CONVOLUTIONAL NEURAL NETWORK

OUTLINE

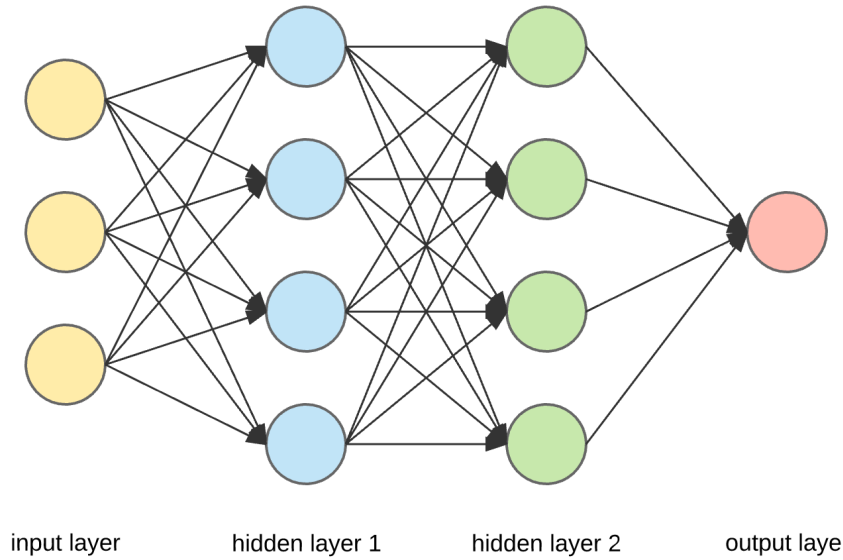
- Basic concepts
- Convolutional Neural Network History
- Convolutional Neural Network Architectures
- Applications

CONVOLUTIONAL NEURAL NETWORK

Basic concepts

Neural network A network or a ciucuit of neurons

Artificial neural networks(ANN) computing systems insipred by biological neural network that constitute animal brain



Node (Perceptron) A computational unit that has one or more weighted input connections

Layers Sets of neurons

Shallow learning Neural network with 1 hidden layer

Deep learning Neural network with more than 1 hidden layer

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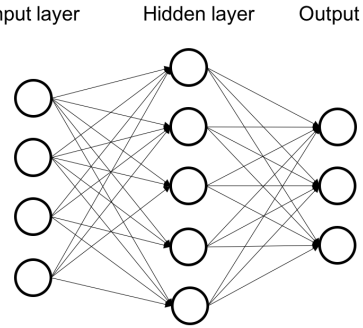
Convolutional Neural Network History

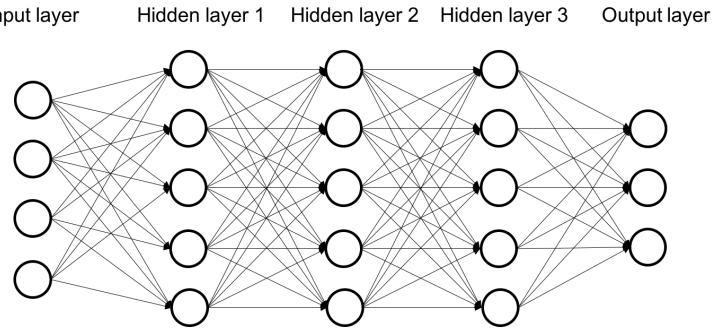
Convolutional neural network : is a class of deep neural networks, most commonly applied to analyzing visual imagery

- **LeNet** (Yann LeCun, 1989), LeNet-5 (Yann LeCun, 1998)
- **Max pooling:** 1990, Yamaguchi
- **AlexNet** : 2012
- **ZFNet** : 2013
- **VGGNet** : 2014
- **GoogleNet, ResNets** : 2015
- **Densenet** : 2016

Shallow



Deep



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Convolutional Neural Network Architectures

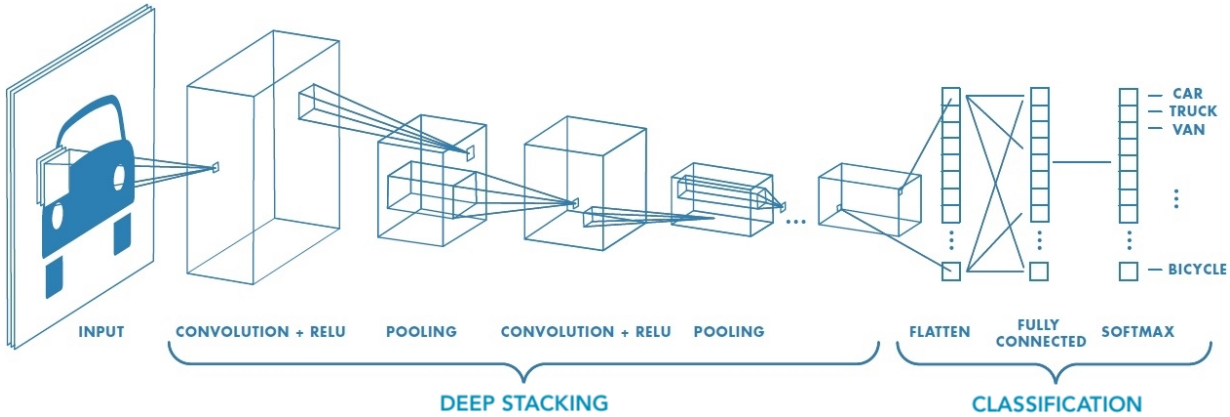

Figure: A Generality of Convolutional Neural Network Architectures

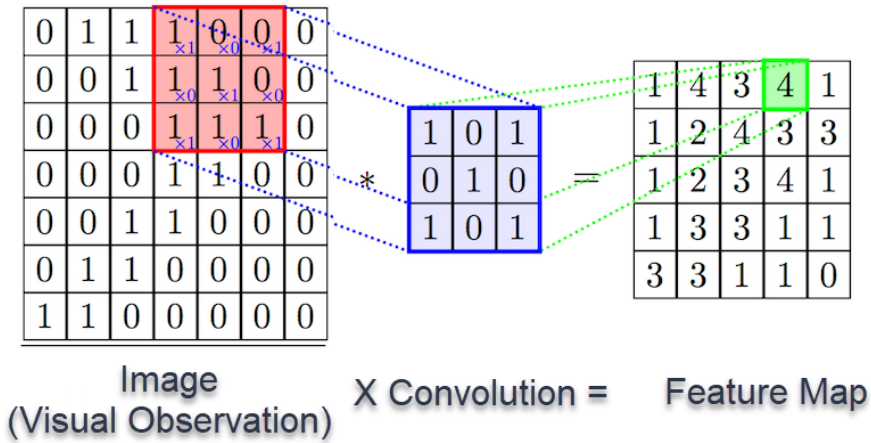

Figure: Visualization of Convolution

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Convolutional Neural Network Architectures

Other techniques

- Pooling:

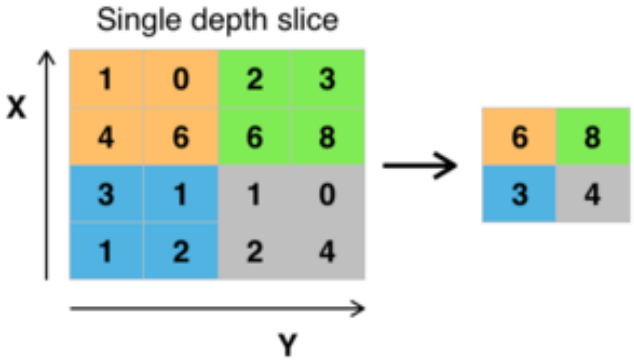


Figure: Max pooling

- Dropout:

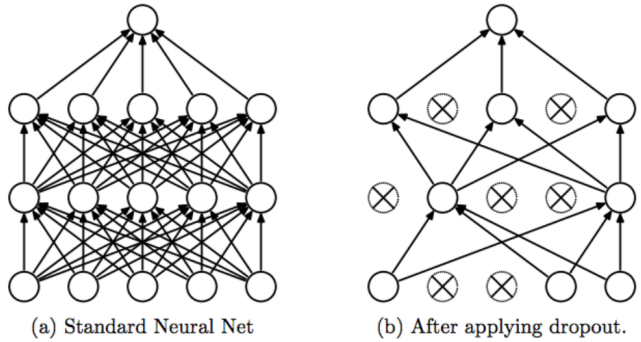
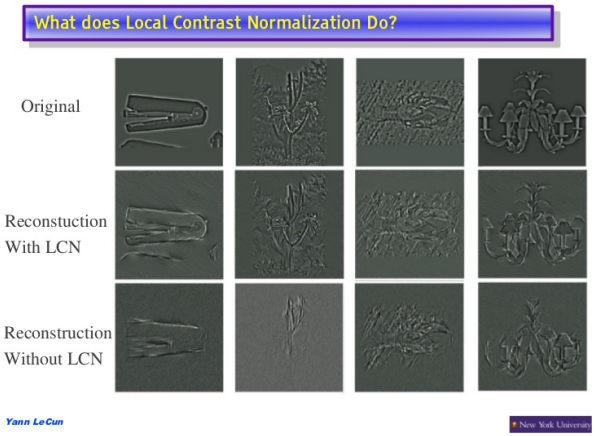


Figure: Dropout

- Local Contrast Normalization:



- Backpropagation
- Stochastic Gradient Descent
- Learning Rate Decay
- Long Short-Term Memory

CONVOLUTIONAL NEURAL NETWORK

Convolutional Neural Network Architectures

- **Advantages:**
  - Simplify computation to a great extent without losing the essence of the data
  - Great at handling image classification
- **Disadvantages:**
  - Slow to train on a old GPU
  - Need pre-processing (hand-engineered)
  - CNN do not encode the position and orientation of the object
  - Lack of ability to be spatially invariant

CONVOLUTIONAL NEURAL NETWORK

Applications

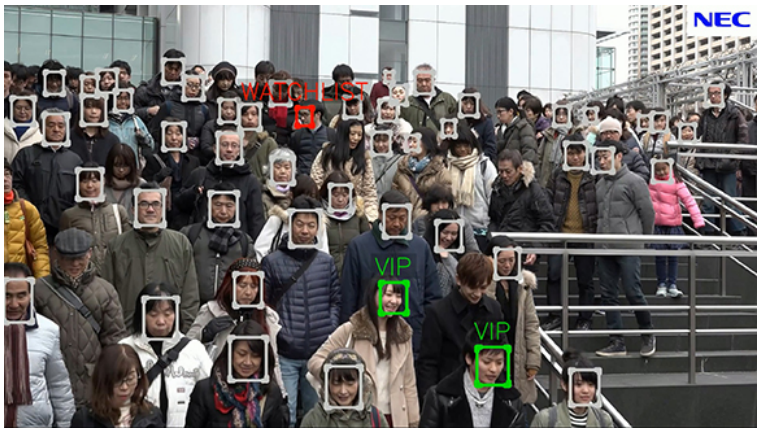


Figure: Image and video recognition

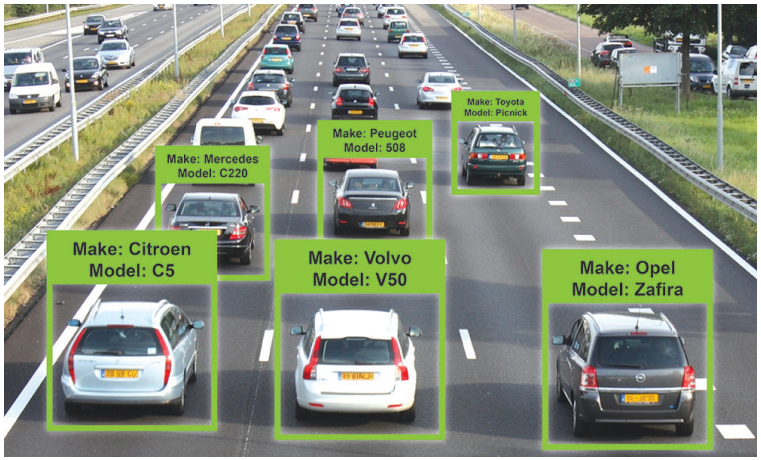


Figure: Recommendation system

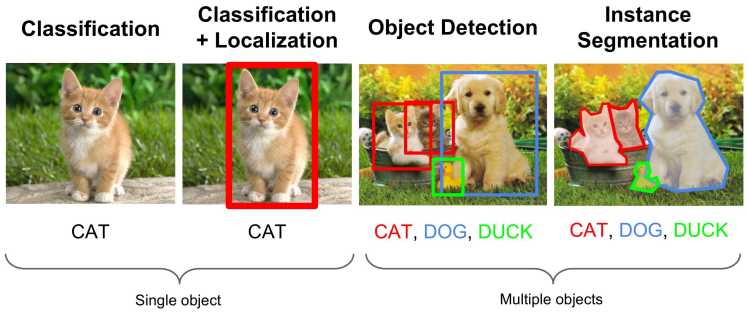


Figure: Image classification

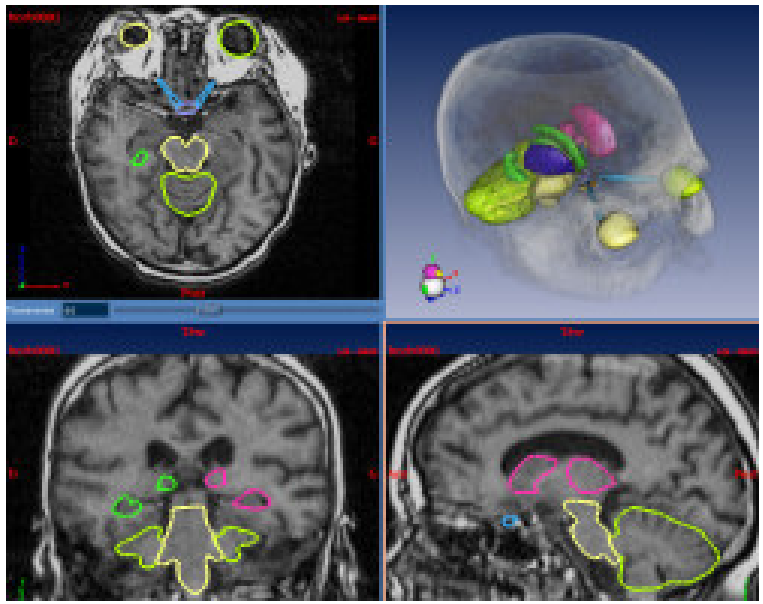


Figure: Medical image analysis