

CNN theory

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Outline

Nueral Network

Structure

Training

Convolutional

Nueral Network

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Convolution

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Nonlinear

Innerproduct

Loss Layer

Build your own CNN

Difference

# CNN theory

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July 13, 2015

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# Attention

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Difference

- Only basic theory
- No formulas
- Mainly images

# How do human learn from data

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### Convolutional Nueral Network

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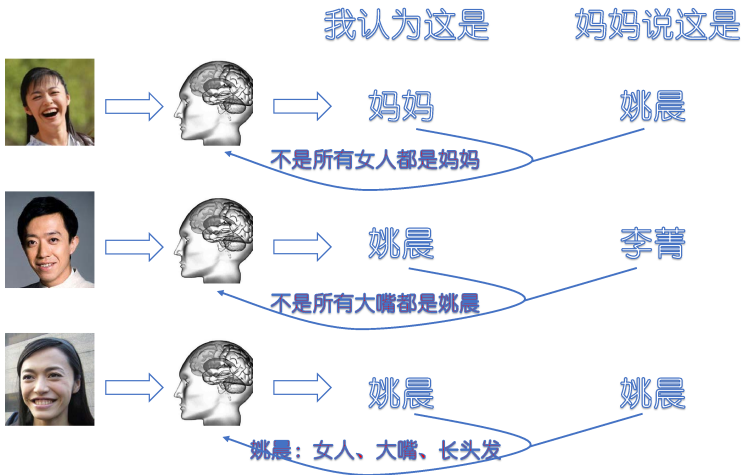
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# What we want

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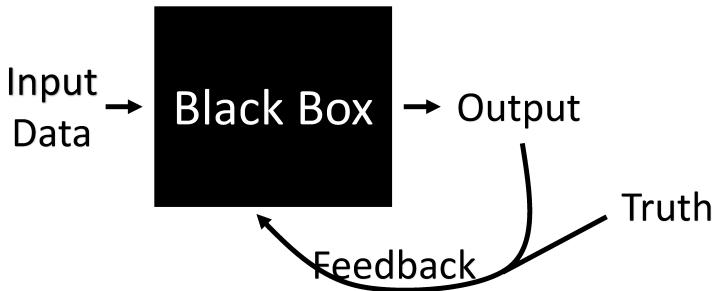


Figure: Make machine learn as people

# Pipe

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Figure: Control the pipes to let water flow into correct target

# Minist Demo

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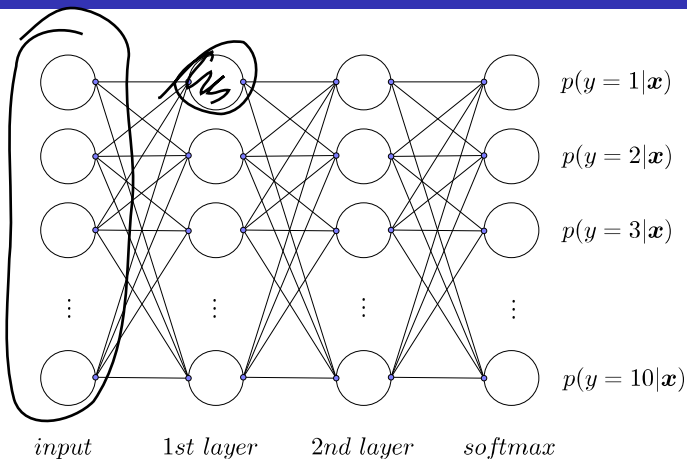
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**Figure:** A demo neural network for digits recognition. Parameters are those pipes, controlling the input data (water) flowing into every exit.

# Neurons

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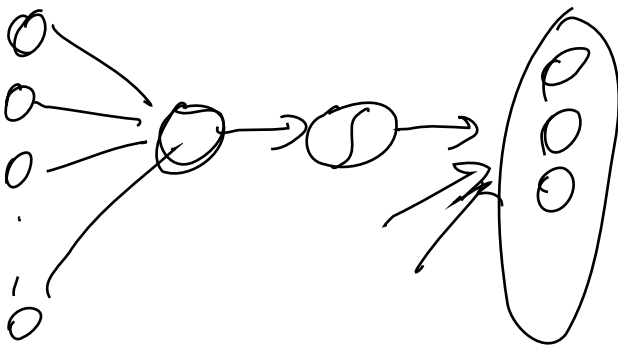
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Difference

- 1 Linear combination of all the neuron outputs of last layer
- 2 Pass through an active unit, bringing nonlinear components





# Training steps

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- 1 Forward
- 2 Backpropagation
- 3 Update parameters



# CNN structure

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Difference

CNN is an extended Neural Network mainly designed for 2D input. More wonderful layers and extend 1D features to 2D feature maps.

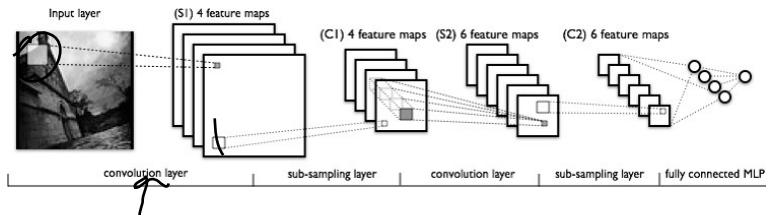


Figure: A simple CNN.

# Convolution

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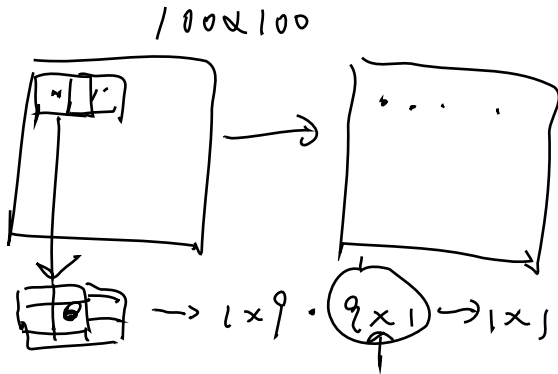
Innerproduct

Loss Layer

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Difference

- 1 Actually is still inner product
- 2 Combined with location information
- 3 Done locally



# Convolution

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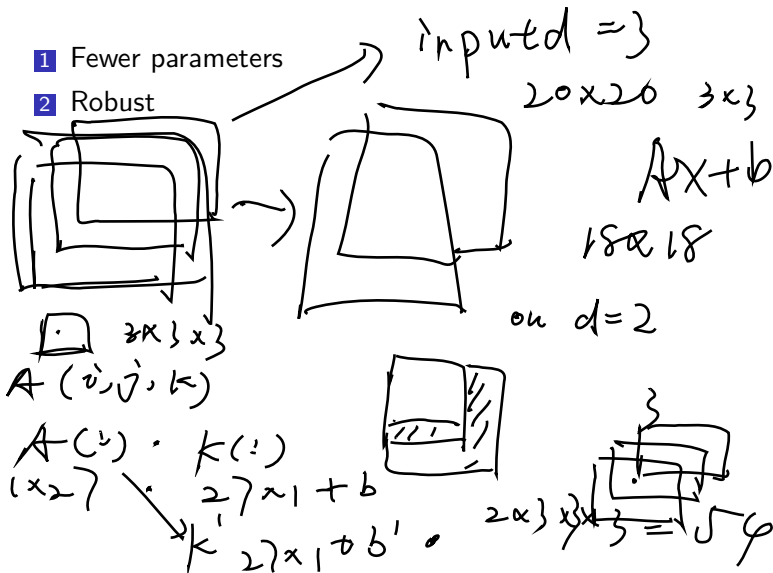
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# Pooling (Subsampling)

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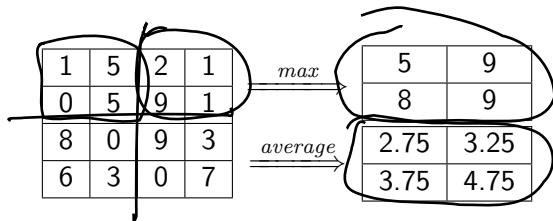
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Difference

- 1 Preventing from overfitting
- 2 Translation invariant
- 3 Max or average and so on
- 4 Simple



# Nonlinear

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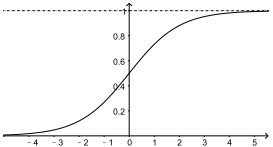
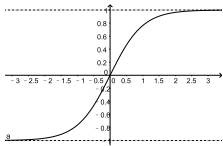
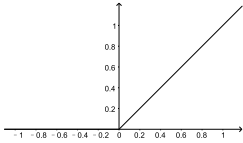
**Nonlinear**

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Name	Function	Range	Plot
<u>Sigmoid</u>	$\frac{1}{1+e^{-x}}$	$(0, 1)$	
TanH	$\frac{e^x - e^{-x}}{e^x + e^{-x}}$	$(-1, 1)$	
<u>ReLU</u>	$\max(0, x)$	$(0, +\infty)$	

# Innerproduct

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Difference

- 1 Traditional Neural Networks
- 2 Large Parameter Space

# Loss Layer

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- 1 Softmax Loss – Classification
- 2 Euclidean (L2) Loss – Regression

$$\|y - y_1\|_2$$

$$\frac{e^{-\theta x}}{e^{-\theta_1 x} + \dots + e^{-\theta_n x}}$$



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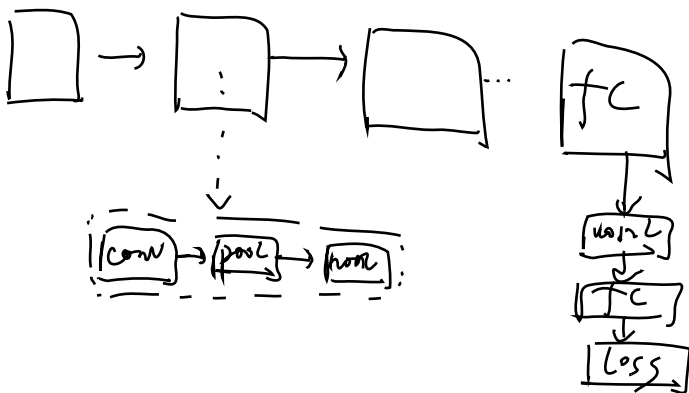
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# Difference

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**Difference**

- 1 Dimension
- 2 Fewer parameters
- 3 More types of layers
- 4 Avoiding overfitting

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**Difference**

# Thanks!