Meetup

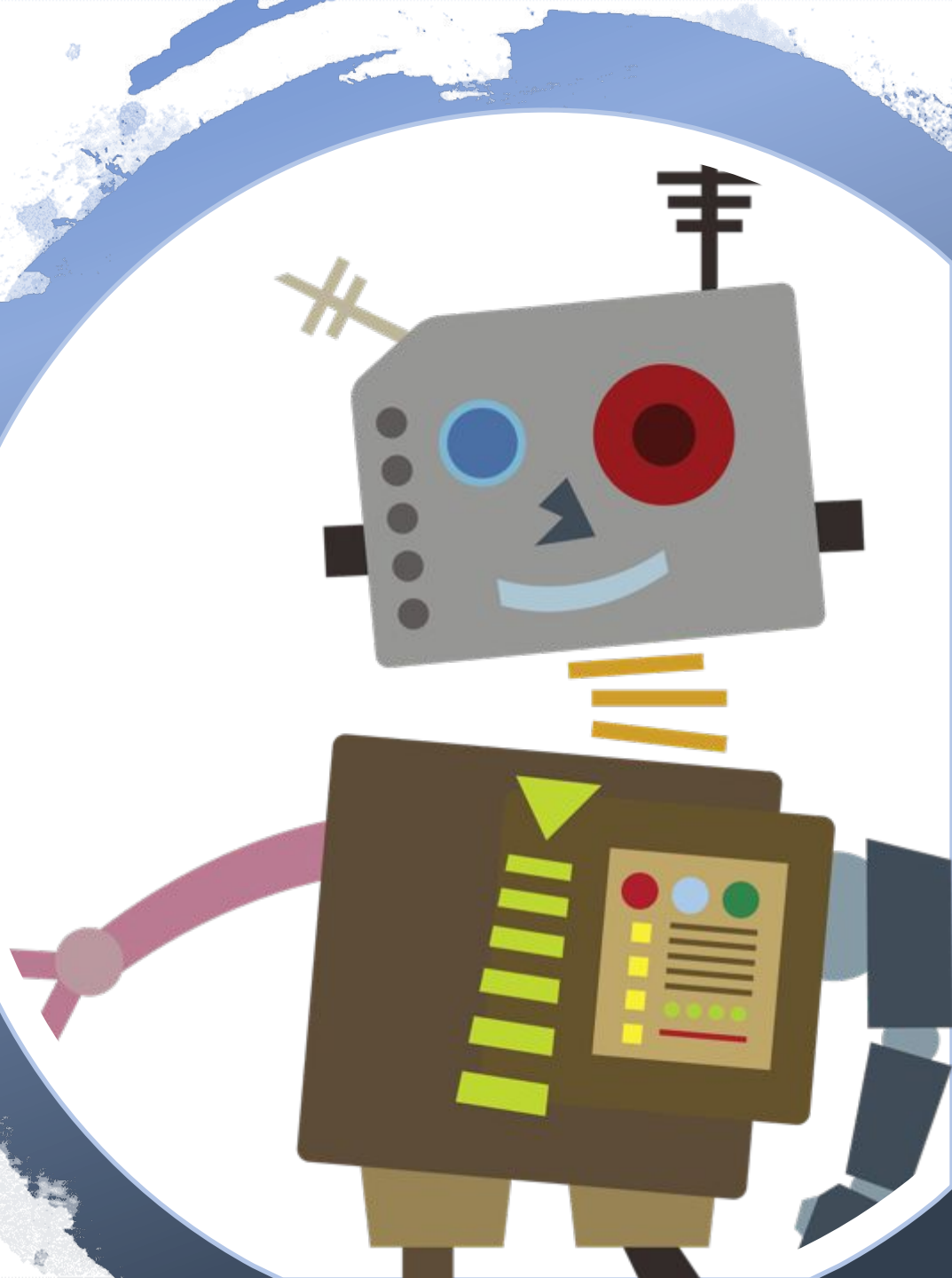
IoT hacking & Data Science Innovators

The future is in the AIoT!

When the IoT meets the AI

By Marcelo Rovai

June 25th, 2020



Marcelo Rovai

Brazilian from São Paulo, Master in Data Science by UDD, Chile, and MBA by IBMEC, Brazil. Graduated in 1982 as an Engineer from UNIFEI with pos graduation by Poli/USP, both in Brazil. Marcelo worked as a teacher, engineer, and executive in several companies in the technology area such as AVIBRAS Aeroespacial, SID Informática, ATT-GIS, NCR, DELL, COMPAQ (HP) and more recently at IGT where he continues as Senior Advisor.

In 2016, Marcelo began writing about electronics, publishing his works in sites of the area as MJRoBot.org (Editor/Writer), Hackster.io (#1 Contributor), Instructables.com, and Medium.com (TDS – Towards Data Science). Besides winning several Instructables competitions in the areas of electronics, robotics, and IoT.

Marcelo lives with his wife Ilza in Santiago, Chile, where he divides his time between his consultant work and sharing ideas in the field of Data Science, Electronics, IoT, Physical Computing and Robotics.

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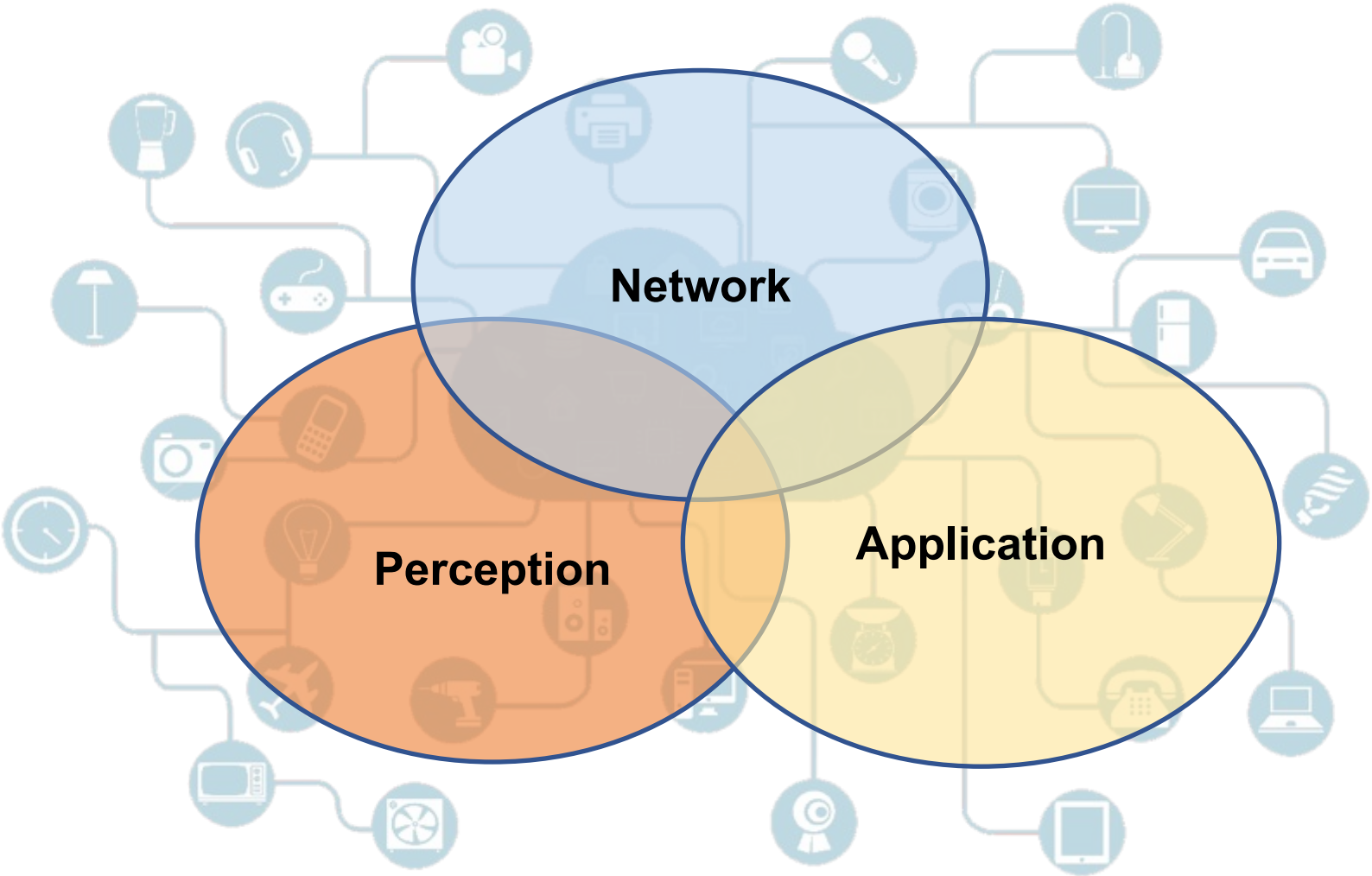
IoT Architecture



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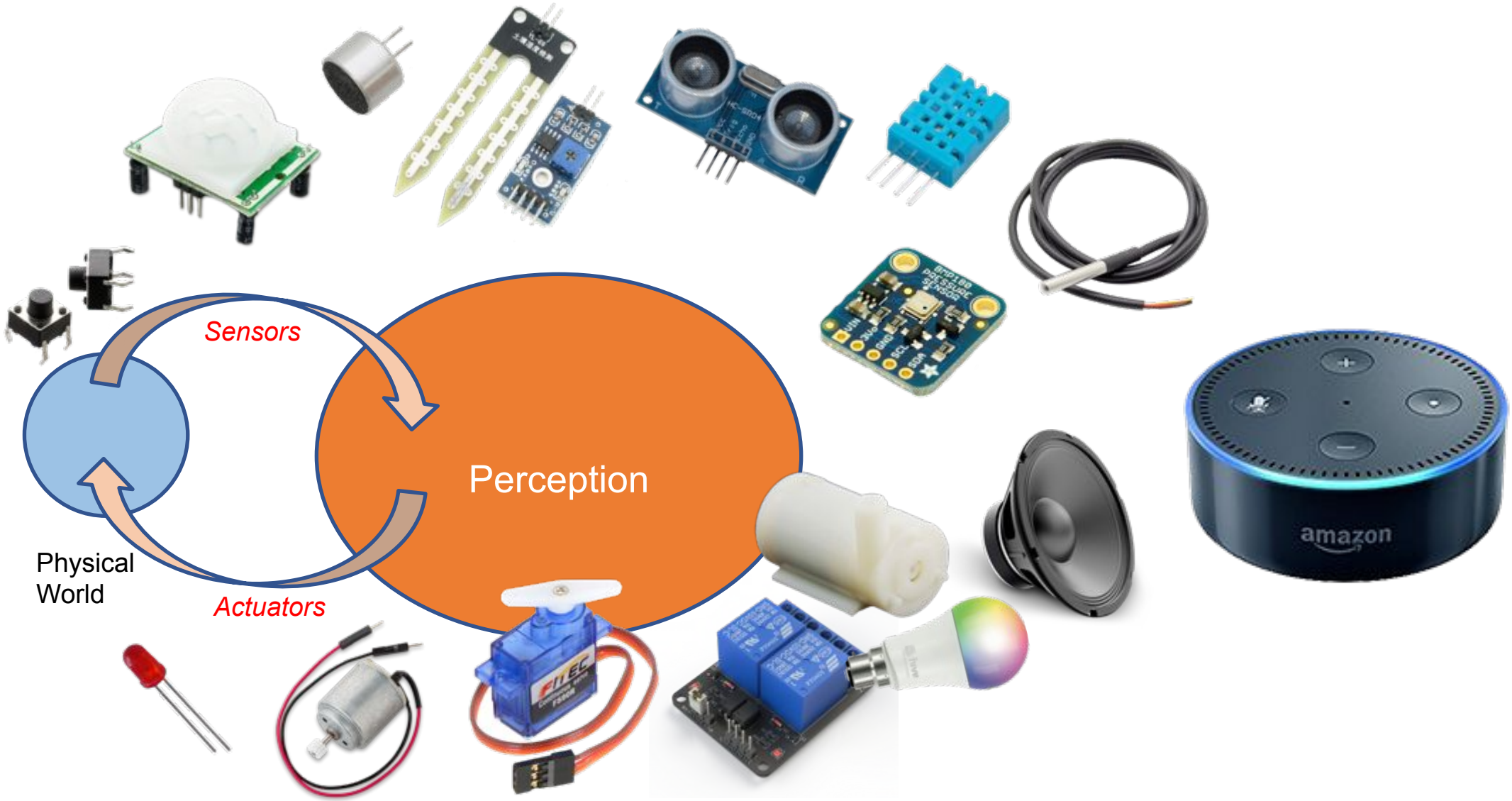
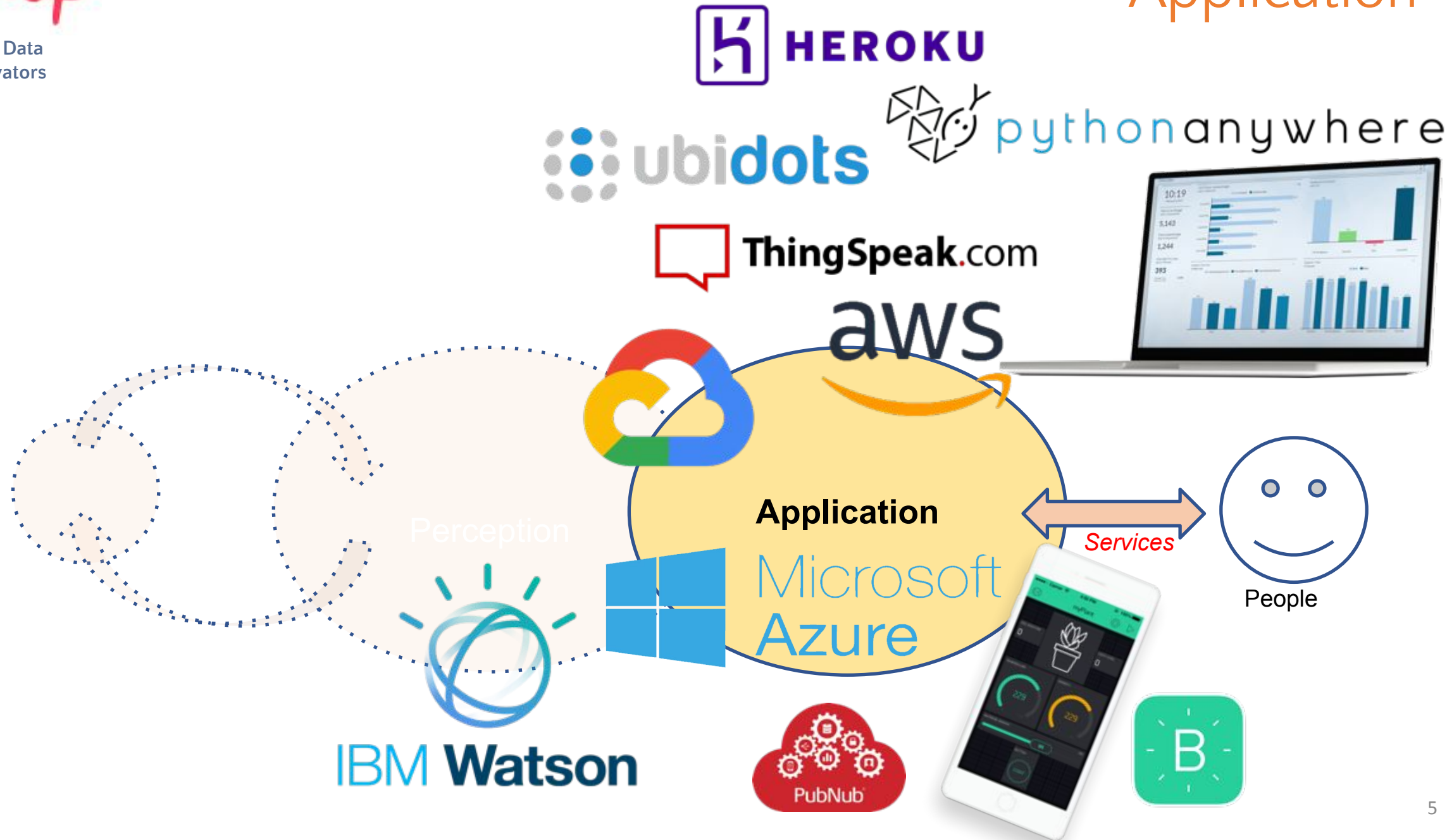
Perception



Application



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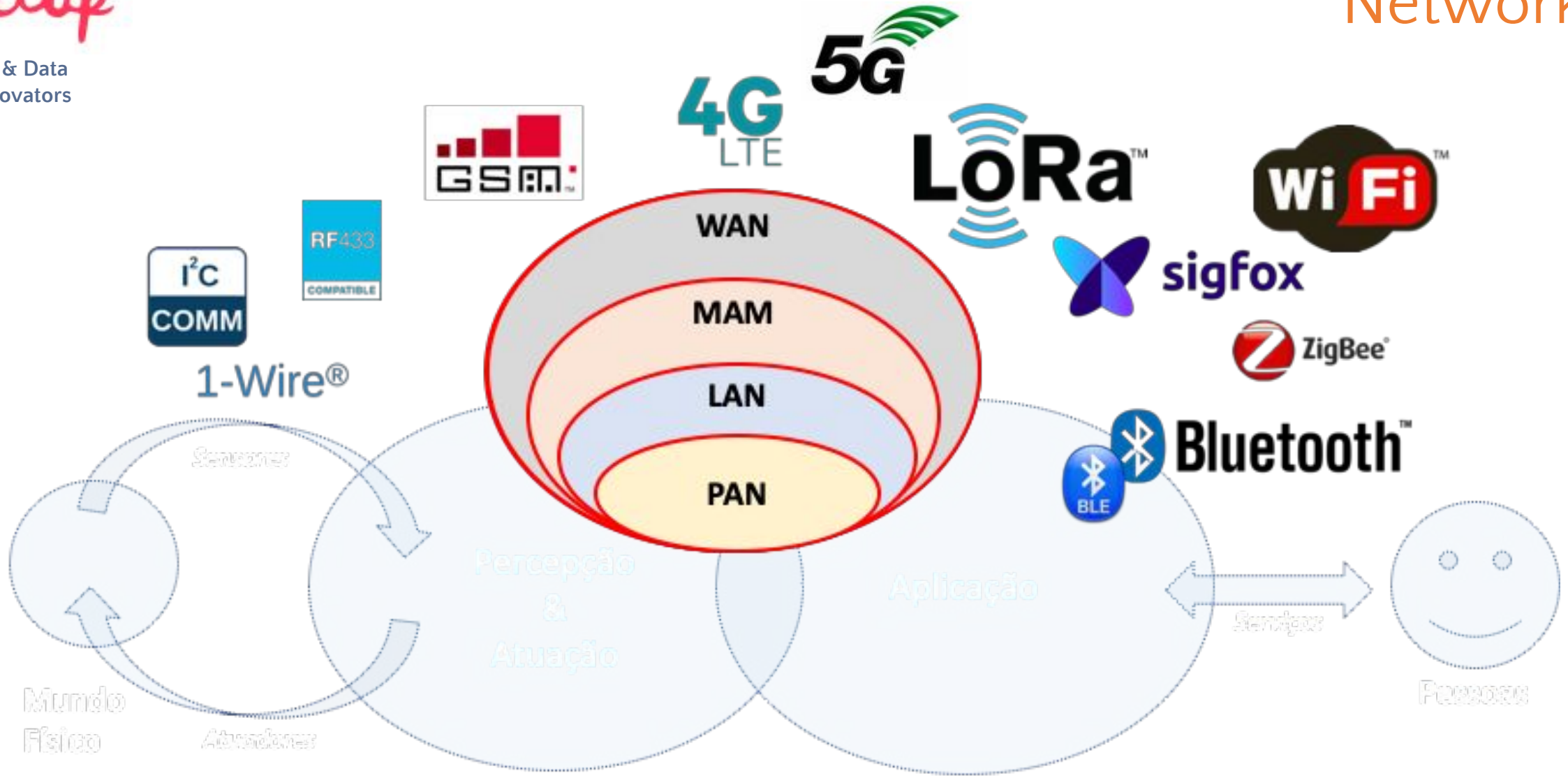
Network



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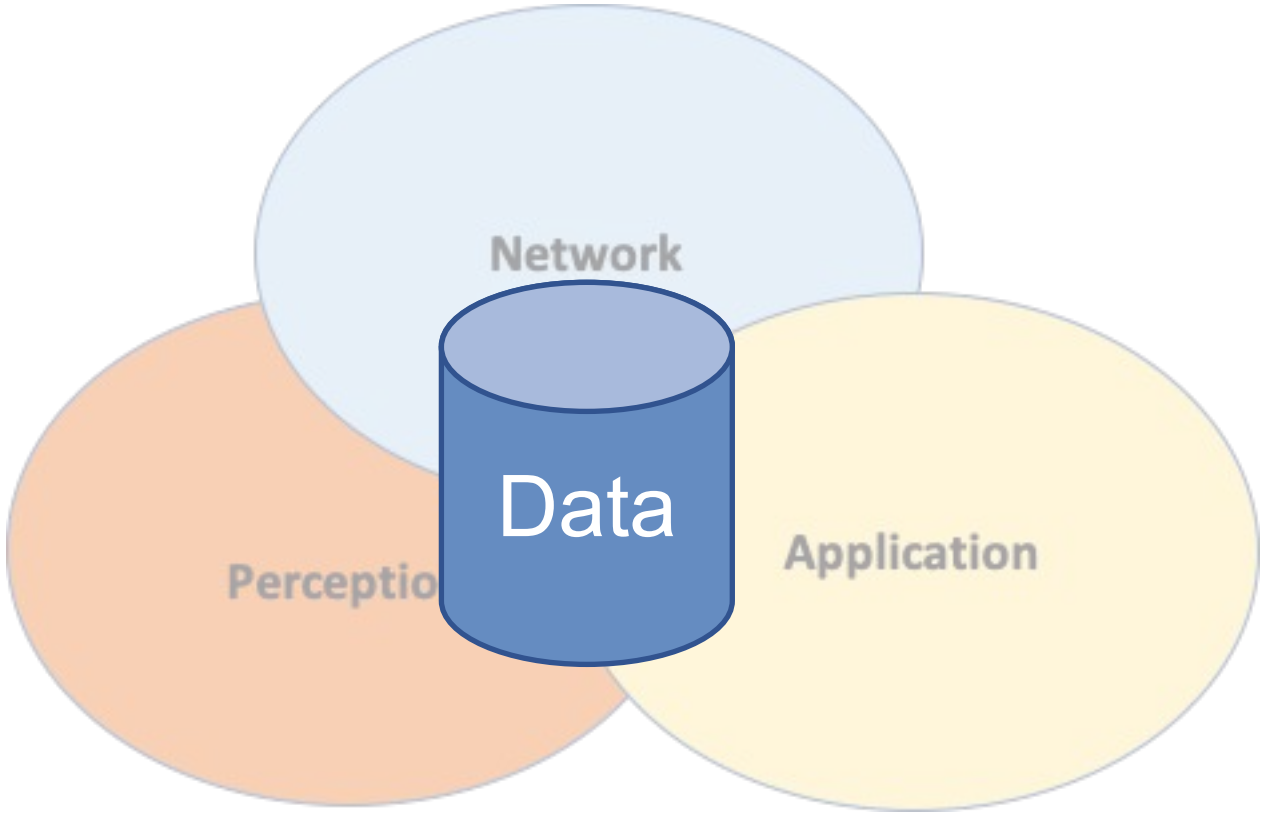
IoT hacking & Data
Science Innovators

IoT -> Data



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IoT -> Data

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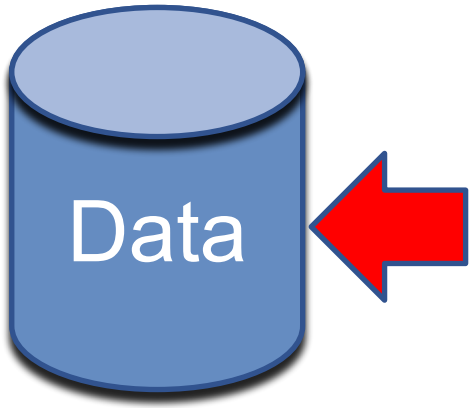
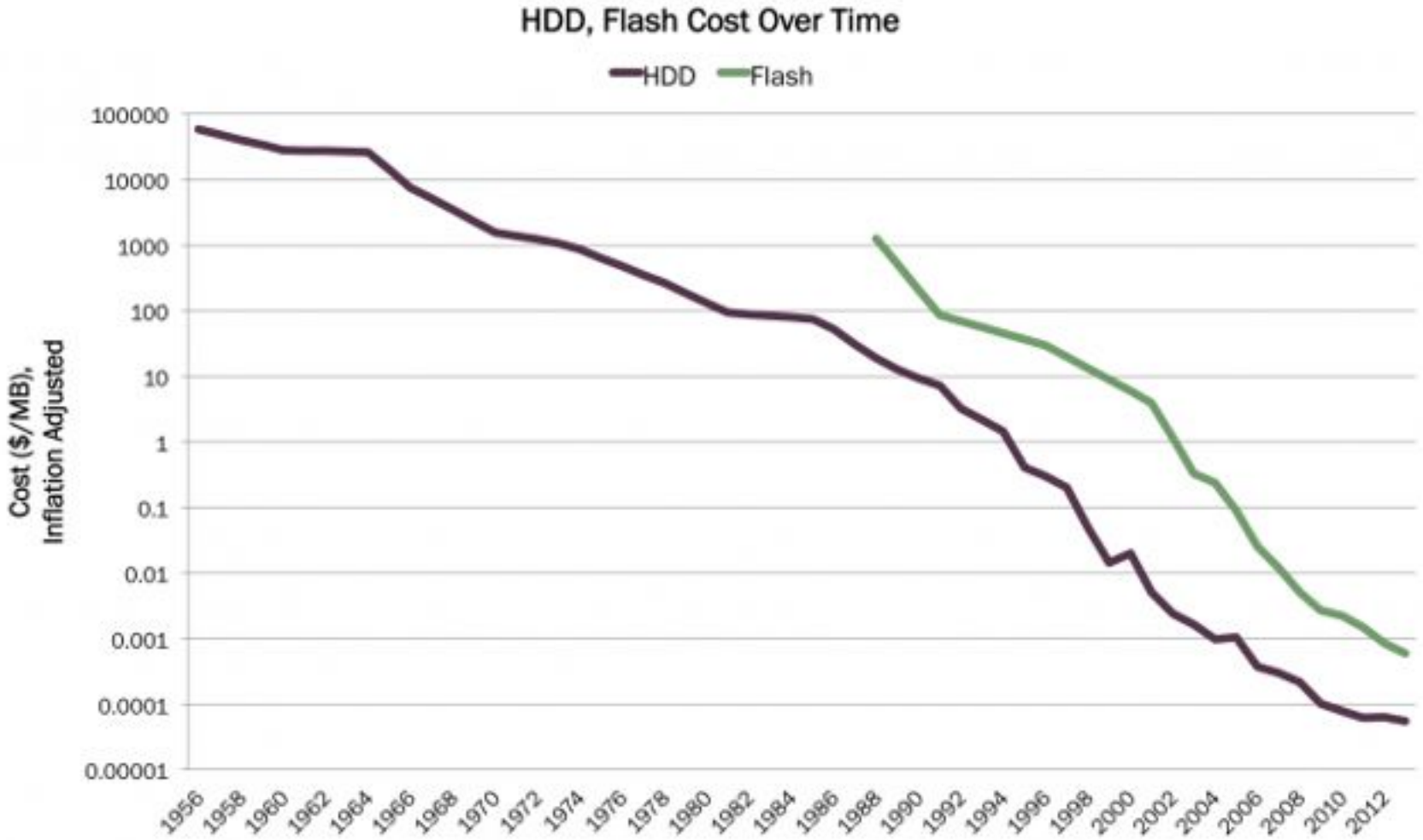
IoT -> Data -> Storage





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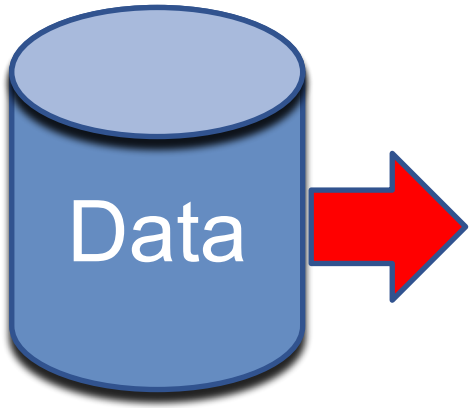
IoT -> Data -> Processing



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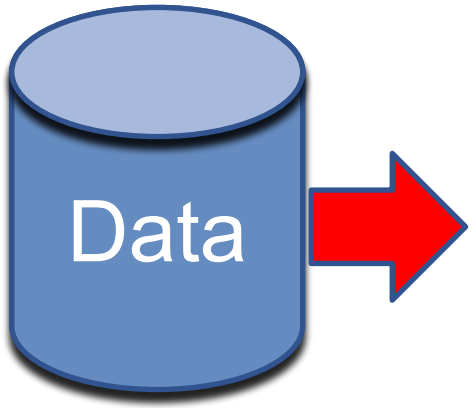
IoT -> Data -> Edge Computing

Edge Computing



ESP32

RaspBerry Pi

BeagleBone

NVIDIA Jetson

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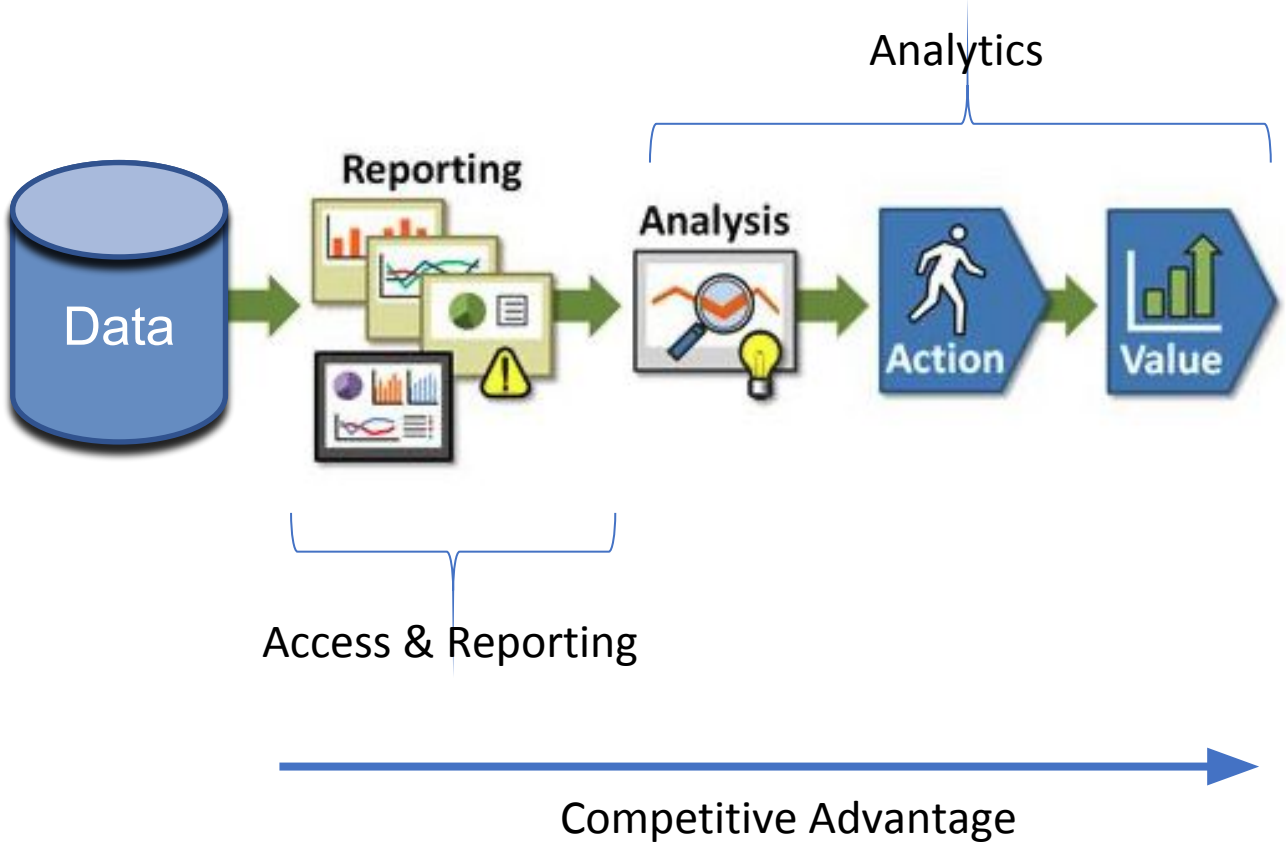
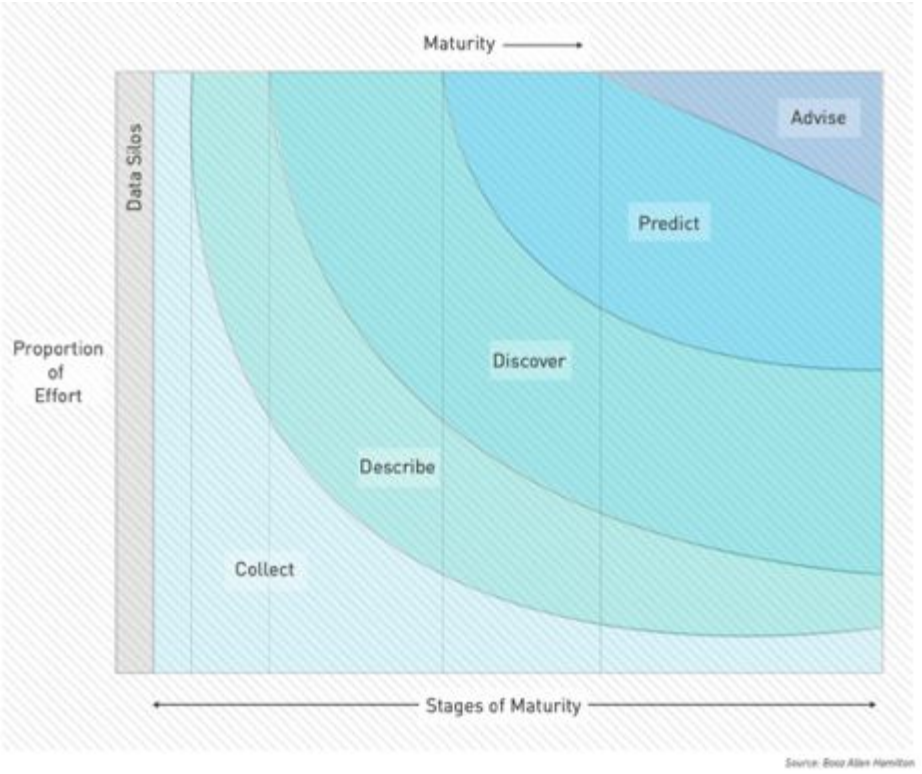
What to do with Data?





Adapted from Creating Data Driven Organization, Carl Anderson

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IoT –> Data –> … –> Value

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IoT -> Data -> ...-> Value

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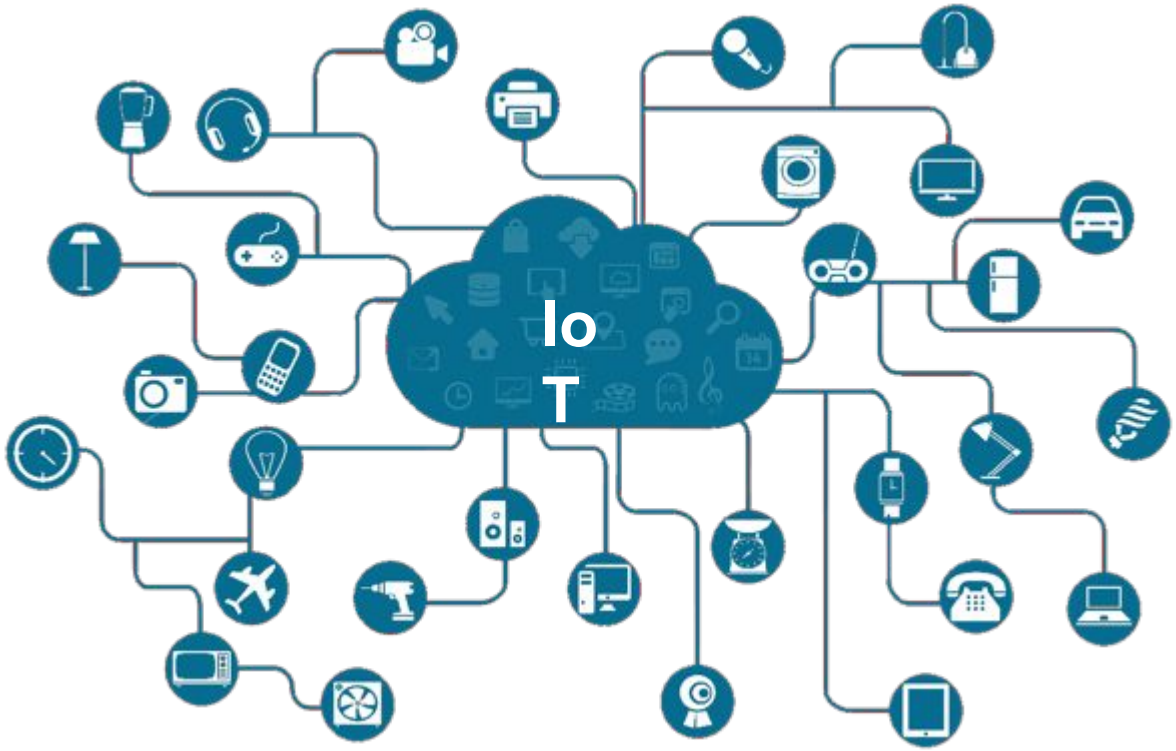
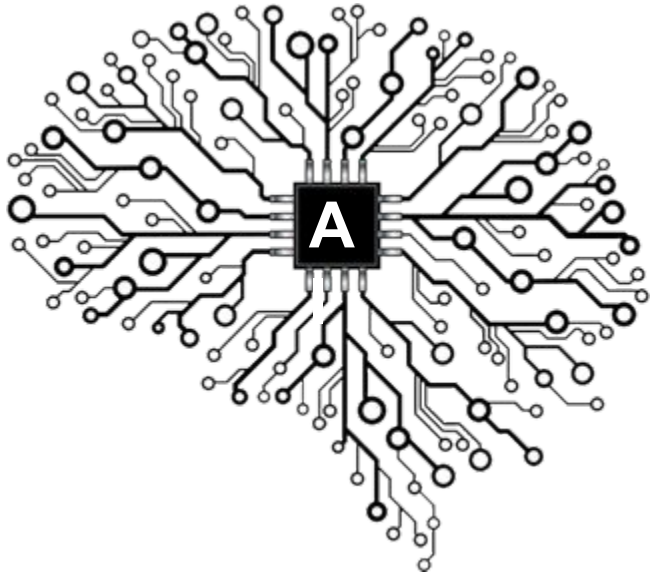
IoT -> Data -> ...-> Value





Data Science

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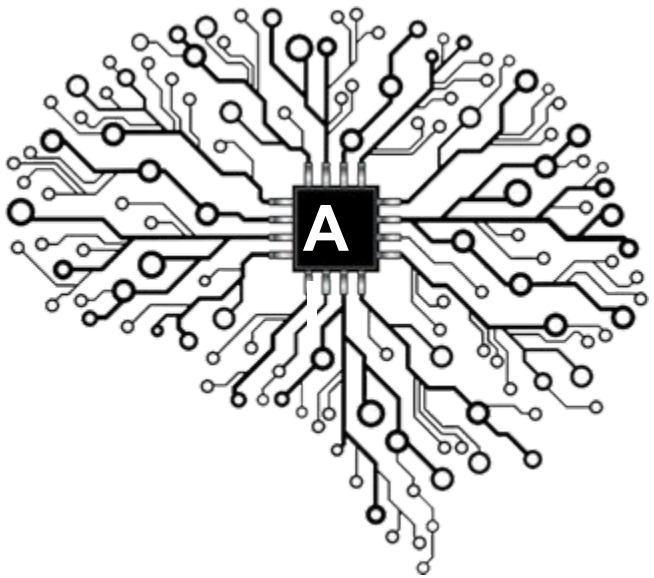
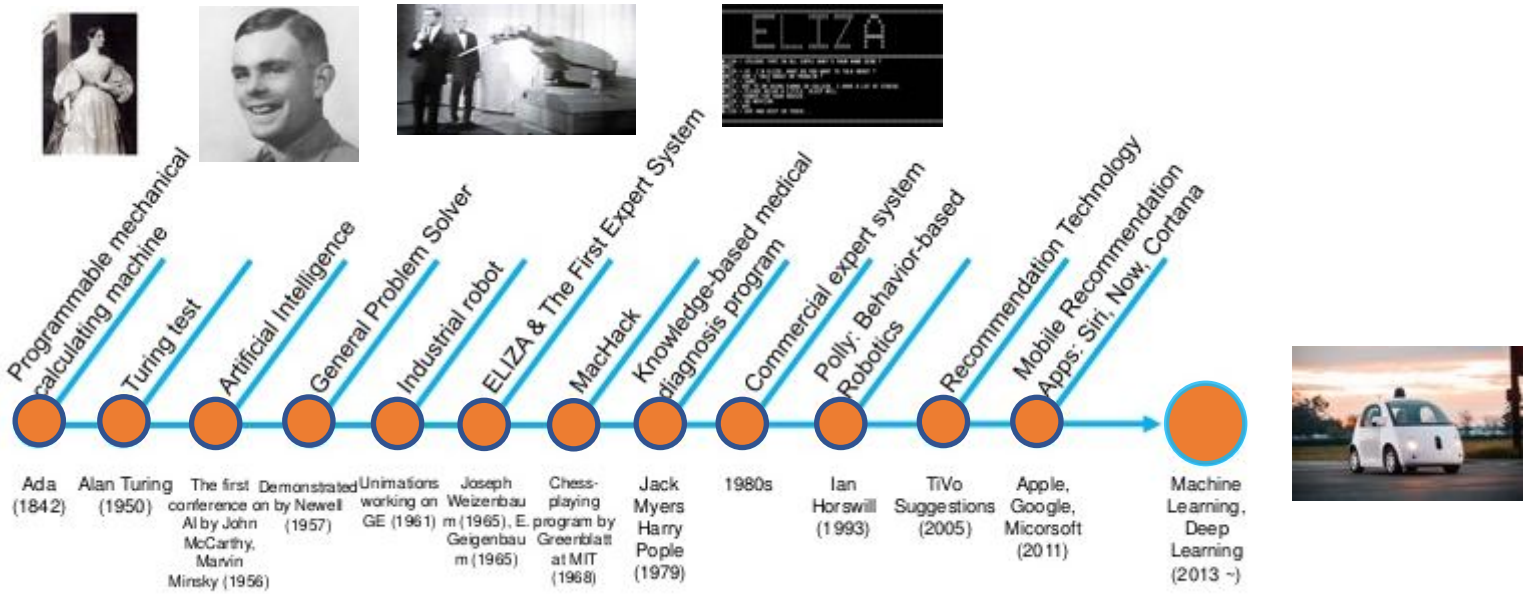
Artificial Intelligence – AI Timeline





1951: Claude Shannon's maze-solving robots

1955: Arthur Samuel's Checkers, the world's first self-learning program

https://en.wikipedia.org/wiki/Timeline_of_artificial_intelligence

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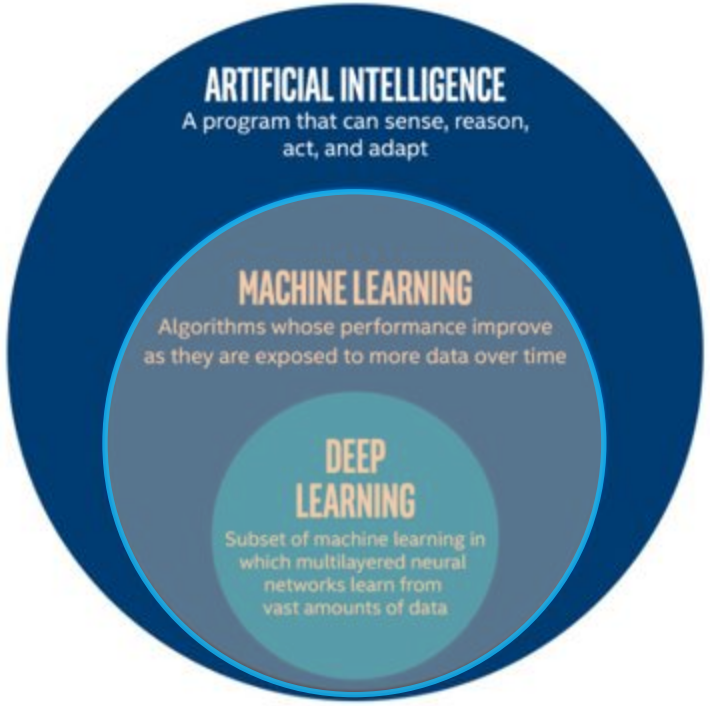
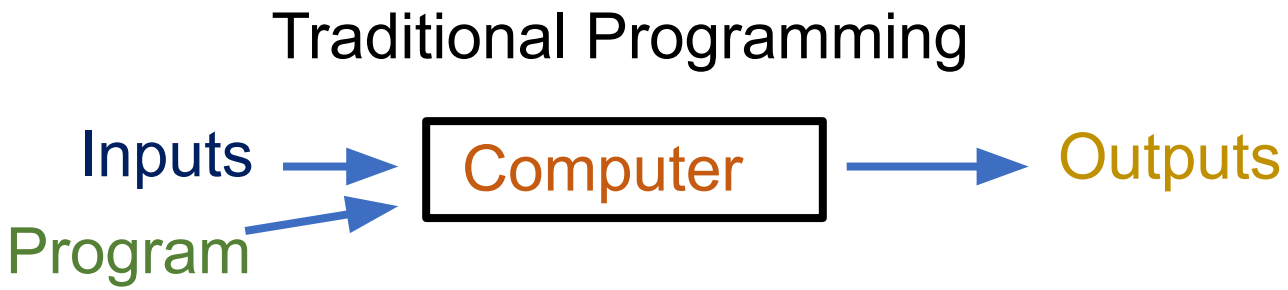
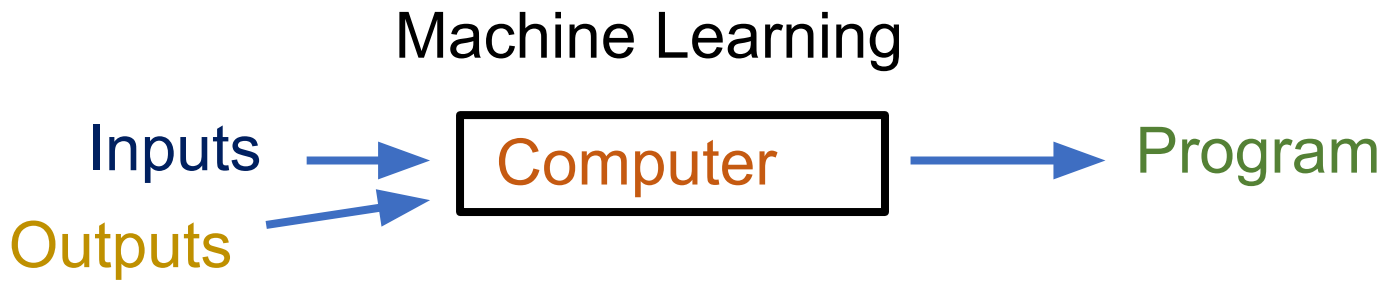
Machine Learning – ML







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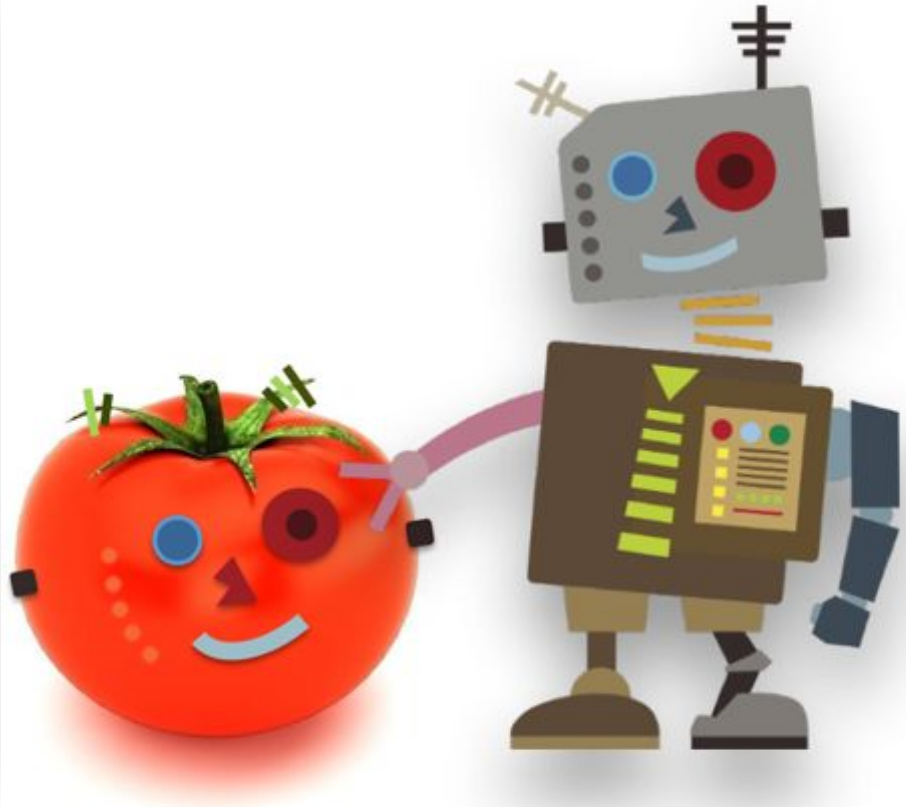
ArduFarmBot – AIoT Project



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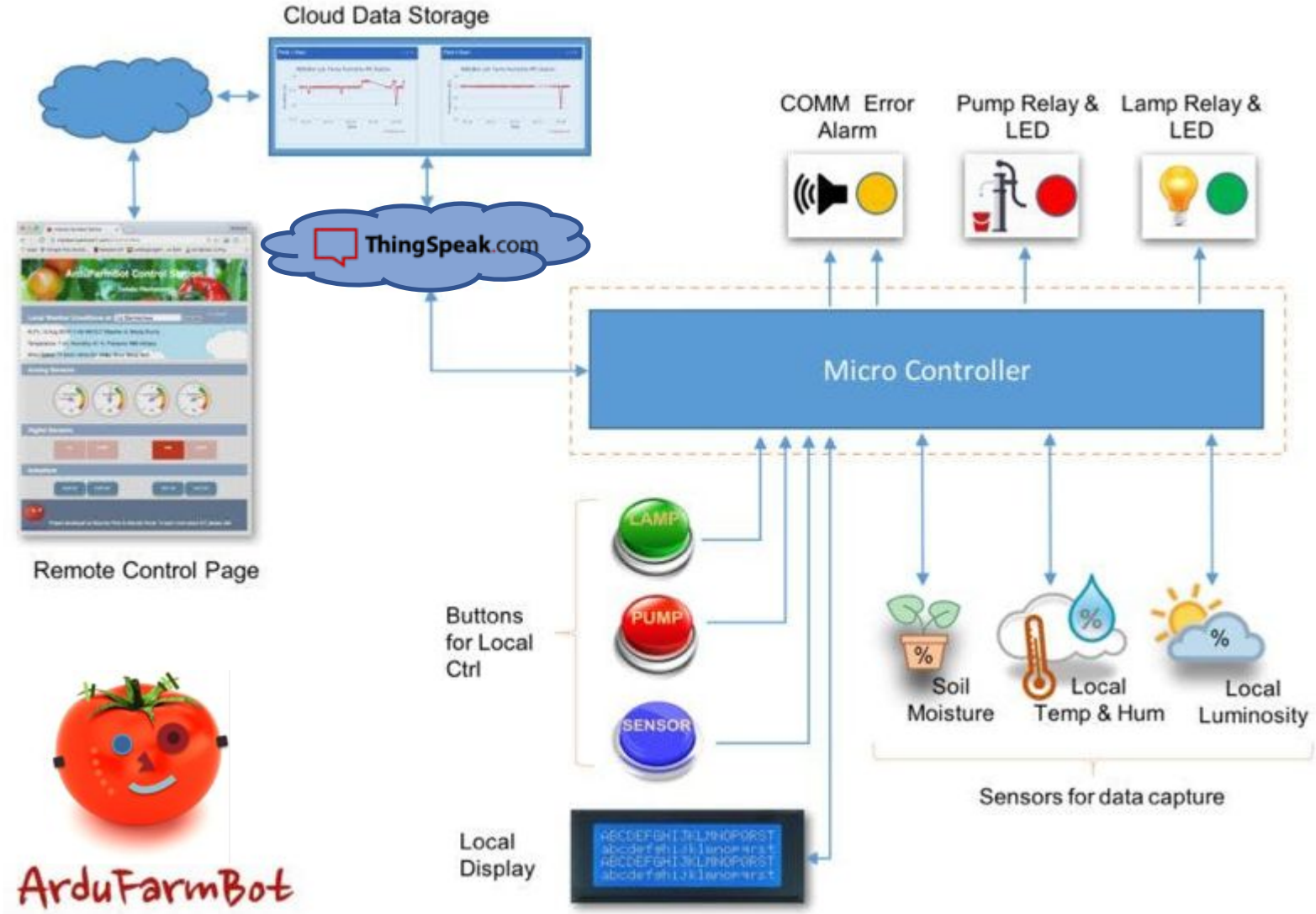
ArduFarmBot – AIoT Project



https://www.amazon.com/ArduFarmBot-automation-Internet-MJRoBot-Tutorials-ebook/dp/B06Y4CTW23

IoT hacking & Data Science Innovators

Data Preparation and Cleaning

The Dataset used in this work is the historical data retrieved from ThingSpeak website from September to December 2016 (*):

On the dataset, there are 47,164 samples divided into 10 columns:

- ✔ “created_at",
- ✔ "entry_id",
- ✔ "Temperature",
- ✔ "Humidity",
- ✔ "Luminosity",
- ✔ "Soil Moisture",
- ✔ "Pump Echo",
- ✔ "Lamp Echo",
- ✔ "Capacitive Soil Moisture" and
- ✔ "Spare".

(*) https://thingspeak.com/channels/146159.

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Data Preparation and Cleaning

- Input variables (Sensors): Temperature, Humidity, Luminosity, Soil Moisture,
- Output variables (Actuators): Pump and Lamp

	temp	humi	lumi	soil	pump	lamp
504	23.0	32.0	73.0	8.0	0.0	0.0
505	23.0	32.0	73.0	8.0	0.0	0.0
506	23.0	32.0	73.0	8.0	0.0	0.0
507	23.0	32.0	73.0	8.0	0.0	0.0
508	23.0	32.0	73.0	8.0	0.0	0.0

Sensors Actuators

ML Model: Decision Tree (Classification)

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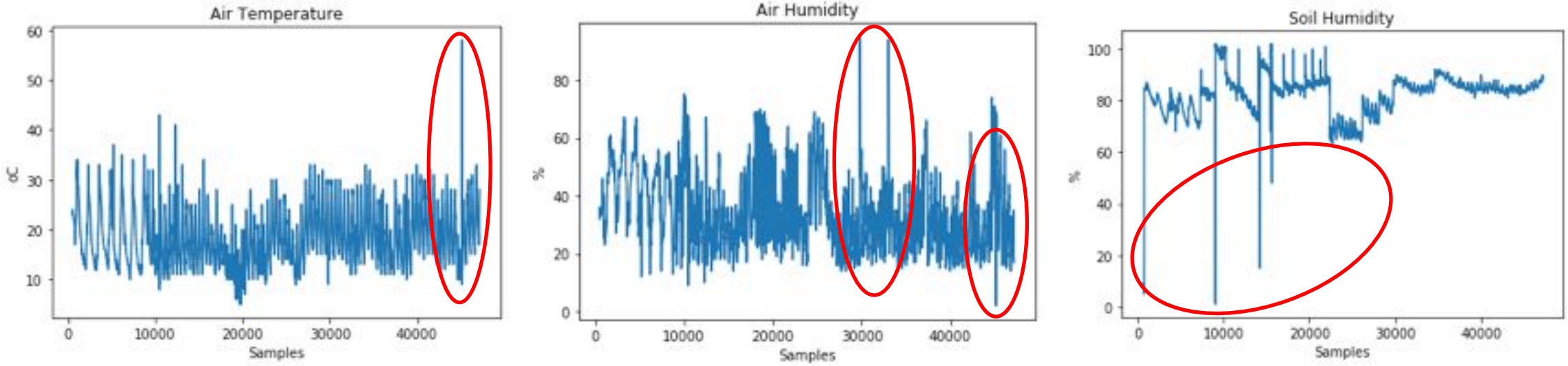
Data Preparation and Cleaning

Noise on data should be eliminated. The right range should be:

- ✔ Temperature lower than 45oC
- ✔ Air Humidity between 10% and 80%
- ✔ Soil Moisture with humidity greater than 60%



After total cleaning, around 17,700 samples are available for analyses.

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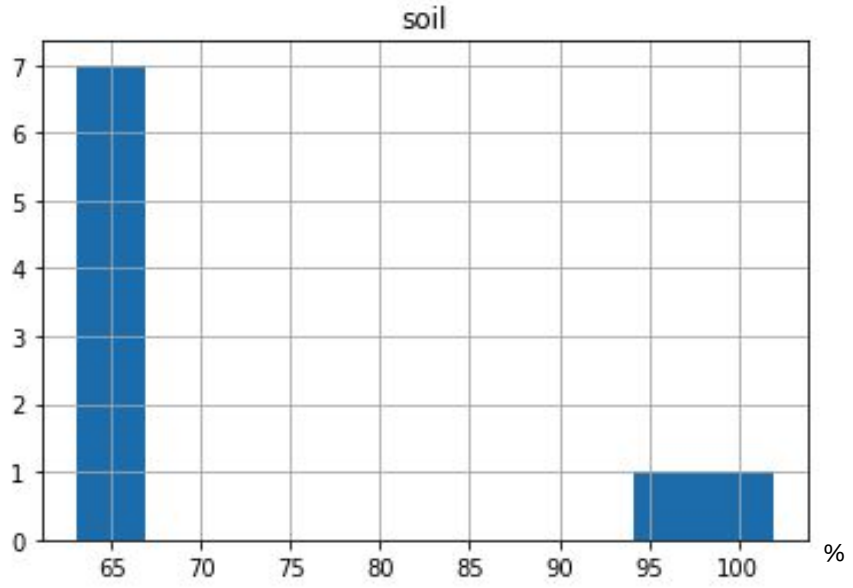
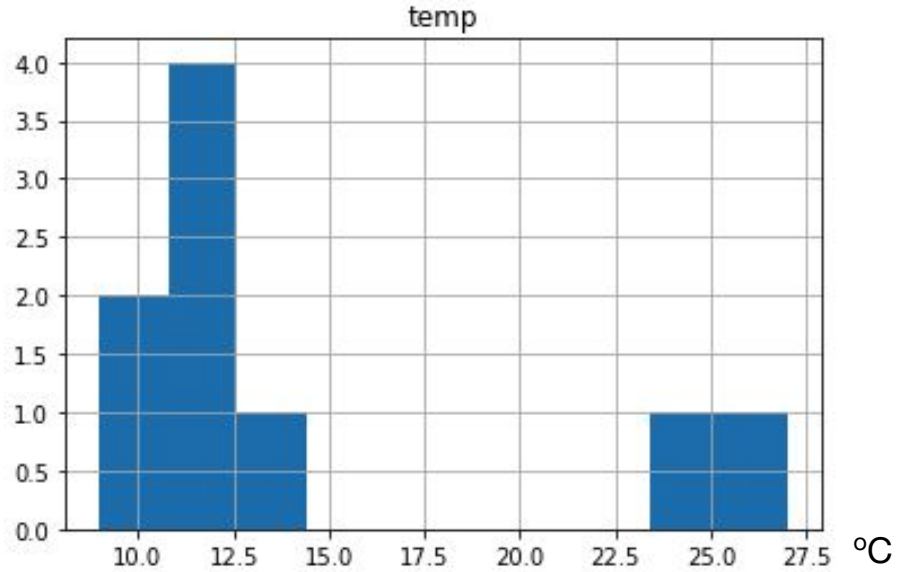
Prediction on Pump operation

- ✔ Applying the model on test data we got a 99% of accuracy
- ✔ Looking only on samples were target variable was “1” (Pump Turned ON), we get:





Pump is Turned ON automatically every time that soil humidity reaches its lowers at 65% and Temperature is low (10ºC to 15ºC). Some actuations also appears around 100% what should be manual commands

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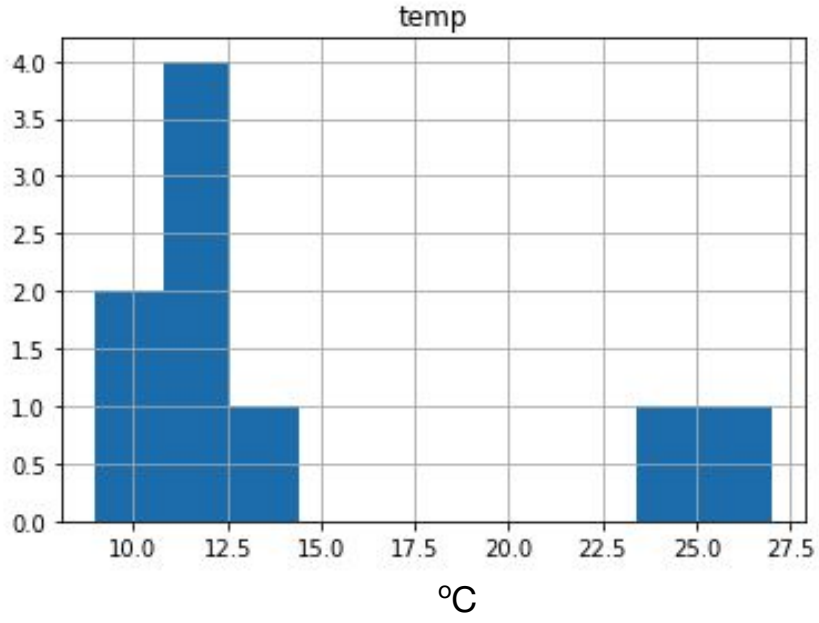
Prediction on Lamp operation

- ✔ Applying the model on test data we got a 93% of accuracy
- ✔ Looking only on samples were target variable was “1” (Lamp Turned ON), we get:



The lamp is turned ON automatically at lower temperatures (around 12ºC). Some actuations also appear around 25ºC what can be attributed to manual commands.

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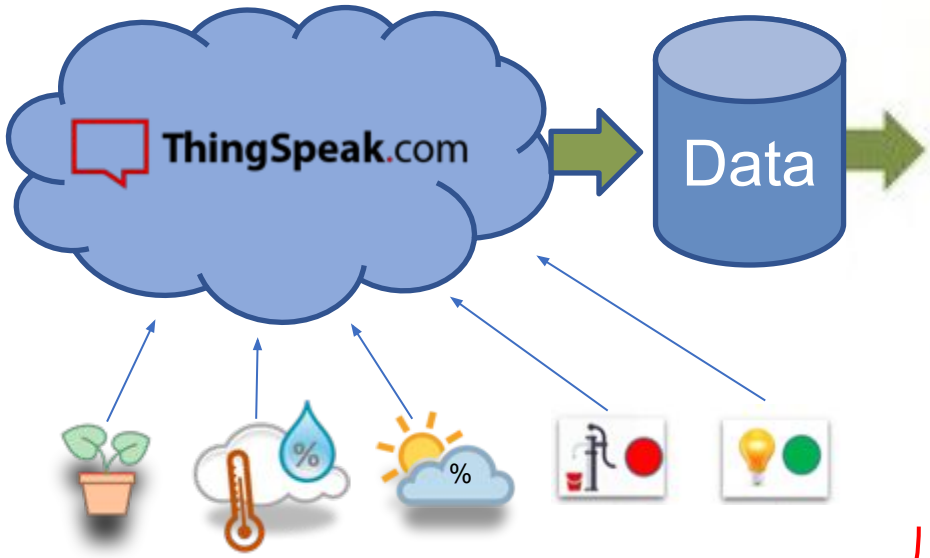

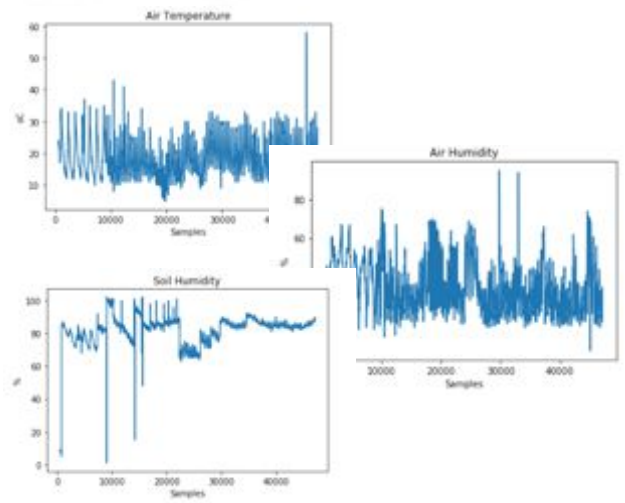

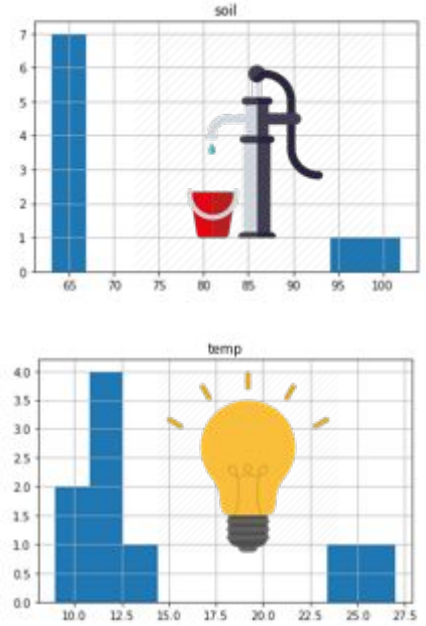

IoT **EDA** **AI (ML)**

ARDUINO

Pandas

matplotlib

scikit learn

https://github.com/Mjrovai/Python4DS/tree/master/ArduFarmBot_Data_Analysis

NYC Taxi – Trip Prediction Project

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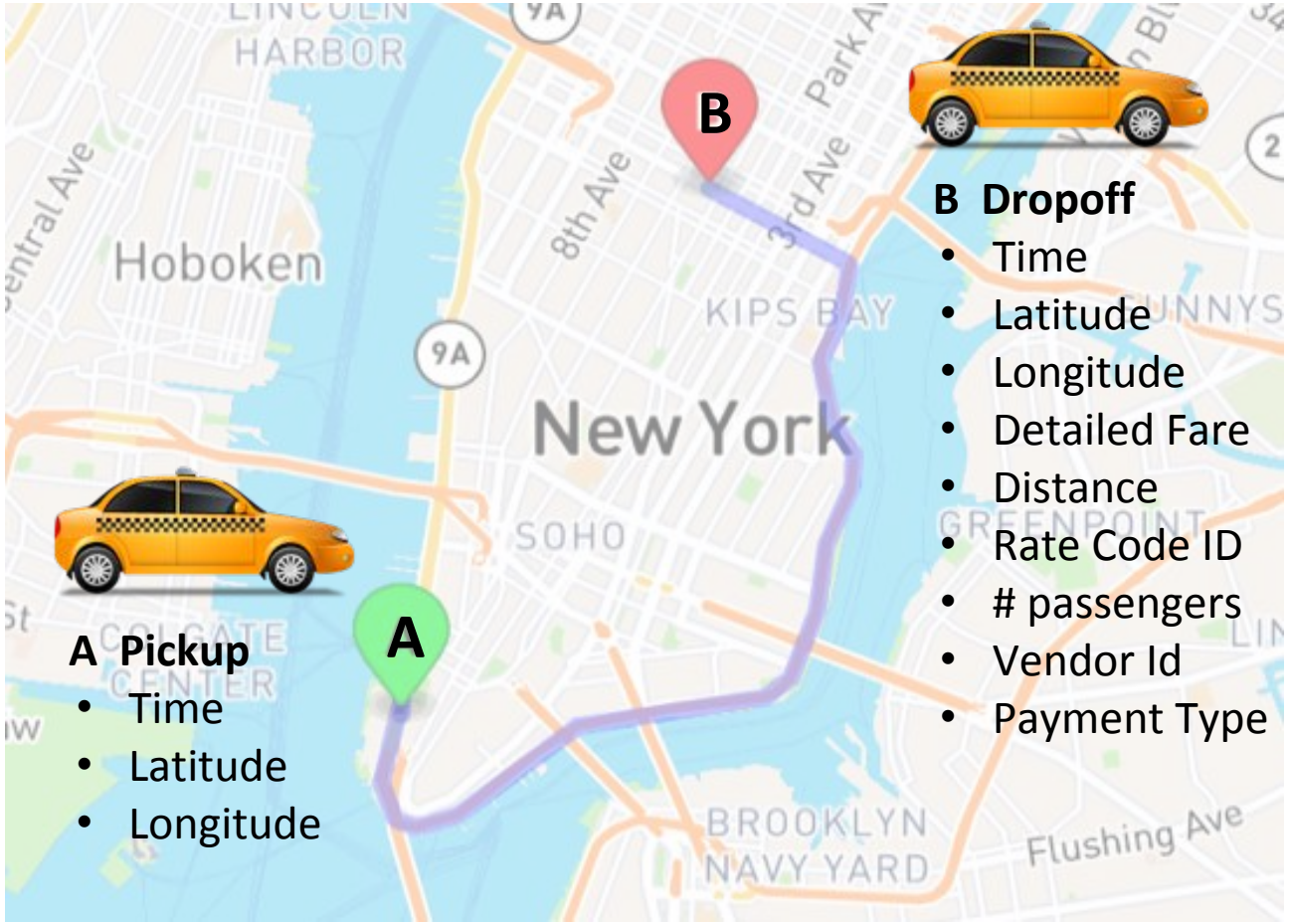
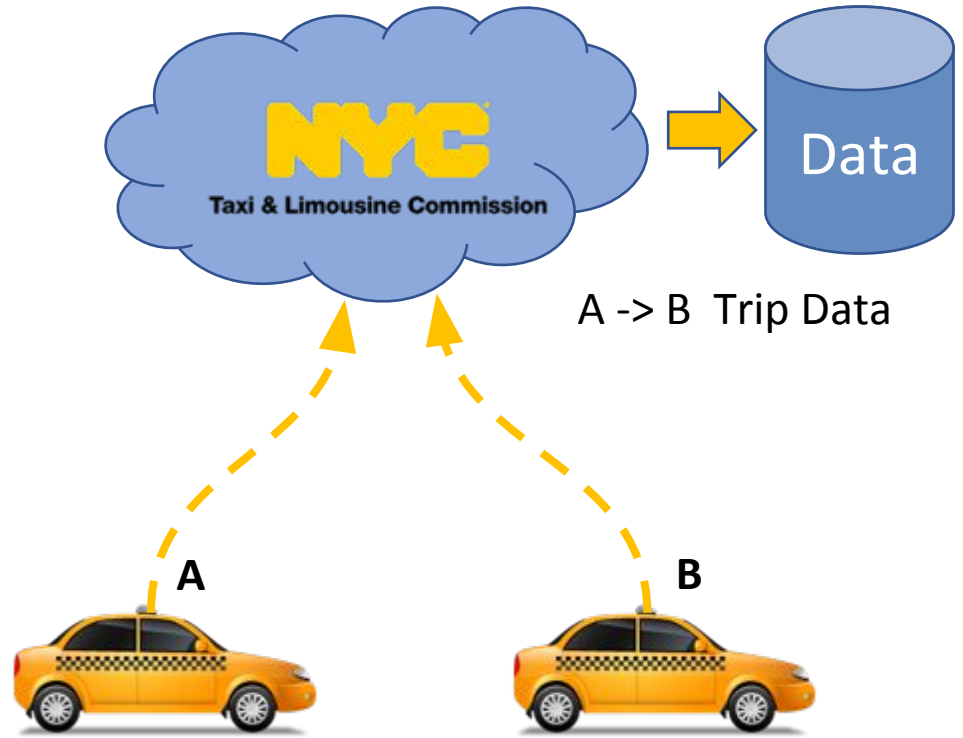
IoT hacking & Data Science Innovators

NYC Taxi – IoT – Getting data





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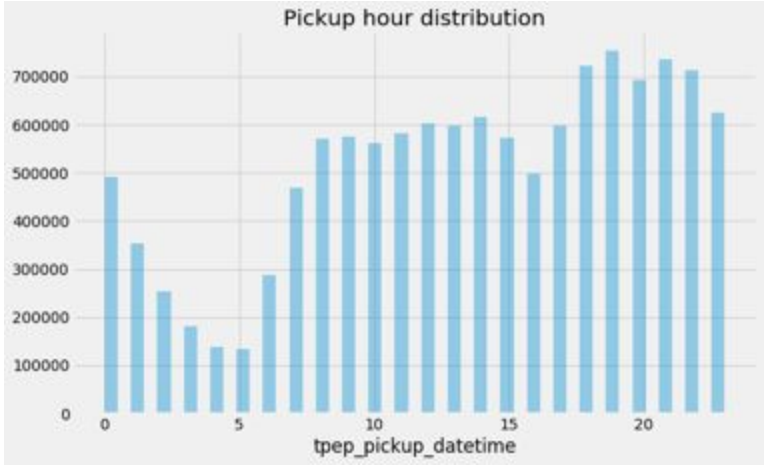
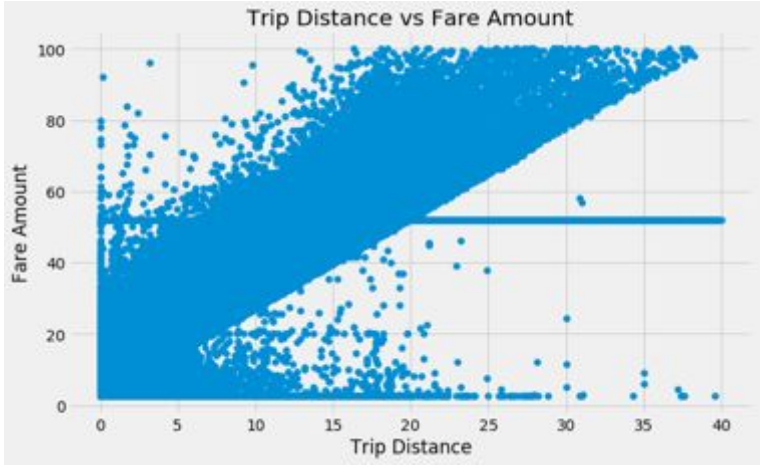
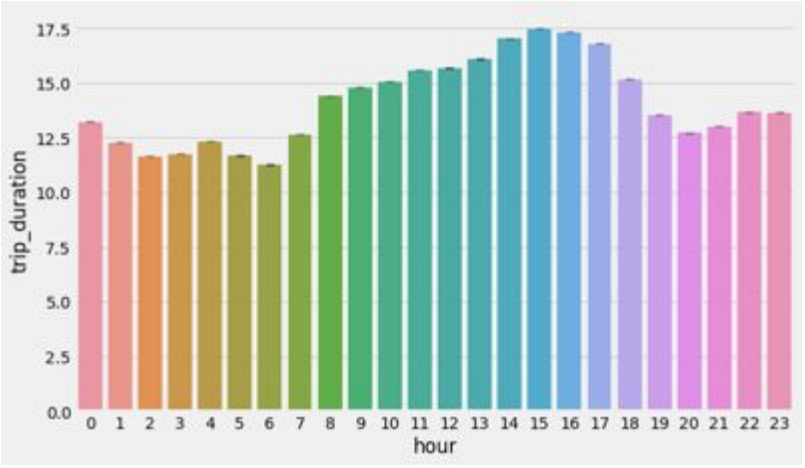
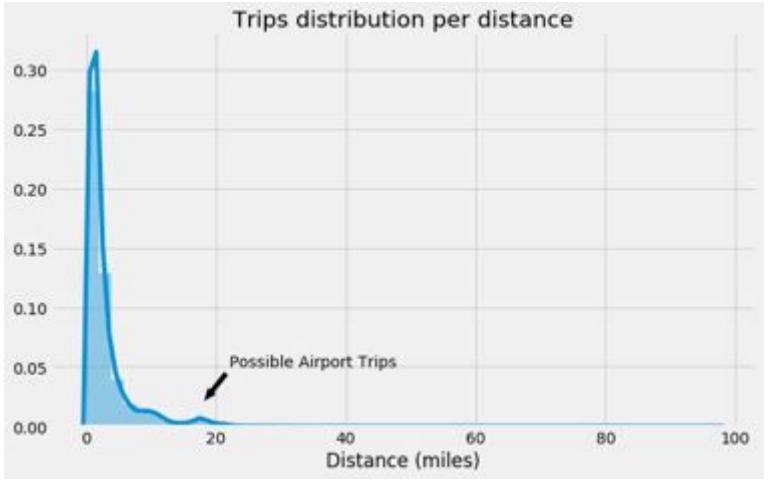
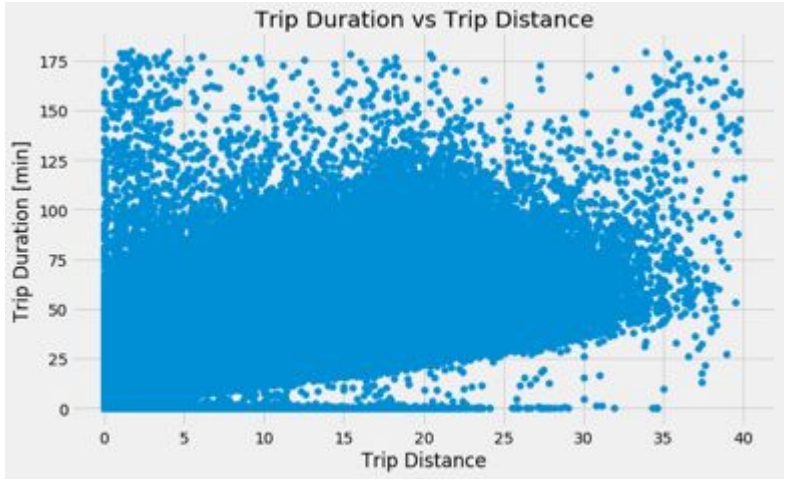
NYC Taxi – AIoT Project – EDA

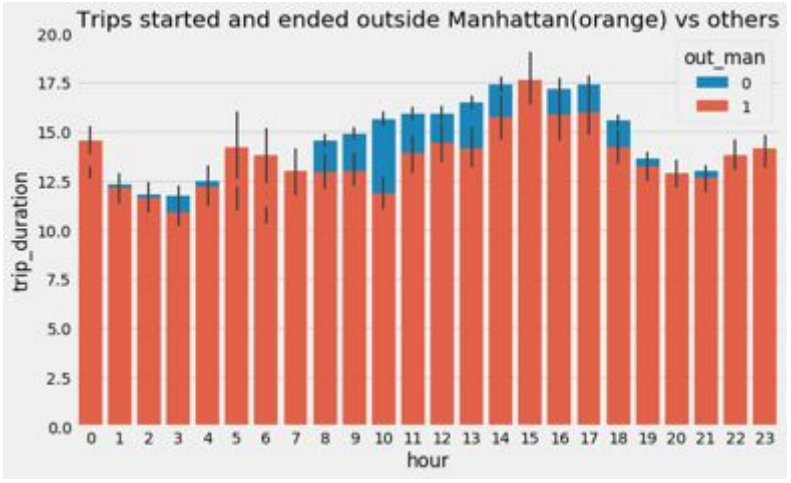












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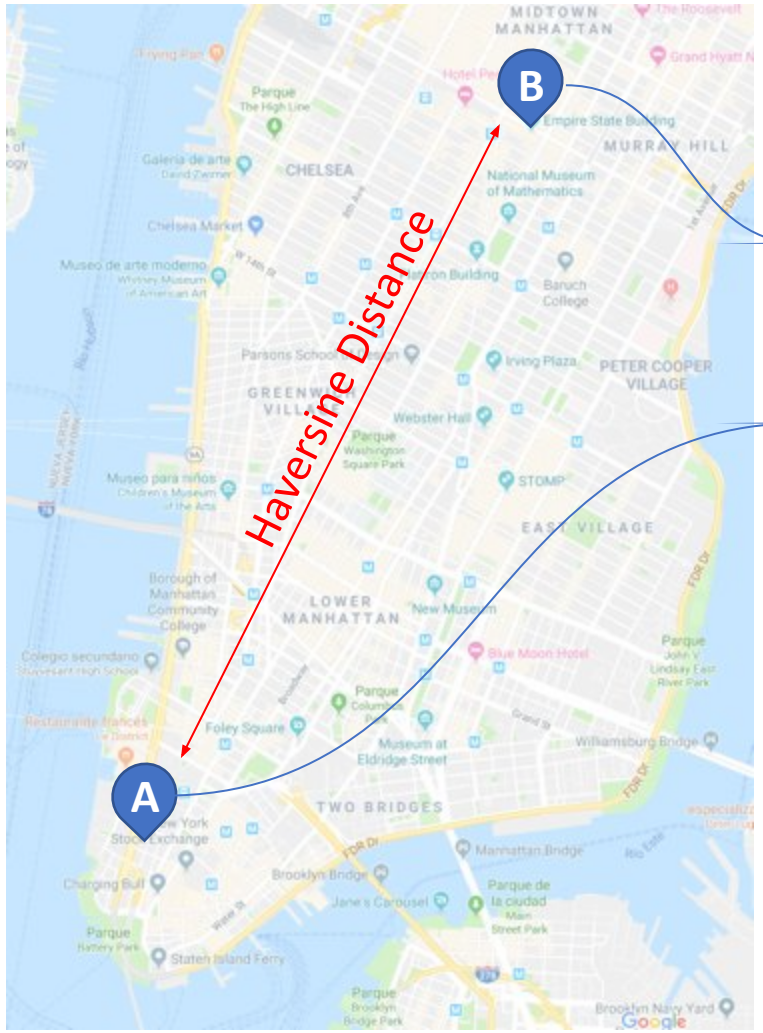
NYC Taxi Trip Prediction - ML



Dropoff Latitude
Dropoff Longitude

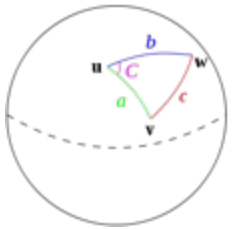
Pickup Latitude
Pickup Longitude
Pickup Time

ML Models

Fare

Distance

Duration

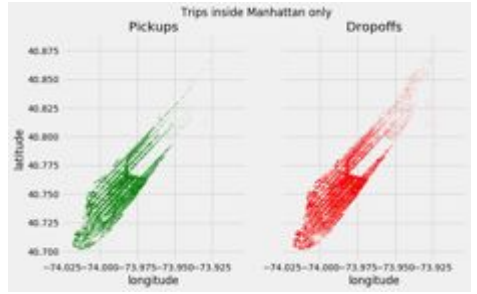


$$2r\arcsin\left(\sqrt{\sin^2\left(\frac{\varphi_2-\varphi_1}{2}\right)+\cos(\varphi_1)\cos(\varphi_2)\sin^2\left(\frac{\lambda_2-\lambda_1}{2}\right)}\right)$$

Hav. Dist.

Rate Code

In/Out Manh.



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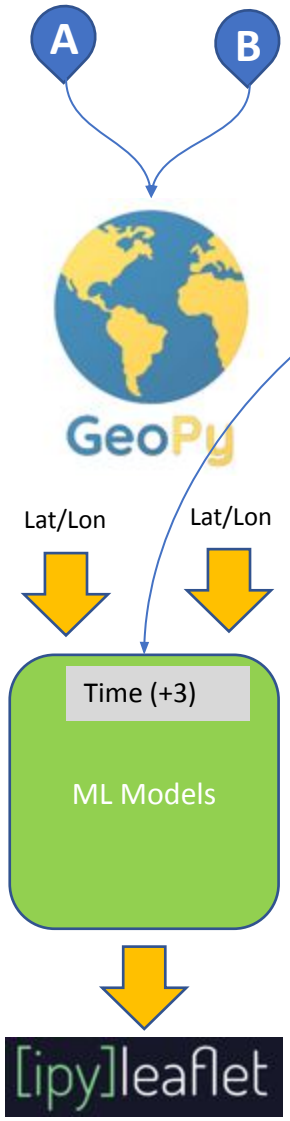
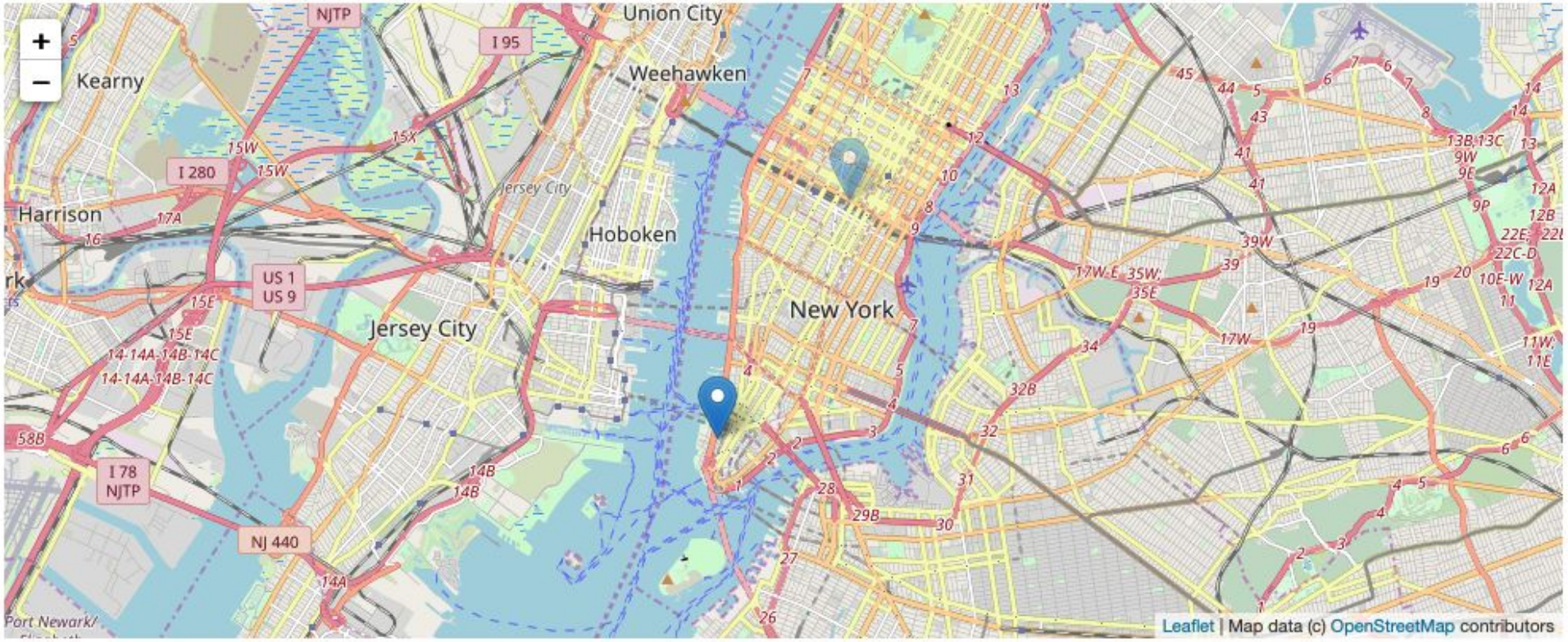
NYC Taxi Trip Prediction - Deploy




```
1  start_loc = "New York Marriott Downtown"
2  end_loc = "Empire State Building"
3
4  predict_trip(start_loc, end_loc)
```

executed in 4.16s, finished 12:03:08 2019-02-08

```
Trip has 4.8 miles and will last 28.0 minutes, with a basic cost od $21.57
[Trip Info]: Trip inside Manhattan; Rate Code: Standard
```



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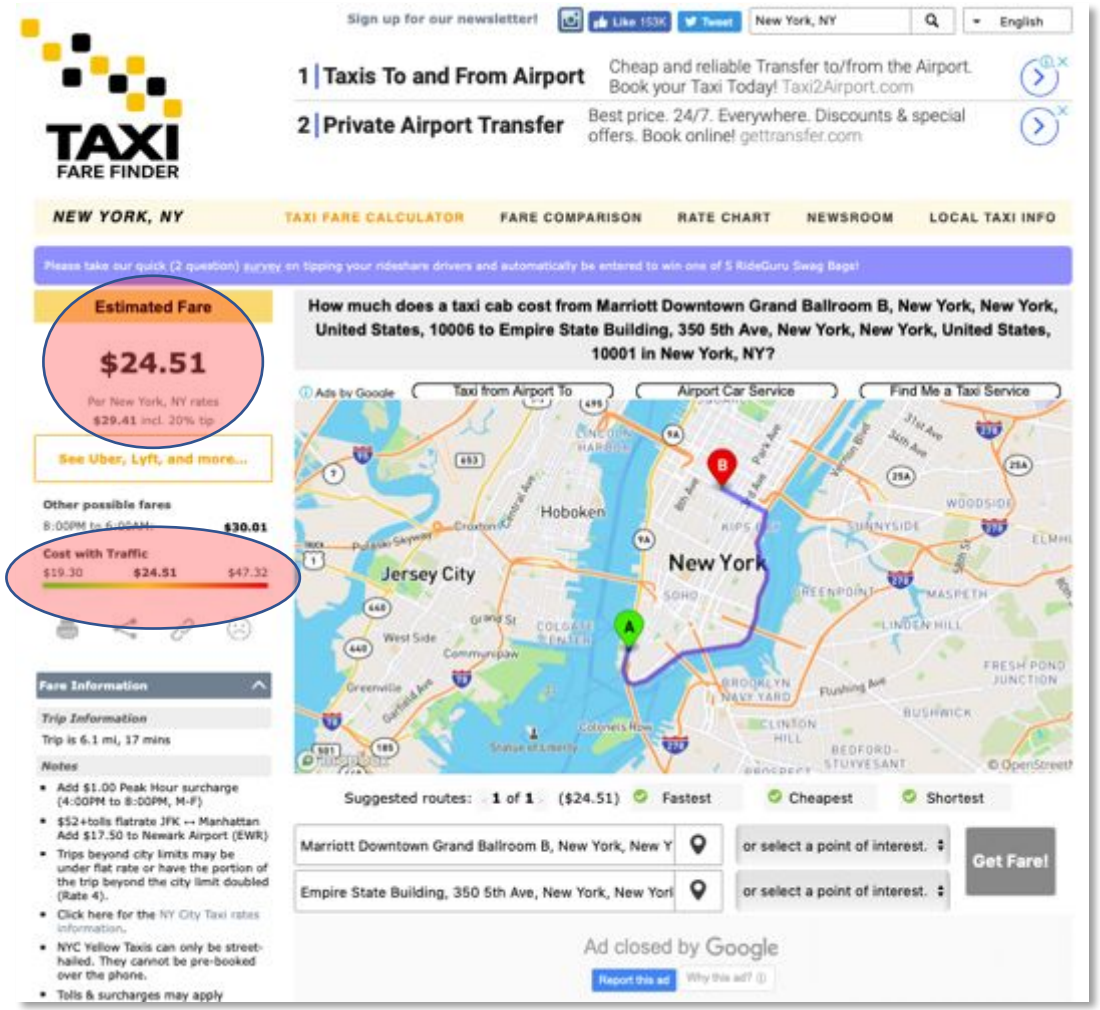
NYC Taxi Trip Prediction – Benchmark

```
Trip has 4.8 miles and will last 28.0 minutes, with a basic cost od $21.57
[Trip Info]: Trip inside Manhattan; Rate Code: Standard
```



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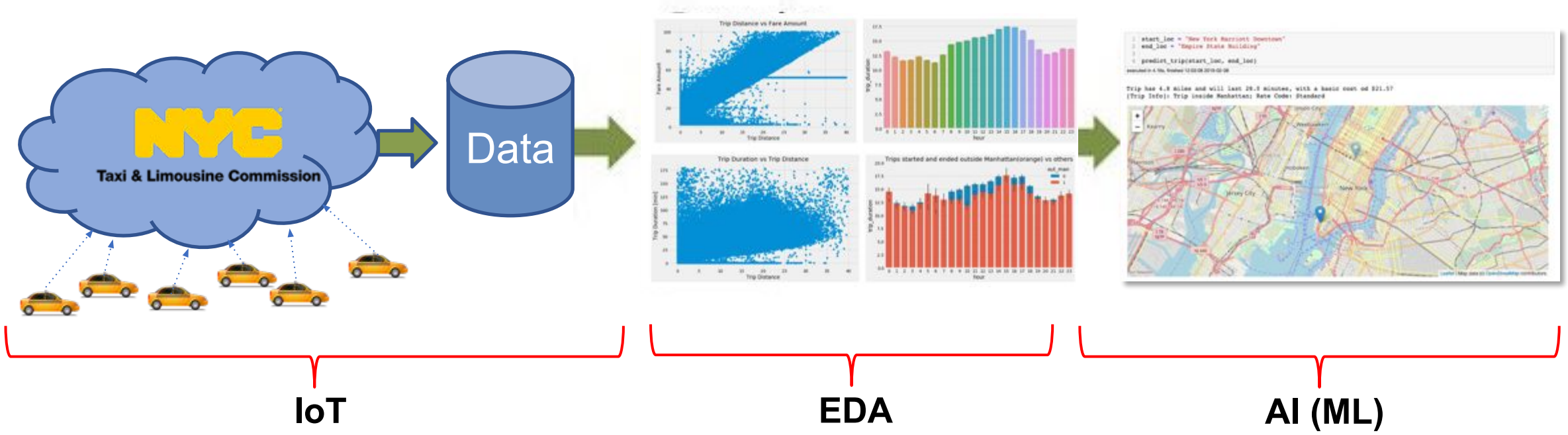
NYC Taxi – AIoT Project



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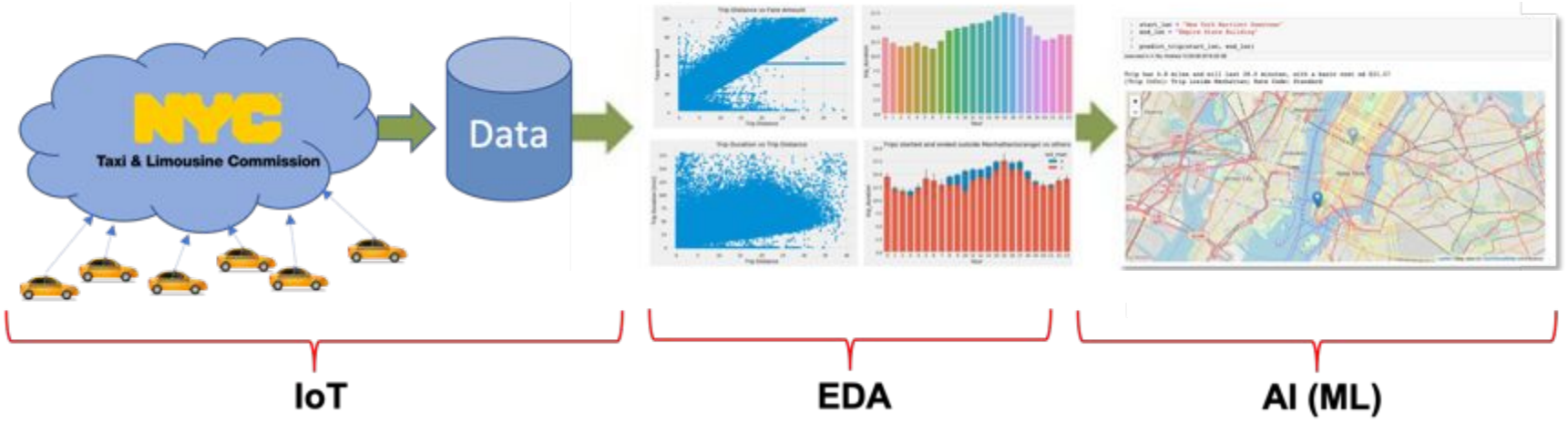
Data Science Environment

ANACONDA

jupyter



Pandas

matplotlib

Seaborn

[ipy]leaflet

GeoPy

scikit learn

NumPy

https://github.com/Mjrovai/UDD_Master_Data_Science/tree/master/AML-NYC_TAXI_TRIP_PREDICTION

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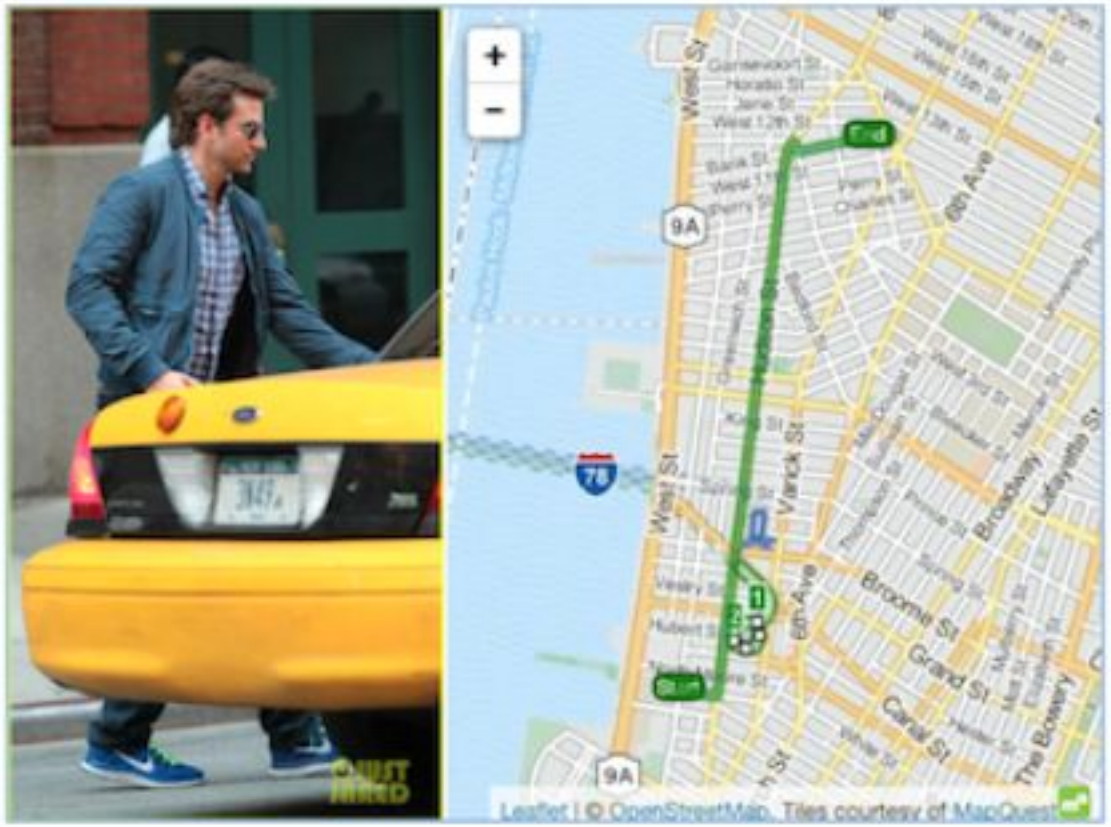
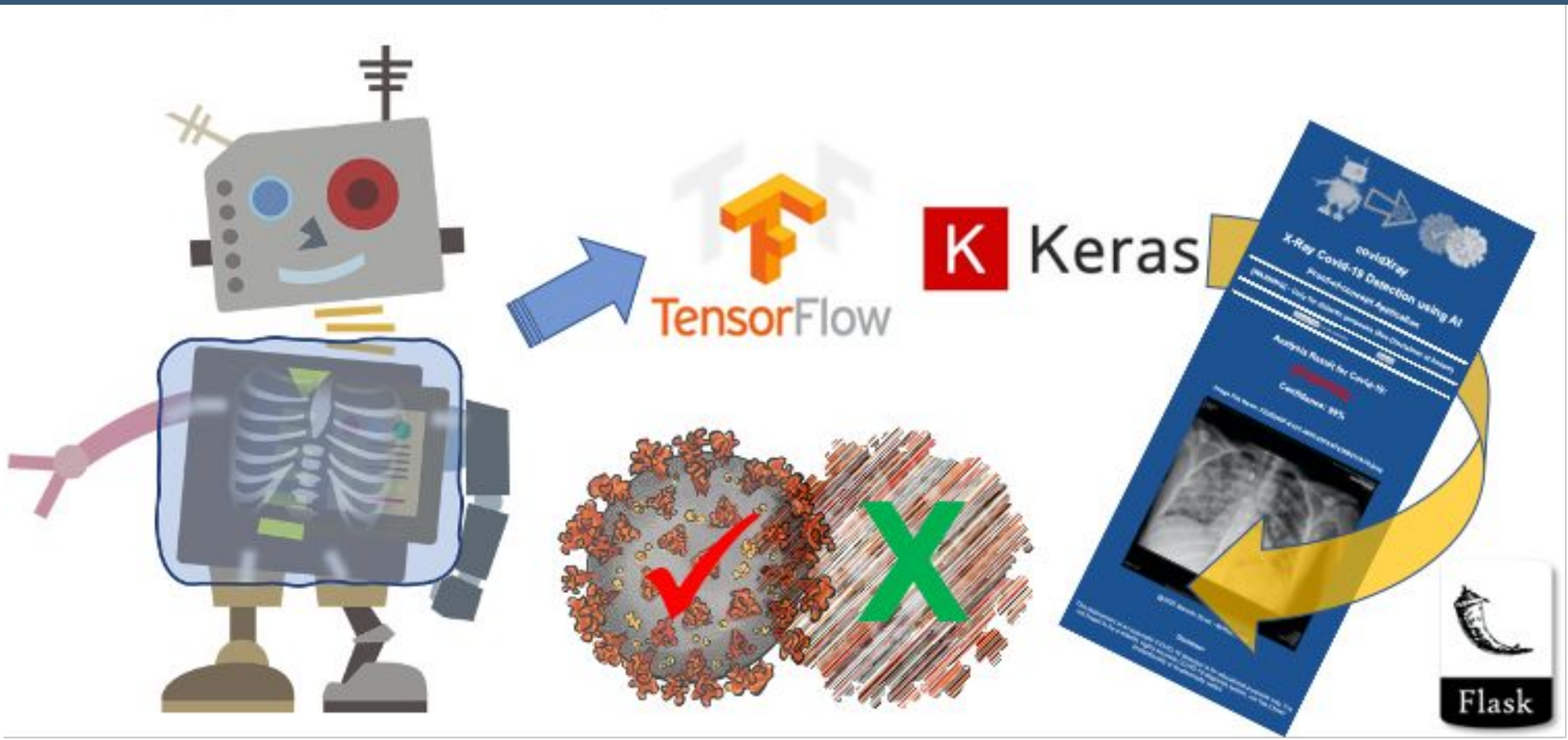
Warning – Violating privacy

Stalking celebrities



A few innocent nights at the gentlemen's club



Applying Artificial Intelligence techniques in the development of a web-app for the detection of Covid-19 in X-ray images

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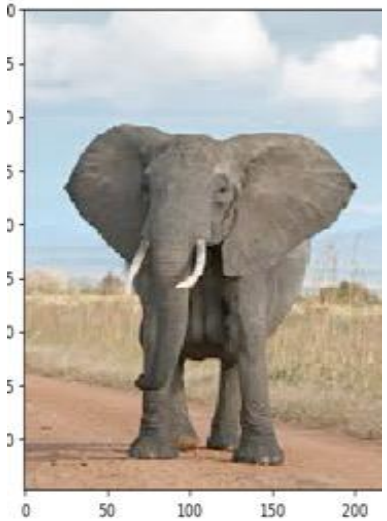
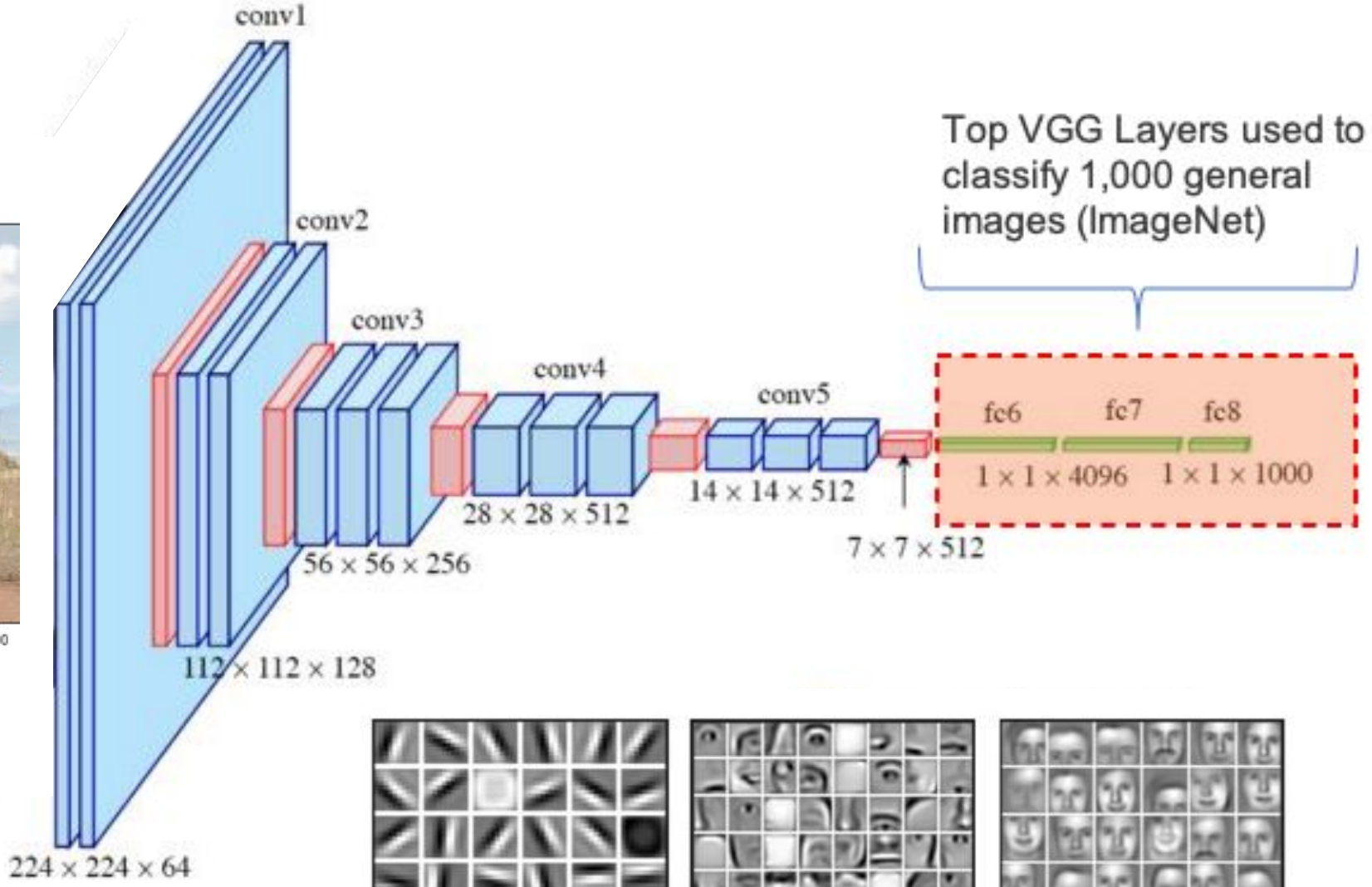
VGG-16 Convolutional Neural Network Model



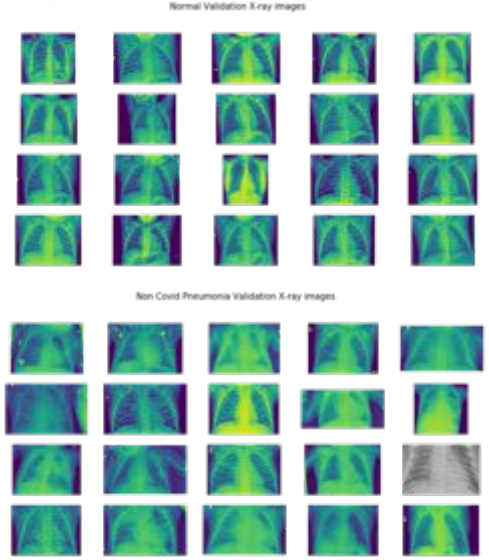


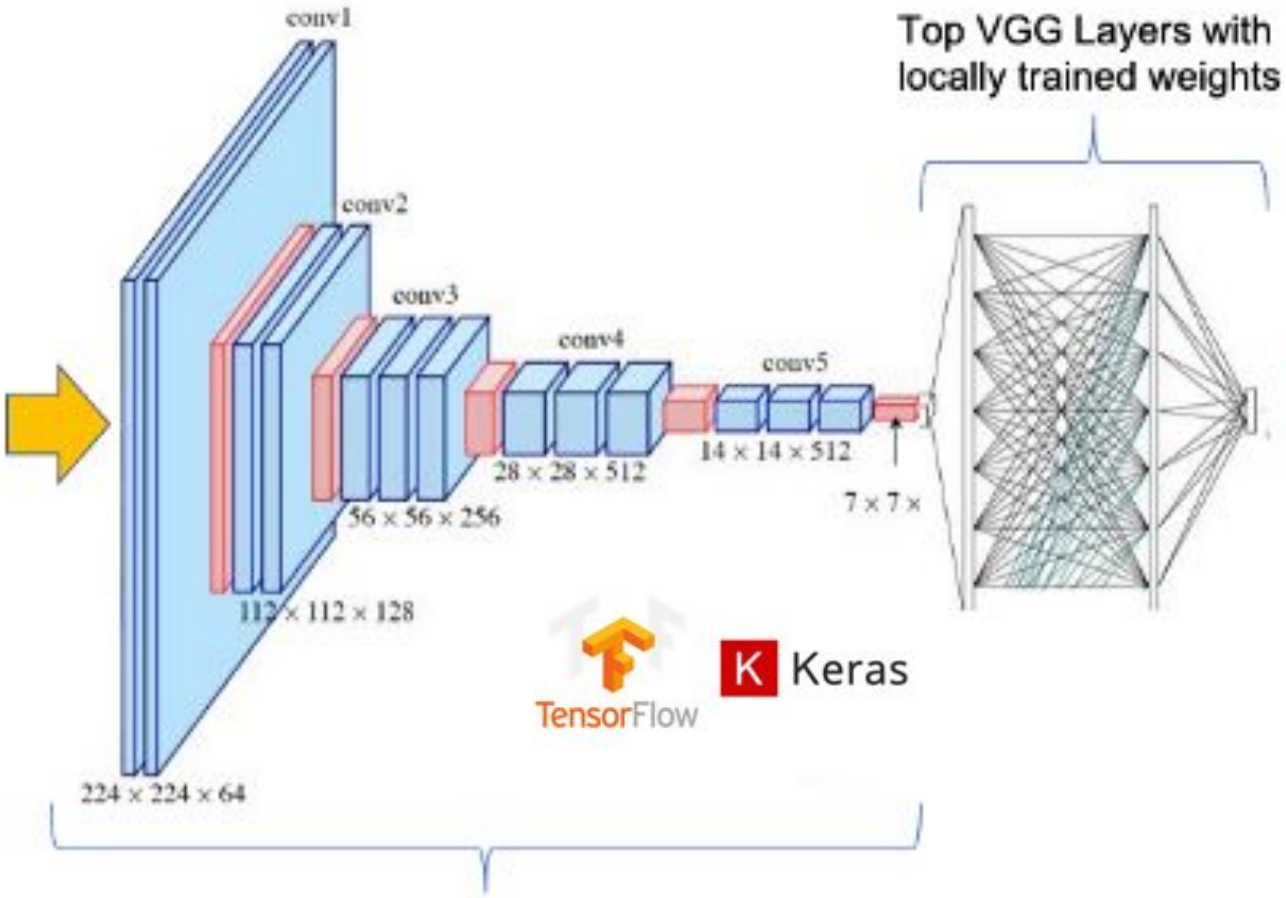
Elephant
93.0%

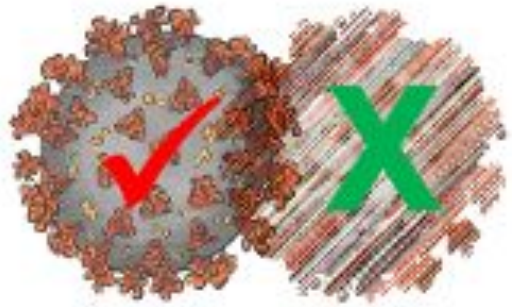
First Layer Representation | Second Layer Representation | Third Layer Representation

Training the model (Transfer Learning)

Input Image (Chest X-Ray)







Classify:
Positive/Negative
for Covid-19

Ds_1

Ds_2

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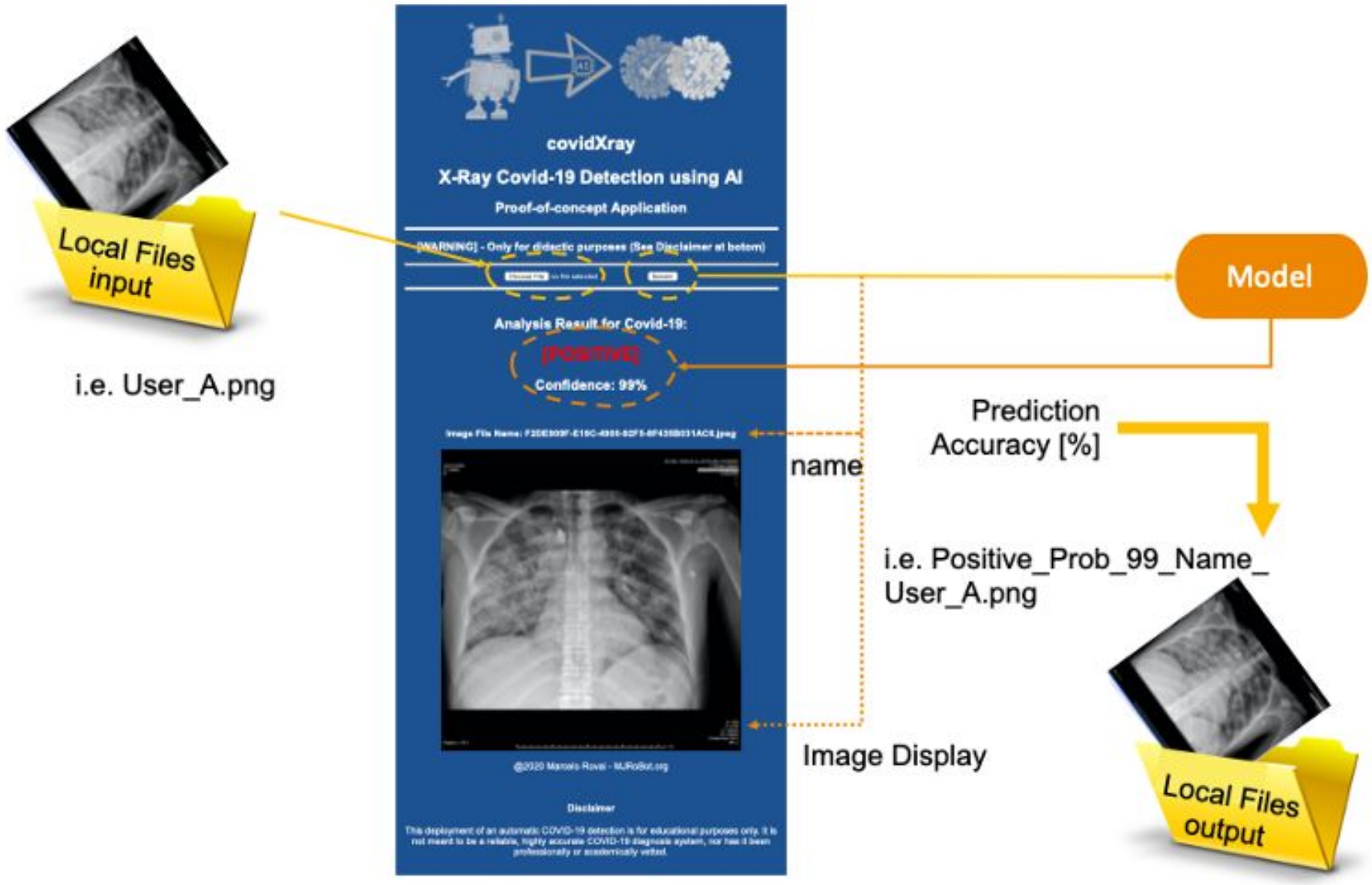
How it works



https://github.com/Mjrovai/covid19Xray

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“To infinity and beyond!”

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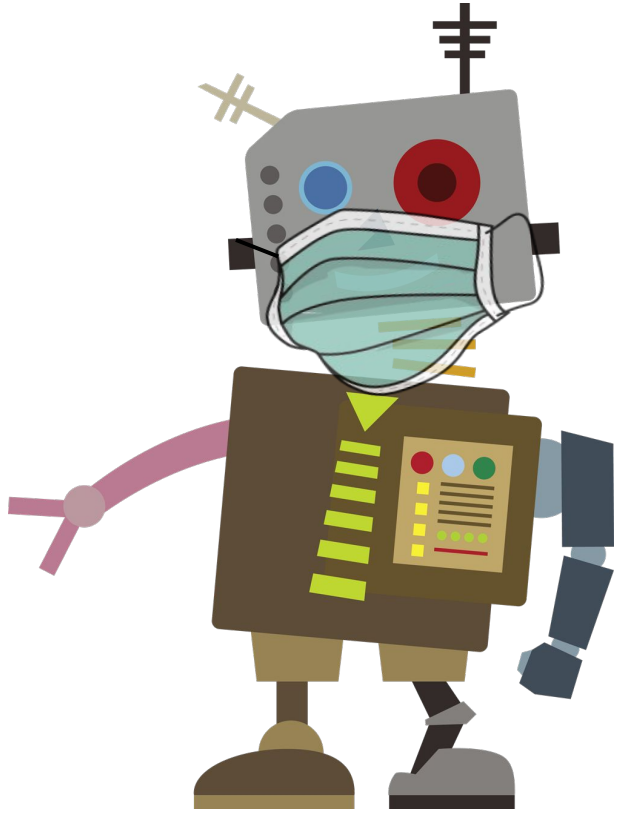

Thanks

And keep safe!

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