

Deep Learning Made Easy

The Basics

Schedule

week	Date	Topic
1	02.11	Introduction
2	02.18	The basics: python, math, and AI development
3	02.25	AI history & Perceptron
4	03.06	Training: forward propagation & backpropagation
5	03.13	CNN
6	03.20	Metrics
7	03.27	Word embedding
8	04.03	RNN
9	04.10	Autoencoder & GAN
10	04.17	Project presentation

Today's Class

- Recap
- What is CNN?
 - What is convolution?
 - Stride
 - Padding
 - Max pooling
 - Dropout
- Lab time

Recap – neural network

- Neural network as a function
 - $y = f(x)$
- Perceptron
 - $Y = WX + b$
 - Two inputs: x_1, x_2
 - One output: y
 - Linear regression
- XOR problem
 - Linear regression can't solve the XOR problem
 - Require multivariate regression

Recap - Training

- What it take to train a neural network:
 - Hypothesis: $H = WX + b$
 - Activation function: Sigmoid, tanh, ReLU, LeakyReLU, Softmax, etc.
 - Cost function: MSE, cross entropy, etc.
 - Gradient descent: backpropagation
- Training a neural network is basically the problem of minimizing the cost function: minimize $\text{cost}(W, b)$
- Gradient descent is the most popular optimizer.
- Training a neural network is NOT easy!
 - Finding hyperparameters, random initial weights, local minima, vanishing/exploding gradients, overfitting/underfitting, etc.

Activation functions

- Introduces non-linearity
- Normalizes the output: activation functions are also called Normalization functions
- Different kinds
 - Step function: $f(\mathbf{x}) = \begin{cases} 1 & \text{if } \mathbf{w} \cdot \mathbf{x} + b > 0, \\ 0 & \text{otherwise} \end{cases}$
 - Sigmoid:

$$S(x) = \frac{1}{1 + e^{-x}}$$

$S(x)$ = sigmoid function

e = Euler's number

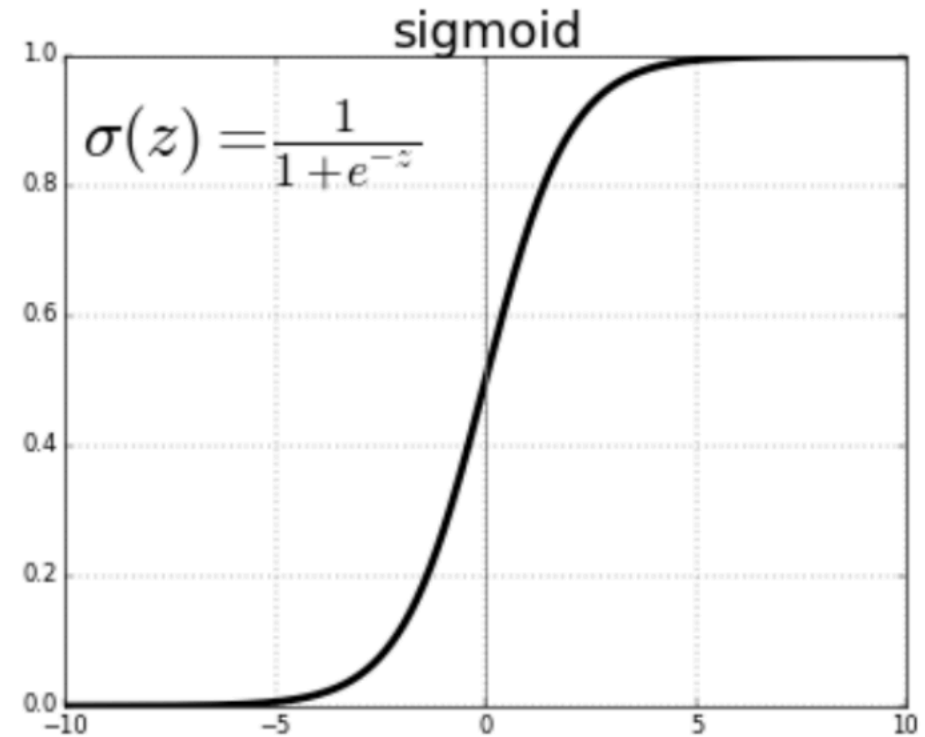
Activation function: Sigmoid

- Sigmoid:

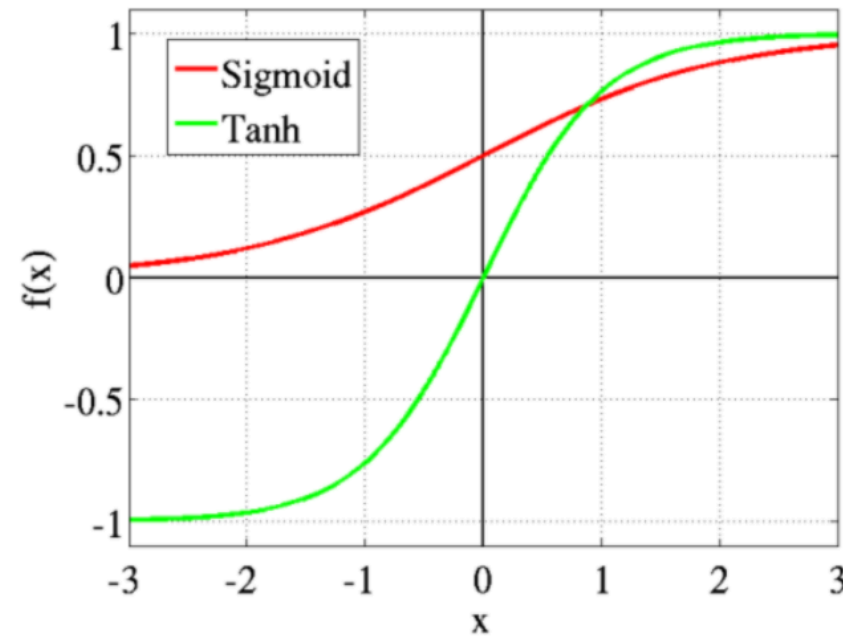
$$S(x) = \frac{1}{1 + e^{-x}}$$

$S(x)$ = sigmoid function

e = Euler's number



Activation functions: Sigmoid and Tanh



<https://www.neuronactivator.com/blog/what-even-is-activation-function>

Activation Functions: ReLU and Leaky ReLU

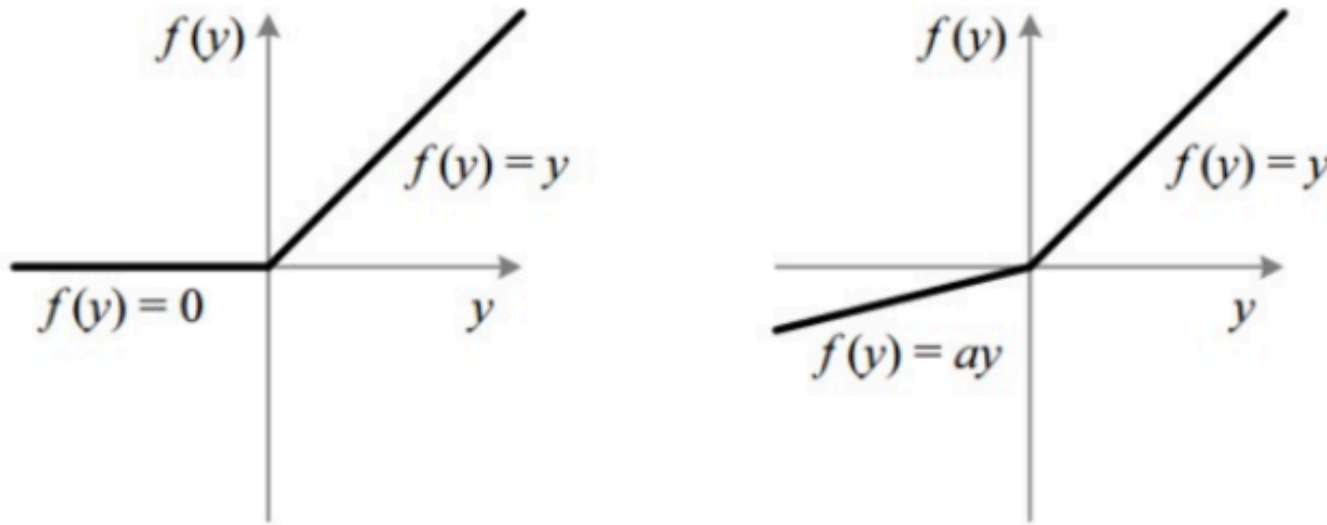


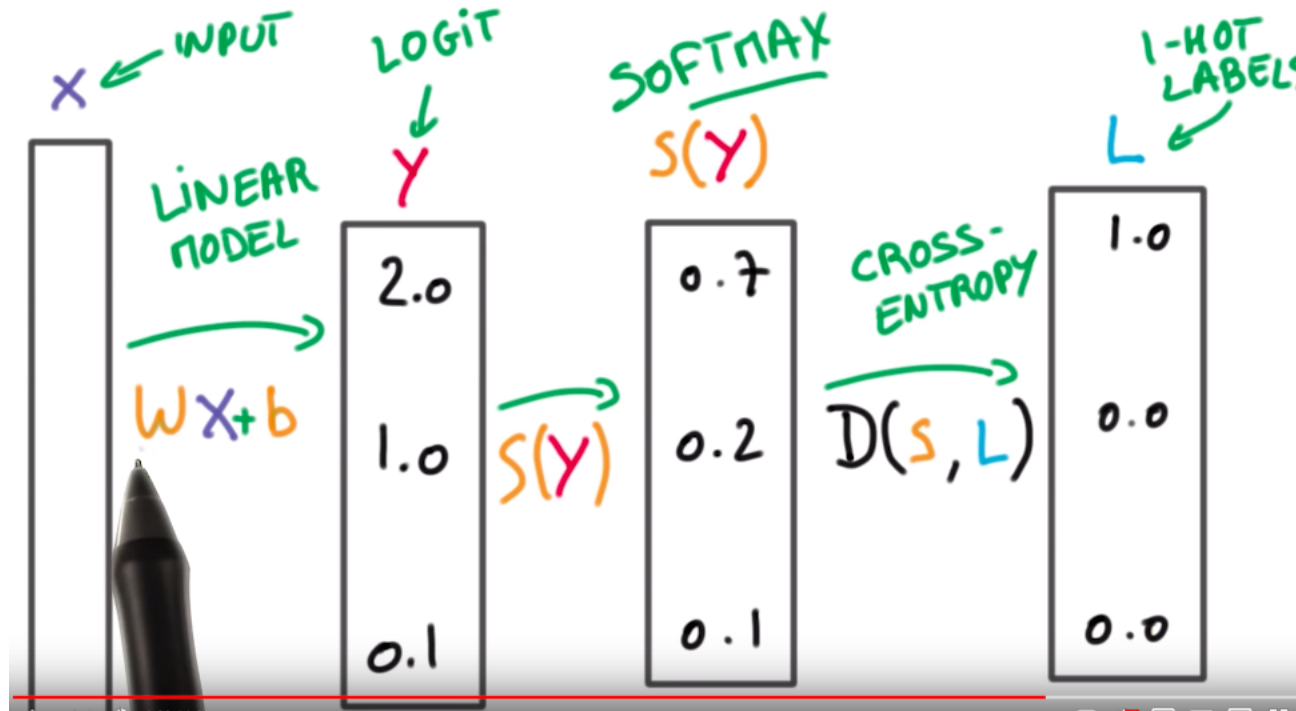
Fig : ReLU v/s Leaky ReLU

<https://www.neuronactivator.com/blog/what-even-is-activation-function>

Activation Function: Softmax

- The softmax function is often used in the final layer of a neural network-based classifier.
- All probabilities sum to one
- Often used with a [log loss](#) (or [cross-entropy](#)) cost function
- To solve a non-linear variant of multinomial logistic regression.

Loss Function: Cross Entropy

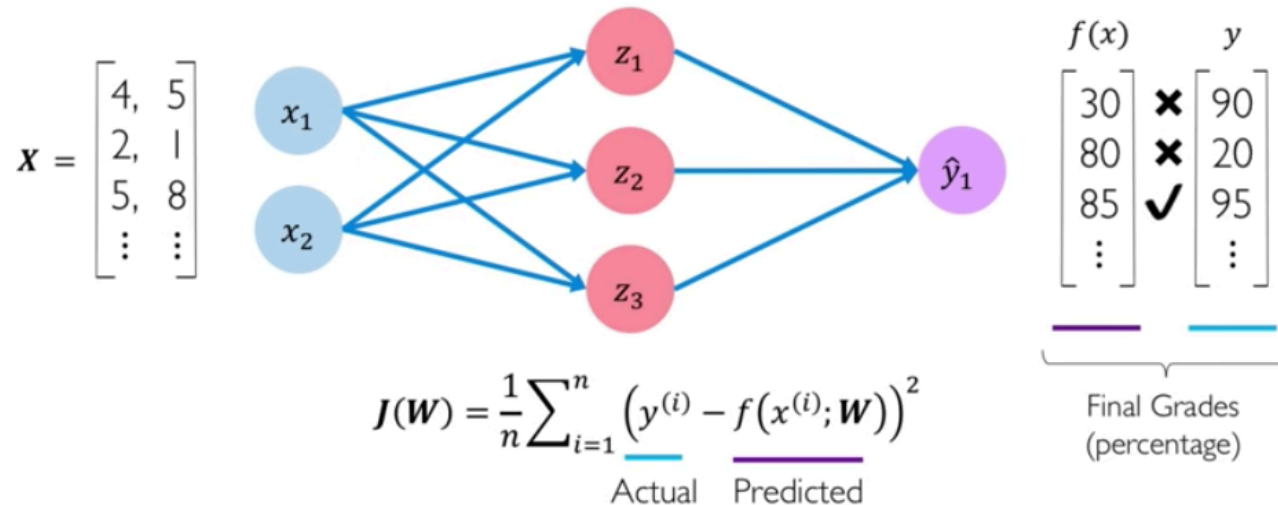


<https://medium.com/data-science-bootcamp/understand-cross-entropy-loss-in-minutes-9fb263caee9a>

Loss Function: Mean Squared Error

Mean Squared Error Loss

Mean squared error loss can be used with regression models that output continuous real numbers



```
loss = tf.reduce_mean( tf.square(tf.subtract(y, predicted)) )
```

What is convolution?

- A kernel (filter) is applied to an image
- Element-wise multiplication (dot product) is performed to calculate the output

3x3 portion
of an image

0.6	0.2	0.6
0.1	-0.2	-0.3
-0.5	-0.1	-0.3

*

filter

1	1	1
0	0	0
-1	-1	-1

= 2.3

-0.6	-0.2	-0.6
-0.1	0.2	0.3
0.5	0.1	0.3

*

1	1	1
0	0	0
-1	-1	-1

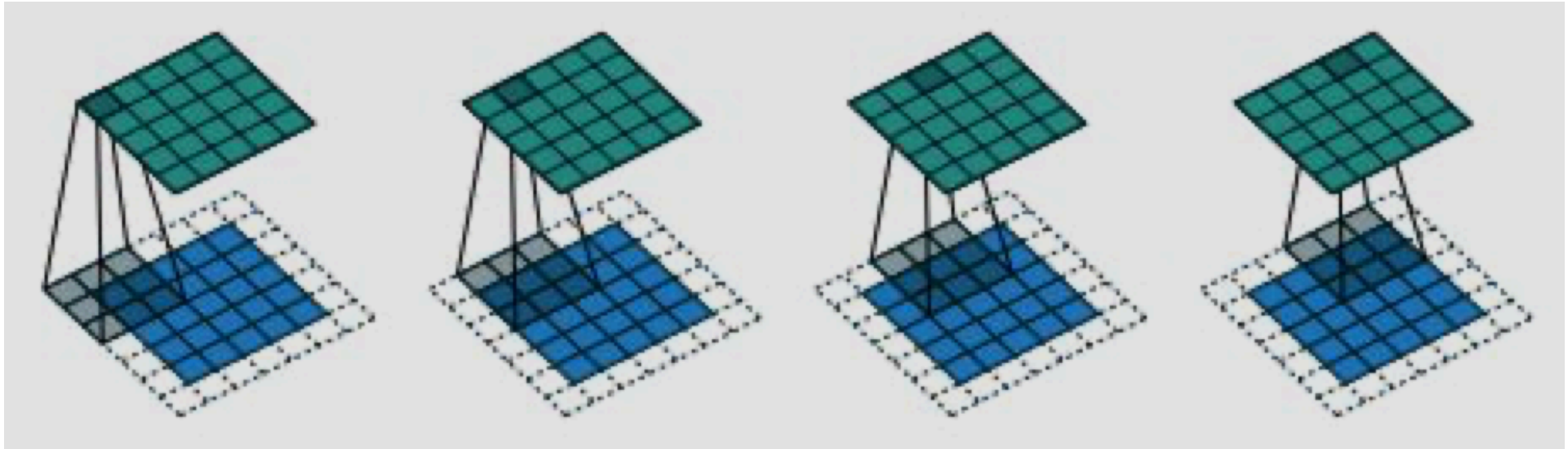
= -2.3

What is involved in convolution

- Stride: step size
- Padding: putting zeroes around the outer edge of the input data.
“same” means the output size will be the same as the input size when stride = 1.
- Kernel: the filter that extracts features
- Max pooling: means pooling the maximum value from the filtered feature map. The result is a down-sampling image (reduced dimensionality)
- Batch normalization: normalizing
- Dropout: regularization technique to prevent overfitting

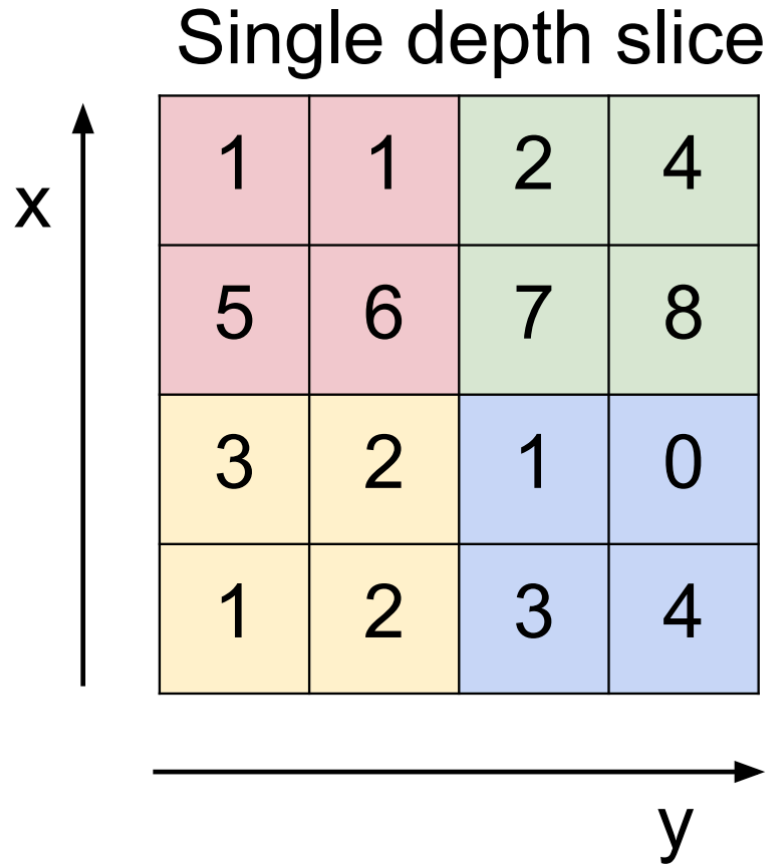
Convolution in action

- stride = 1, padding = “same”

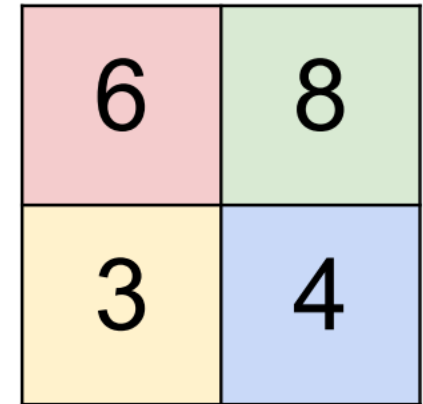


- What will happen if there is no padding?

Max pooling



Max pooling with 2x2
filters with stride 2



Visualization Tools

- [Convolution Visualizer](#)
- [CNN Explainer](#)

Neural Style Transfer

- The example is copied from the TensorFlow tutorial:
 - <https://github.com/changsin/DeepLearningMadeEasy/blob/main/04-cnn-style-transfer.ipynb>
- Try a different content and style of your own choosing.

Assignment

- Try other types of training for Teachable Machine: i.e., audio and pose.
- Try a different content and styles in the neural style transfer notebook.

Lab time

- To clone: from your terminal
 - >git clone <https://github.com/changsin/DeepLearningMadeEasy.git>
- Or use google colab to open the git hub repository
- Git is an open source version control system
 - Github is a host service using git.