Introduction to Deep Learning

Deep Learning in Remote Sensing

Episode-1

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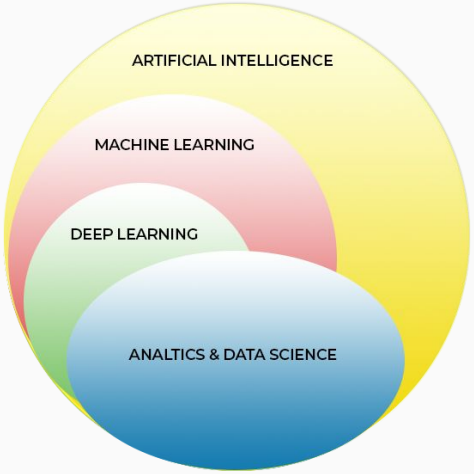
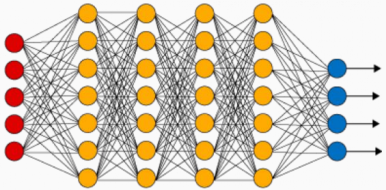
01

AI - DL - ML - Data Terms



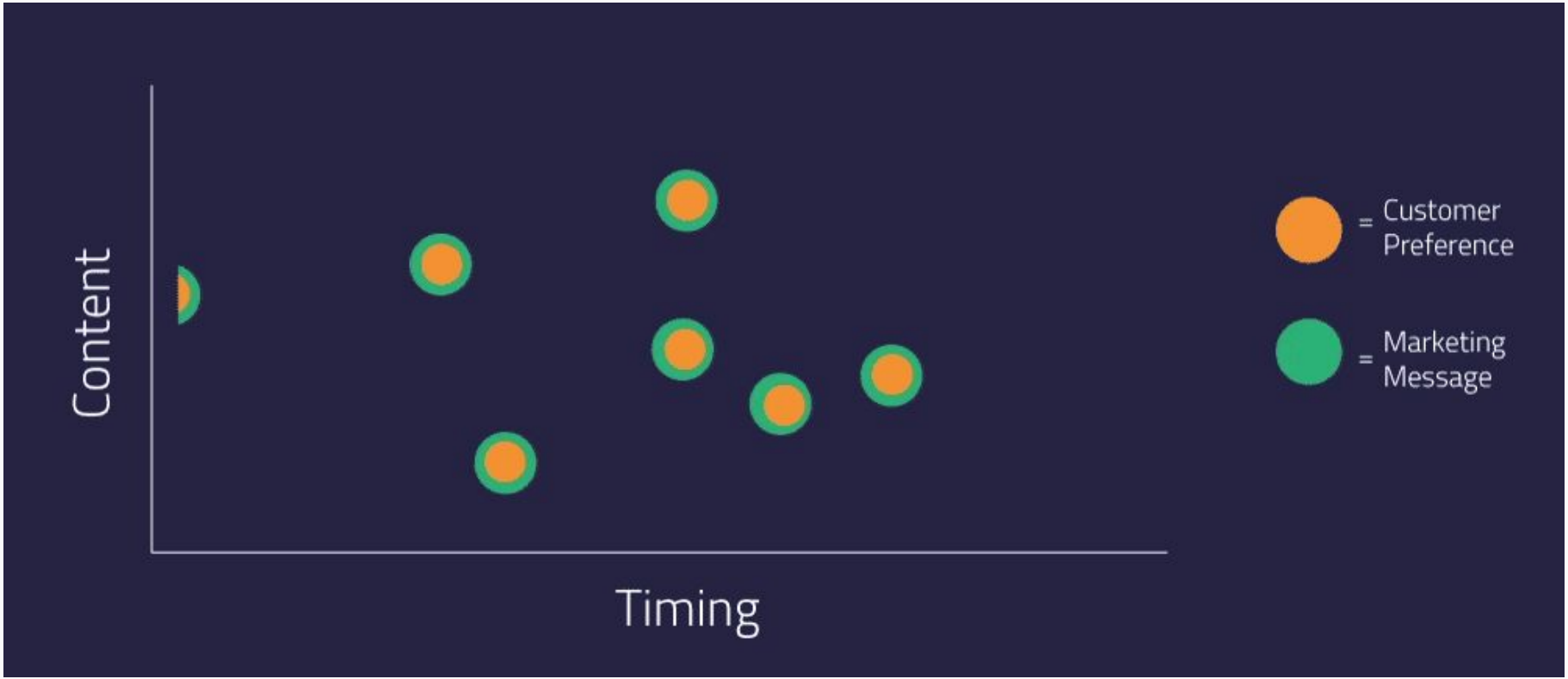
Artificial Neural Network

Machine Learning



Deep Learning

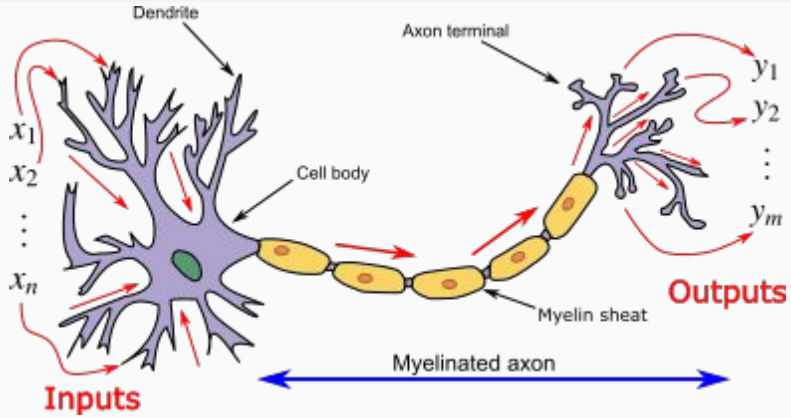
1950 1970 1980 1990 2010

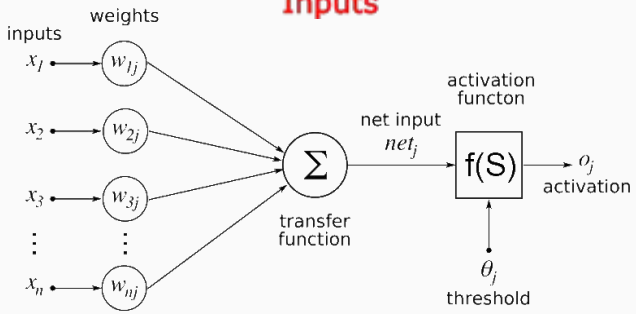

Content
Timing
= Customer Preference
= Marketing Message

Artificial Neuron

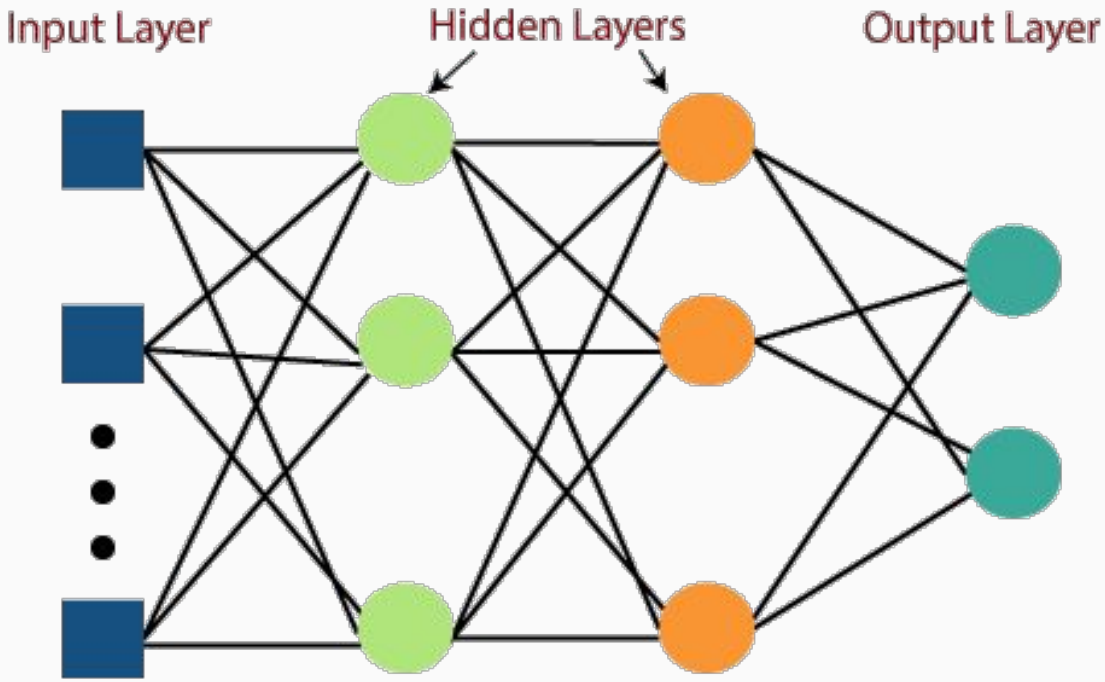
y = f (P i wi xi)
xi : inputs
wi : weights
f : non-linearity

$$Y = \sum (weight * input) + bias$$

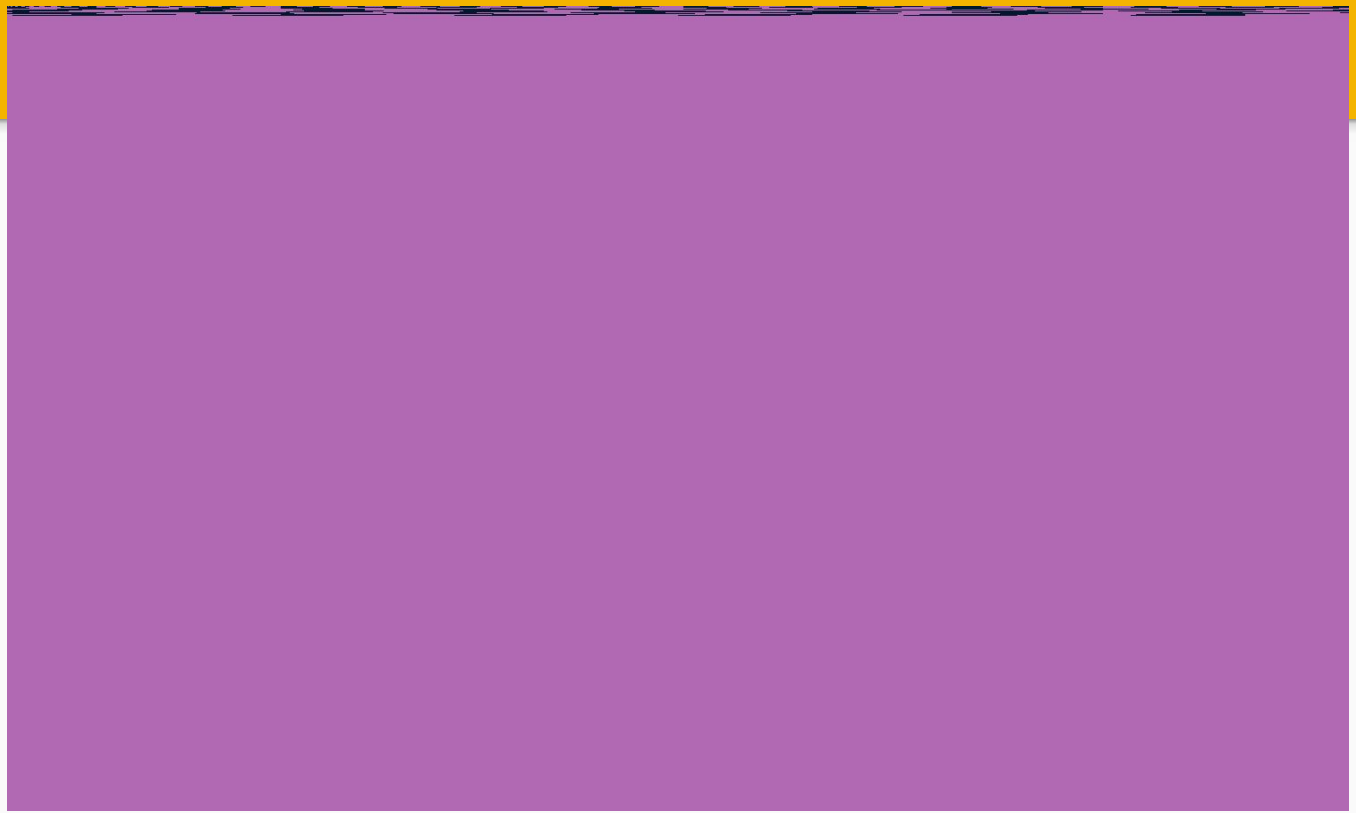




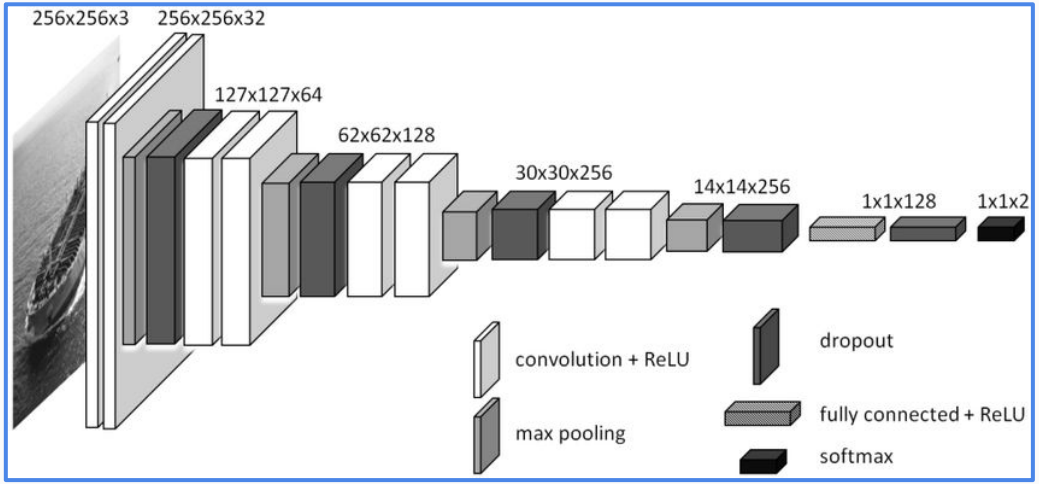
Organization in layers



Deep Learning and Classification



Types of Deep Learning Algorithms



- Convolutional Neural Networks (CNNs)
- Long Short Term Memory Networks (LSTMs)
- Recurrent Neural Networks (RNNs)
- Generative Adversarial Networks (GANs)
- Radial Basis Function Networks (RBFNs)
- Multilayer Perceptrons (MLPs)
- Self Organizing Maps (SOMs)
- Deep Belief Networks (DBNs)
- Restricted Boltzmann Machines(RBMs)

Recurrent Neural Networks

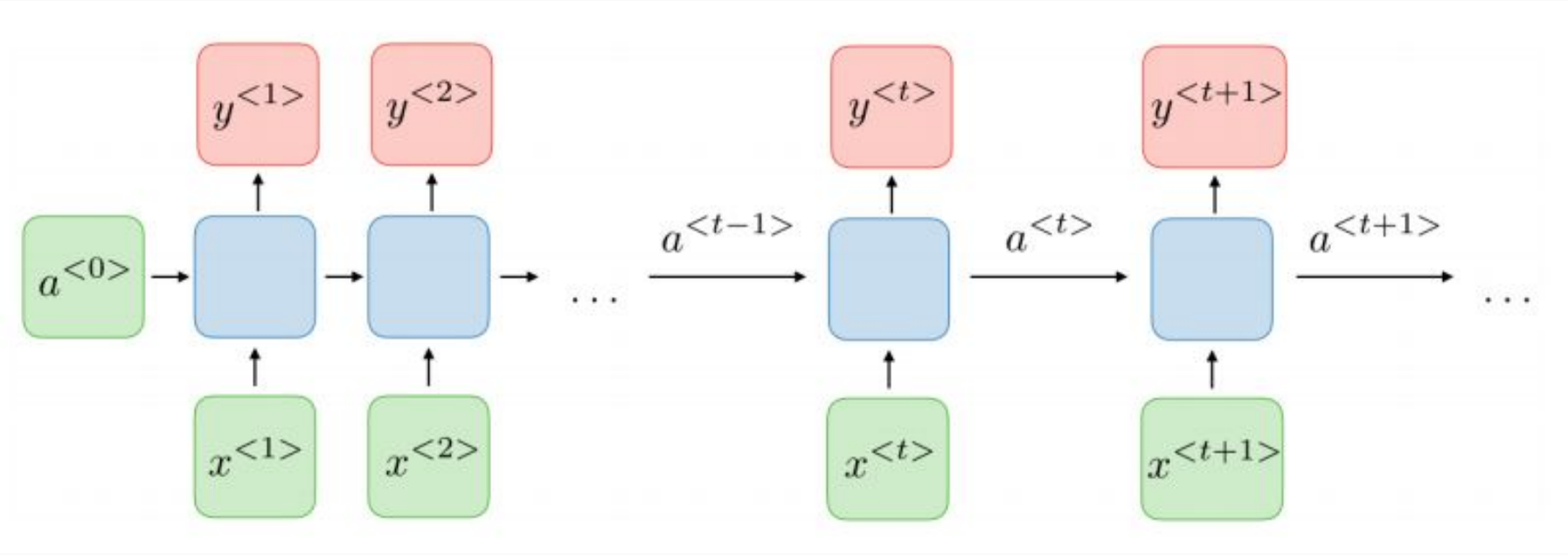


Image Source: Afshine Amidi and Shervine Amidi
November25, 2018

Creating Model - Example CNN

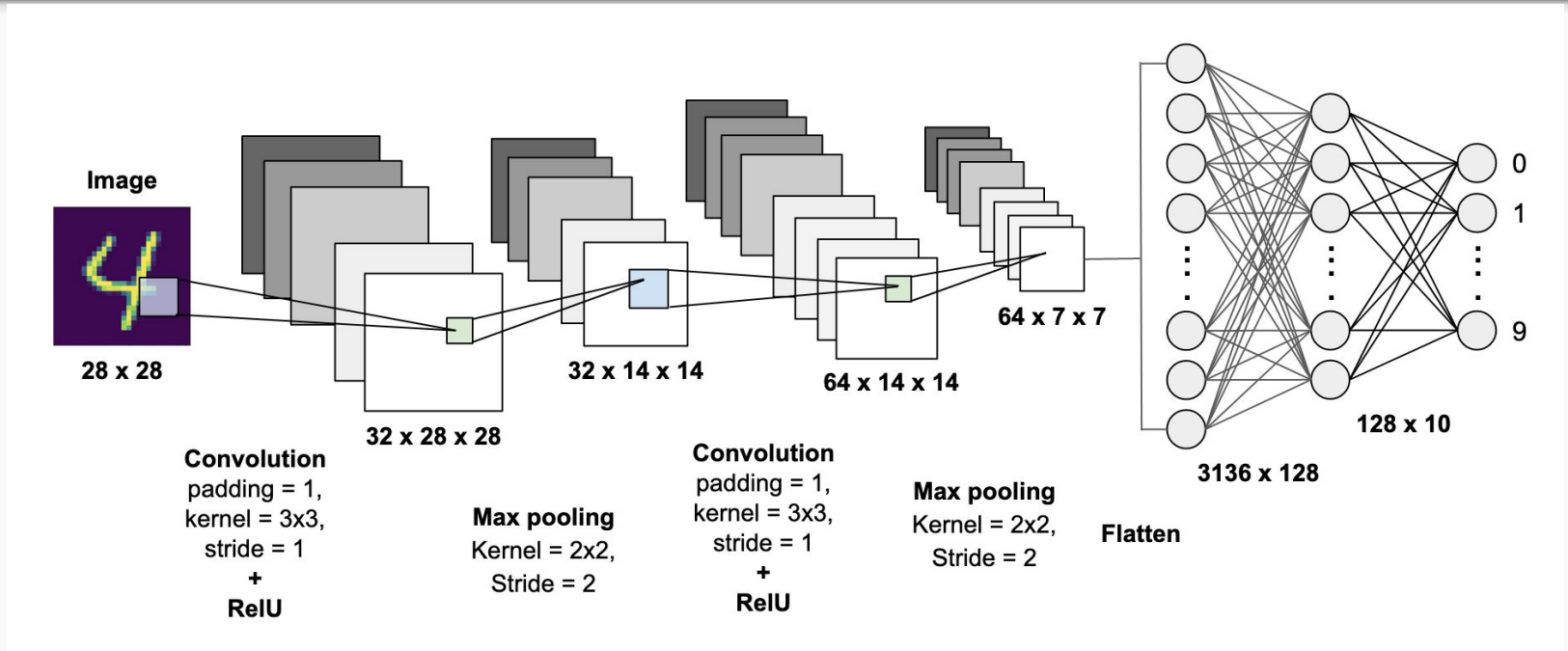
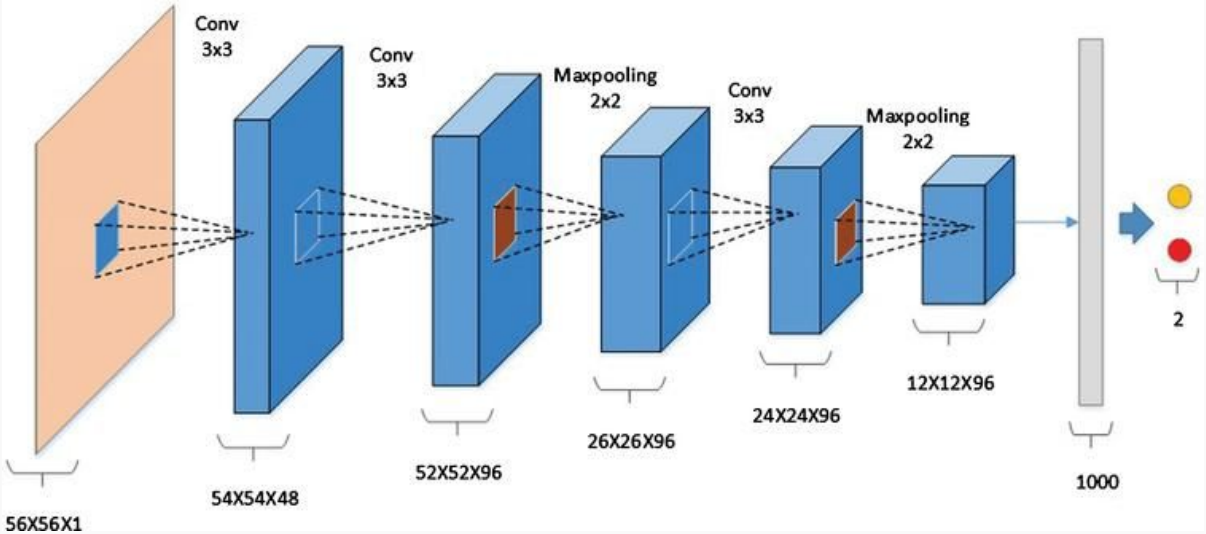
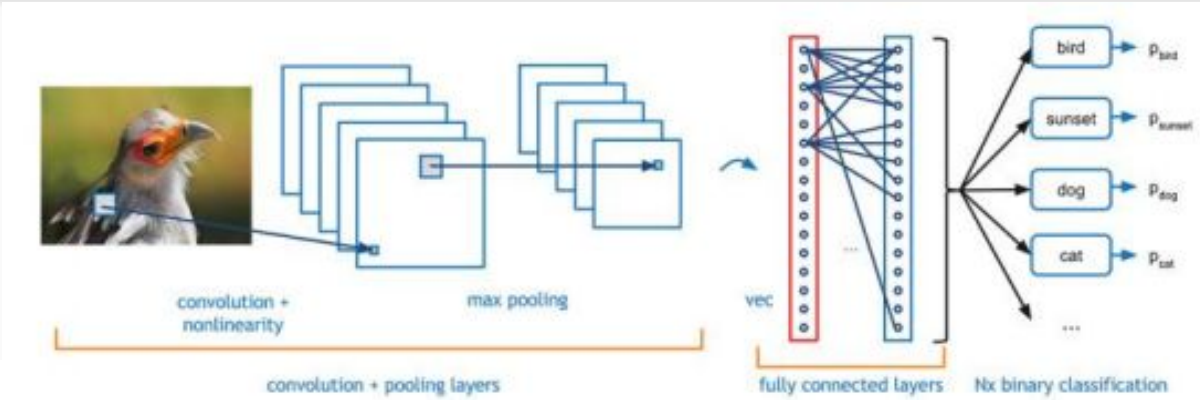


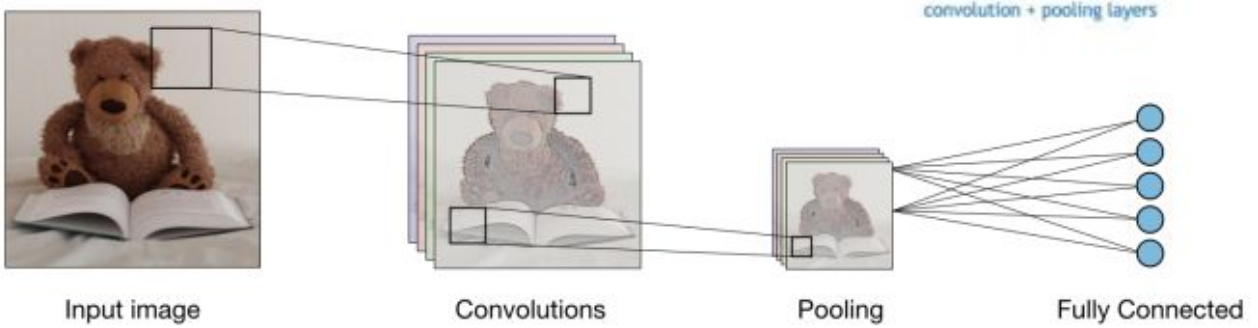
Image Source: Medium, becominghuman.ai , Shreyak

- Convolutional Layer
- Non-Linearity Layer
- Pooling (Downsampling Layer)
- Stride
- Padding
- Flattening Layer
- Fully-Connected Layer



Convolutional Neural Networks





Source: Afshine Amidi and Shervine Amidi
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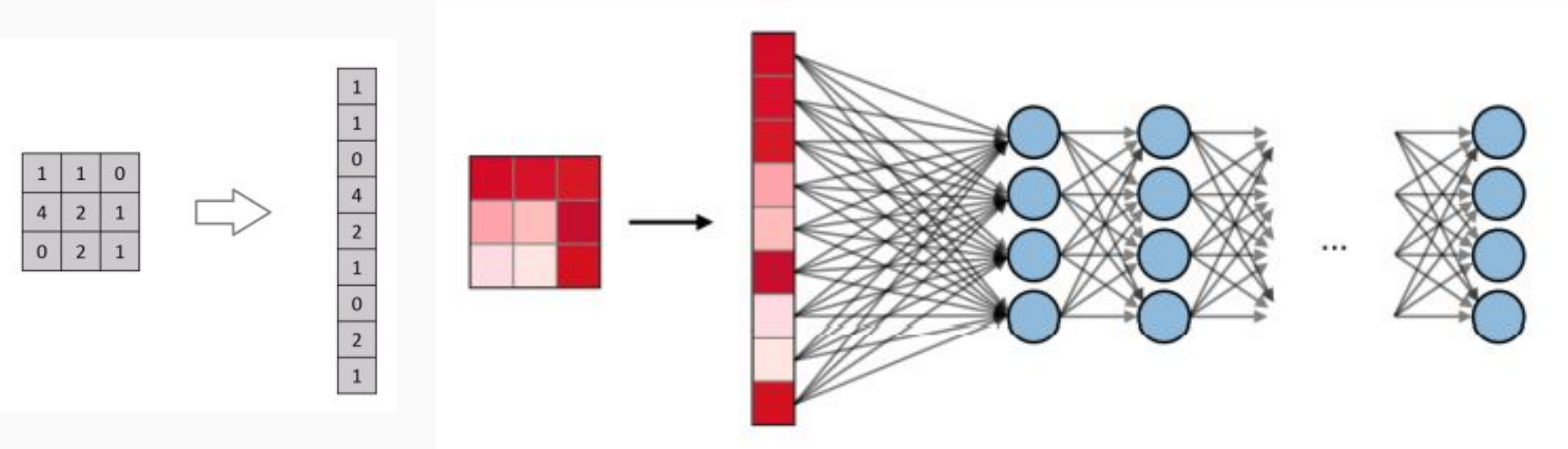
Flatten and Fully Connected



Source: Afshine Amidi and Shervine Amidi
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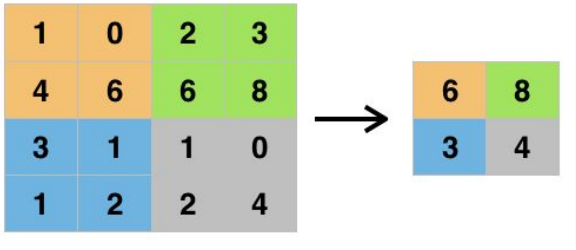
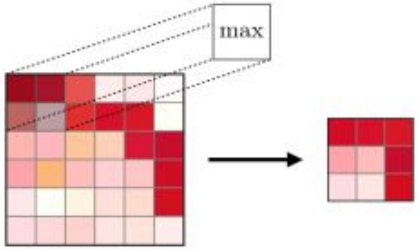
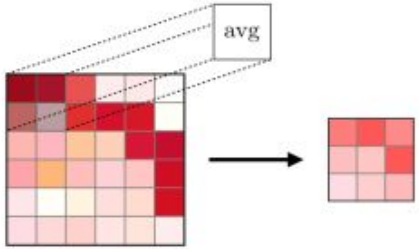
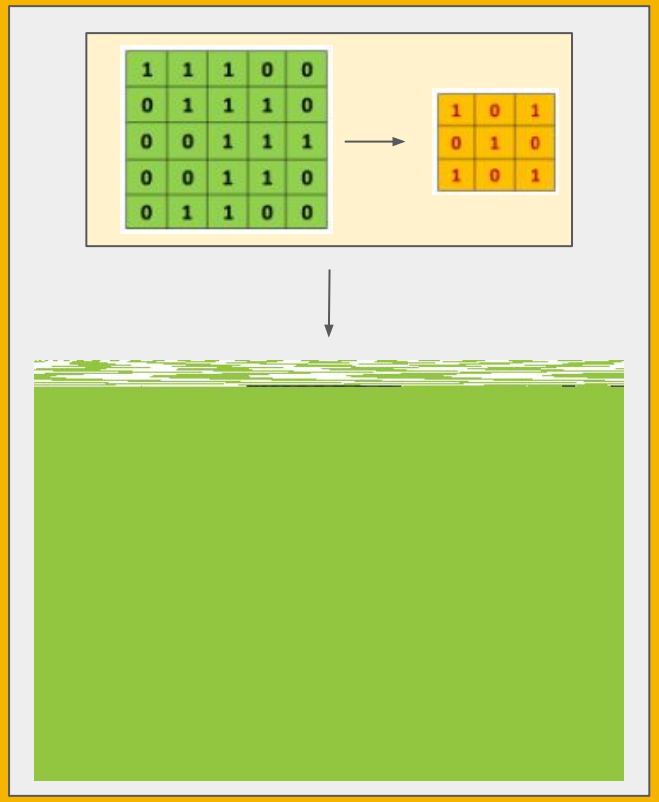
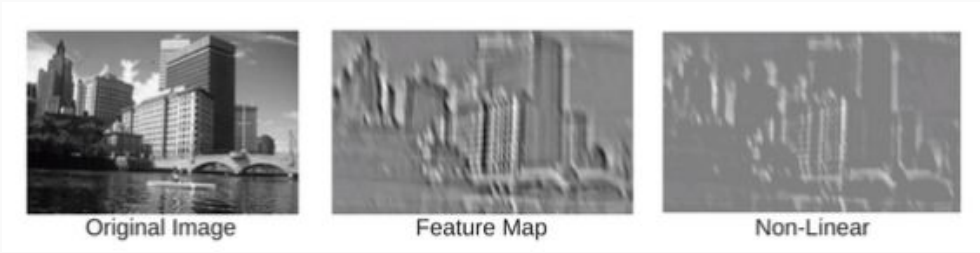
Pooling



	Max pooling	Average pooling
Purpose	Each pooling operation selects the maximum value of the current view	Each pooling operation averages the values of the current view
Illustration		
Comments	- Preserves detected features - Most commonly used	- Downsamples feature map - Used in LeNet

Source 1: medium/@tuncerergin
Source 2: Afshine Amidi and Shervine Amidi
November25, 2018

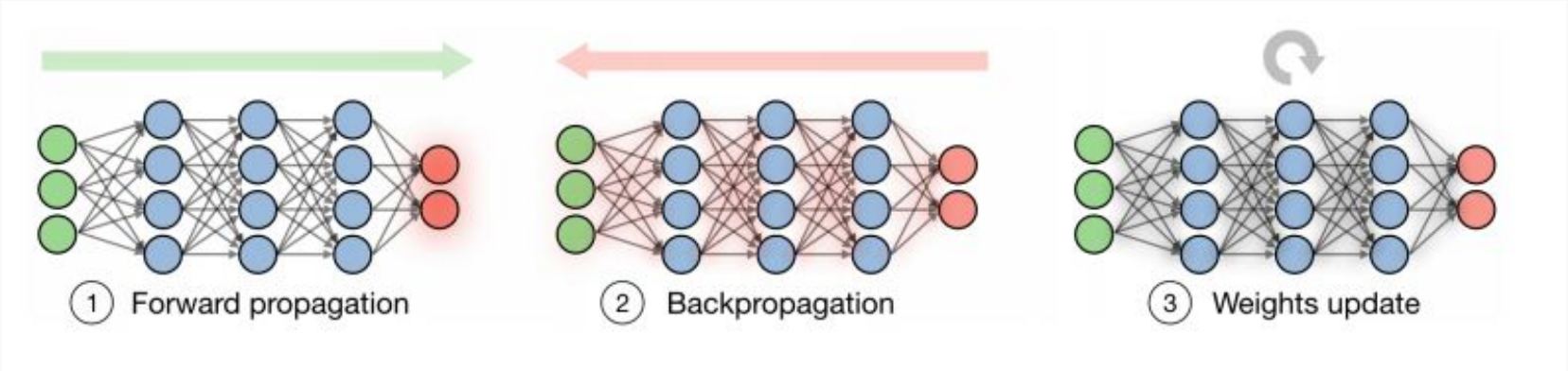


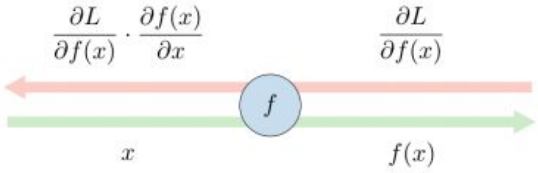


Source: medium/@tuncerergin

Backpropagation and Updating weights

$$Y = \sum (weight * input) + bias$$





Using this method, each weight is updated with the rule:

$$w \longleftarrow w - \alpha \frac{\partial L(z,y)}{\partial w}$$

Source: Afshine Amidi and Shervine Amidi
November25, 2018

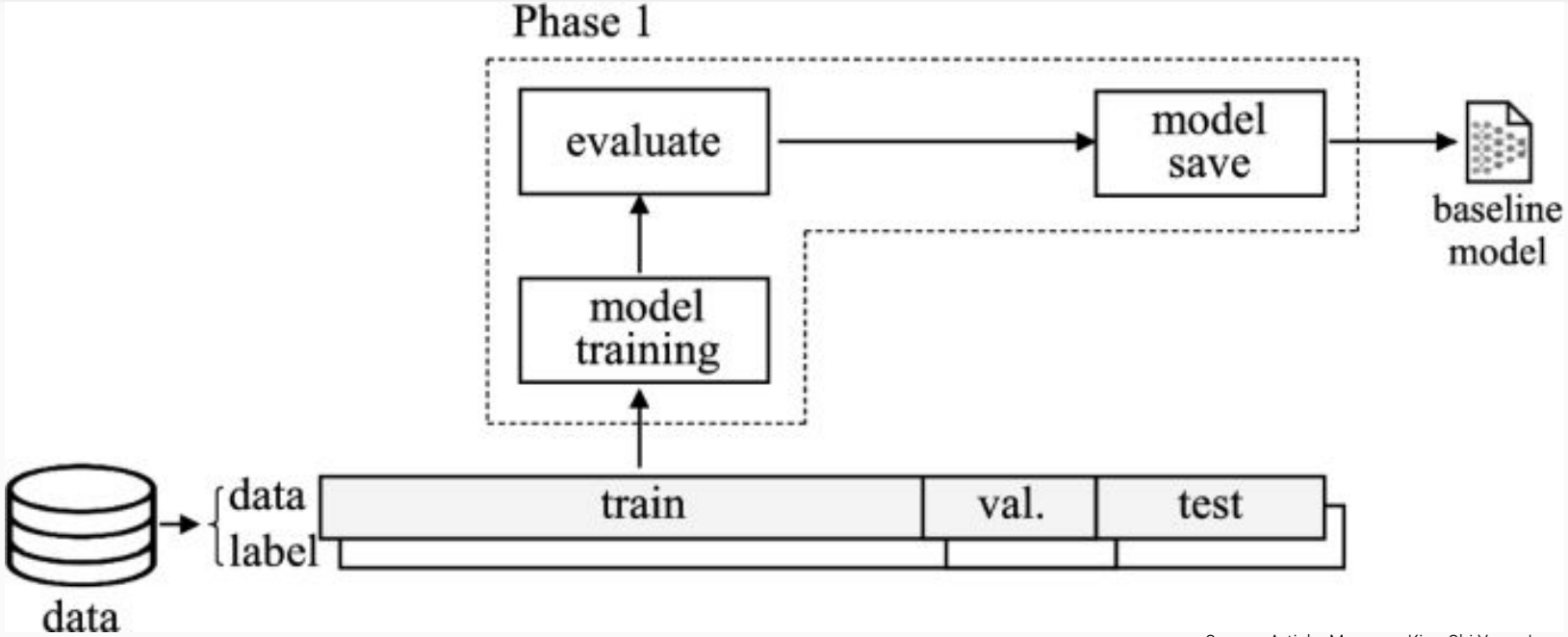
Data Augmentation

Original	Flip	Rotation	Random crop
			
- Image without any modification	- Flipped with respect to an axis for which the meaning of the image is preserved	- Rotation with a slight angle - Simulates incorrect horizon calibration	- Random focus on one part of the image - Several random crops can be done in a row

Color shift	Noise addition	Information loss	Contrast change
			
- Nuances of RGB is slightly changed - Captures noise that can occur with light exposure	- Addition of noise - More tolerance to quality variation of inputs	- Parts of image ignored - Mimics potential loss of parts of image	- Luminosity changes - Controls difference in exposition due to time of day

Source: Afshine Amidi and Shervine Amidi
November25, 2018

Create General Baseline Model



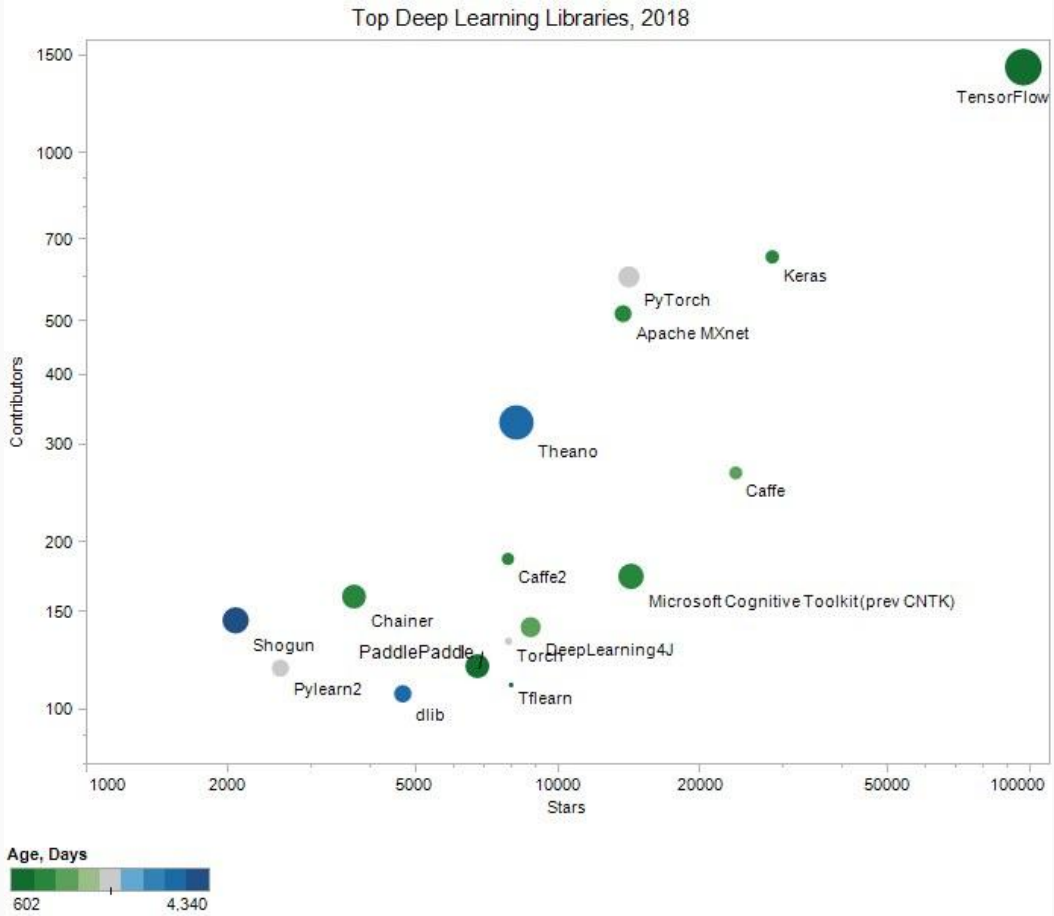
Source: Article, Mooseop Kim, Chi Yoon Jeong, Label-preserving data augmentation for mobile sensor data

02

DL Frameworks and Libraries

Some DL Frameworks

- Tensorflow
- Keras
- Pytorch
- MXNet
- Theano
- Caffe

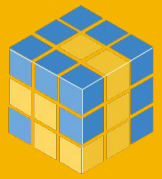


Some Most Popular and Useful Python Libraries

- Scikit-learn
- Pandas
- Numpy
- OpenCV
- Matplotlib

Numpy

The fundamental package for scientific computing with Python



NumPy

```python
import numpy as np

x = np.array([[1,2],[3,4]])
y = np.array([[5,6],[7,8]])

v = np.array([9,10])
w = np.array([11, 12])

# Inner product of vectors; both produce 219
print(v.dot(w))
print(np.dot(v, w))

# Matrix / vector product; both produce the rank 1 array [29 67]
print(x.dot(v))
print(np.dot(x, v))

# Matrix / matrix product; both produce the rank 2 array
# [[19 22]
#  [43 50]]
print(x.dot(y))
print(np.dot(x, y))
```

Source: cs231n.github.io

Pandas

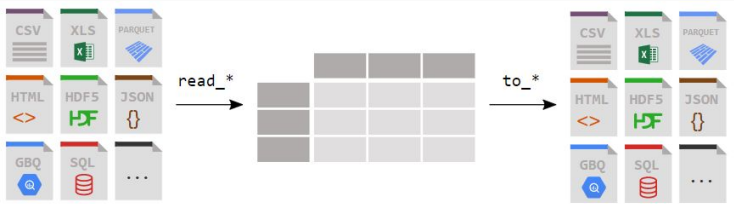
Pandas; open source data analysis and manipulation tool

pandas

```
In [2]: titanic = pd.read_csv("data/titanic.csv")
```

```
In [3]: titanic
Out[3]:
     PassengerId  Survived  Pclass  ...     Fare Cabin  Embarked
0              1         0       3  ...   7.2500   NaN         S
1              2         1       1  ...  71.2833   C85         C
2              3         1       3  ...   7.9250   NaN         S
3              4         1       1  ...  53.1000  C123         S
4              5         0       3  ...   8.0500   NaN         S
..           ...       ...     ...  ...      ...   ...       ...
886          887         0       2  ...  13.0000   NaN         S
887          888         1       1  ...  30.0000   B42         S
888          889         0       3  ...  23.4500   NaN         S
889          890         1       1  ...  30.0000  C148         C
890          891         0       3  ...   7.7500   NaN         Q

[891 rows x 12 columns]
```



Source: pandas.pydata.org

Scikit-learn

- Simple and efficient tools for predictive data analysis
- Accessible to everybody, and reusable in various context
- Built on Numpy, SciPy, and Matplotlib


```
$ python
>>> from sklearn import datasets
>>> iris = datasets.load_iris()
>>> digits = datasets.load_digits()
```

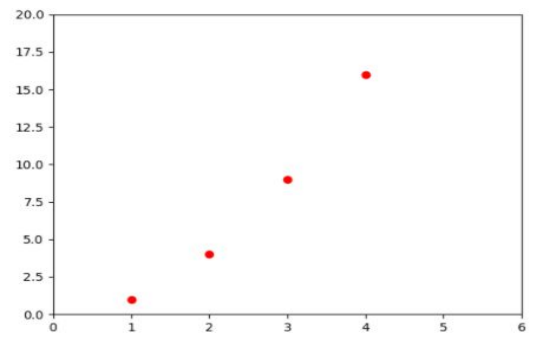
```
>>> print(digits.data)
[[ 0.   0.   5. ...   0.   0.   0.]
 [ 0.   0.   0. ...  10.   0.   0.]
 [ 0.   0.   0. ...  16.   9.   0.]
 ...
 [ 0.   0.   1. ...   6.   0.   0.]
 [ 0.   0.   2. ...  12.   0.   0.]
 [ 0.   0.  10. ...  12.   1.   0.]]
```

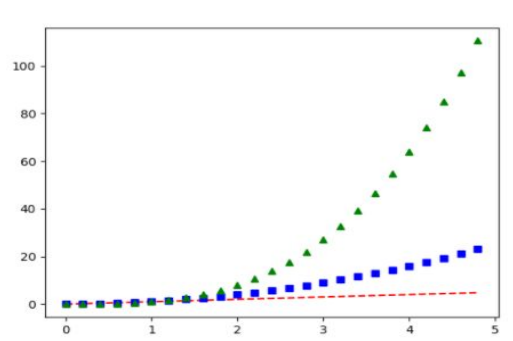
```
>>> digits.target
array([0, 1, 2, ..., 8, 9, 8])
```

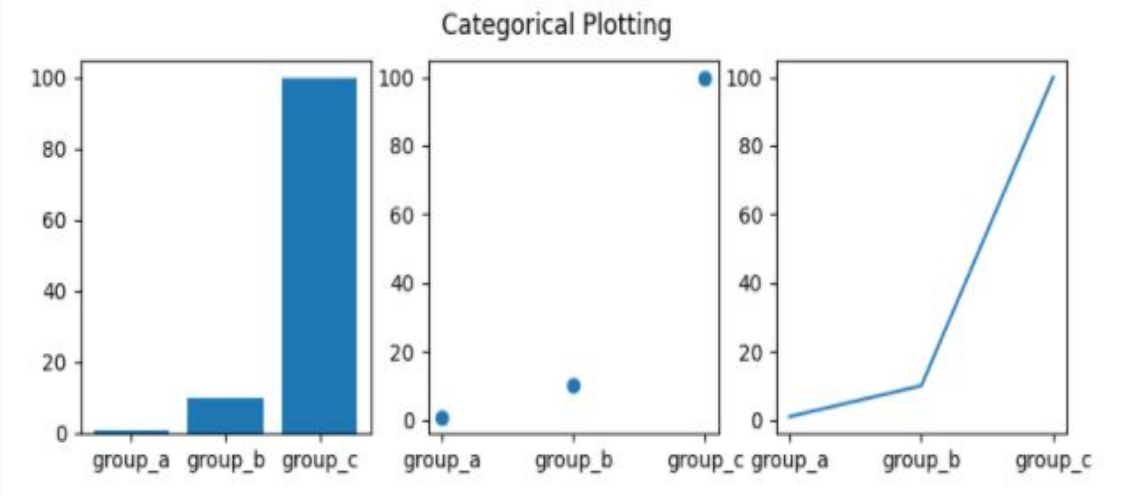
Source: scikit-learn.org

Matplotlib

Visualization with Python







Source: matplotlib.org

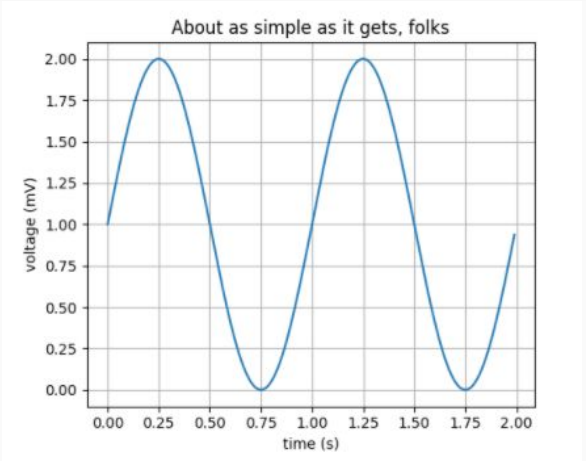
Matplotlib

Visualization with Python

```
import matplotlib.pyplot as plt
import numpy as np

t = np.arange(0.0, 2.0, 0.01)
s = 1 + np.sin(2*np.pi*t)
plt.plot(t, s)

plt.xlabel('time (s)')
plt.ylabel('voltage (mV)')
plt.title('About as simple as it gets, folks')
plt.grid(True)
plt.savefig("test.png")
plt.show()
```



Source: matplotlib.org

OpenCV

OpenCV is an open source library used in real-time computer vision and machine learning software library.

OpenCV has C++, Python, Java and MATLAB interfaces.


```
# read data
image = cv2.imread(self.images_fps[i])
image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
mask = cv2.imread(self.masks_fps[i], 0)
```

03

DL Working Environments

Deep Learning - Working Environment

Some environments that can be used while developing a deep learning model

Local Environment:

- Anaconda
- Spyder
- Jupyter Notebook

Cloud Environment:

- Google Colab
- AWS
- Azure

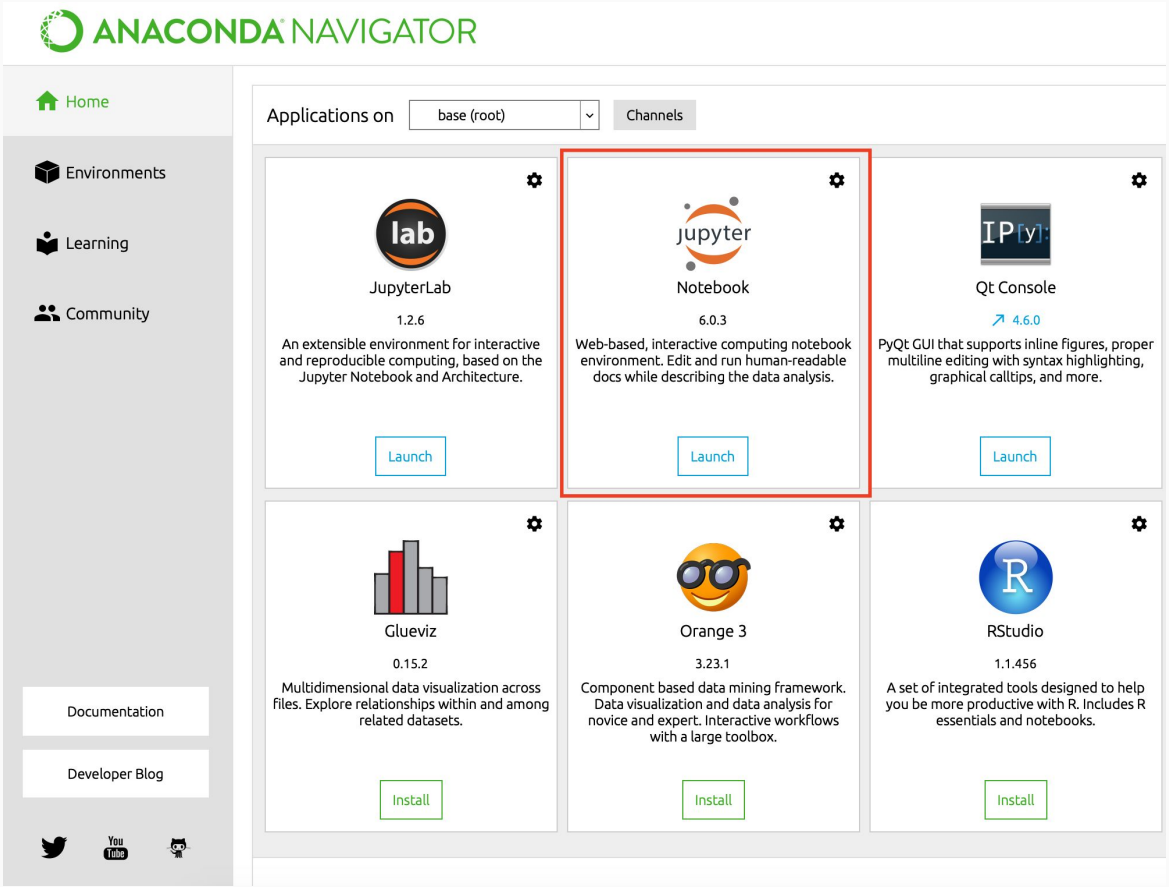
Computer Needed:

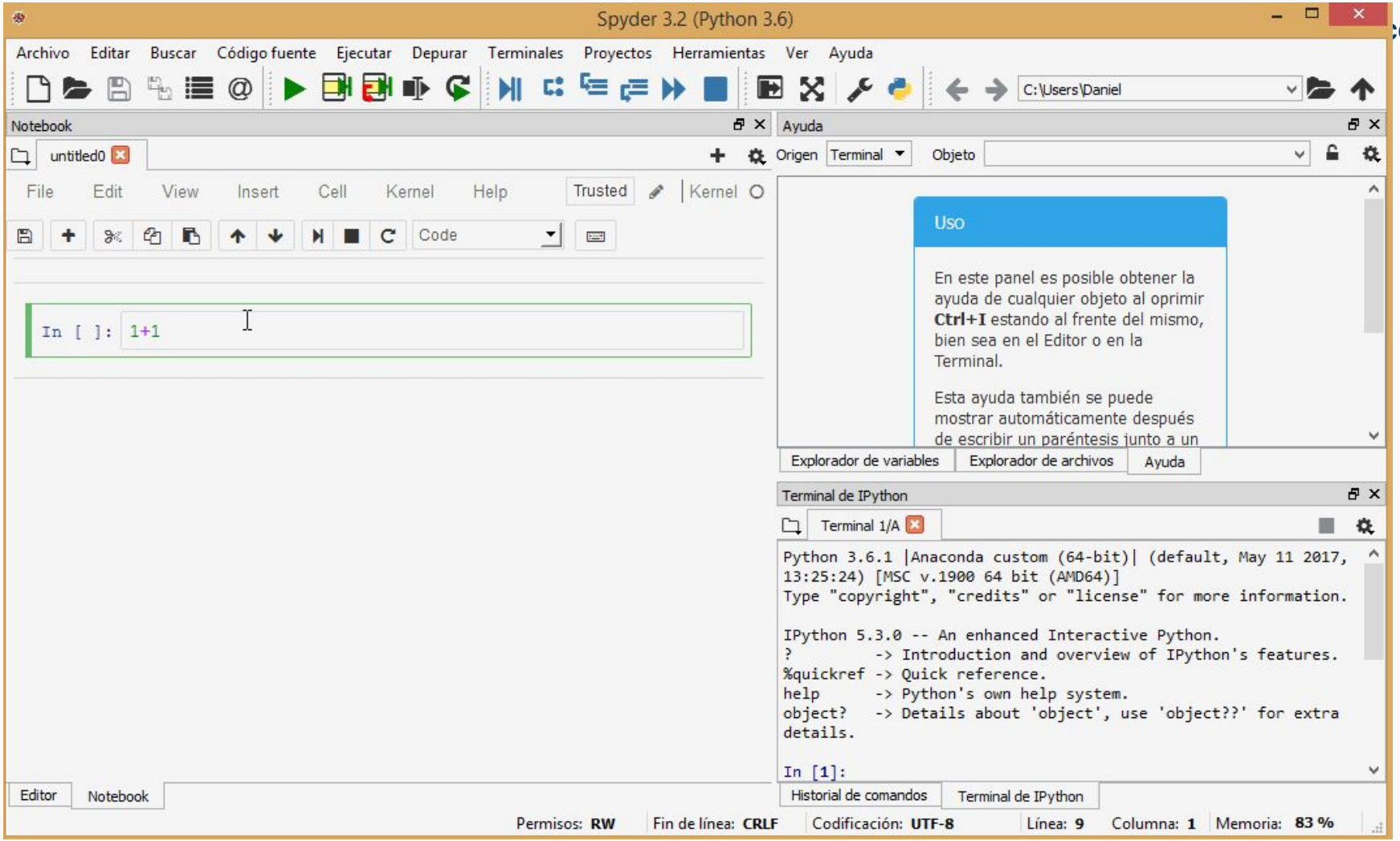
- GPU Supported, Cuda, cuDNN

Container Engine

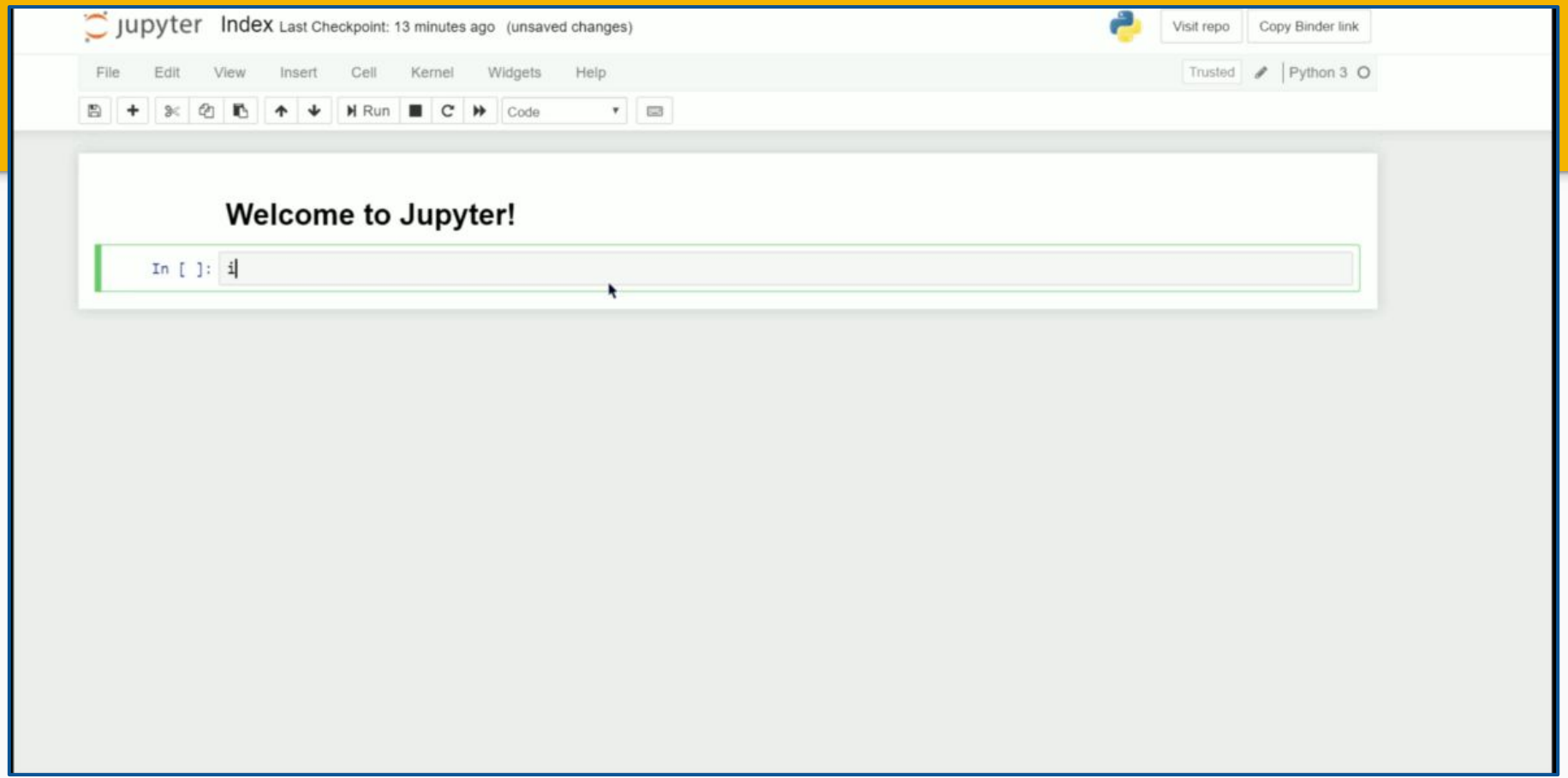
- Docker

Anaconda Navigator

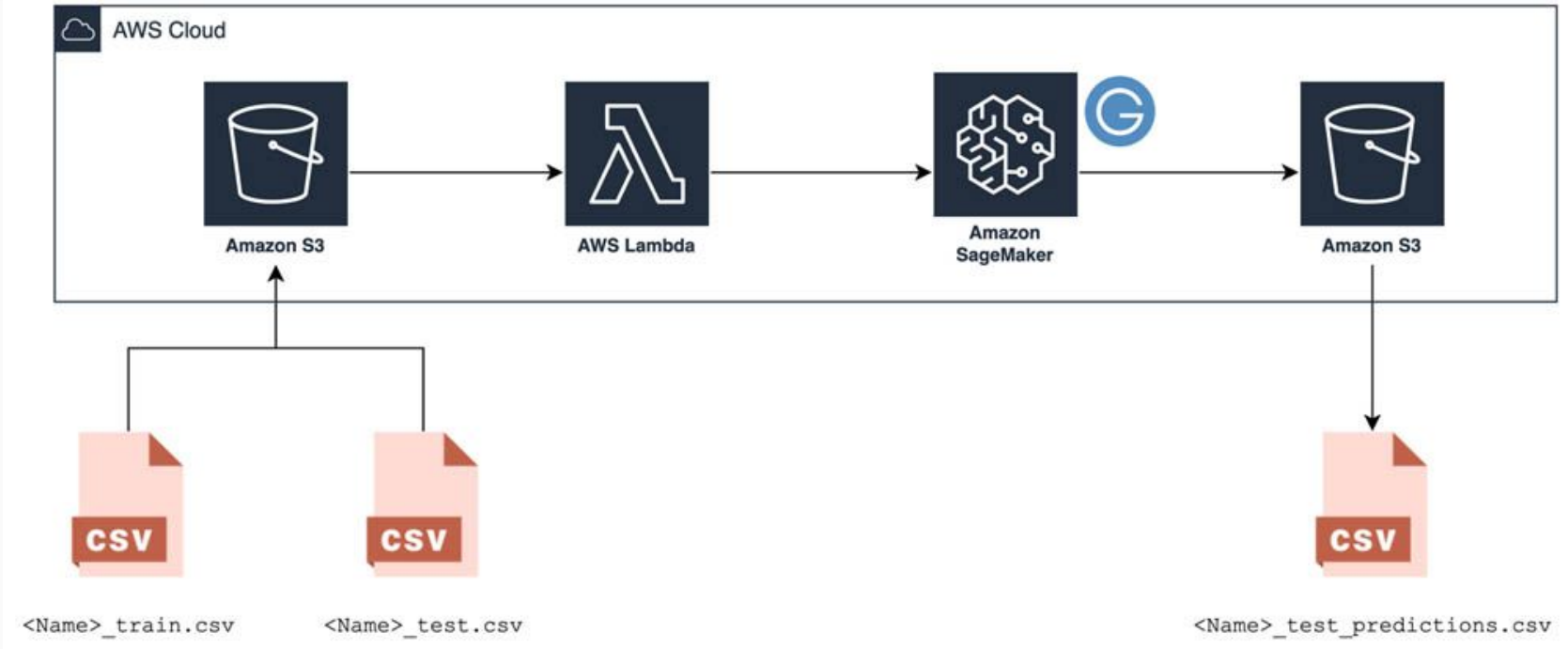



Spyder 3.2 (Python 3.6)
Archivo Editar Buscar Código fuente Ejecutar Depurar Terminales Proyectos Herramientas Ver Ayuda
C:\Users\Daniel
Notebook
untitled0
File Edit View Insert Cell Kernel Help
Trusted
Kernel
Code
In [ ]: 1+1
Ayuda
Origen Terminal
Objeto
Uso
En este panel es posible obtener la ayuda de cualquier objeto al oprimir Ctrl+I estando al frente del mismo, bien sea en el Editor o en la Terminal.
Esta ayuda también se puede mostrar automáticamente después de escribir un paréntesis junto a un
Explorador de variables
Explorador de archivos
Ayuda
Terminal de IPython
Terminal 1/A
Python 3.6.1 |Anaconda custom (64-bit)| (default, May 11 2017, 13:25:24) [MSC v.1900 64 bit (AMD64)]
Type "copyright", "credits" or "license" for more information.
IPython 5.3.0 -- An enhanced Interactive Python.
? -> Introduction and overview of IPython's features.
%quickref -> Quick reference.
help -> Python's own help system.
object? -> Details about 'object', use 'object??' for extra details.
In [1]:
Editor
Notebook
Historial de comandos
Terminal de IPython
Permisos: RW
Fin de línea: CRLF
Codificación: UTF-8
Línea: 9
Columna: 1
Memoria: 83 %

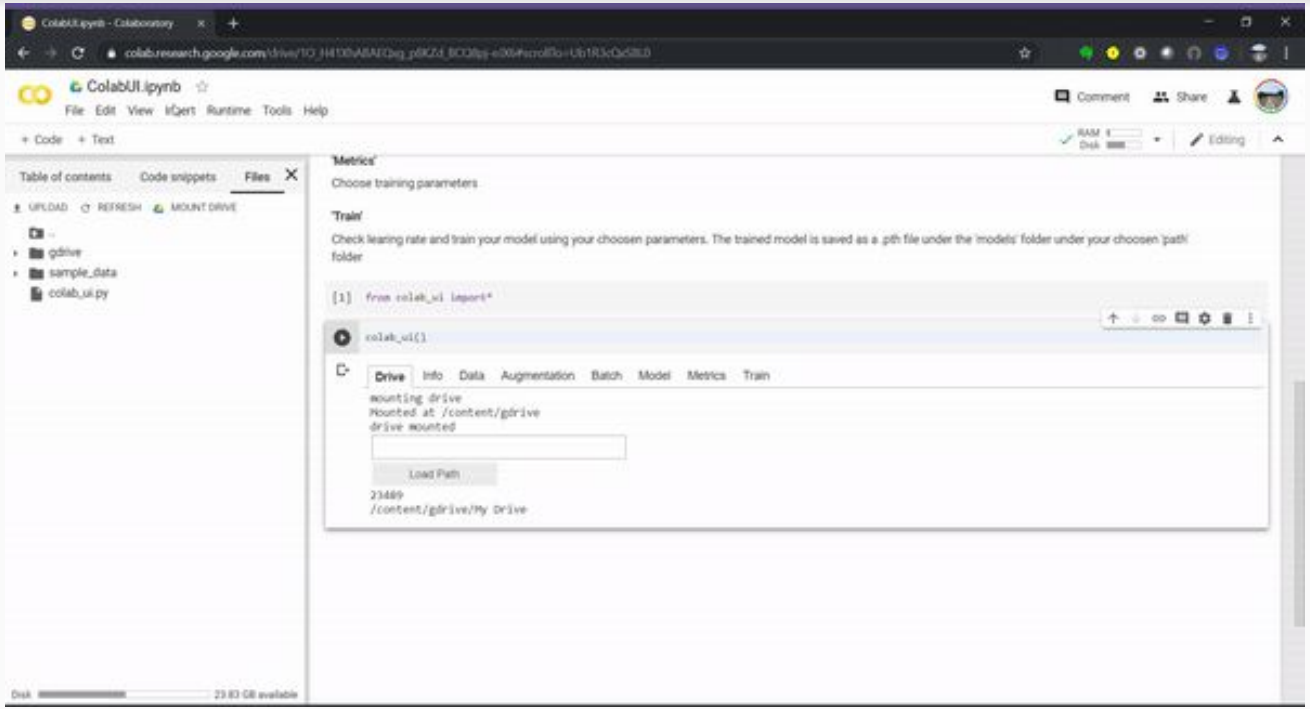
Jupyter Notebook



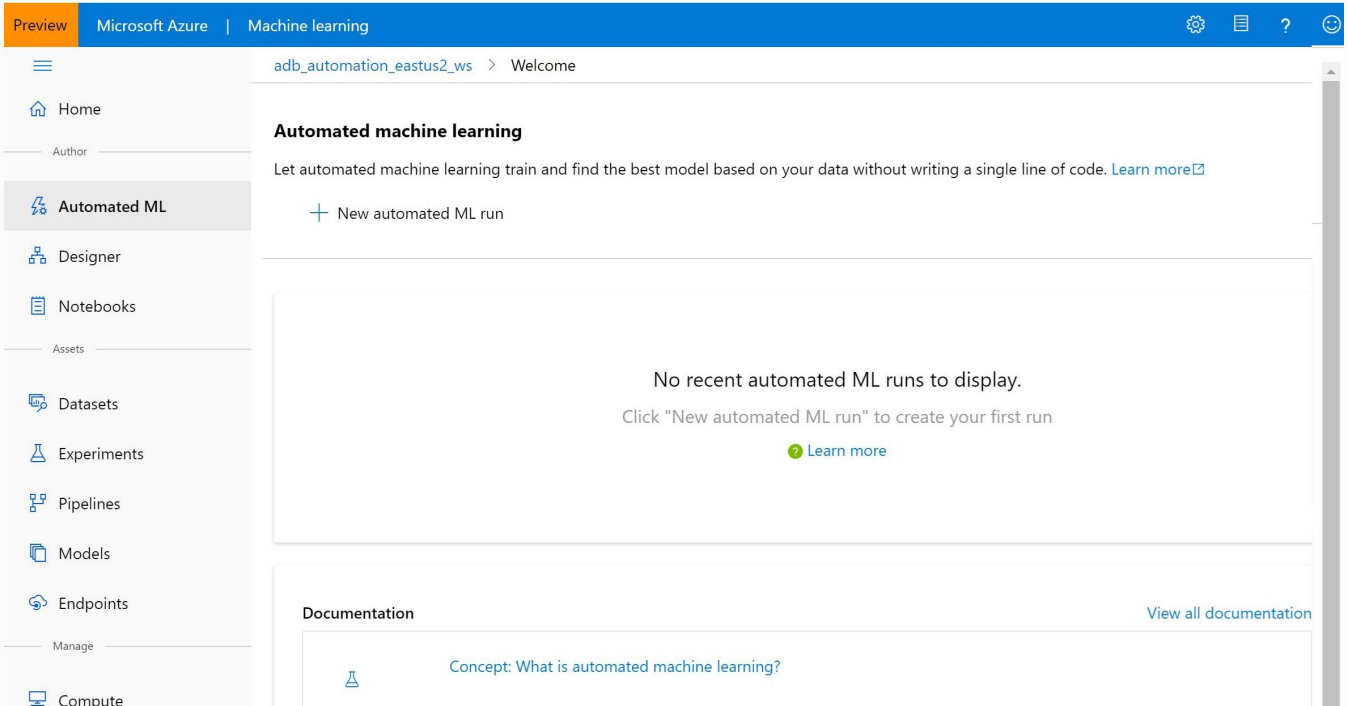
AWS


AWS Cloud
Amazon S3
AWS Lambda
Amazon SageMaker
Amazon S3
csv
csv
csv
<Name>_train.csv
<Name>_test.csv
<Name>_test_predictions.csv

Google Colab



Microsoft Azure



Docker

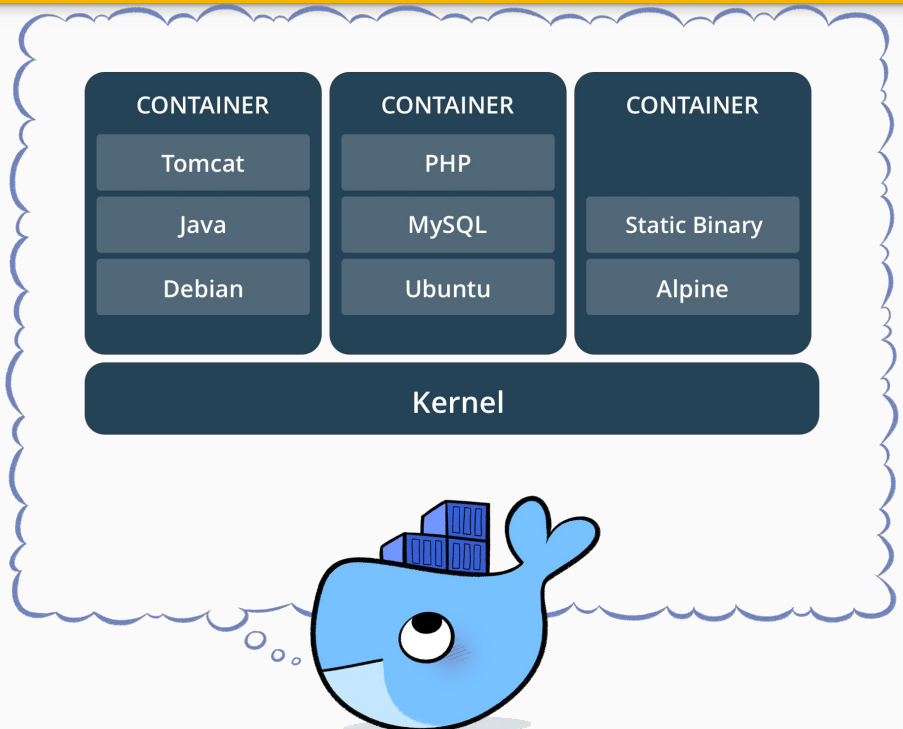


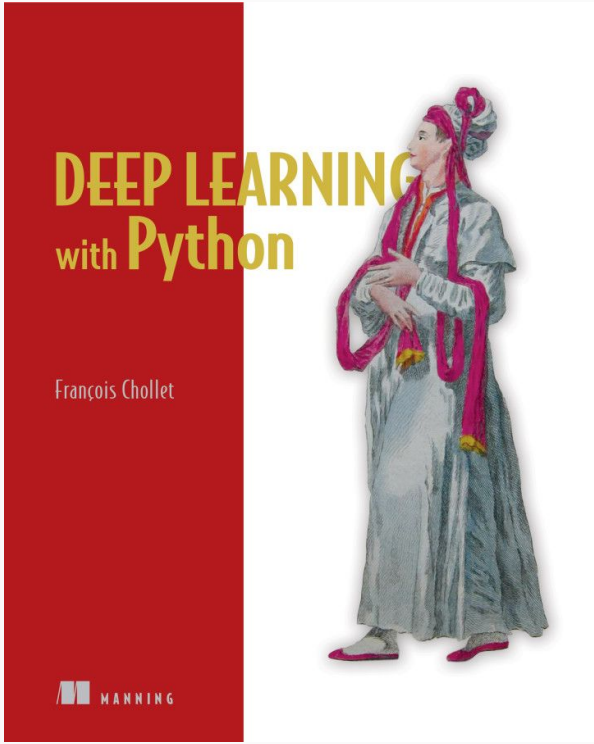
Image source: GeoNode

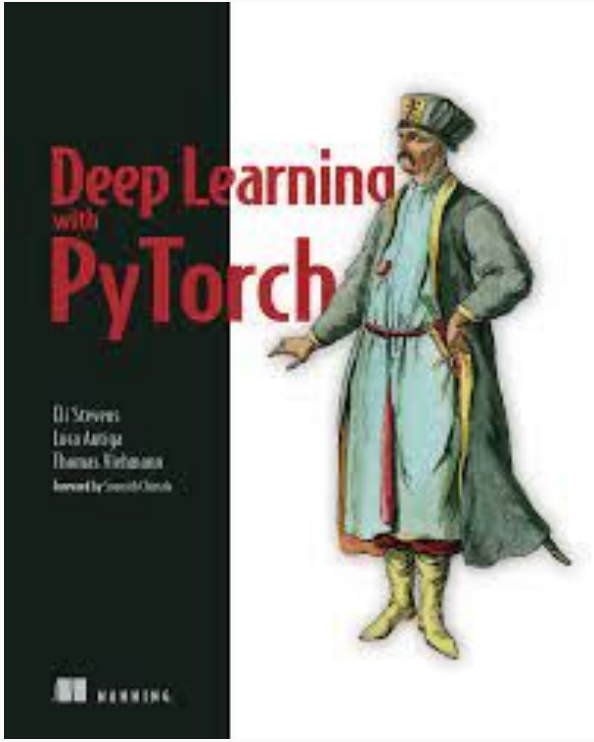
04

Suggested Resources

Suggested Resources -Book-

Recommended for those learning deep learning and getting started with PyTorch and TensorFlow/Keras





coursera

Browse > Data Science > Machine Learning

Offered By

Stanford

Machine Learning

★★★★★ 4.9 156.670 ratings • 40.081 reviews

Andrew Ng TOP INSTRUCTOR

Enroll for Free
Started Mar 15

Financial aid available

4,001,864 already enrolled

kaggle

stackoverflow

GitHub

THANKS

Does anyone have any questions?

iremkomurcubm@gmail.com
iremkomurcu.com