Deep Learning

2018 AI Summer Program, Asia University

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Department of Bioinformatics and Medical Engineering
Centre for Artificial Intelligence

http://aicenter.asia.edu.tw/

About

王昭能 Charles C.N. Wang

- **CURRENTLY**

  Department of Bioinformatics and Medical Engineering

  Centre for Artificial Intelligenc

- **EDUCATION**

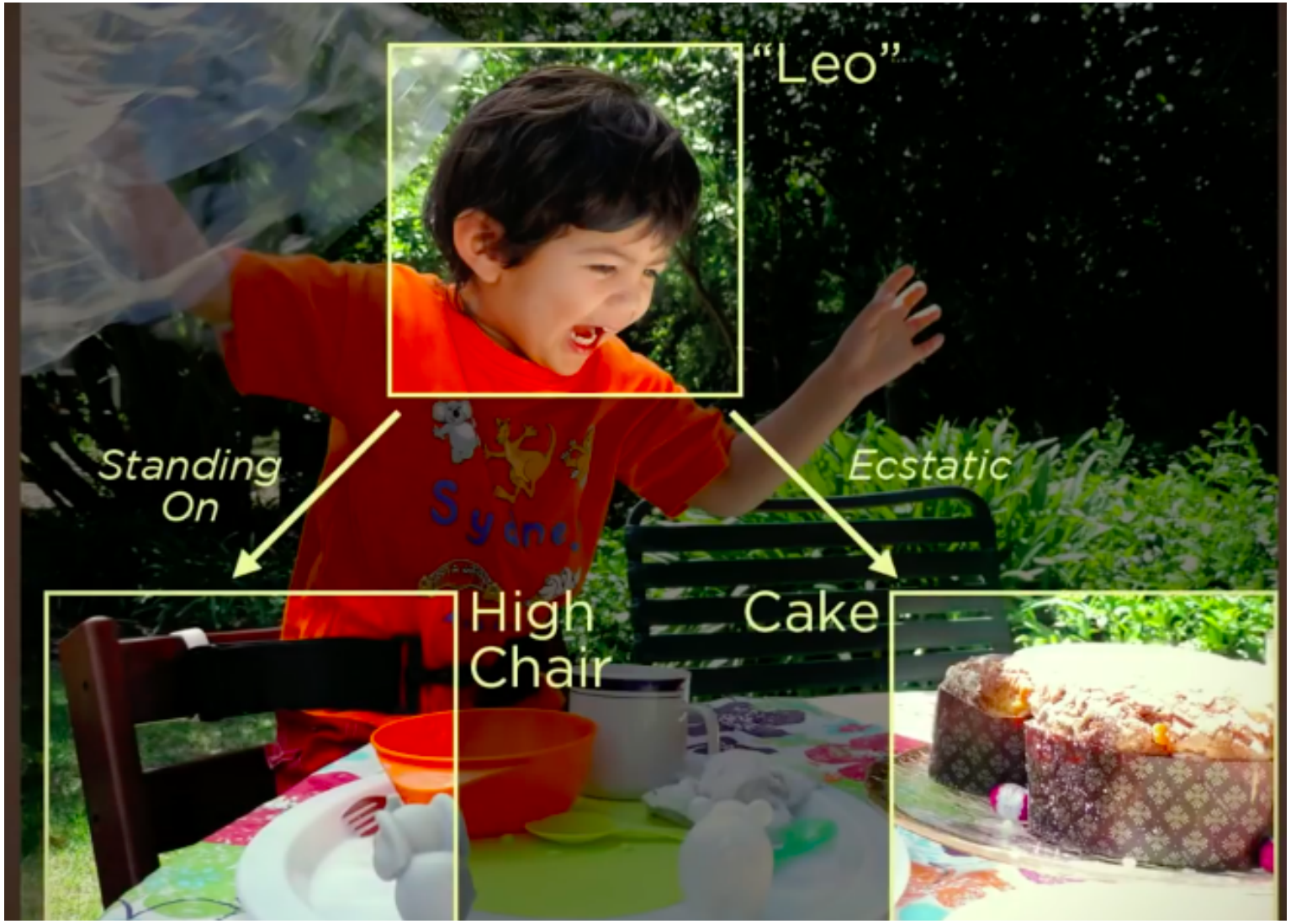
  Ph.D. in Bioinformatics, Asia University, Taiwan

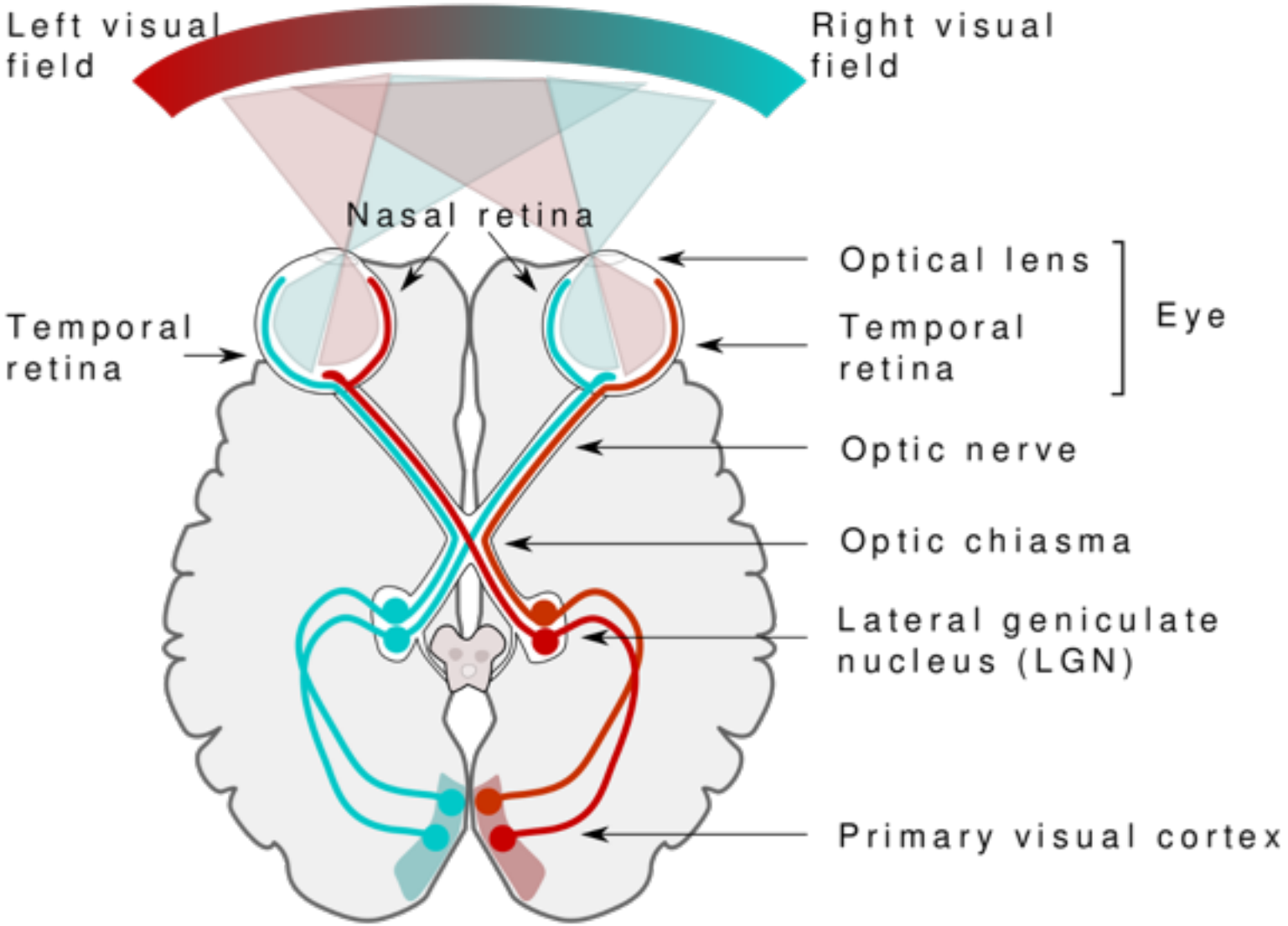
  M.S. in Bioinformatics, Asia University, Taiwan

- **RESEARCH FIELD**

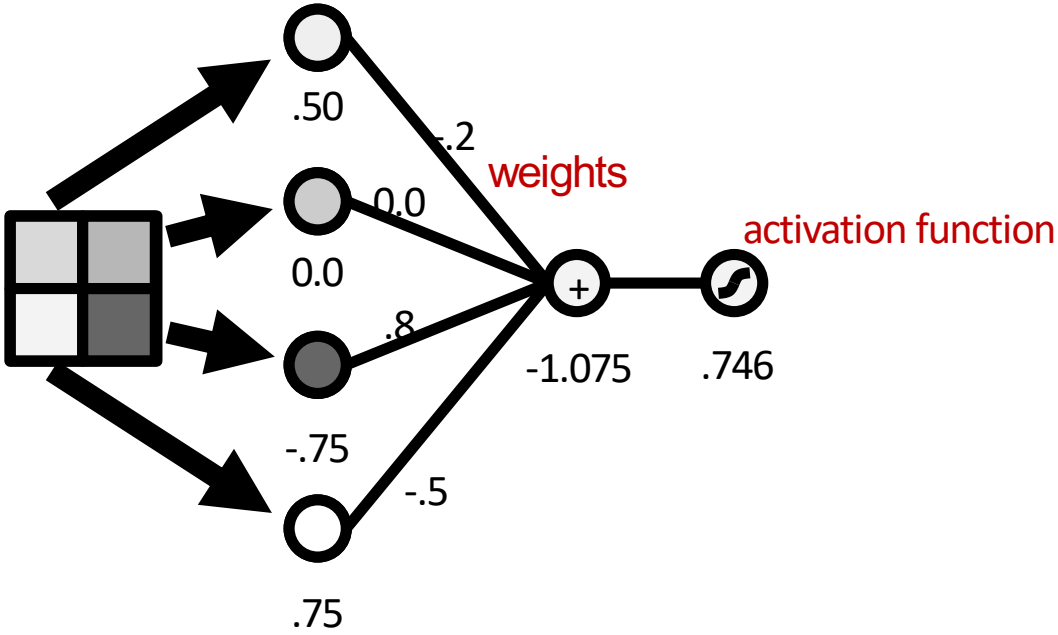
  Bioinformatics, Systems Biology, Semantic Computing, Text Mining and Knowledge Discovery

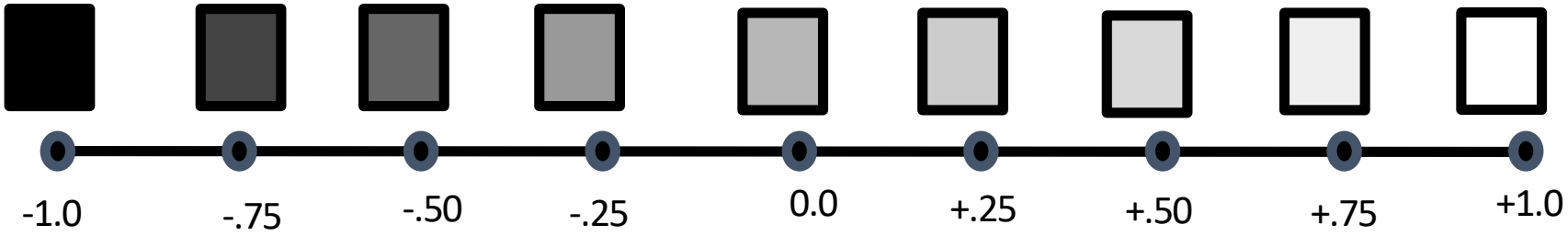

Sydney

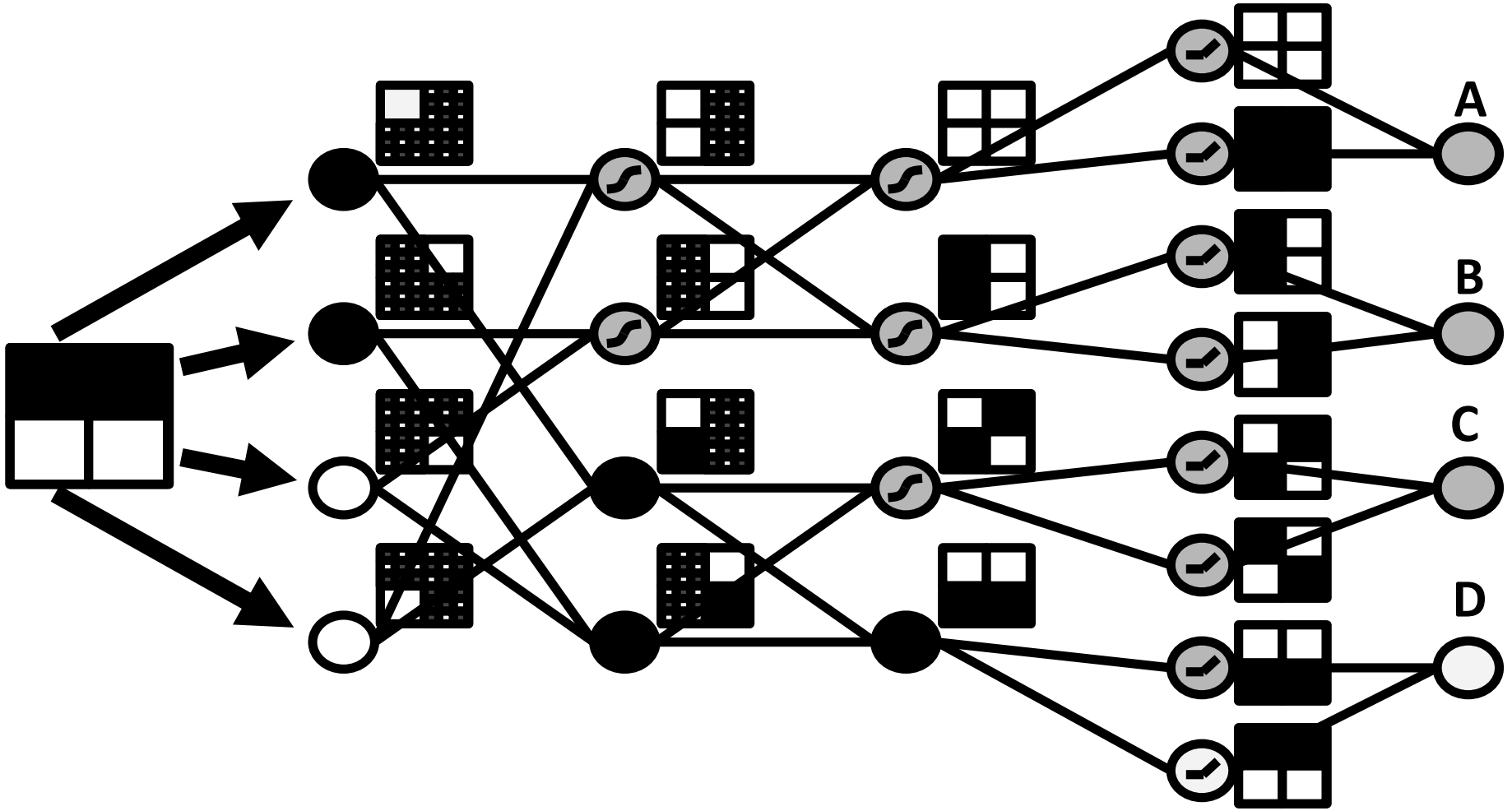

"Leo"
Standing On
Ecstatic
High Chair
Cake

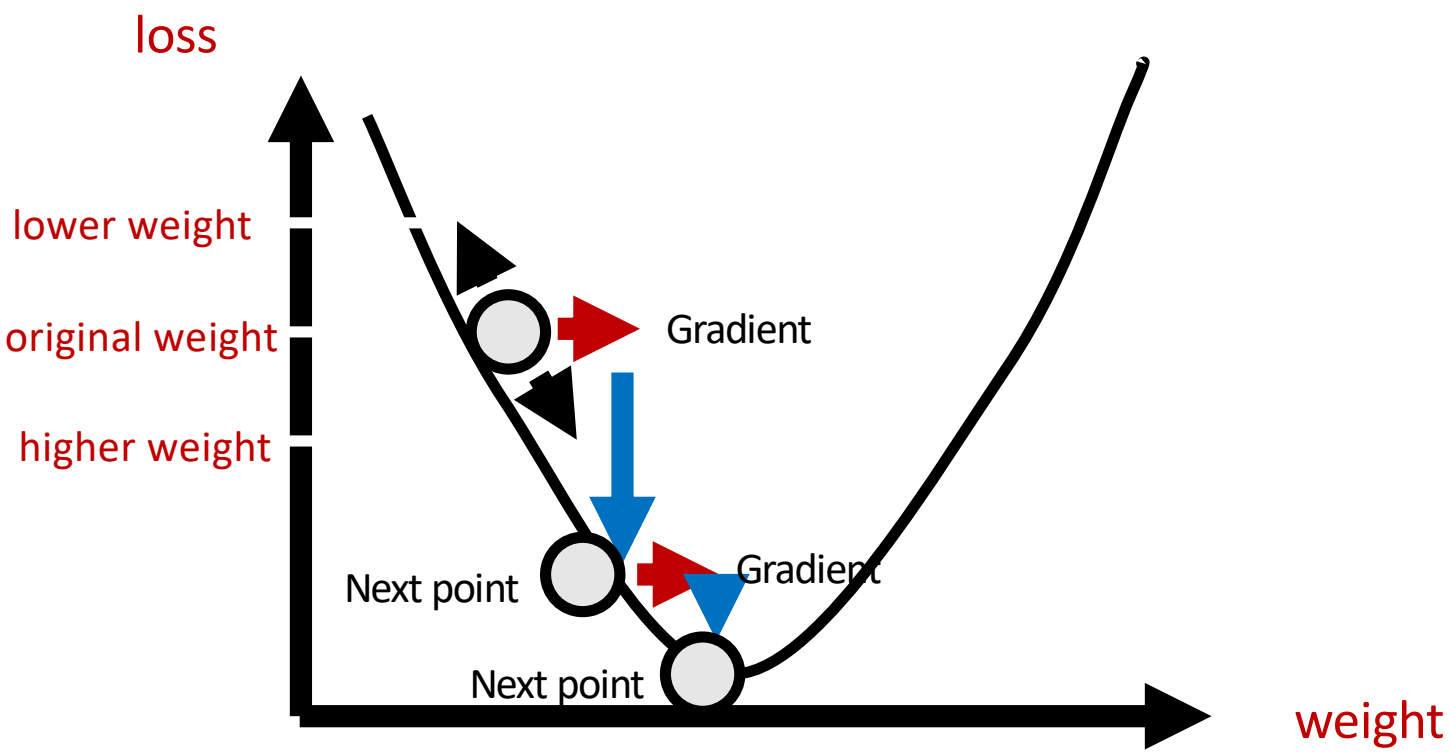

Left visual field
Right visual field
Nasal retina
Temporal retina
Optical lens
Temporal retina
Eye
Optic nerve
Optic chiasma
Lateral geniculate nucleus (LGN)
Primary visual cortex

Neural Network


.50
0.0
-.75
.75
-.2
0.0
.8
-.5
weights
+
-1.075
activation function
.746

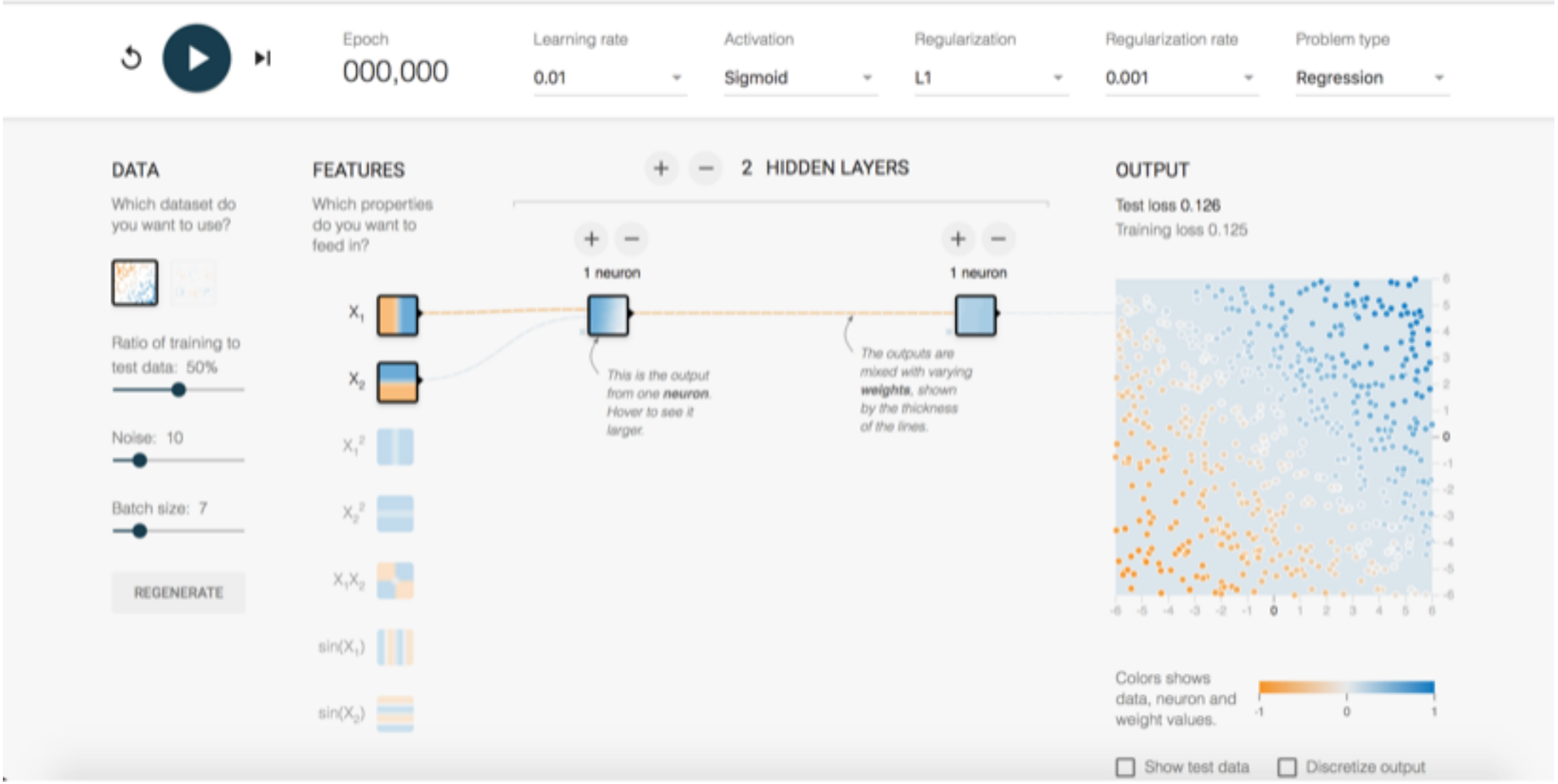

-1.0
-.75
-.50
-.25
0.0
+.25
+.50
+.75
+1.0


A
B
C
D



Regression problems yield convex loss vs weight plots.

Ref: https://youtu.be/BR9h47Jtqyw

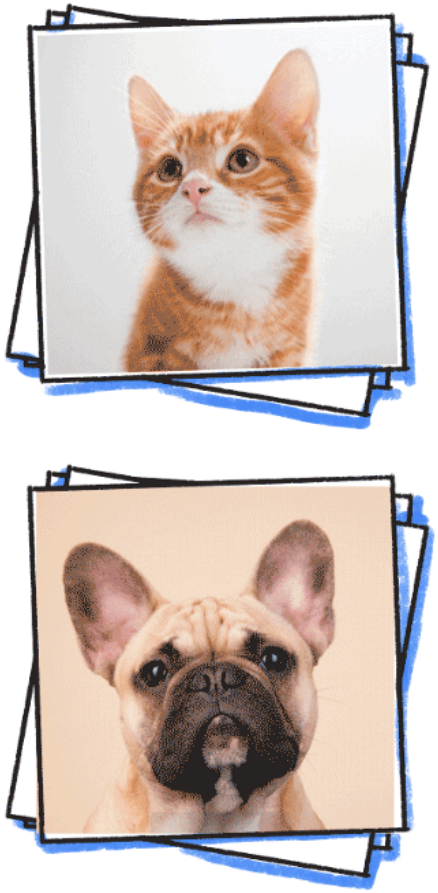

Epoch
000,000
Learning rate
0.01
Activation
Sigmoid
Regularization
L1
Regularization rate
0.001
Problem type
Regression
DATA
Which dataset do you want to use?
Ratio of training to test data: 50%
Noise: 10
Batch size: 7
REGENERATE
FEATURES
Which properties do you want to feed in?
X1
X2
X1²
X2²
X1X2
sin(X1)
sin(X2)
2 HIDDEN LAYERS
1 neuron
1 neuron
This is the output from one neuron. Hover to see it larger.
The outputs are mixed with varying weights, shown by the thickness of the lines.
OUTPUT
Test loss 0.126
Training loss 0.125
Colors shows data, neuron and weight values.
-1
0
1
Show test data
Discretize output

Convolutional Neural Networks

CAT

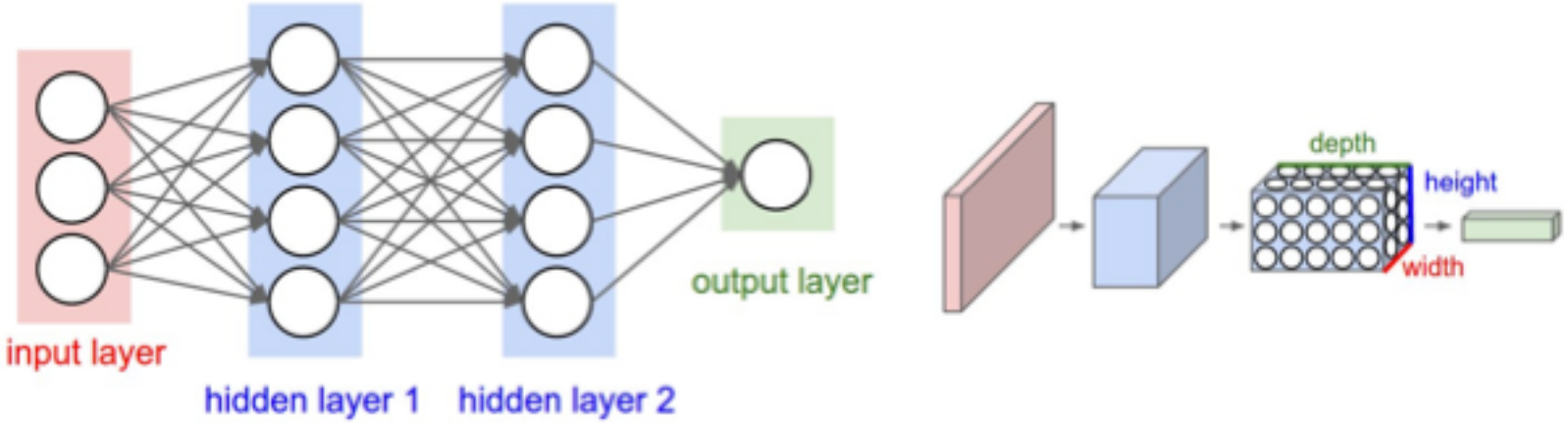
(LABELED PHOTOS)

DOG

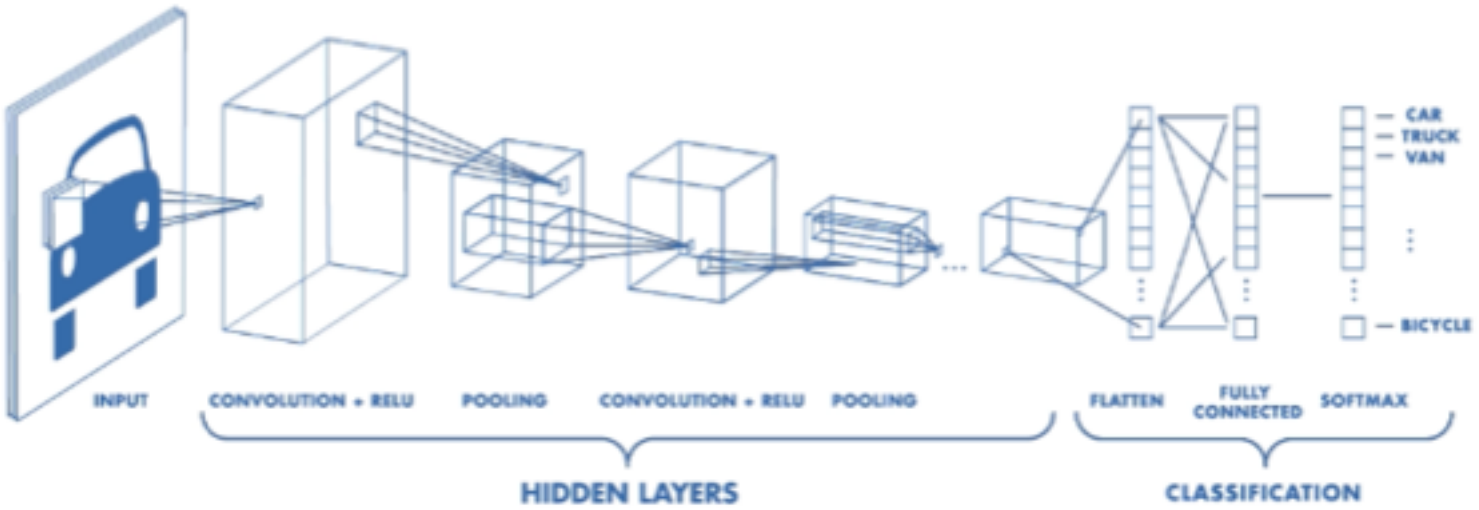


OUTPUT

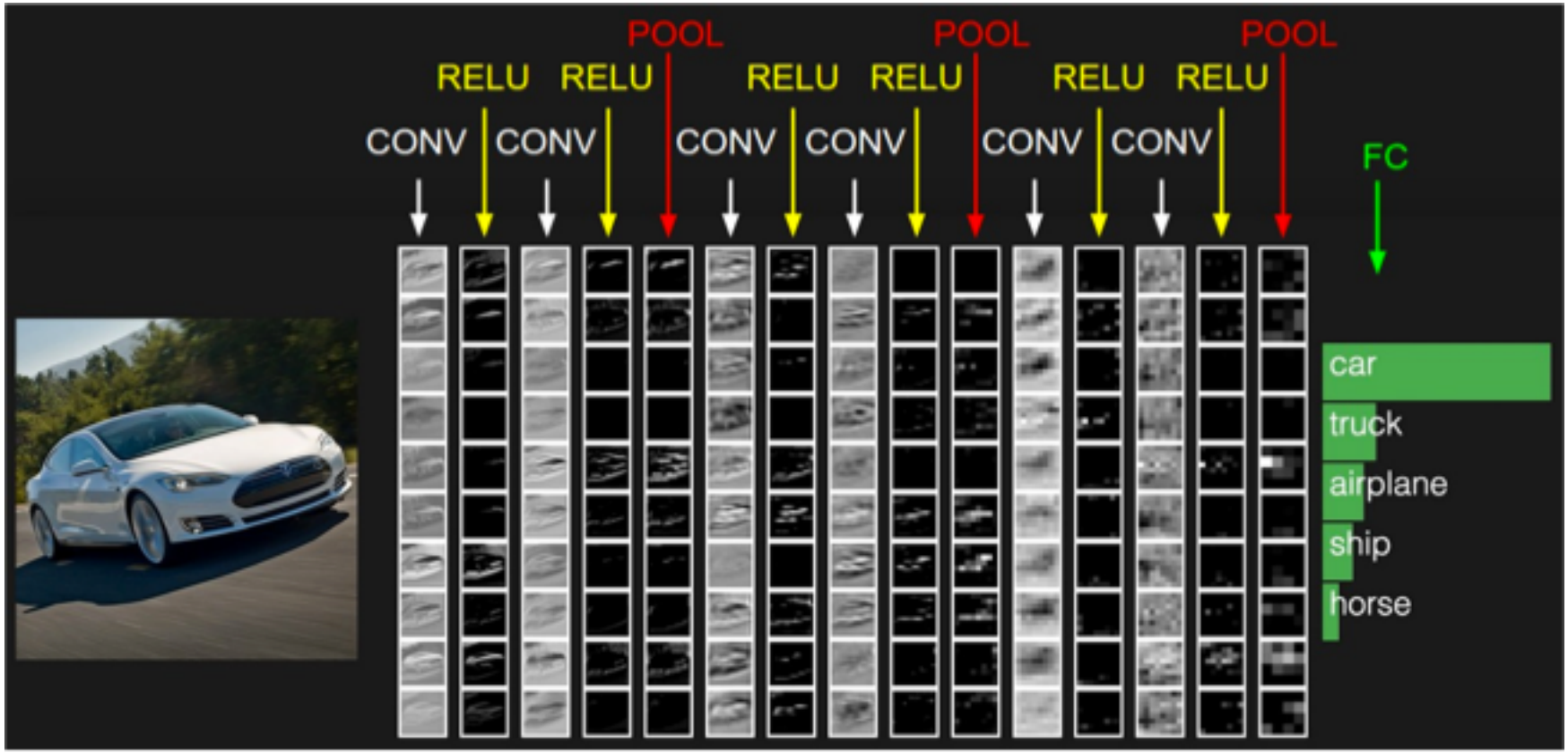
Architecture Overview



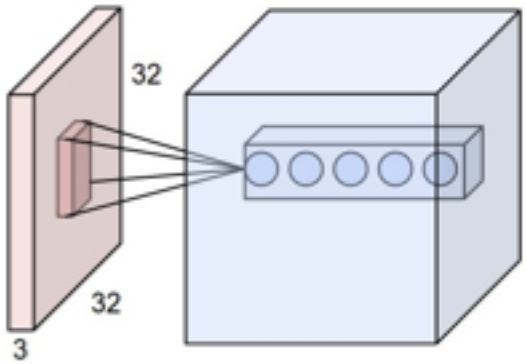
Left: A regular 3-layer Neural Network. Right: A CNN arranges its neurons in three dimensions (width, height, depth), as visualized in one of the layers. Every layer of a CNN transforms the 3D input volume to a 3D output volume of neuron activations. In this example, the red input layer holds the image, so its width and height would be the dimensions of the image, and the depth would be 3 (Red, Green, Blue channels).

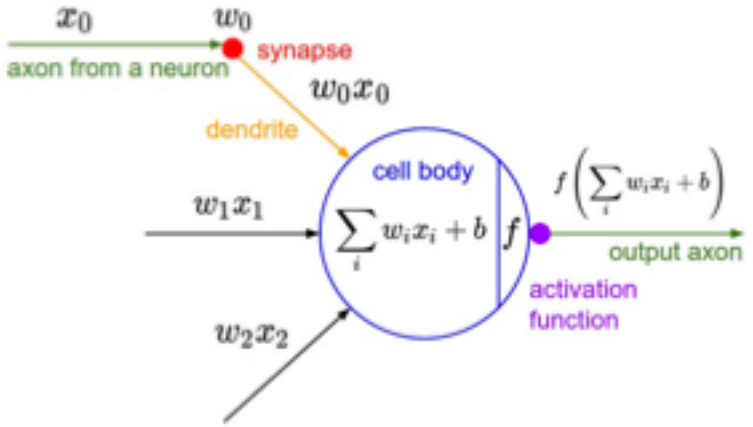


Convolutional Layer # Pooling Layer #Normalization Layer #Fully-Connected Layer


POOL
POOL
POOL
RELU
RELU
RELU
RELU
RELU
RELU
CONV
CONV
CONV
CONV
CONV
CONV
FC
car
truck
airplane
ship
horse

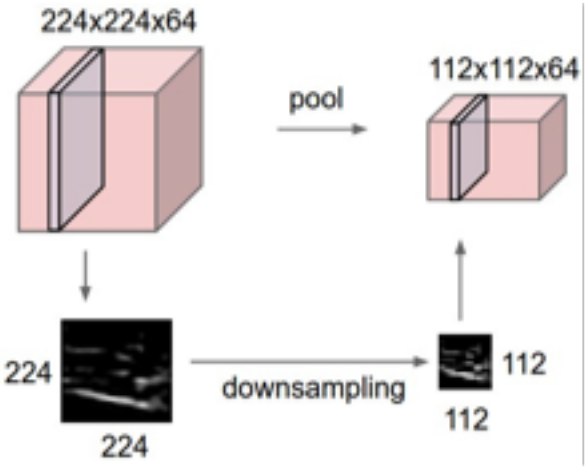
Convolutional Layer

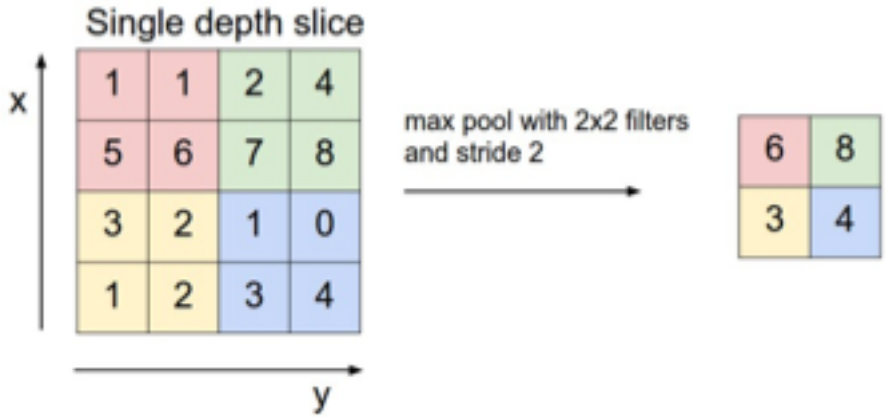




Left: An example input volume in red (e.g. a 32x32x3 CIFAR-10 image), and an example volume of neurons in the first Convolutional layer. Each neuron in the convolutional layer is connected only to a local region in the input volume spatially, but to the full depth (i.e. all color channels). Note, there are multiple neurons (5 in this example) along the depth, all looking at the same region in the input - see discussion of depth columns in text below. **Right:** The neurons from the Neural Network chapter remain unchanged: They still compute a dot product of their weights with the input followed by a non-linearity, but their connectivity is now restricted to be local spatially.

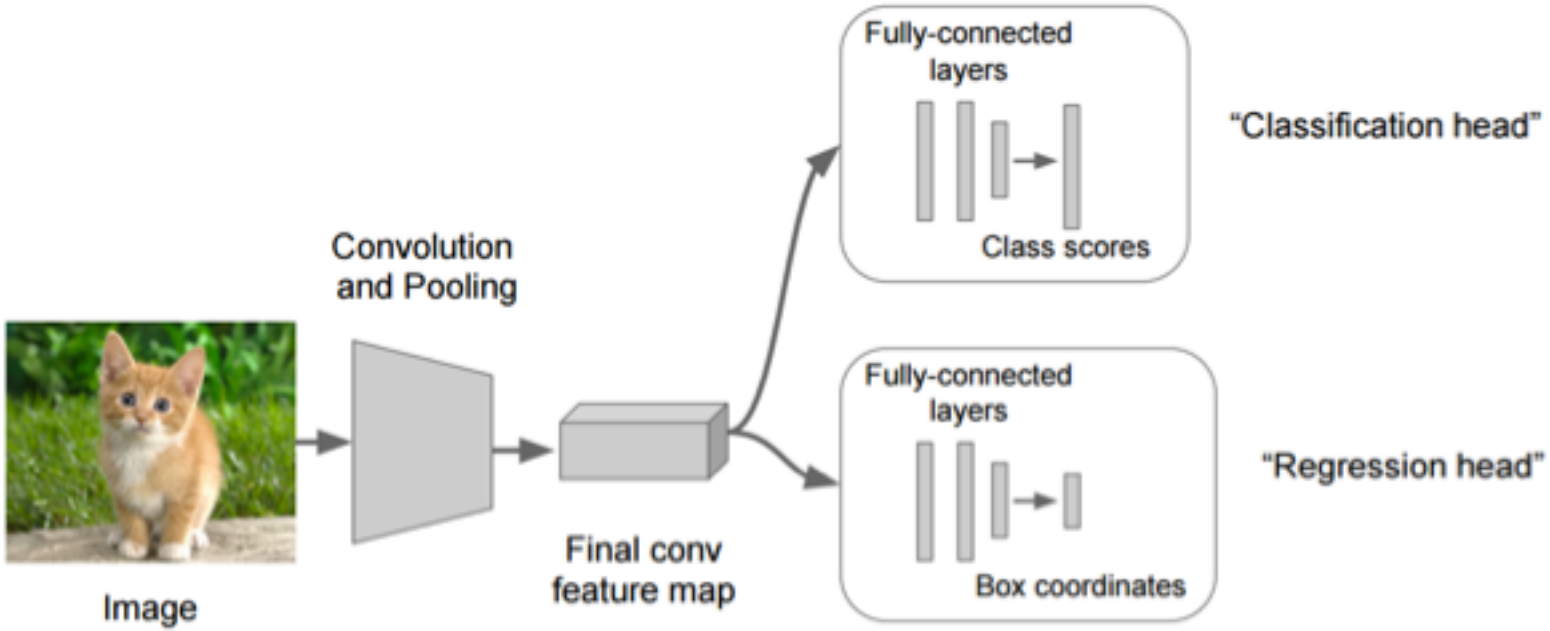
Pooling Layer





Pooling layer downsamples the volume spatially, independently in each depth slice of the input volume. **Left:** In this example, the input volume of size [224x224x64] is pooled with filter size 2, stride 2 into output volume of size [112x112x64]. Notice that the volume depth is preserved. **Right:** The most common downsampling operation is max, giving rise to **max pooling**, here shown with a stride of 2. That is, each max is taken over 4 numbers (little 2x2 square).

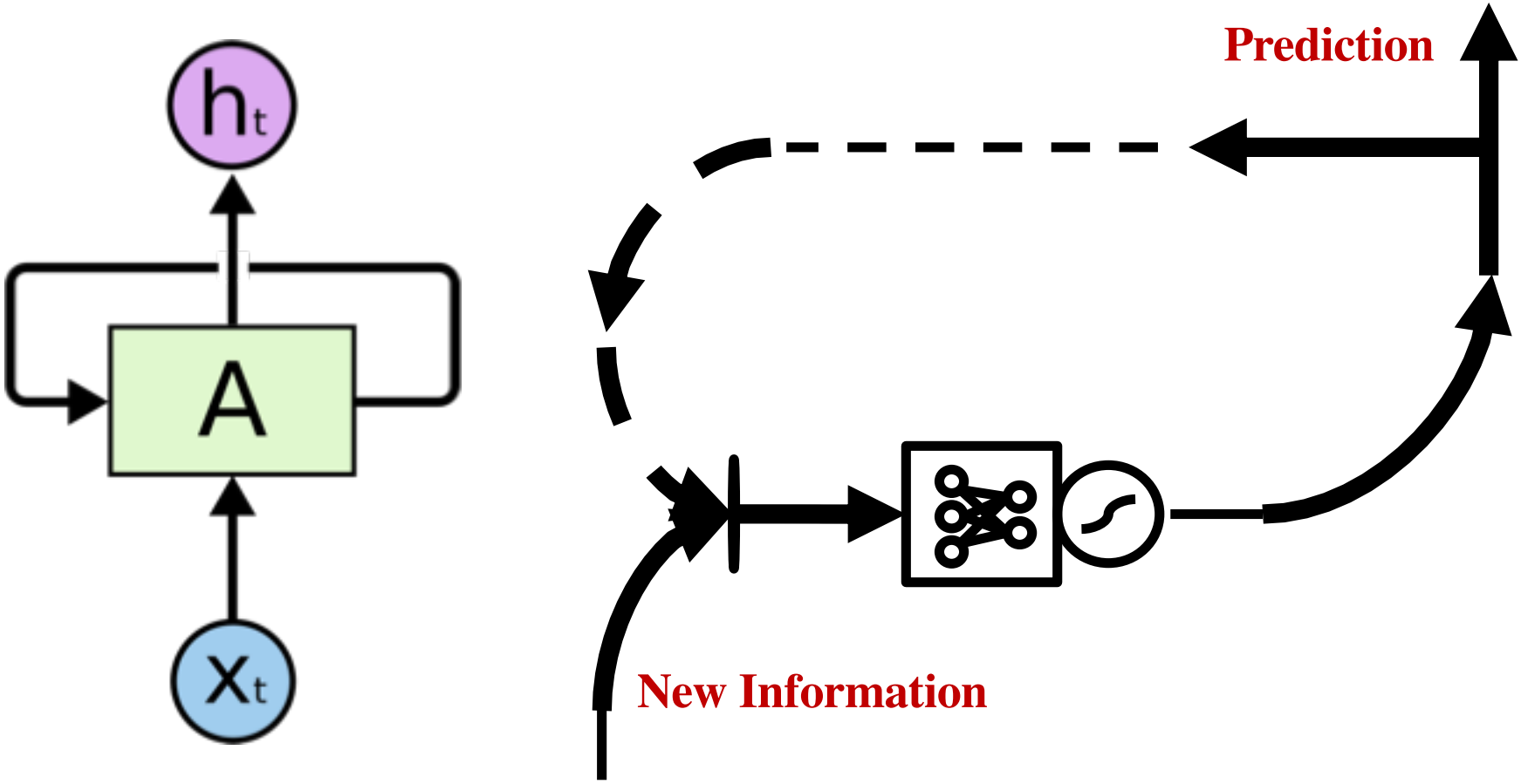
Fully connected layers

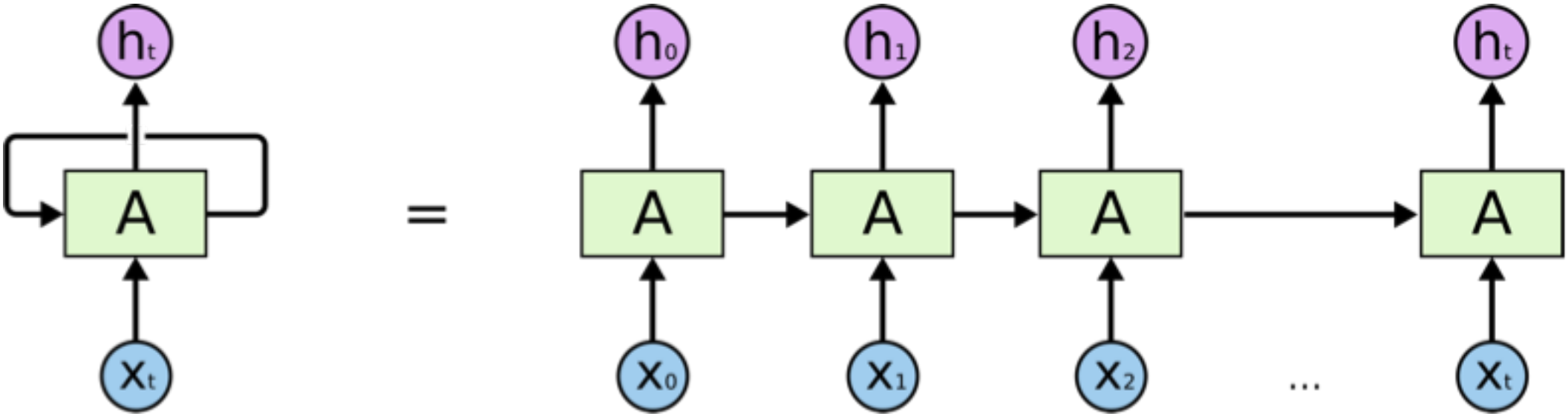


Ref:https://youtu.be/2-Ol7ZB0MmU

- In summary, CNNs are especially useful for image classification and recognition. They have two main parts: a feature extraction part and a classification part.
- The main special technique in CNNs is convolution, where a filter slides over the input and merges the input value + the filter value on the feature map.

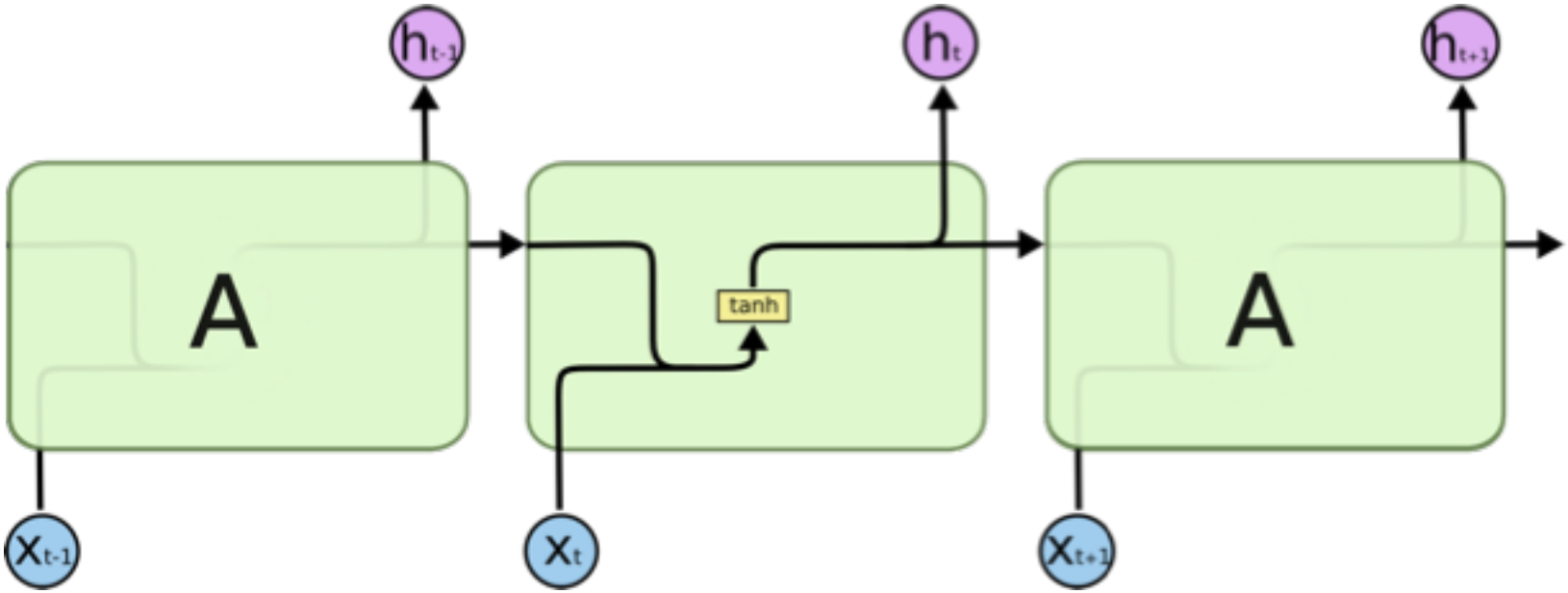
Recurrent Neural Network


h_t
A
X_t
Prediction
New Information

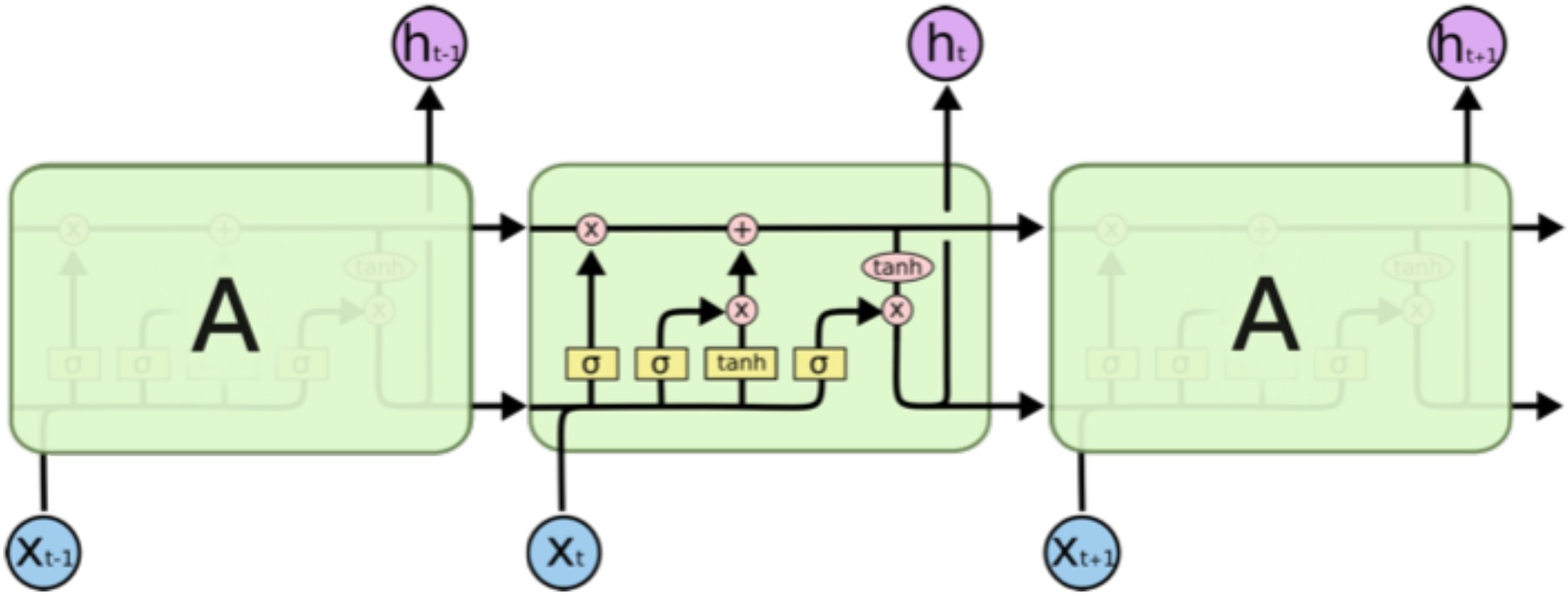

h_t
A
x_t
=
h_0
h_1
h_2
h_t
A
A
A
A
x_0
x_1
x_2
...
x_t

Ref:https://youtu.be/UNmqTiOnRfg

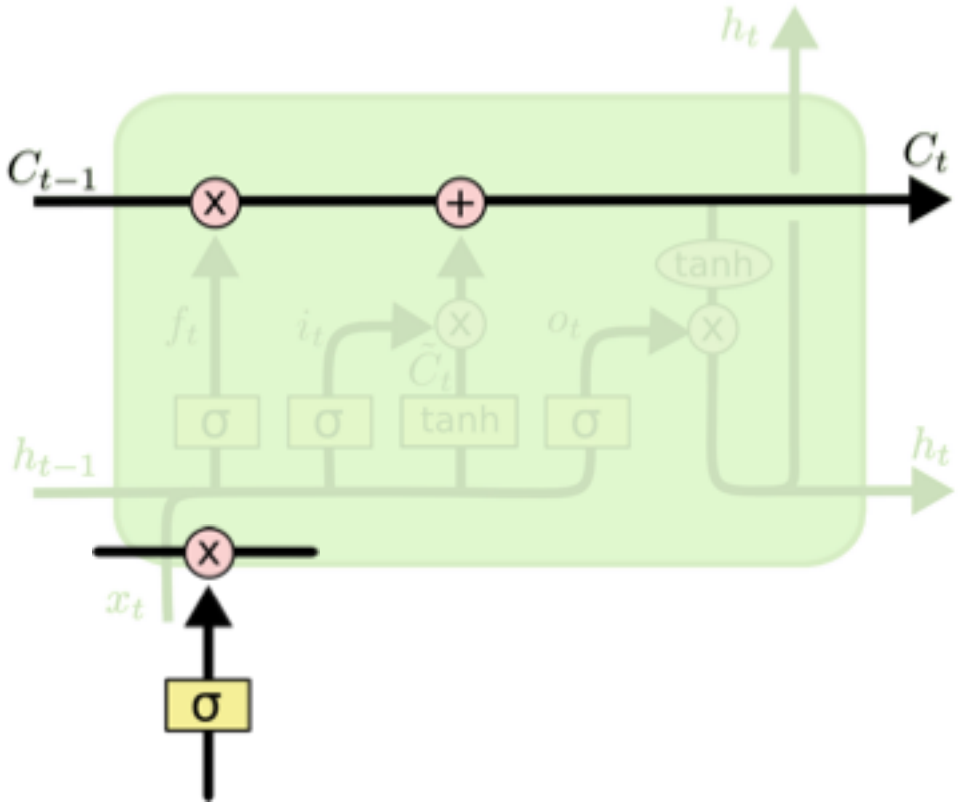
Long Short Term Memory networks(LSTM)



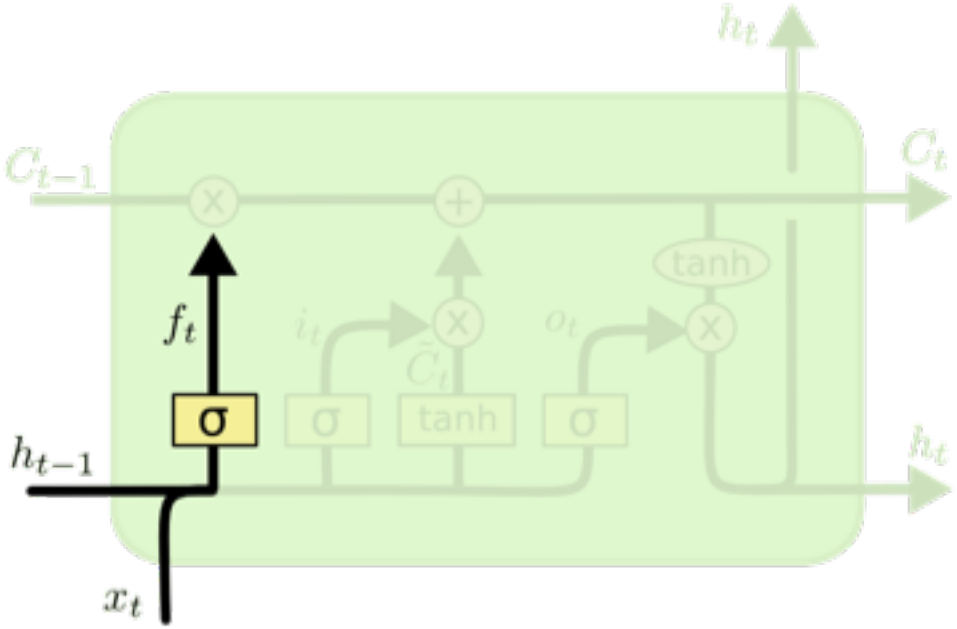
The repeating module in a standard RNN contains a single layer.



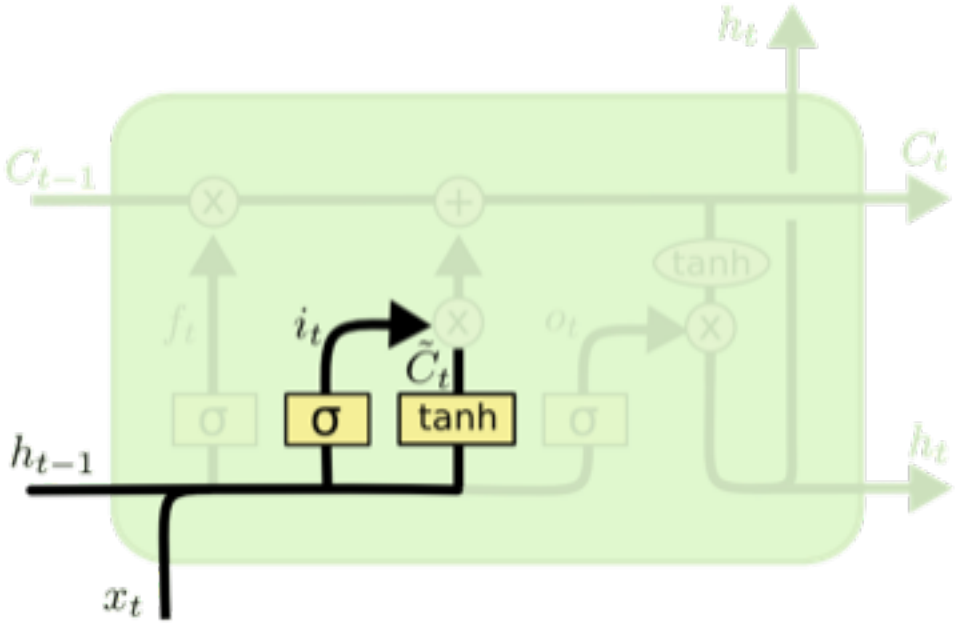
The repeating module in an LSTM contains four interacting layers.


h_t
C_{t-1}
C_t
tanh
f_t
i_t
o_t
$\tilde{C}_t$
σ
σ
tanh
σ
h_{t-1}
h_t
x_t
σ

Step-by-Step LSTM Walk Through

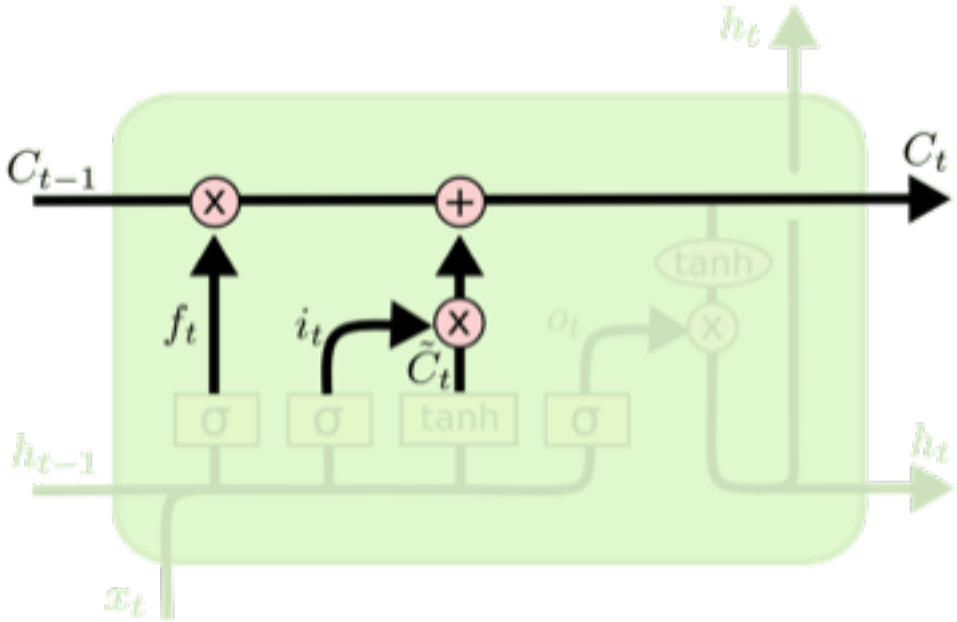


$$f_t = \sigma\left(W_f \cdot [h_{t-1}, x_t] \; + \; b_f\right)$$

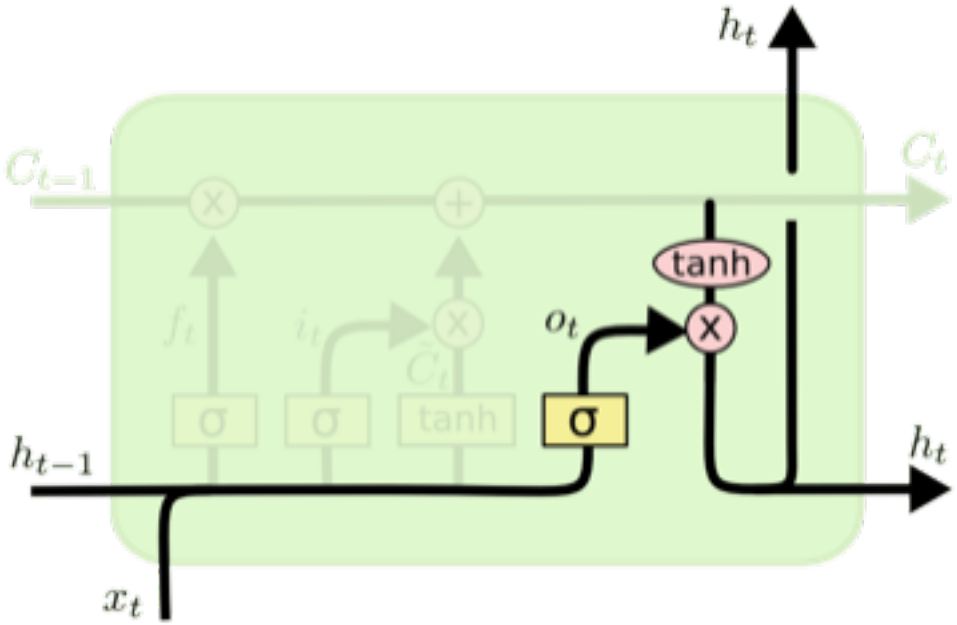


$$i_t = \sigma\left(W_i \cdot [h_{t-1}, x_t] \; + \; b_i\right)$$

$$\tilde{C}_t = \tanh(W_C \cdot [h_{t-1}, x_t] \; + \; b_C)$$



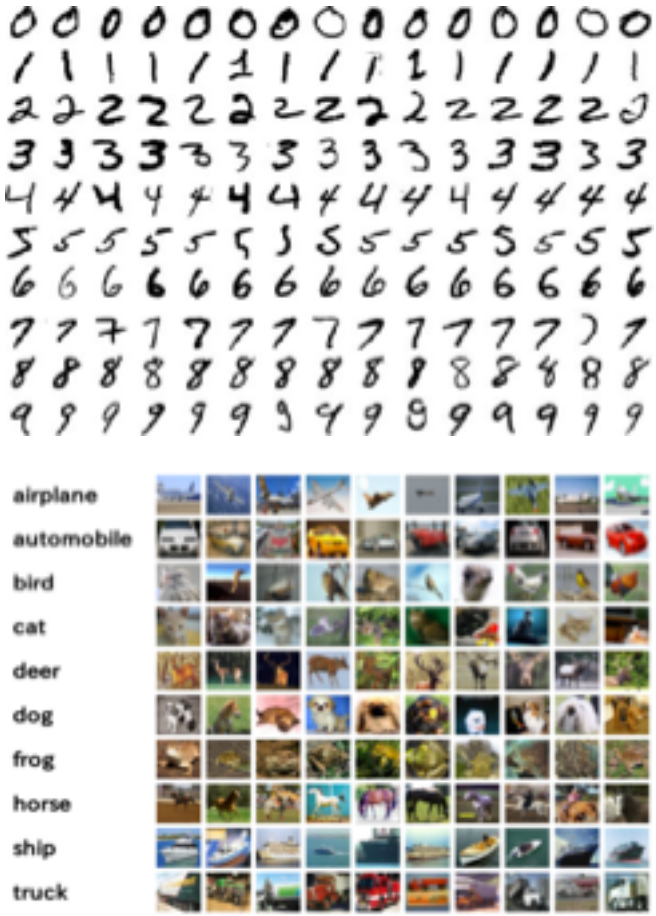
$$C_t = f_t * C_{t-1} + i_t * \tilde{C}_t$$



$$o_t = \sigma\left(W_o\left[h_{t-1}, x_t\right] + b_o\right)$$

$$h_t = o_t * \tanh\left(C_t\right)$$

Case study : MNIST and CIFAR-10



TensorFlow ™ Install Develop API r1.8 Deploy Extend Community Versions 搜尋 GITHUB

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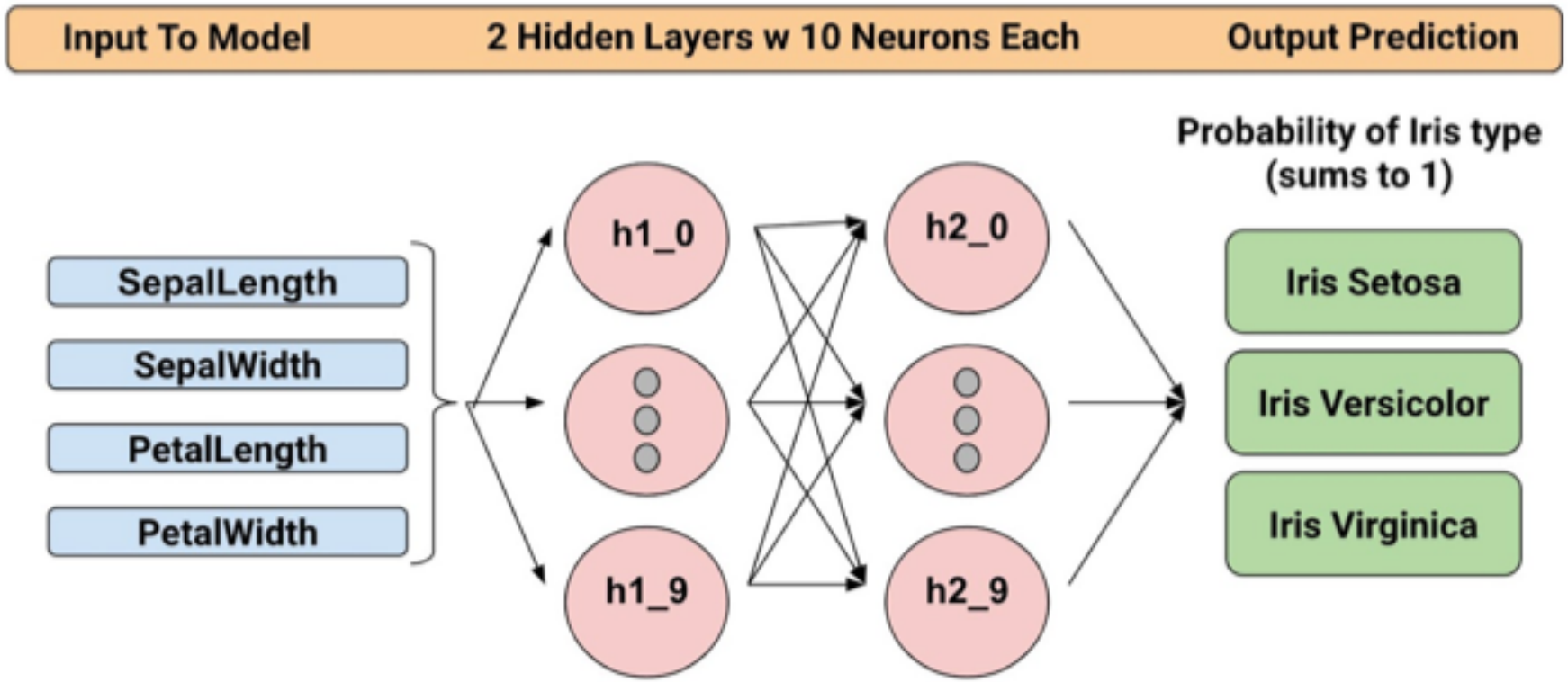
A Neural Network in TensorFlow for Iris Dataset

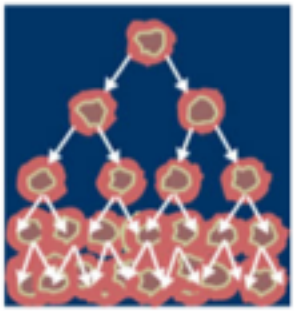


UCIrvine

Breast Cancer Wisconsin (Diagnostic) Data Set

Download: Data Folder, Data Set Description

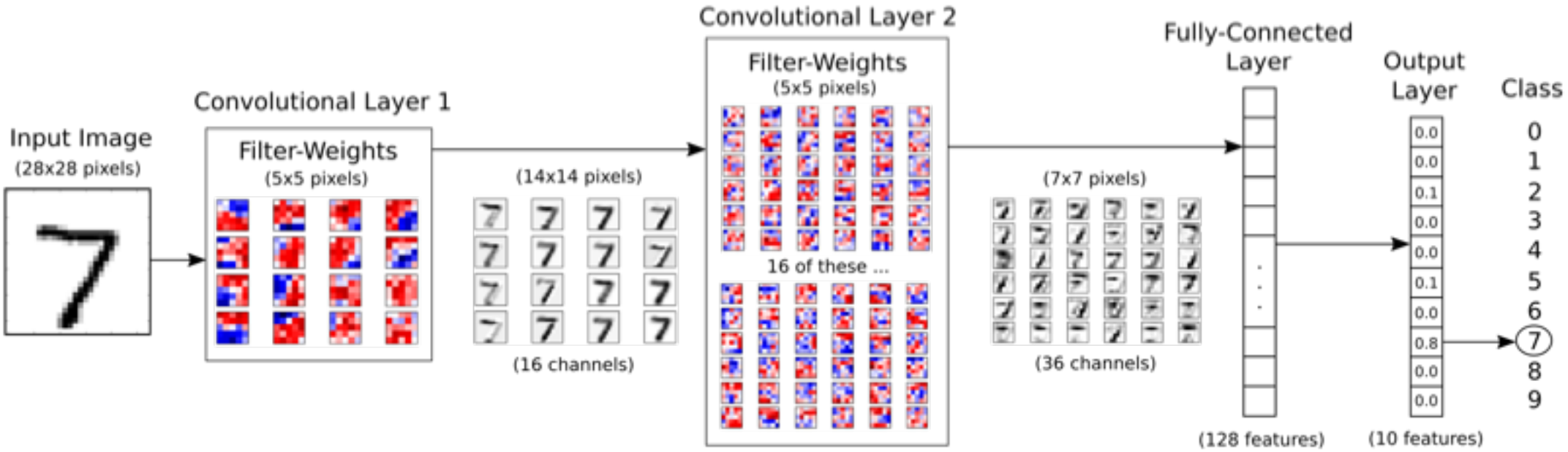
Abstract: Diagnostic Wisconsin Breast Cancer Database



Data Set Characteristics:	Multivariate	**Number of Instances:**	569	**Area:**	Life
Attribute Characteristics:	Real	**Number of Attributes:**	32	**Date Donated**	1995-11-01
Associated Tasks:	Classification	**Missing Values?**	No	**Number of Web Hits:**	728613

http://archive.ics.uci.edu/ml/index.php

Case study : MNIST



Case study : CIFAR-10