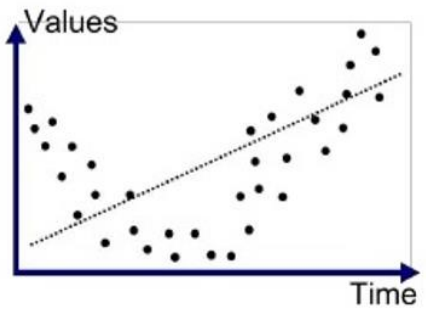
- Lets code our first CNN from scratch

Lecture 07 - CNN Architecture

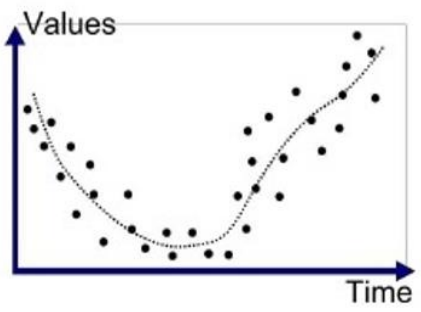
Overfitting

- Overfitting occurs when a model captures noise or specific patterns in the training data, impairing its ability to generalize to unseen data. Strategies such as regularization, dropout, data augmentation, and transfer learning help mitigate this by controlling model complexity and leveraging pre-learned features.

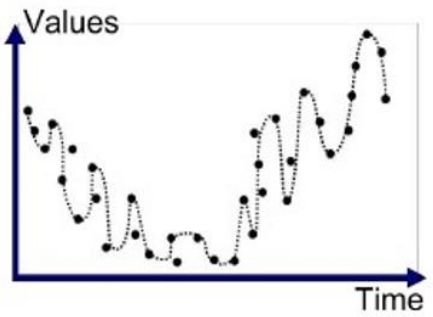




Underfitted



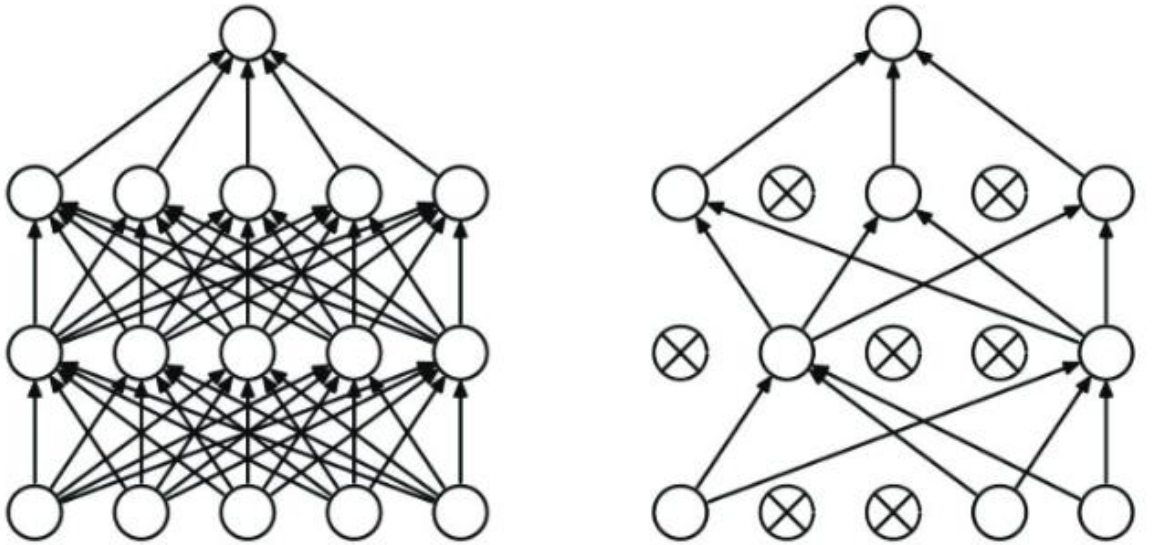
Good Fit/Robust



Overfitted

Dropout

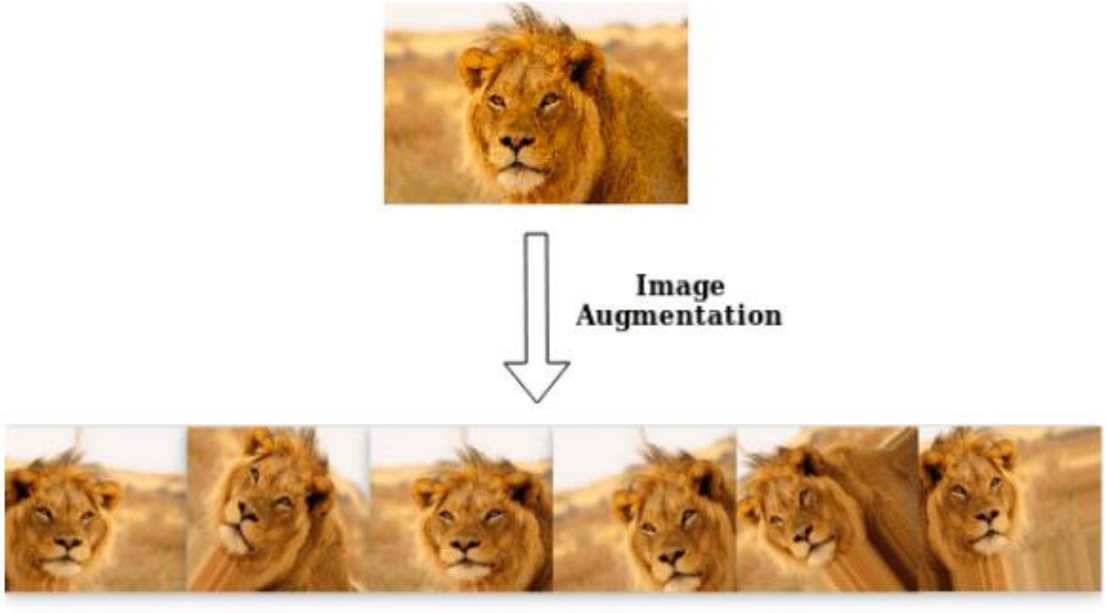
- Dropout is a regularization technique that randomly deactivates a fraction of neurons during training, forcing the model to learn redundant representations and reducing overfitting.



(a) Standard Neural Network (b) Neural Net with Dropout

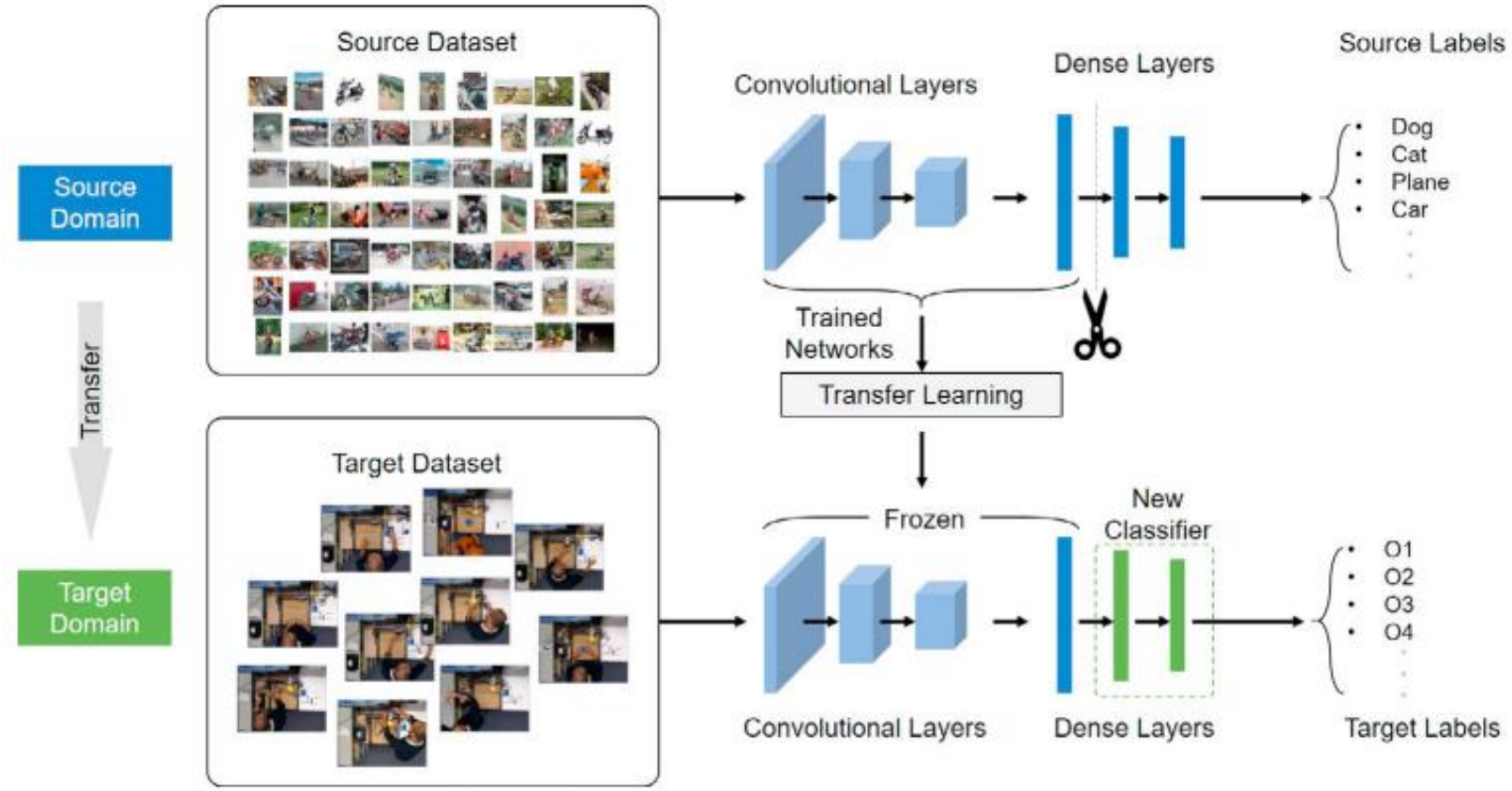
Data Augmentation

- Enlarge the dataset with synthetic samples
  - Rotation
  - Crop
  - Brightness



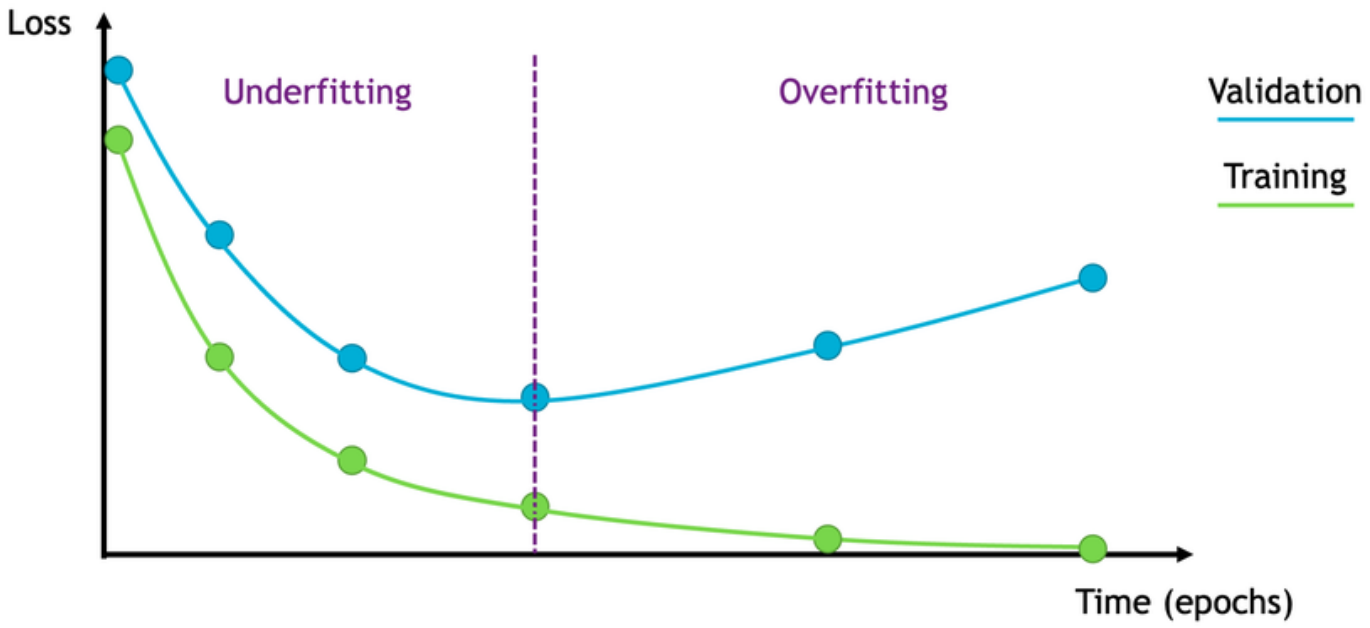
Transfer Learning

- Weight Sharing
- Feature Extraction weights are frozen (or not...) during learning



Miscellaneous

- Save and Load Weights
- Model Checkpoint
- Resuming Training
- Early Stopping



Let's Code

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