TENSOR FLOW

JOHN MAURICE P. SISON

ITELE 102: PLATFORM TECHNOLOGIES

Scope of the Discussion

- Machine Learning
- Deep Learning
- Deep Learning Libraries
- Introduction to TensorFlow
- Tensor
- Data Flow Graphs
- Deep Learning Visualization
- Projects Examples
- Why TensorFlow
- Demonstration

TensorFlow

Machine Learning

Introduction: What is Machine Learning?

> Subfield of Artificial Intelligence (AI) gives “computer the ability to learn without being explicitly programmed”

> Machine Learning is preferred approach to:

- Weather prediction
- Recommendation Systems
- Spam Filtering

TensorFlow

Deep Learning

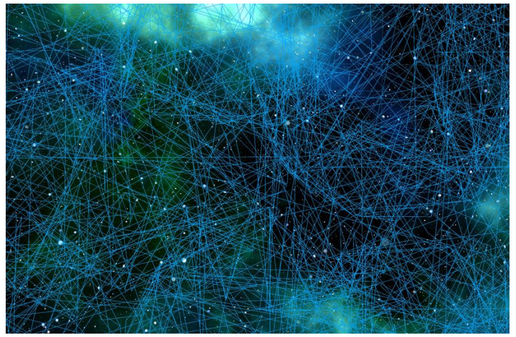
Introduction: What is Deep Learning?

> Deep Learning is a subfield of Machine Learning concerned with algorithms inspired by the structure and the function of the brain called artificial neural network

Introduction: What is Deep Learning?

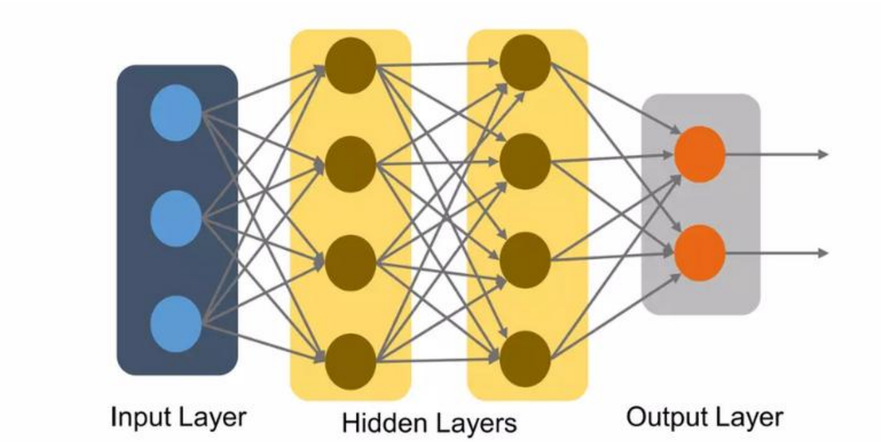
Neurons in the brain

> our brains has a lot of neurons connected together and the strength of connections between neurons represents long term knowledge.

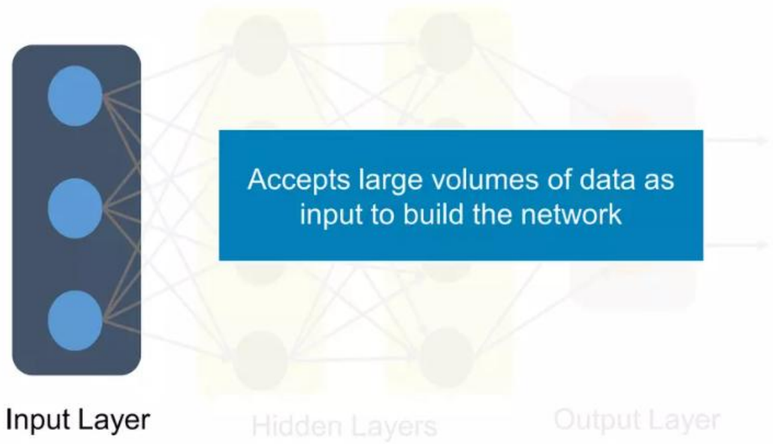
Introduction: What is Deep Learning?

Neural Network (Deep Learning)



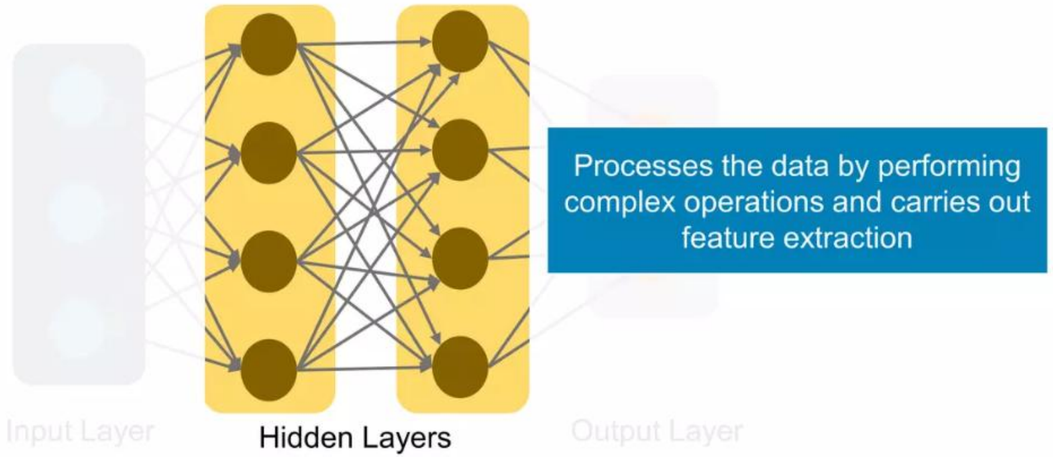
Introduction: What is Deep Learning?

Neural Network (Deep Learning)



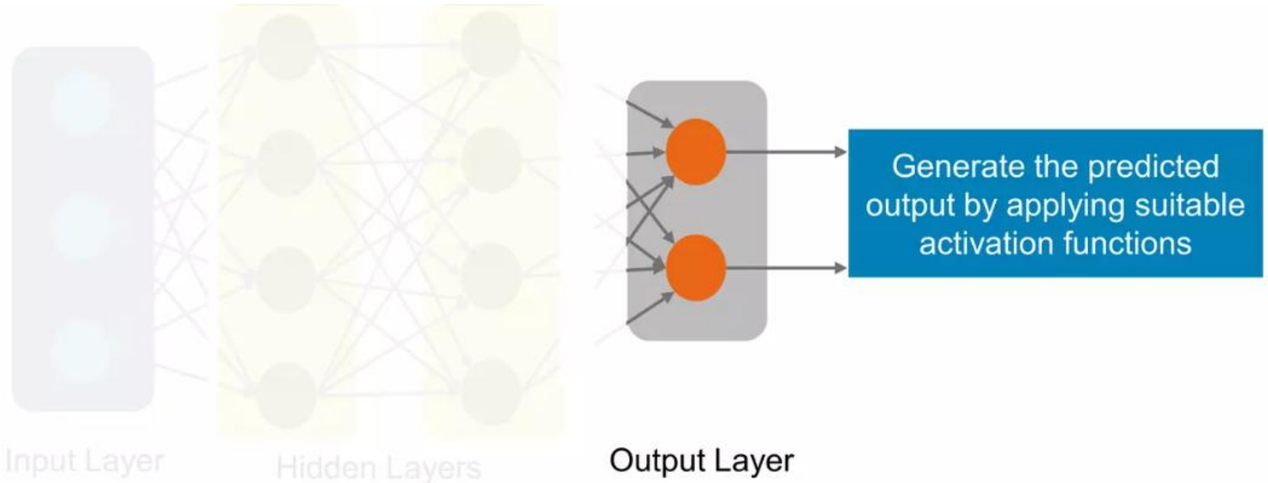
Introduction: What is Deep Learning?

Neural Network (Deep Learning)



Introduction: What is Deep Learning?

Neural Network (Deep Learning)



Introduction: Deep Learning, Why Now?

> Big Data

> Big Processing Power

> Robust Neural Network

Use Deep Learning when?

> You have a lots of data (10k + examples)

> The problem is “complex” - speech, vision, and natural language

> The data is unstructured

> You need the absolute best model

Don’t use Deep Learning When?

> You don’t have a large dataset

> You are performing sufficiently well with traditionally ML methods

> Your data is structured and possess the proper domain knowledge.

> Your model should be explainable

Tools

TensorFlow

Top Deep Learning Libraries

Keras

Tensor Flow

PyTorch

Theano

Caffe

TensorFlow

Introduction to TensorFlow

What is Tensor Flow?

> **TensorFlow** is an open source library for Deep Learning and Machine Learning.

> Developed by the **Google Brain Team** and release in November 2015.

> TensorFlow is mainly use for: **Classification, Perception, Understanding, Discovery, Prediction, and Creation.**

What is Tensor Flow?

TensorFlow = Tensor + Flow = Data + Flow

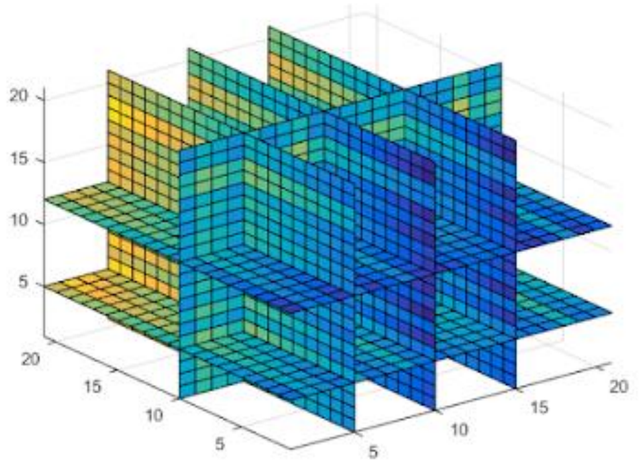
TensorFlow

What is Tensor?

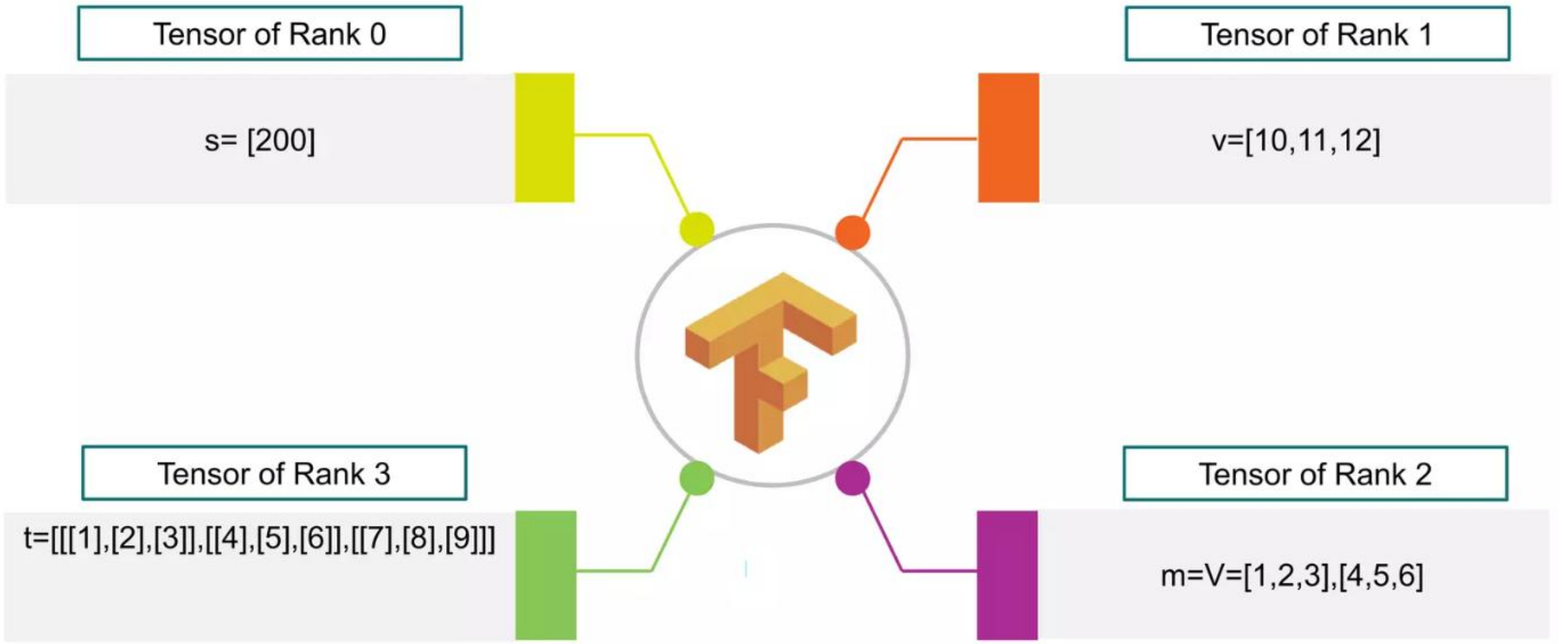
What is Tensor?

An n-dimensional array:

- 0-d tensor: scalar(number)
- 1-d tensor: vector
- 2-d tensor: matrix
- and higher

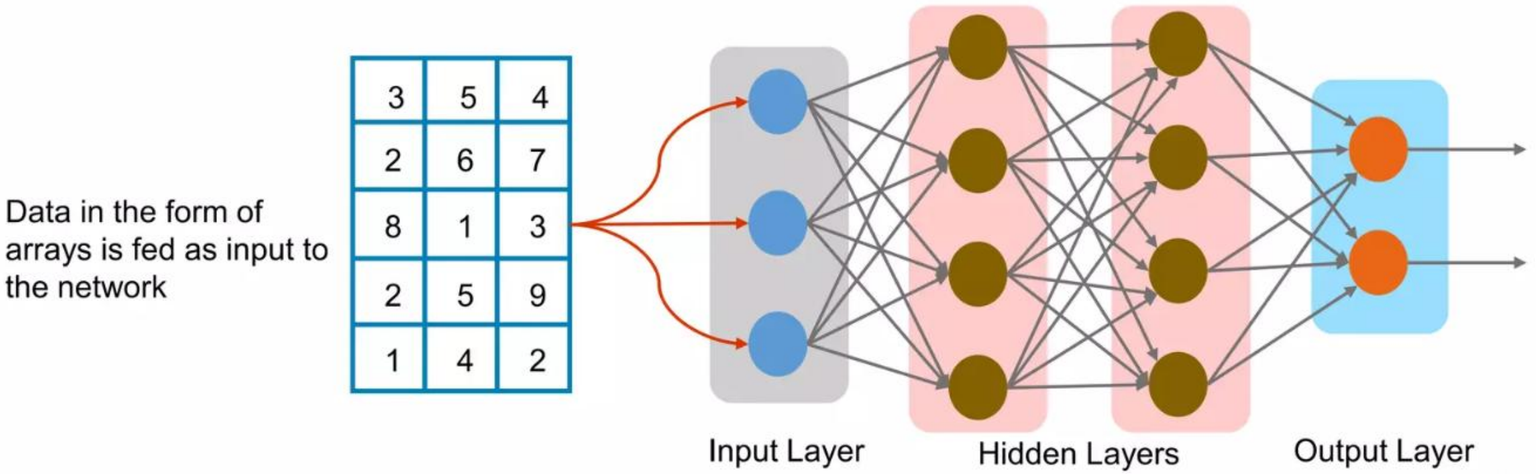


What is Tensor?



What is Tensor?

> **Tensor** is the generalization of vectors and matrices of potentially higher dimensions. Arrays of data with different dimensions and ranks that are fed as input to the neural network are called **Tensors**.



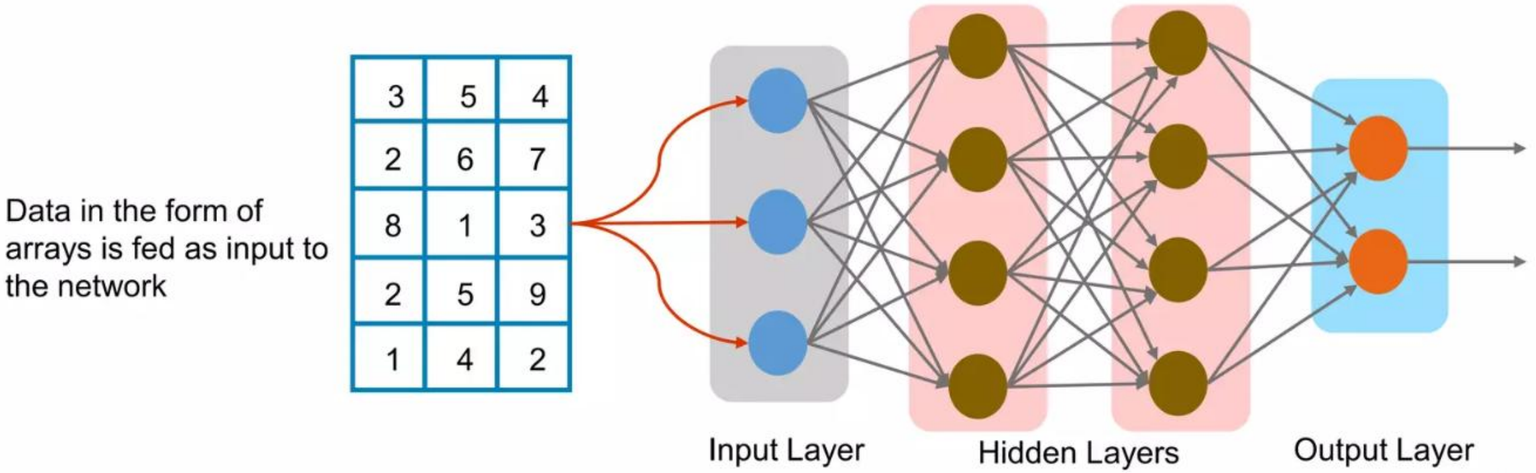
TensorFlow

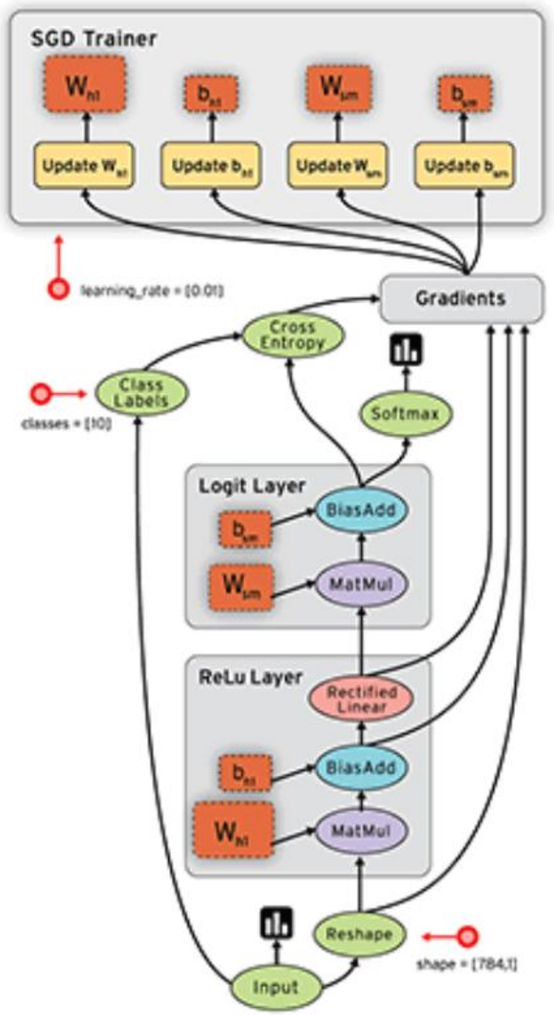
What is Data Flow?

But, What is Data Flow?

> Data Flow Graphs

- Dataflow is a common programming model for parallel computing.
- TensorFlow uses a dataflow graph to represent your computation.





Source: [TensorFlow website]

What is Data Flow Graph?

> Each computation in TensorFlow is represented as a Data Flow Graph.

> Each node in the graph represents a mathematic operation (add, subtract, multiply, etc.) and each edge represents multidimensional arrays(Tensors).

> Computational Graph is the graph of programming logic with TensorFlow builds in the memory.

What are the benefits of using graphs?

> **Parallelism**

- it is easy for the system to identify operations that can execute in parallel.

> **Distributed execution**

- it is possible for TensorFlow to partition your program across multiple devices such as CPUs, GPUs, and TPUs.

What are the benefits of using graphs?

> **Compilation**

- generate faster codes

> **Portability**

- you can build a dataflow graph in Python, store it in a saved model, and restore it in a C++ Program.

TensorFlow

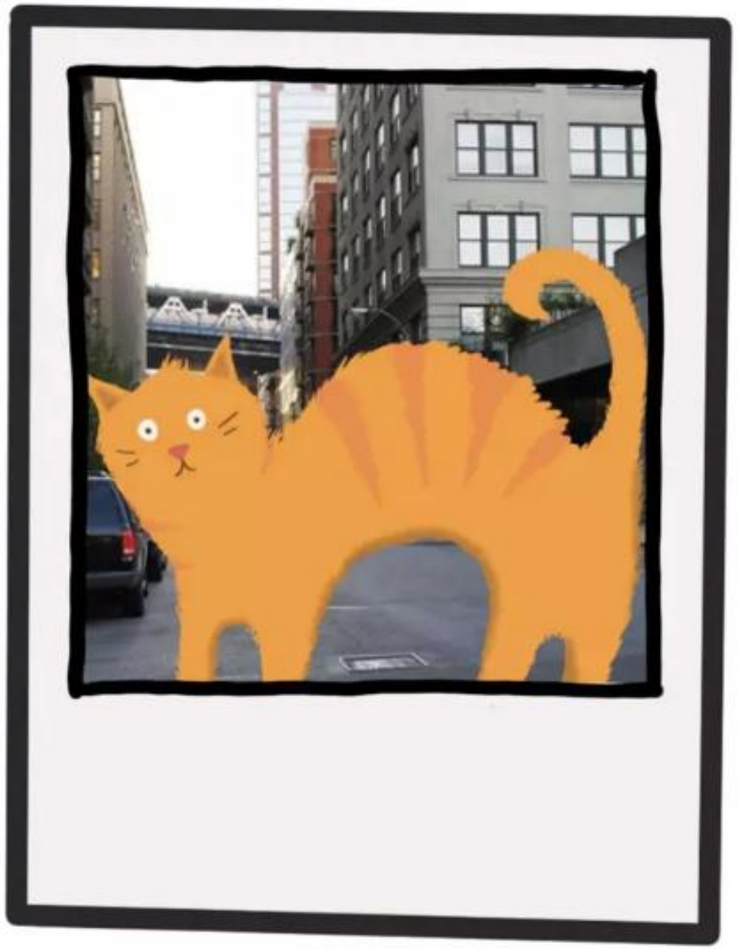
Deep Learning
Visualizations

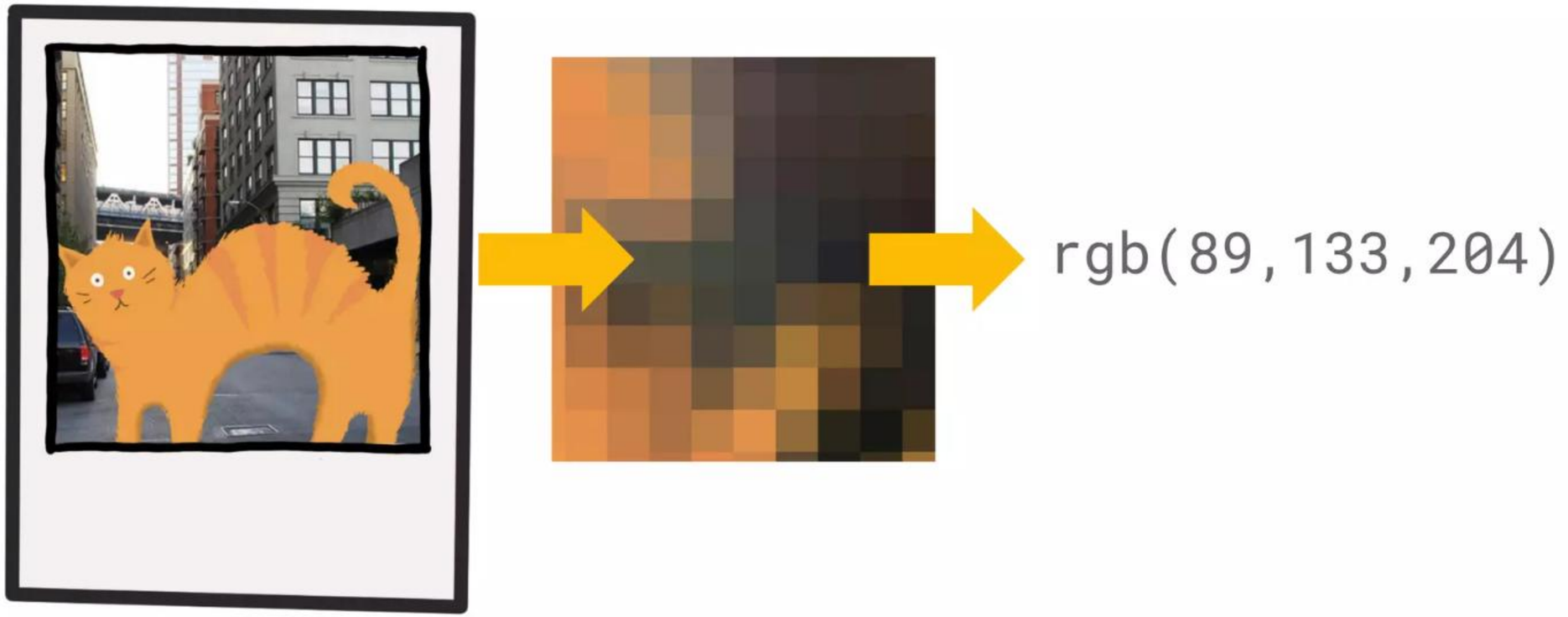
Examples of cats

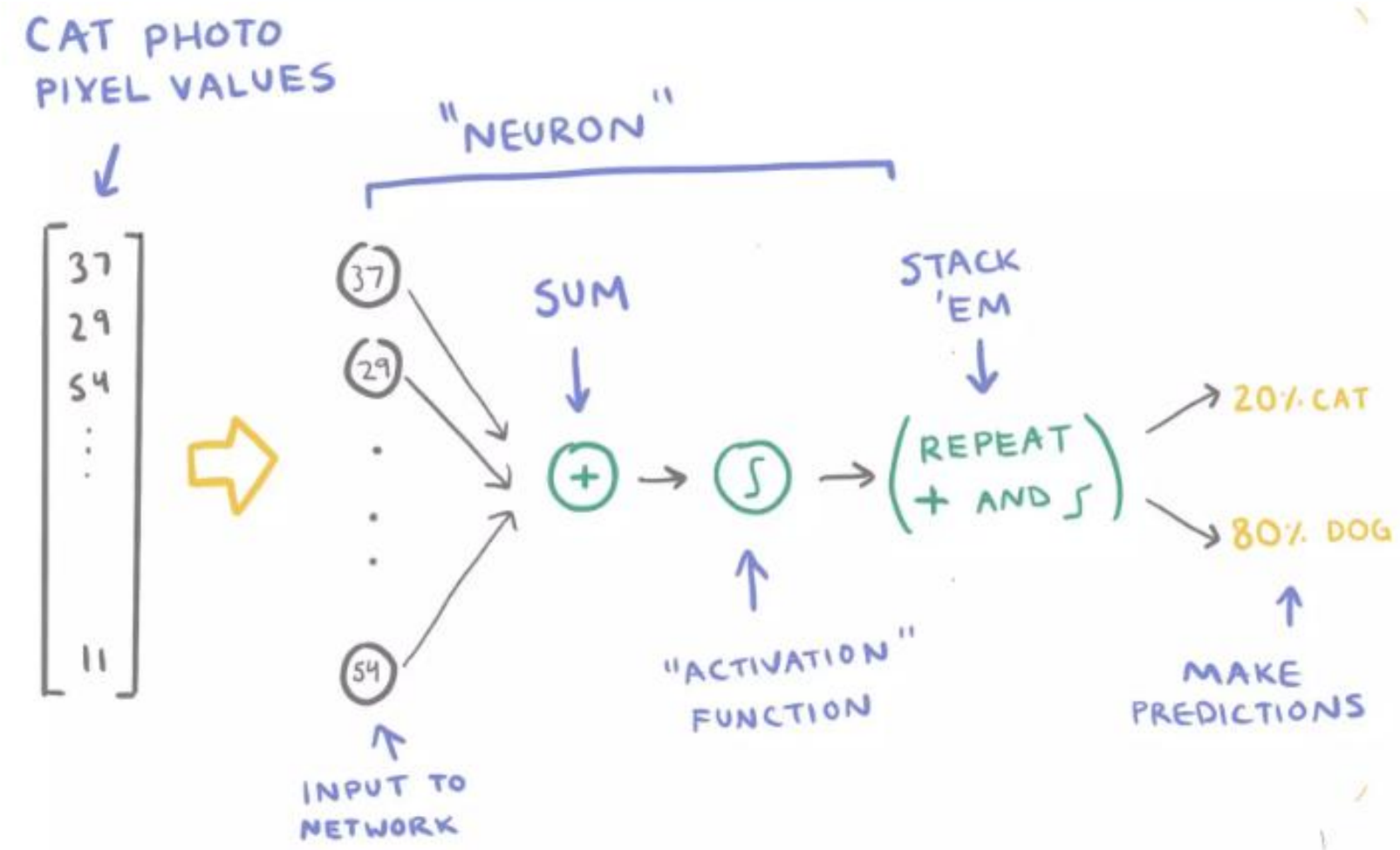


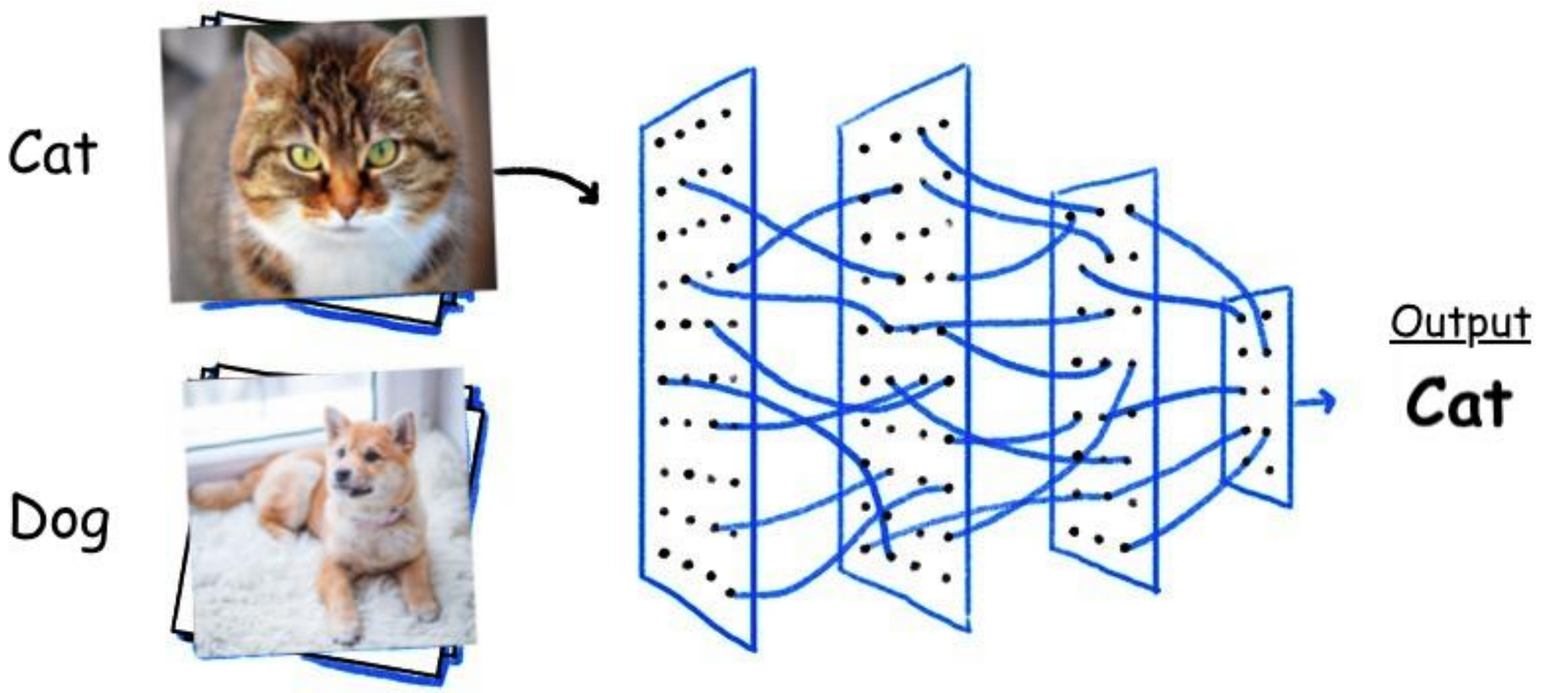

Examples of dogs



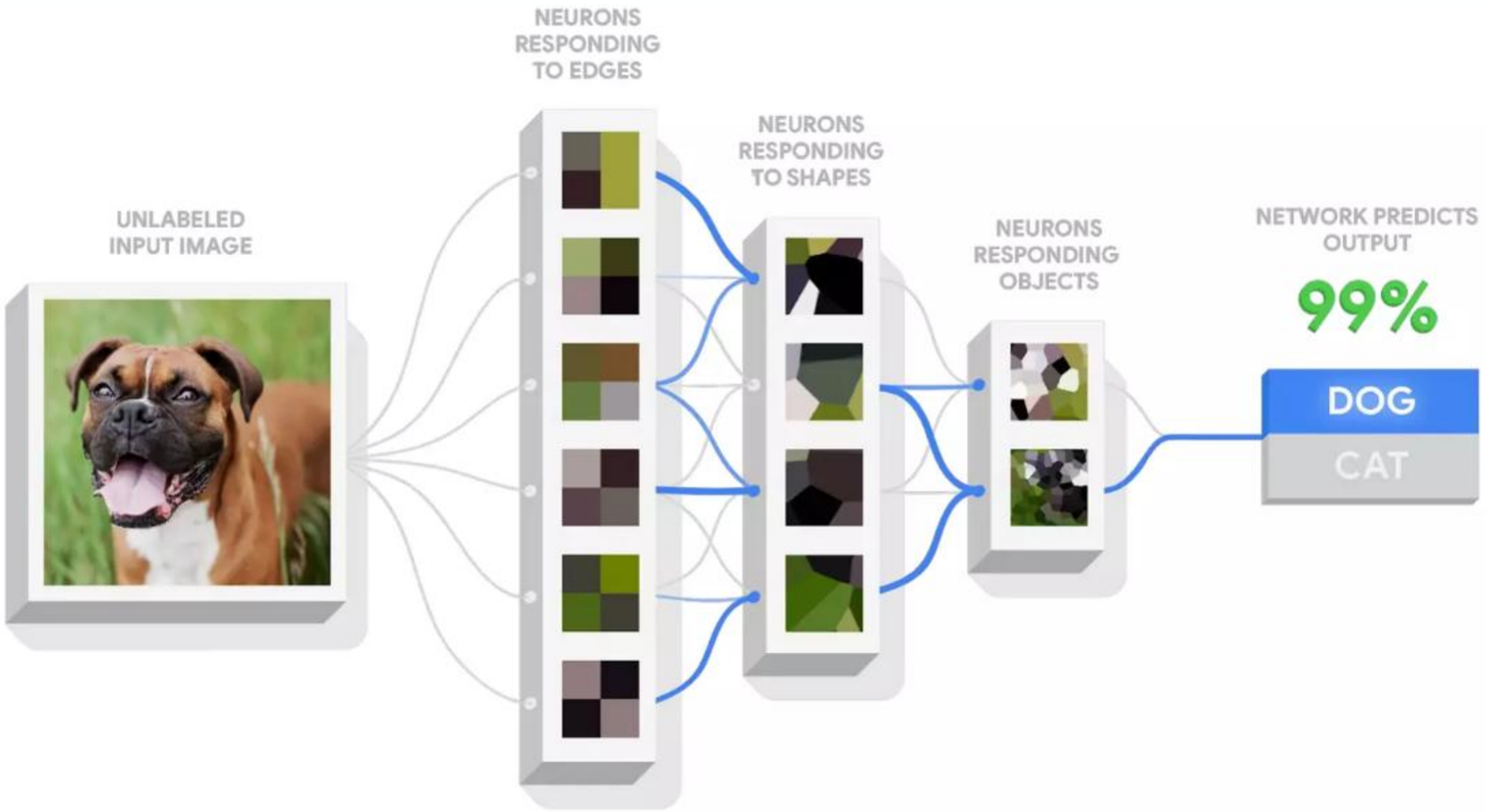




rgb(89,133,204)


CAT PHOTO
PIXEL VALUES
37
29
54
11
"NEURON"
37
29
54
SUM
+
STACK
'EM
REPEAT
+ AND ∫
∫
"ACTIVATION"
FUNCTION
20% CAT
80% DOG
MAKE
PREDICTIONS
INPUT TO
NETWORK


Cat
Dog
Output
Cat

TensorFlow

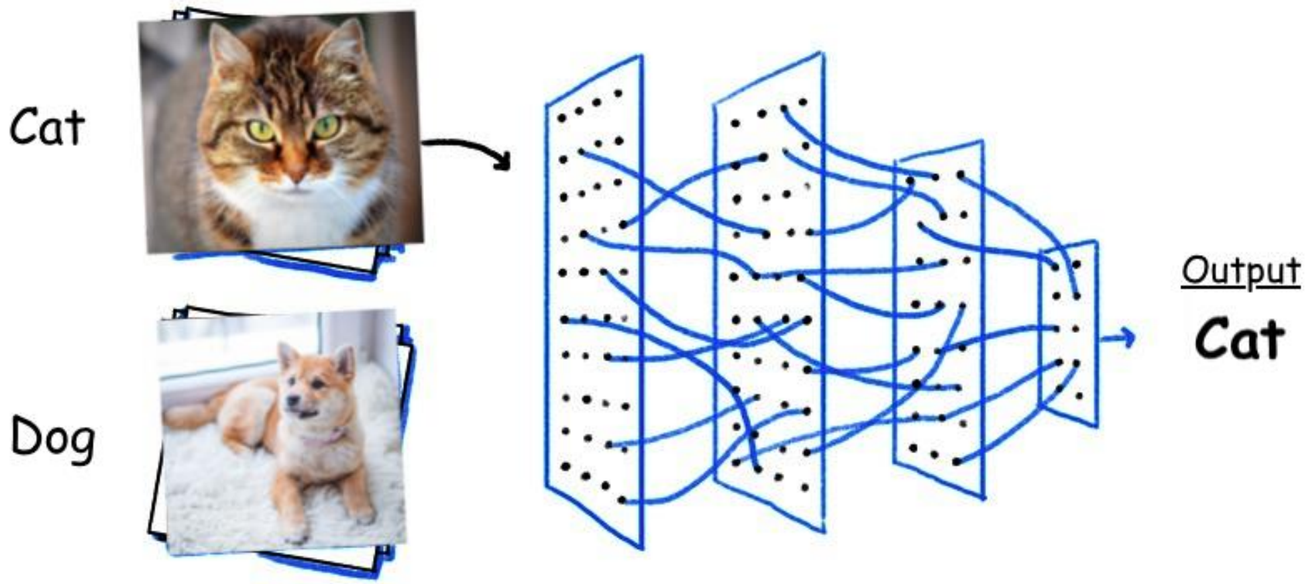

UNLABELED
INPUT IMAGE
NEURONS
RESPONDING
TO EDGES
NEURONS
RESPONDING
TO SHAPES
NEURONS
RESPONDING
OBJECTS
NETWORK PREDICTS
OUTPUT
99%
DOG
CAT

TensorFlow

TensorFlow Project Examples

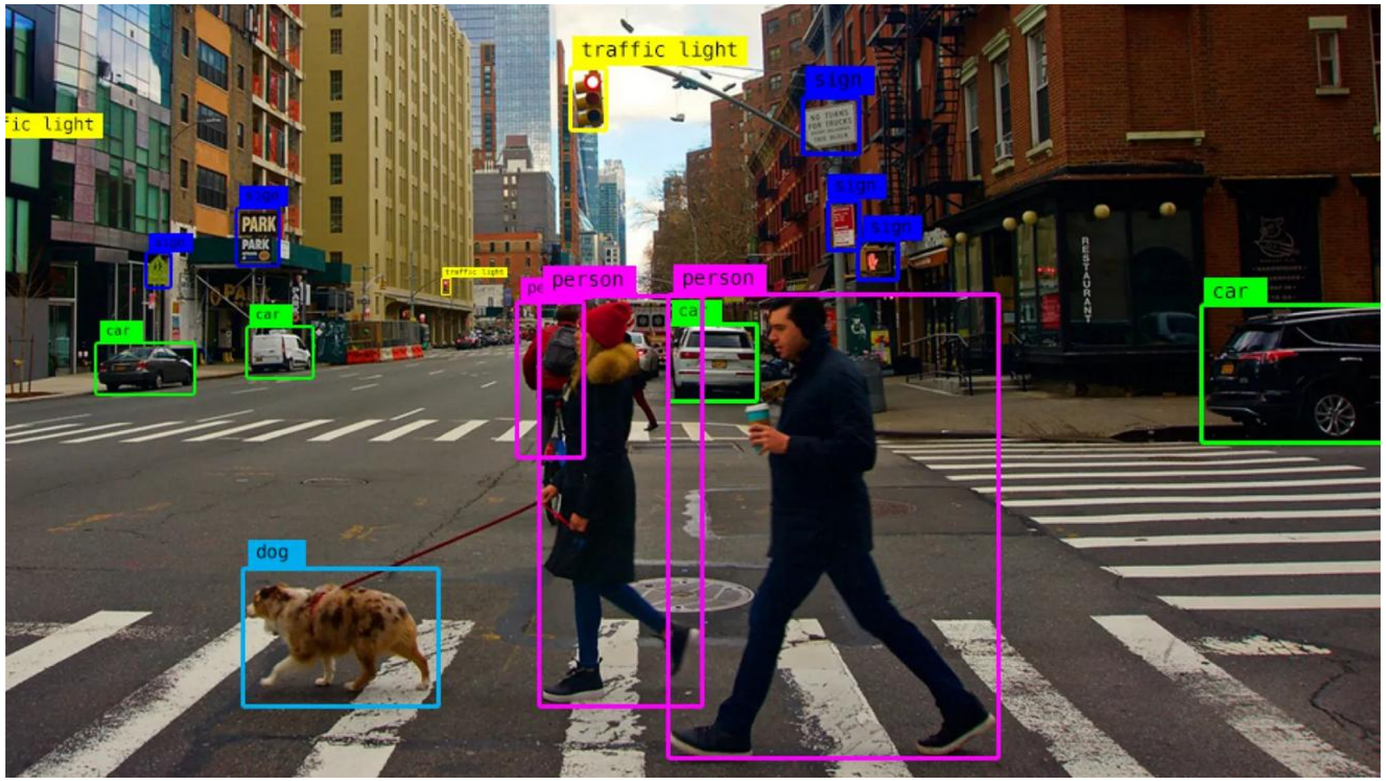
TensorFlow Projects

Image Classification



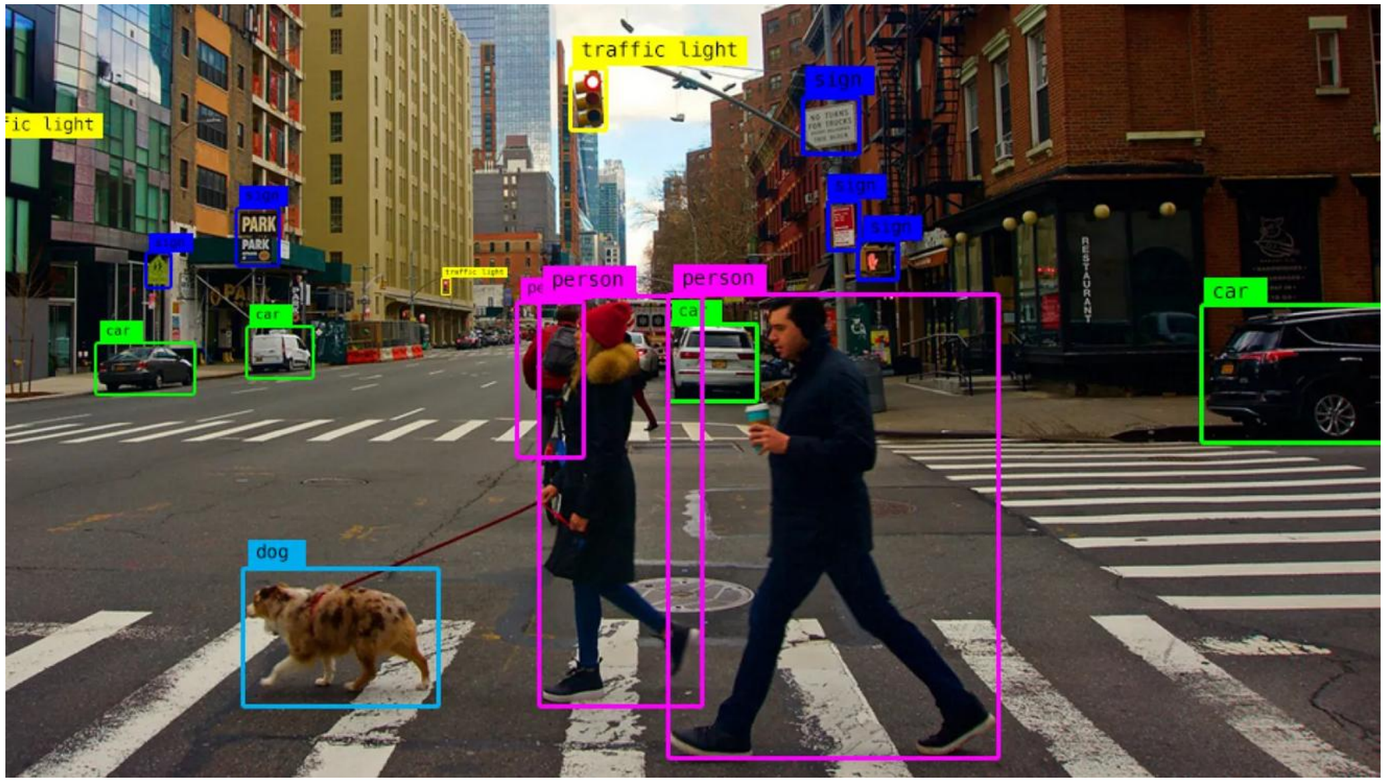
TensorFlow Projects

Object Detection



TensorFlow Projects

Object Detection



TensorFlow Projects

Speech Recognition

TensorFlow Projects

Restore Colors of B&W in photos and videos

TensorFlow Projects

Transferring styles from famous paintings

Why TensorFlow?

Why TensorFlow: Runs Everywhere

Run on desktop and mobile devices such as

- Linux
- MacOs
- IOS
- Android
- and Windows

Why TensorFlow: Deploy Anywhere

Servers

TensorFlow
Extended

Edge devices

TensorFlow
Lite

JavaScript

TensorFlow
.JS

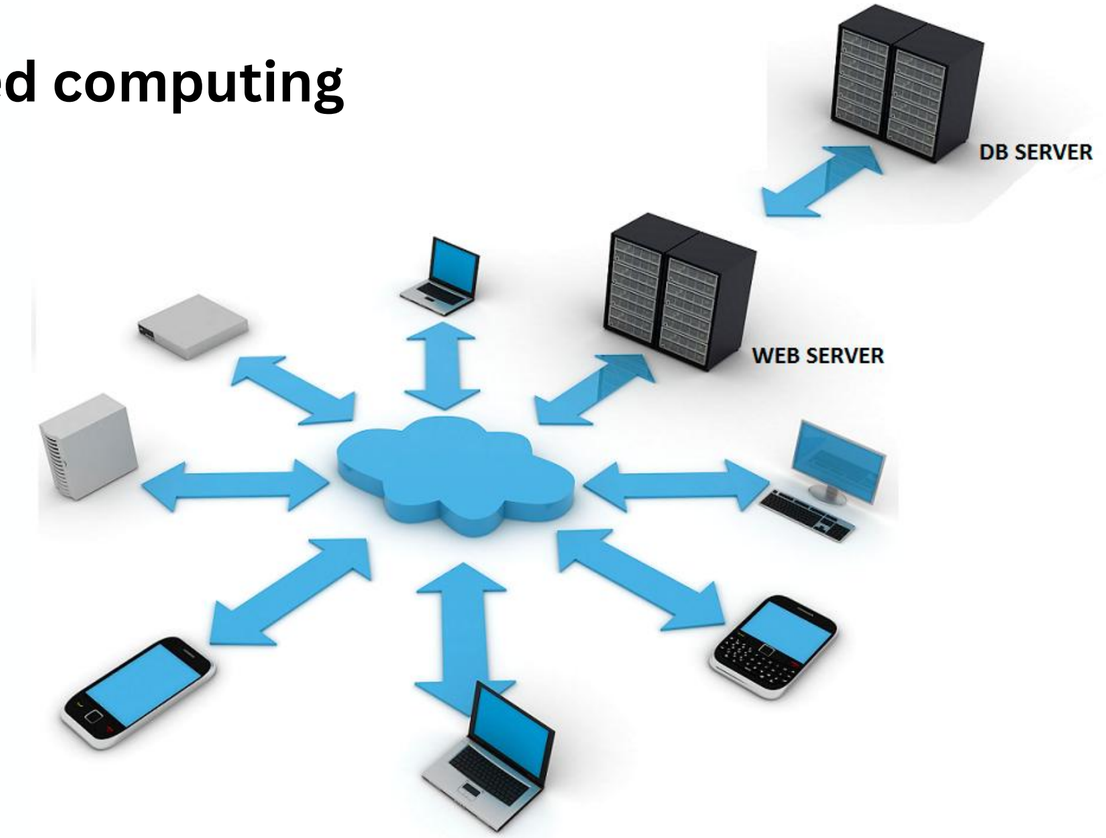
Why TensorFlow: Flexibility

> Python API offers flexibility to create all sorts of computations (including any neural network architecture we can think of)

> Includes highly efficient C++ implementations of many ML operations

Why TensorFlow: Parallel Computation

> TensorFlow supports distributed computing



Why TensorFlow: Large Community

> One of the **most popular open sources projects** on **GitHub**

> It has **dedicated team of passionate and helpful developers**

> **Growing community** contributing to improve it

Why TensorFlow: Google Products

> It powers many of Google's large-scale services, such as

- Google Search
- Google Photos
- and Google Cloud Speech

Why TensorFlow: Big Companies using TensorFlow

> Google

> OpenAI

> DeepMind

> Uber

> Ebay

> DropBox

> A bunch of startups

Lets try TensorFlow

Demonstration

Demonstration

Import Necessary Libraries

```
# import the necessary libraries
import tensorflow as tf
import matplotlib.pyplot as plt
```

Demonstration

Load and Split the Data

```
# load the data and split the data to training set and test set
(train_images, train_labels), (test_images, test_labels) =
tf.keras.datasets.mnist.load_data()
```

Demonstration

Scale down Pixel values

```
# scale down the value of the image pixels from 0-255 to 0-1
train_images = train_images / 255.0
test_images = test_images / 255.0
```

Demonstration

Visualize Data

```
# visualize the data

print(train_images.shape)

print(test_images.shape)

print(train_labels)


plt.imshow(train_images[0], cmap='gray')

plt.show()
```

Demonstration

Define the Machine Learning Model

```
# define the model
my_model = tf.keras.models.Sequential()
my_model.add(tf.keras.layers.Flatten(input_shape=(28, 28)))
my_model.add(tf.keras.layers.Dense(128, activation='relu'))
my_model.add(tf.keras.layers.Dense(10, activation='softmax'))
```

Demonstration

Compile the Model

```
# compile the model
my_model.compile(optimizer='adam',
loss='sparse_categorical_crossentropy', metrics=['accuracy'])
```

Demonstration

Train the Model

```
# train the model
my_model.fit(train_images, train_labels, epochs=3)
```

Demonstration

Check the Model for Accuracy on the Test Data

```
# check the model for accuracy on the test data
val_loss, val_acc = my_model.evaluate(test_images, test_labels)
print("Test accuracy: ", val_acc)
```

Demonstration

Save the Model

```
# save the model for later use

my_model.save('my_mnist_model.keras')
```

Demonstration

Retrieve the Model

```
# load the model from file system

my_new_model = tf.keras.models.load_model('my_mnist_model.keras')
```

Demonstration

Check the New Model for Accuracy

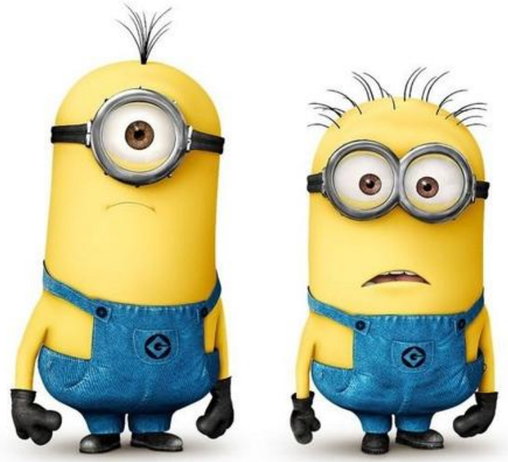
```
# check the new model for accuracy on the test data
new_val_loss, new_val_acc = my_new_model.evaluate(test_images,
test_labels)
print("New Test accuracy: ", new_val_acc)
```

References

1.Tensor Flow Tutorials
2. tensorflow.org
3. quora.com/topic/TensorFlow-software-library
4.developers.googleblog.com/en/highlights-from-tensorflow-dev-summit-2018/
5. youtube.com/playlist?list=PLQY2H8rRoyvzuJw20FG82Lgm2SZjTdIXU
6. ibm.com/topics/deep-learning
7. geeksforgeeks.org/deep-learning-projects/
8. oracle.com/ph/artificial-intelligence/machine-learning/what-is-deep-learning/
9. deepai.org/machine-learning-glossary-and-terms/tensor
10. datasciencecentral.com/understanding-dataflow-graphs-in-tensorflow/

TensorFlow

ANY QUESTIONS?



TensorFlow

THANK YOU!