

ILT 4 - TensorFlow in Practice

Ground Rules

Observe the following rules to ensure a supportive, inclusive, and engaging classes



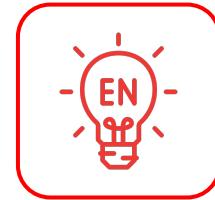
Give full attention
in class



Mute your microphone
when you're not talking



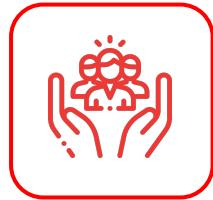
Keep your
camera on



Turn on the CC Feature
on Meet



Use raise hand or chat
to ask questions

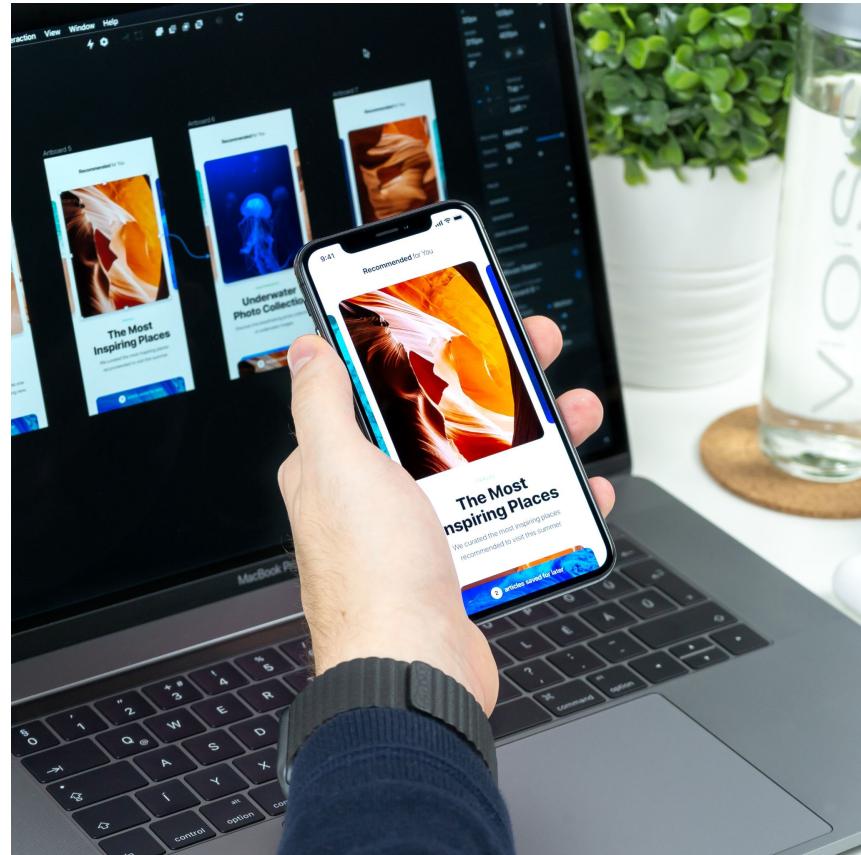


Make this room a safe place
to learn and share

Quiz

Outline Session

- Introduction to Machine Learning
- Introduction to Deep Learning
- Convolutional Neural Network
- Natural Language Processing
- Time Series



Introduction to Machine Learning

A New Programming Paradigm



```
if(speed<4){  
    status=WALKING;  
}
```



```
if(speed<4){  
    status=WALKING;  
} else {  
    status=RUNNING;
```

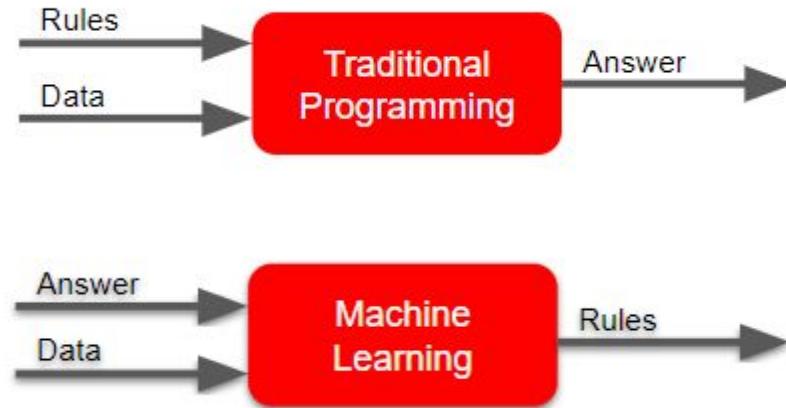


```
if(speed<4){  
    status=WALKING;  
} else if(speed<12){  
    status=RUNNING;  
} else {  
    status=BIKING;
```



// oh crap

A New Programming Paradigm



What is machine learning?

Example: Predict Housing Price



```
price = get_base_price()

if num_bedrooms > 2:
    price = price * 1.2

if lot_size > 7000000:
    price = price * 1.1

if waterfront:
    price = price * 1.3

if near_railroad:
    price = price * 0.9
```

Example: Predict Housing Price



Bedrooms	Bathrooms	Year Built
3	1	1812
4	2	1912
2	1	1999
3	2	2020
3	1	2002
2	1	2012
3	2	2000
2	2	1989
3	1	2020



Rules-based Programming vs Machine Learning

Rules-based

- Humans develop the logic flow
- If/then/else rules
- One-off exceptions
- Limited to human reasoning
- Exposes bias of the implementor

Machine Learning

- Model trained with data
- Emergent patterns in the data
- Experiments and refinements in training and models
- Limited by training data
- Exposes bias of the training data

What **Can** Machine Learning Do?

Classification

What **Can** Machine Learning Do?

Regression



What **Can** Machine Learning Do?

Clustering

What **Can** Machine Learning Do?

Sequences



Introduction to Deep Learning

Terminology

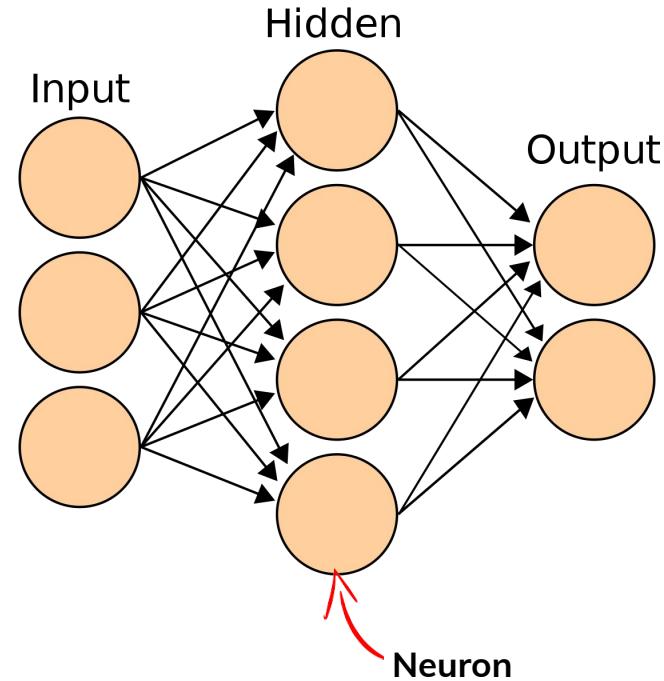
Artificial Intelligence

Machine Learning

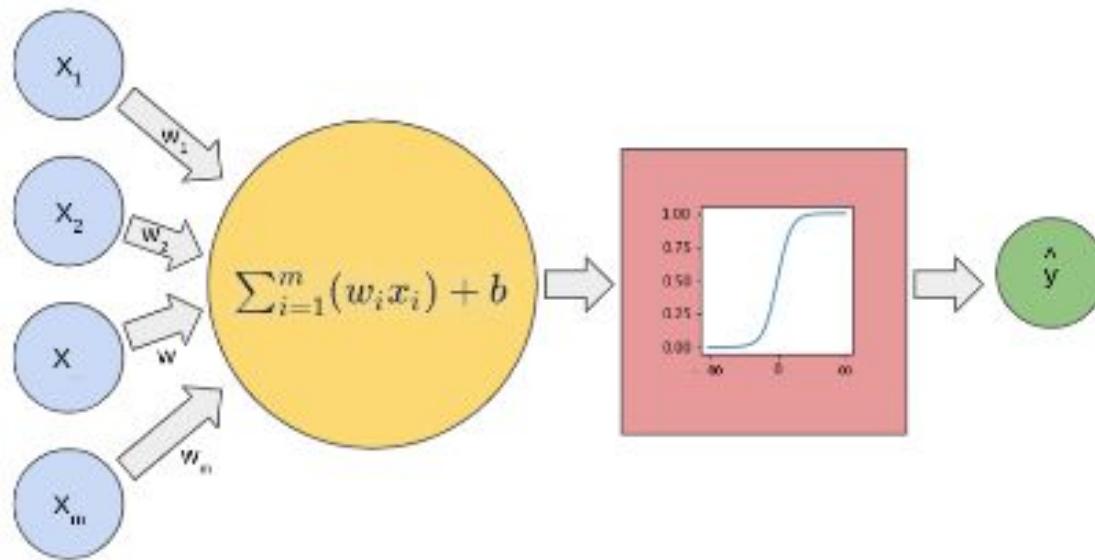
Deep Learning

What is Artificial Neural Network?

Artificial neural networks (ANN) are computational networks inspired by the functioning of the human brain that can **extract patterns from data** to make a prediction



How Neural Network Works?



Inputs

Weights

Sum + Bias

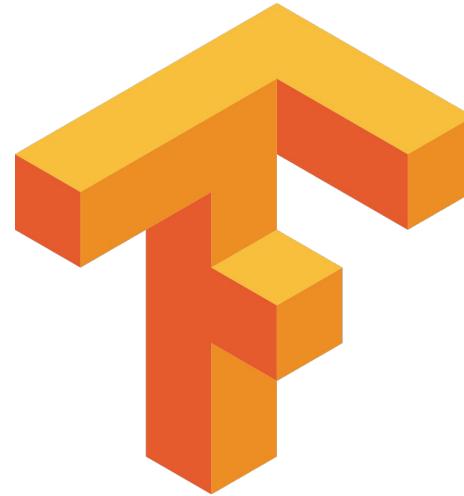
Activation

Output

How to Build Neural Networks Model?

What is TensorFlow?

- An **end-to-end** open source machine learning platform
- TensorFlow provides an easy way to build a **neural networks model**
- TensorFlow also supports **distributed computing, GPUs, and TPUs.**



What is Tensor?

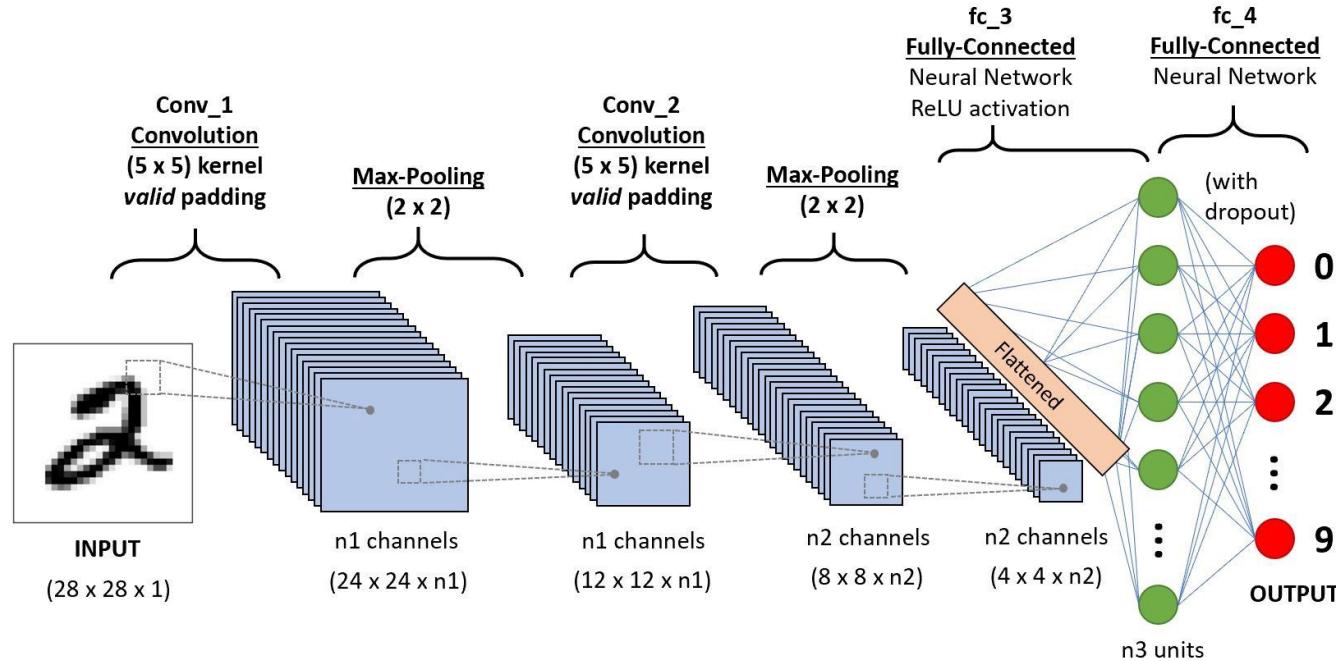


What **Can** Deep Learning Do?



Convolutional Neural Network

Convolutional Neural Network Architecture



Convolution Layer

7	2	3	3	8
4	5	3	8	4
3	3	2	8	4
2	8	7	2	7
5	4	4	5	4

*

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

=

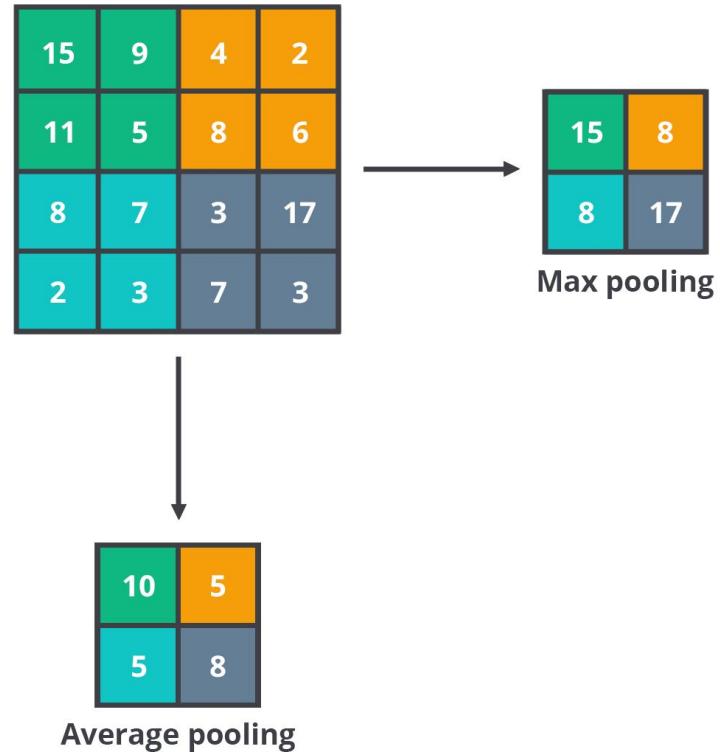
6		

$$\begin{aligned} & 7 \times 1 + 4 \times 1 + 3 \times 1 + \\ & 2 \times 0 + 5 \times 0 + 3 \times 0 + \\ & 3 \times -1 + 3 \times -1 + 2 \times -1 \end{aligned}$$

Pooling Layer

Pooling is a **type of downsampling** that often occurs after convolution

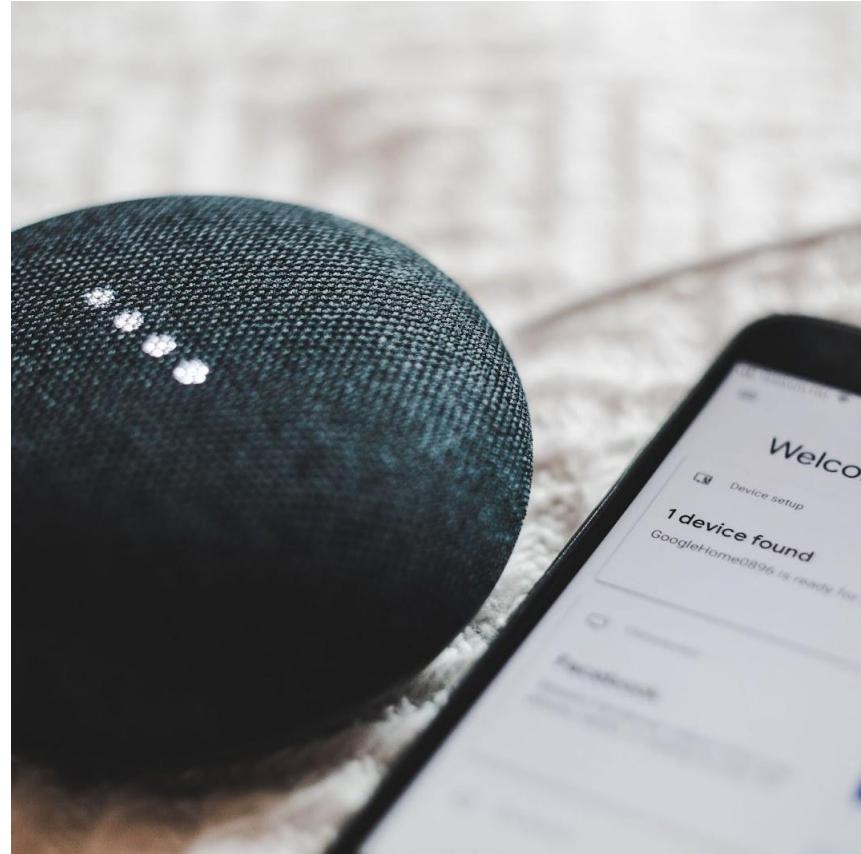
The goal is to **reduce the size** of the training data before it goes into the fully connected network without losing much information



Natural Language Processing

What is NLP?

Natural Language Processing (NLP) is a branch of Artificial Intelligence that gives machines the ability to read, understand and derive meaning from human languages



How Computer Processing A Text

I love my cat



{ "I" : 1, "love" : 2, "my" : 3, "cat" : 4 }



Encoded Word = [1, 2, 3, 4]

Important Process in NLP

Tokenizer

- Vectorize a text corpus
- Turning each text into either a sequence of Integers
- Each Integer being the Index of a token in a dictionary

Text to Sequences

- Transforms each text in texts to a sequence of integers.

OOV (Out of Vocabulary)

- Put a special value in when an unseen word encountered.

Technical Usage of Tokenizer : https://www.tensorflow.org/api_docs/python/tf/keras/preprocessing/text/Tokenizer

Padding

Padding is used to fit all dictionaries in one sequence. So, all sequences have the same length.

```
# Import Padding
from
tensorflow.keras.preprocessing.sequence
import pad_sequences

# Example sentences
sentences = ['I love my cat',
             'My cat love to eat fish']

# Tokenizer, sequences, & OOV
implementation
...

# Padding
padded = pad_sequences(sequences)
```

```
# Expected Output
print(tokenizer)
{'i':2, 'love':3, 'my':4, 'cat':5, 'to':6,
'eat':7, 'fish':8, '<OOV>':1}

print(sequences)
[[2,3,4,5],[4,5,3,6,7,8]]

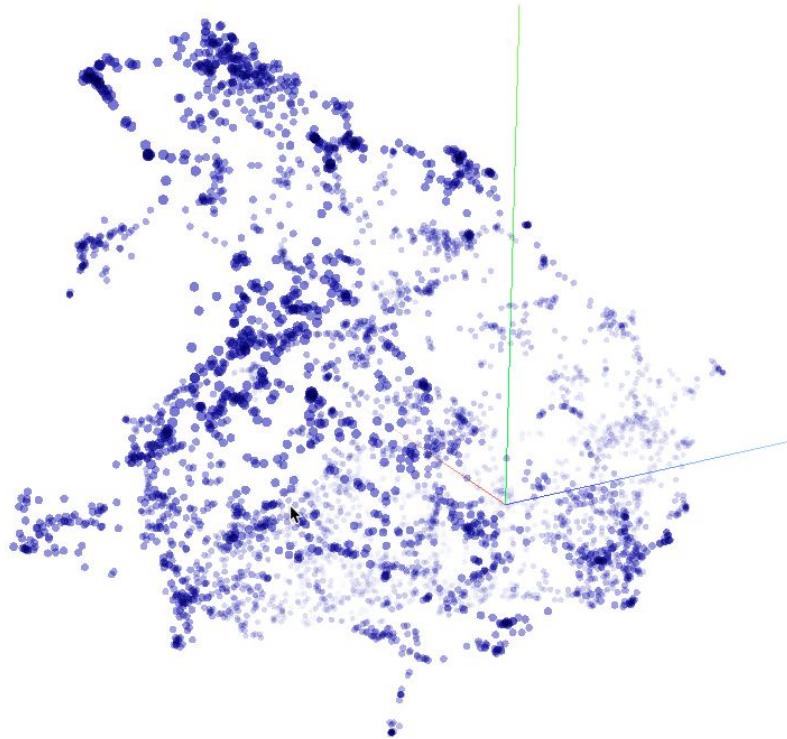
print(padded)
[[0,0,2,3,4,5],
[4,5,3,6,7,8]]

# Optional parameters
pad_sequences(sequences, padding='post',
truncating='post', maxlen=5)
```

Technical Usage of Padding : https://www.tensorflow.org/api_docs/python/tf/keras/preprocessing/sequence/pad_sequences

Words Embedding

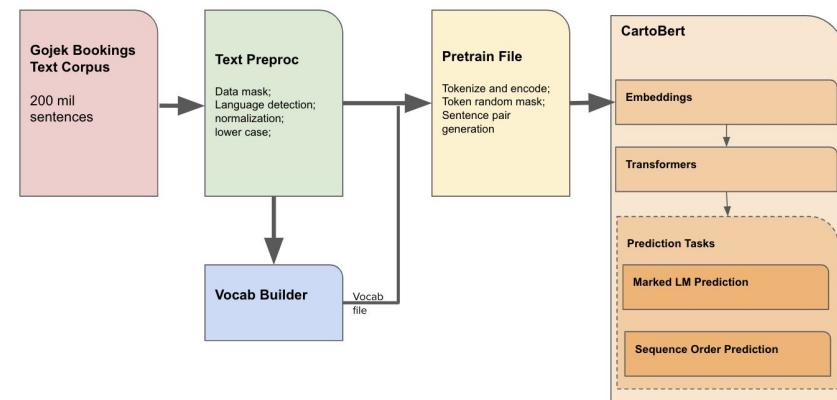
Word embeddings are a type of word representation that allows words with similar meanings to have a **similar representation**



TensorFlow Embedding Projector: <https://projector.tensorflow.org/>

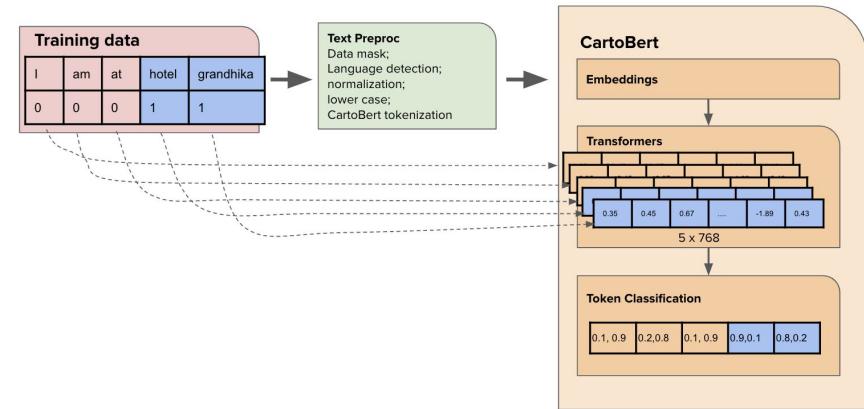
How Gojek Uses NLP to Name Pickup Locations at Scale

- Used a deep-learning NLP model called **CartoBERT**
- Inspired by ALBERT's architecture
- The model is pre-trained to understand Gojek's bookings text using Masked Language Model



How Gojek Uses NLP to Name Pickup Locations at Scale

- For every token in the input sentence, CartoBERT will output a 768-dimension vector
- CartoBERT is fine-tuned to extract pickup point names from bookings text sentences
- The CartoBERT accuracy is ~93%



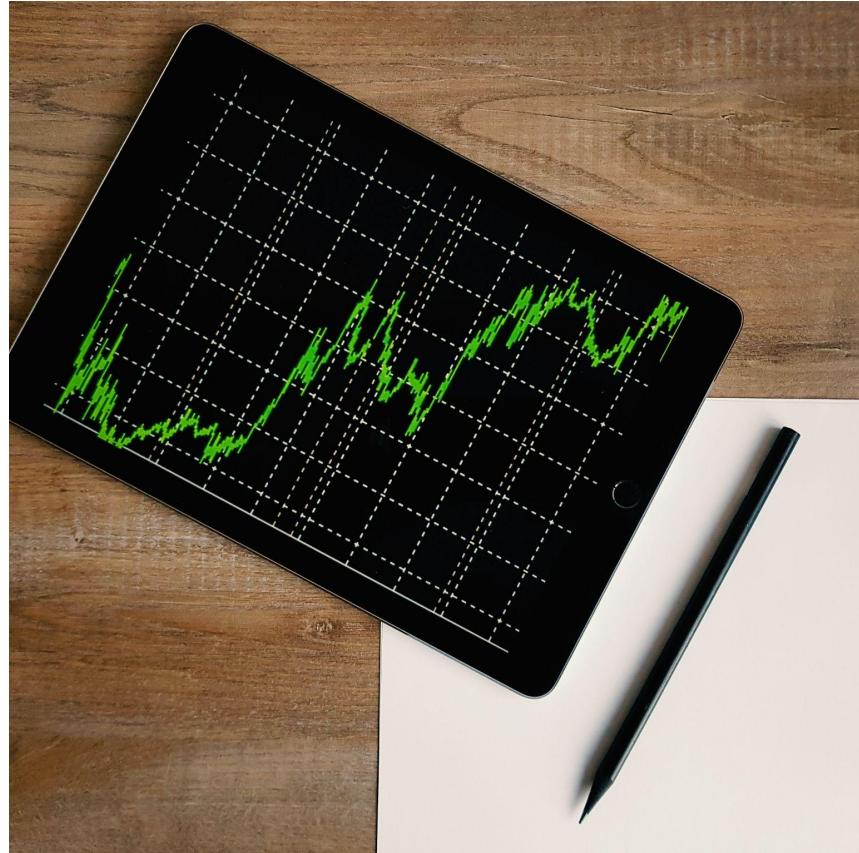
Time Series

What is Time Series?

An ordered sequence of values that are usually equally spaced over time.

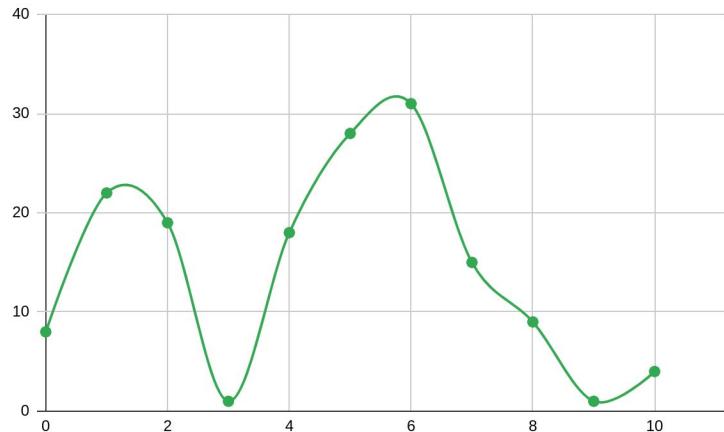
What are they?

- Stock prices.
- Weather forecast.
- Historical trends.

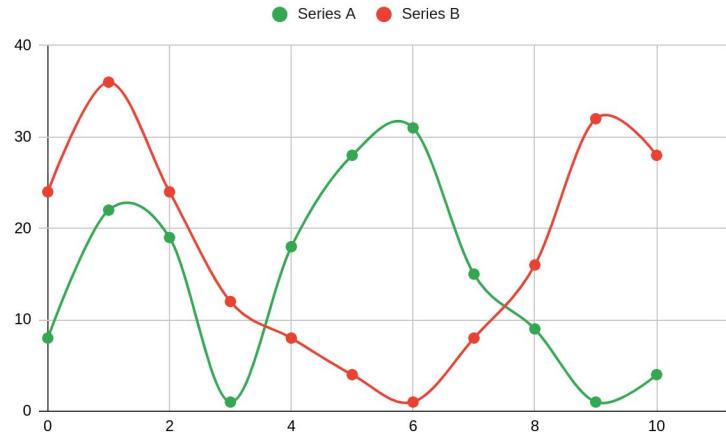


Univariate & Multivariate Time Series

Univariate

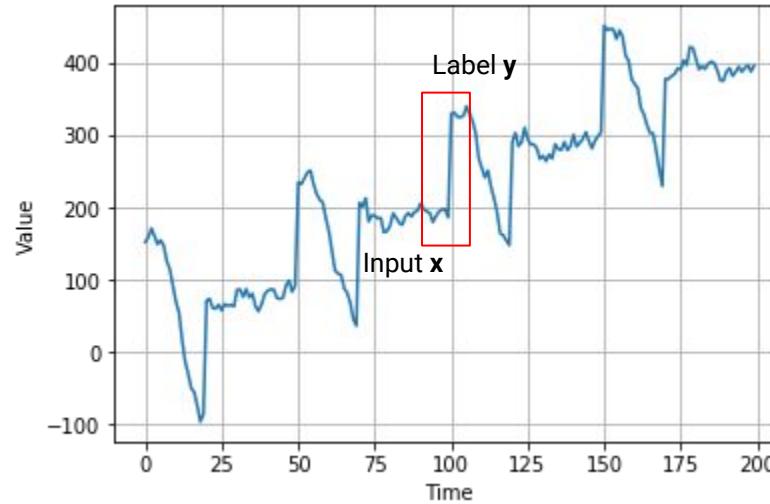


Multivariate



Preparing Features and Labels

Windowing the data to create the features and labels



Resource Image: https://github.com/lmoroney/dlaicourse/blob/master/TensorFlow%20In%20Practice/Course%204%20-%20S%2BP/S%2BP_Week_1_Lesson_2.ipynb

Metrics Evaluation Performance

- errors = forecast - actual
- mse = np.square (errors).mean()
- rmse = np.sqrt (mse)
- mae = np.abs (errors).mean()
- mape = np.abs (errors / x_valid).mean()

Sharing Session

Demo Link

Demo training a simple CNN to classify CIFAR images:

https://colab.research.google.com/drive/1un4ozjhF2g6nlt7TAysOHiL1-9m_AIZL?usp=sharing

Demo training a simple NLP model:

https://colab.research.google.com/drive/1PWBHT0PcpXmbNpkSsD_BPuV5PI5ERF1i?usp=sharing

Demo training a simple time series forecasting:

https://colab.research.google.com/drive/11ka600_QmjsMmovq66v53jq3Azfid36A?usp=sharing

Discussions

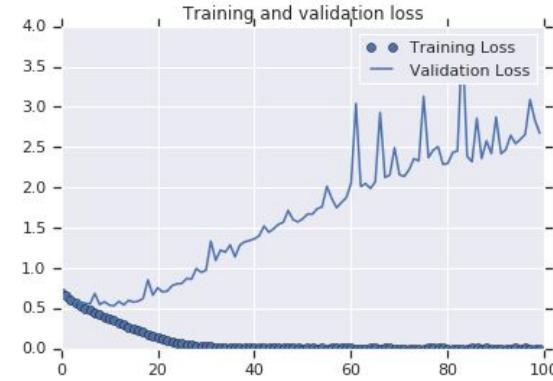
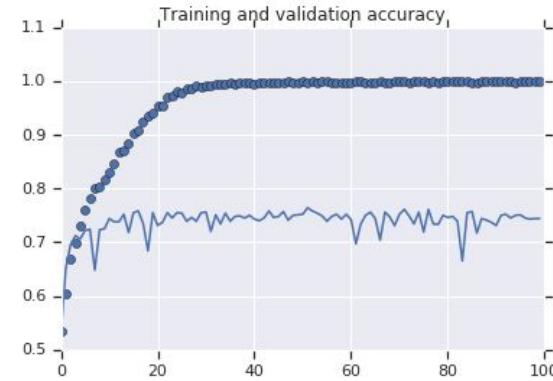
Thank You

Overfitting

- A concept of being over specialized in training, but not so good at test.

How to prevent it?

- Using image augmentation
- Using Dropout layer
- Using Callbacks
- Tuning Parameter
- Use pre-trained model (Transfer Learning)



Transfer Learning

A pre-trained model is a saved network that was previously trained on a large dataset, typically on a large-scale image-classification task.

Two ways to customize pretrained model:

- Feature Extraction:
 - Use the representations learned by a previous network.
 - Do not need to (re)train the entire model.
- Fine Tuning:
 - Unfreeze a few of the top layers of a frozen model base.
 - More relevant for the specific task.

Technical Usage of Transfer Learning: https://www.tensorflow.org/tutorials/images/transfer_learning

Metric Evaluation for Classification

Evaluation metrics are used to **measure the quality** of the machine learning model

- Accuracy
- Precision
- Recall
- F1 Score

		Actual	
		Positive	Negative
Predicted	Positive	True Positive	False Positive
	Negative	False Negative	True Negative