

## Summary:

In Lecun 1990 paper, the authors present a method to recognize handwritten zip code using backpropagation. Their main goal is to show that large neural networks trained with backpropagation can be applied to real image-recognition problems without a large and complex feature extraction stage requiring detailed engineering. In traditional neural network, a fully connected layers are used. The paper mentions several deficiencies of using such approach in this application. First, if the weights in the network is kept small, the network will underfit. However, if the network is made big enough, there will be huge number of parameters which causes overfitting, which is not a very favorable condition for generalization. Therefore, the paper brings an alternative concept of locally connected net. The basic design principle, that paper mentions, is to minimize the number of free parameters that must be determined by the learning algorithm, without affecting the computational power of the network drastically. The paper mentions that their network has local connections in all but the last layer. In Lucen 1998 paper, the author explains what these different layers are and their exact functions. The 3 typical layers in convolutional neural networks are convolutional layer, pooling layer, and fully connected layer. The convolutional layer makes use of learnable filters to detect the presence of specific features or patterns present in the image. Each filter results in an activation/feature map. The pooling layer then reduces the number of parameters and hence the computation in the network. Like mentioned above, this controls overfitting by progressively reducing the spatial size of the network. Finally, fully connected layer is a regular neural network layer with full connection to the output layer. This layer is responsible for classifying the image into a label.

Convolutional neural network ensures some degree of shift, scale, and distortion invariance by combining three architectural ideas: local receptive fields, shared weights, and spatial or temporal subsampling.

## Weakness

- Abstract is too short and not so clear on Lecun 1990 paper.
- It's hard to understand what is going on in some of the figures because of the quality of figures.
- The Lecun 1990 paper does not have many visual representations of how the convolutional neural network works.

## Strengths

- Both the paper does a really good job of explaining why this new approach is better than the older neural network design.
- Both the paper also explains in detail what goes on in the hidden layers in CNN and what each layer does.

## Confusions

- Structural vs Statistical methods?
- What is the difference between artificial generation using stochastic model vs skeletonization? (part 3, Lecun 1990)?

- What exactly is segmentation and how is it performed?
- Substitution vs Rejection?

#### Discussion Questions

- How does the different layers of CNN work for recognizing an object?
- Why is CNN adaptable to problems with high variability and noise?
- How does the backpropagation for CNN looks like?