

IoE: Integration Microservices - Machine Learning

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MEGATRIS COMP. LLC



Internet of Everything

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The Internet of Everything is a global entity organized at a high level of self-regulation of interrelationships between business units (enterprises, service centers, ...) , individuals and intelligent objects able to cooperate with each other. They conduct various types of effective transactions preserving their independence in view of the shared results or common goals. In this sense, the Internet of Everything can be thought of in terms of organizational capacity potentials that favors rapid aggregation for the exploitation of opportunities.

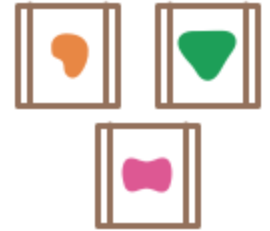
Microservices

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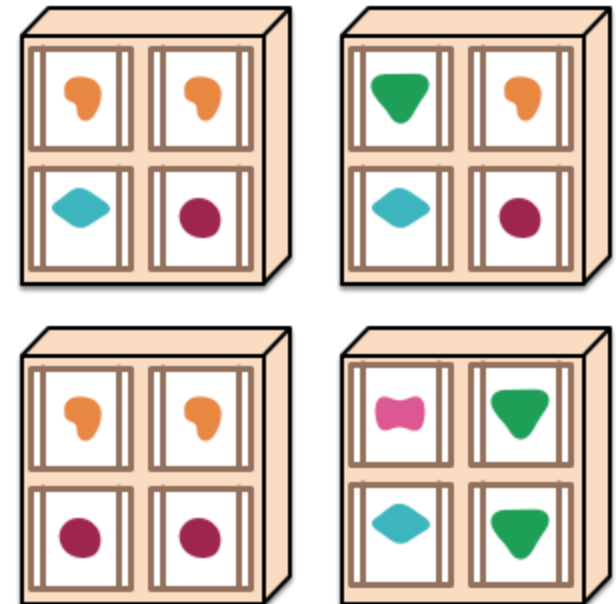
The microservice architectural style is an approach to develop a single application as a suite of small services, each running in its own process and communicating with lightweight mechanisms, often an HTTP resource API.

There is a bare minimum of centralized management of these services, which may be written in different programming languages and use different data storage technologies

A microservices architecture puts each element of functionality into a separate service...



... and scales by distributing these services across servers, replicating as needed.



IoT & Microservices

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IoT (Internet of things) is expanding. More and more devices are now connected, big companies like Samsung, Google and LG are working on the home consumer sector to create a simple way to **connect everything to internet** (IoE – internet of everything).

Every device becomes connected and intelligent thanks to the cloud. We strongly think that a Microservices architecture based on **cloud services** can monitor, analyze data and send- receive commands to/from every object in the IoT cloud.

The object it's not only a thing, but also an agent, that using his mobile devices has the ability to use microservices.

It's clear that we need a simple way to manage so different sources of data and **Microservices are the key** to do that.

Contextual Microservices architecture for the IoT

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A possible solution to easily control the IoT systems is to create an intelligent platform using a microservices architecture.

Each service has one and simple behavior and it's called when a specific event occurs in the system.

Everything is event driven and the flow from the start to the end is influenced by the **context**.

What is machine learning?

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- Machine reads the data, learns from the data, uses it to make predictions
- Can show you correlation but not necessarily causation
- Can find relationships and patterns within volumes of data that the human mind is incapable of processing

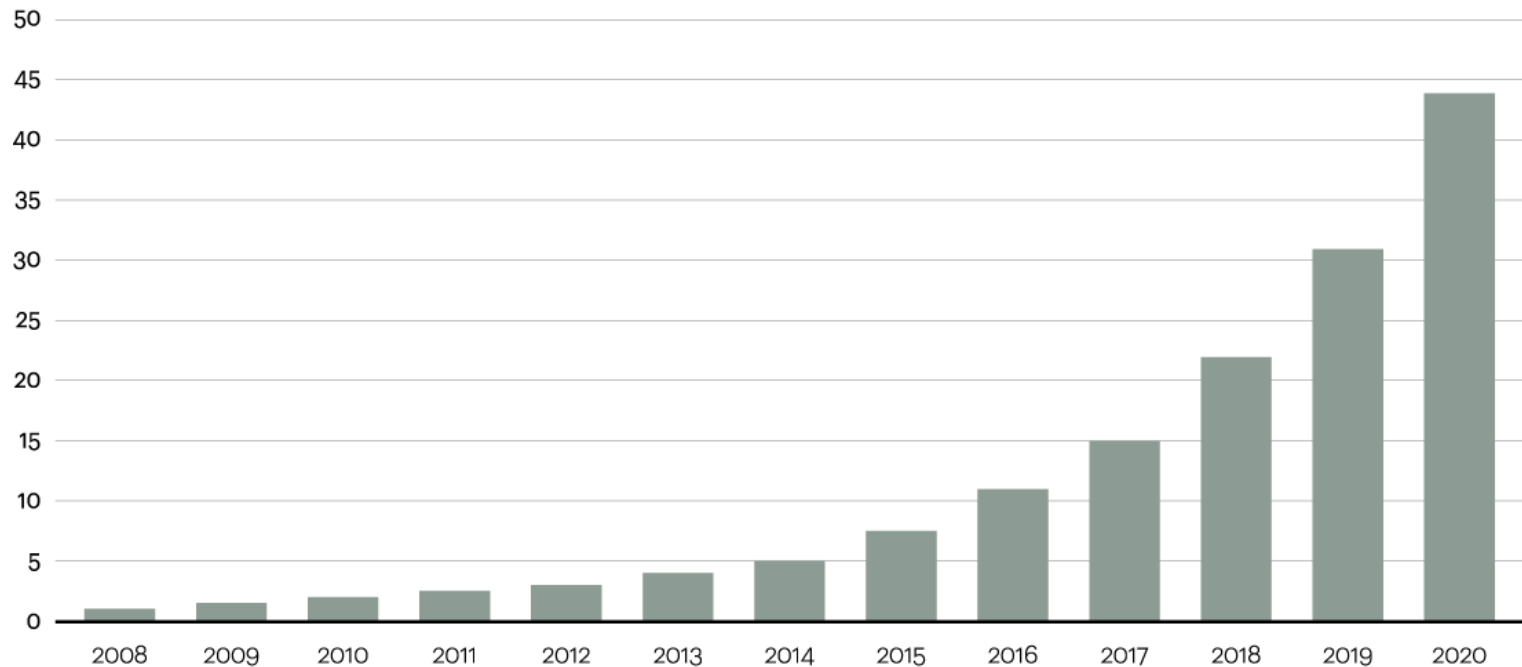
Why Machine Learning?



Figure 1

Data is growing at a 40 percent compound annual rate, reaching nearly 45 ZB by 2020

Data in zettabytes (ZB)



Source: Oracle, 2012

Why Machine Learning?

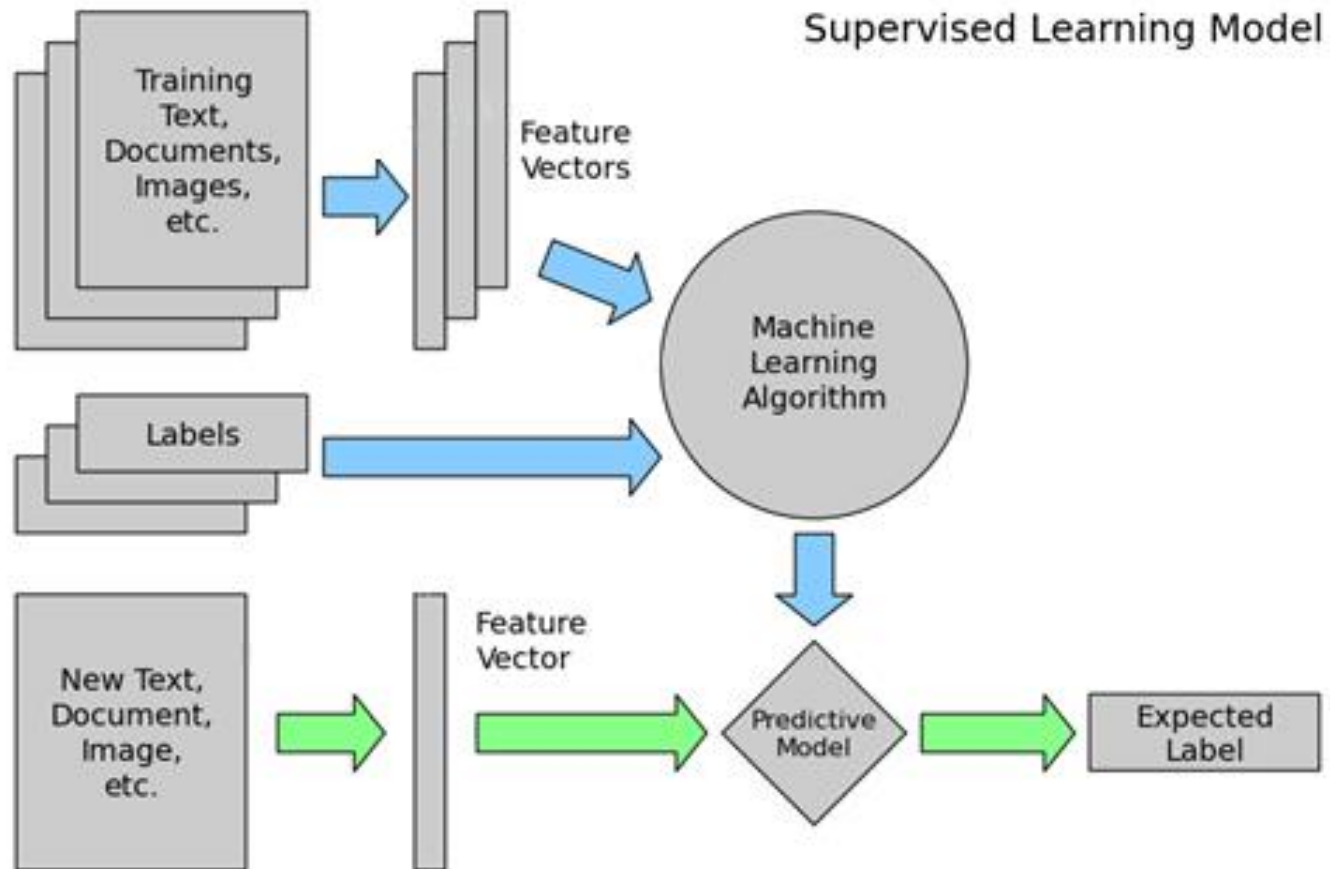
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- ❑ Volume of data collected growing day by day.
- ❑ Data production will be 44 times greater in 2020 than in 2009.
- ❑ Every day, 2.5 quintillion bytes of data are created, with 90 percent of the world's data created in the past two years.
- ❑ Very little data will ever be looked at by a human.
- ❑ Data is cheap and abundant (data warehouses, data marts); knowledge is expensive and scarce.
- ❑ Knowledge Discovery is **NEEDED** to make sense and use of data.
- ❑ Machine Learning is a technique in which computers learn from data to obtain insight and help in knowledge discovery.

Machine Learning Methods in #IoE

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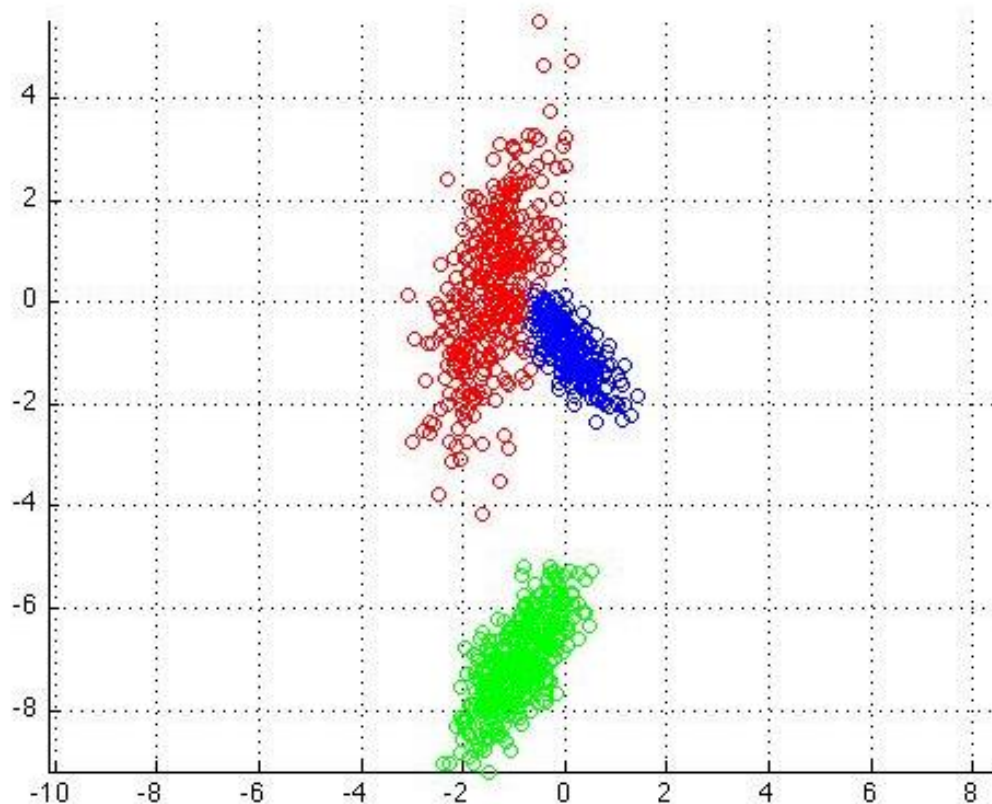
Supervised learning – class labels/ target variable known



Overview (Contd)

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- Unsupervised learning – no class labels provided, need to detect clusters of similar items in the data.



Parametric Vs Nonparametric

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- ❑ Parametric Models:
 - ❑ Assumes prob. distribution for data, and learn parameters from data
 - ❑ E.g. Naïve Bayes classifier, linear regression etc.

- ❑ Non-parametric Models:
 - ❑ No fixed number of parameters.
 - ❑ E.g. K-NN, histograms etc.

Generative Vs Discriminative

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- ❑ Generative model – learns model for generating data, given some hidden parameters.
 - ❑ Learns the joint probability distribution $p(x,y)$. e.g. HMM, GMM, Naïve Bayes etc.

- ❑ Discriminative model – learns dependence of unobserved variable y on observed variable x .
 - ❑ Tries to model the separation between classes.
 - ❑ Learns the conditional probability distribution $p(y|x)$. e.g. Logistic Regression, SVM, Neural networks etc.

Classification

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- ❑ Classification – Supervised learning.
- ❑ Commonly used Methods for Classification –
 - Naïve Bayes
 - Decision tree
 - K nearest neighbors
 - Deep learning: Neural Networks
 - Support Vector Machines.

Classification

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Data Science Concept:

- Classification is the process of taking an input and assigning a label to it.
- The labels could be binomial (Yes, No) or multinomial (High, Medium, Low).

Business Applications:

- Will customers upgrade to new software?
- What age groups tested well for this new TV show? (marketing campaigns)
- Nigerian 419 (spam classification)

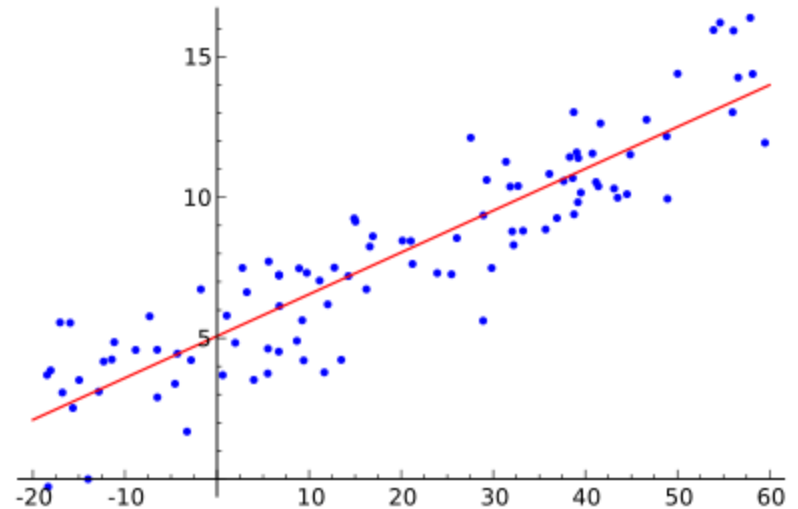
Regression

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❑ Regression – Predicting an output variable given input variables.

❑ Algorithms used :

- Ordinary least squares
- Partial least squares
- Logistic Regression
- Stepwise Regression
- Support Vector Regression
- Neural Networks



Regression

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Data Science Concept:

- Regression predict a continuous numerical value output
- Examples of algorithms and models: Linear Regression, Random Forest

Business Applications:

- How much money would a user who has reached level 200 in Candy Crush spend on in-app purchases? (forecasting)
- How much would a customer expect to pay for car insurance based on age, gender and car type? (prediction)

Clustering

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- ❑ Clustering:
Group data into clusters using similarity measures.

- ❑ Algorithms:
 - K-means clustering
 - Density based EM algorithm
 - Hierarchical clustering.
 - Spectral Clustering

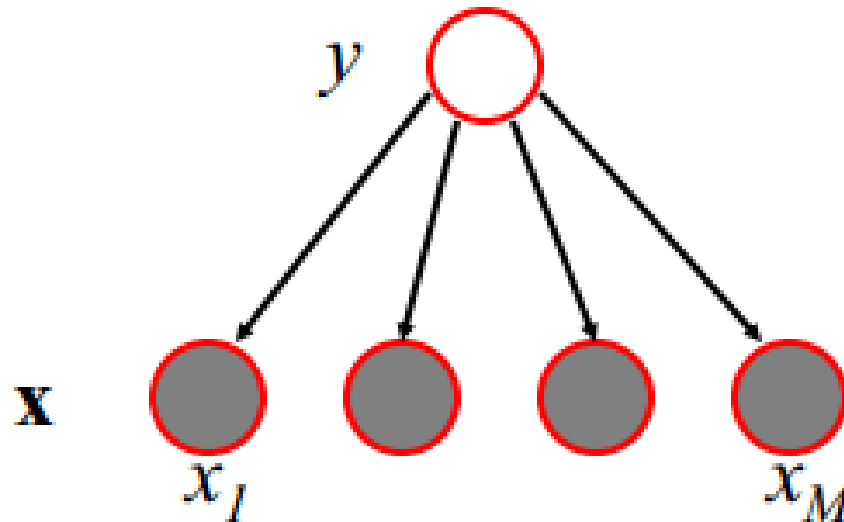
Naïve Bayes

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- Naïve Bayes classifier

Assumes conditional independence among features.

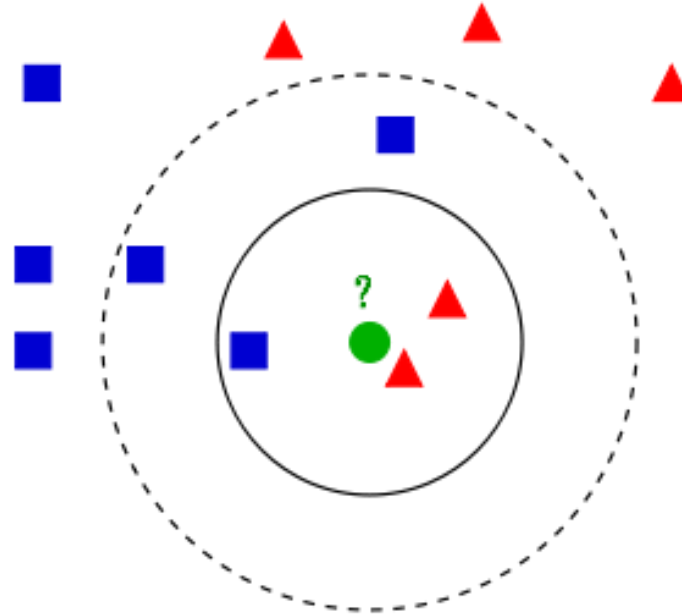
- $P(x_i, x_j, x_k | C) = P(x_i | C)P(x_j | C)P(x_k | C)$



K-Nearest Neighbors

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- ❑ K-nearest neighbors: Classifies the data point with the class of the k nearest neighbors.
- ❑ Value of k decided using cross validation

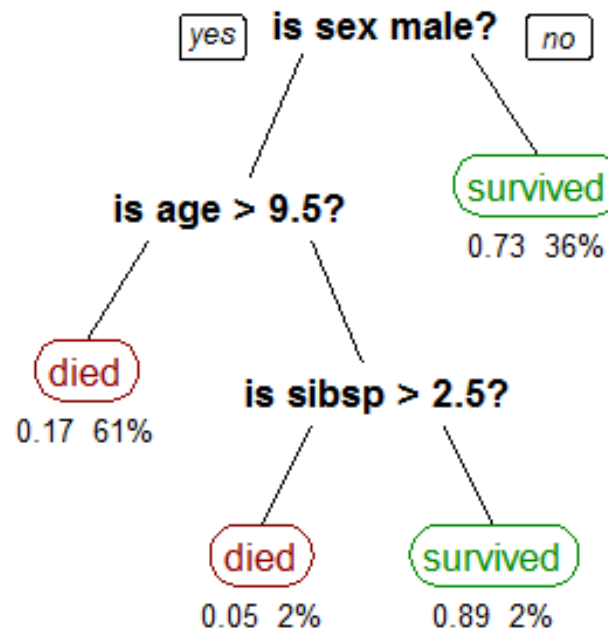


Decision trees

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- ❑ Leaves indicate classes.
- ❑ Non-terminal nodes – decisions on attribute values
- ❑ Algorithms used for decision tree learning

- C4.5
- ID3
- CART.



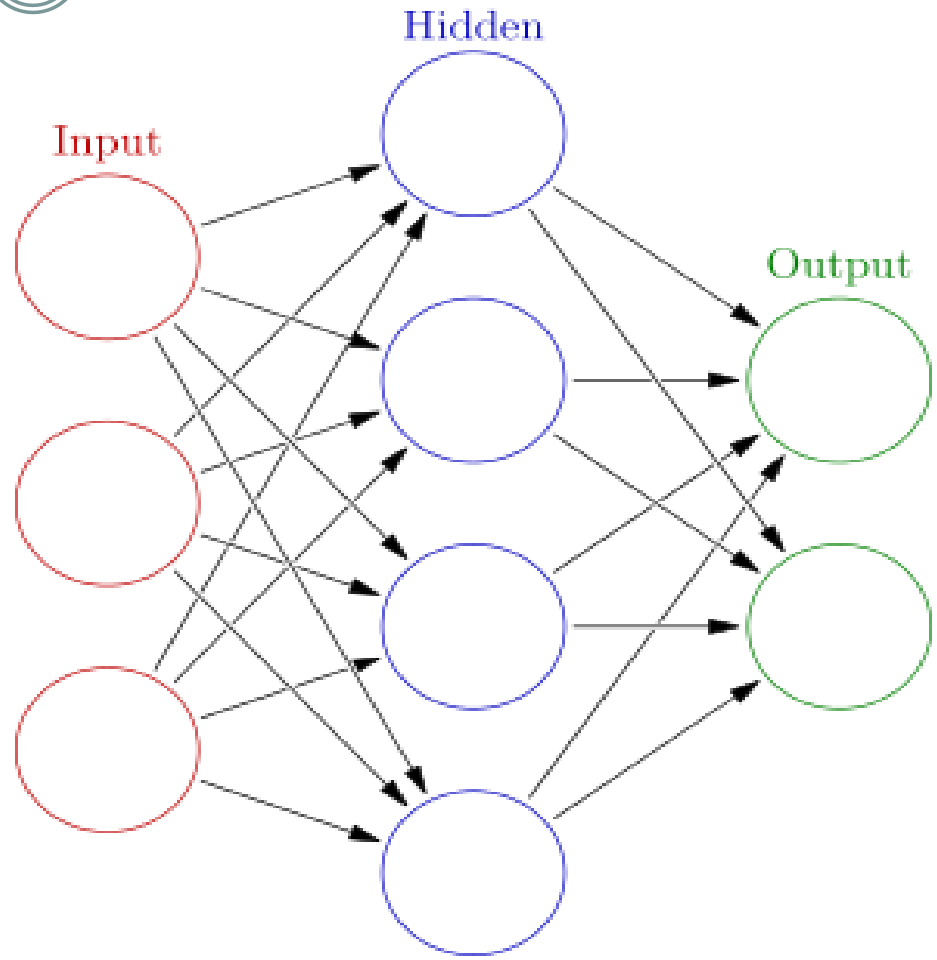
Deep Learning: Neural Networks

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- ❑ Artificial Neural Networks
Modeled after the human brain

- ❑ Consists of an input layer, many hidden layers, and an output layer.

- ❑ Multi-Layer Perceptrons, Radial Basis Functions, Kohonen Networks etc.

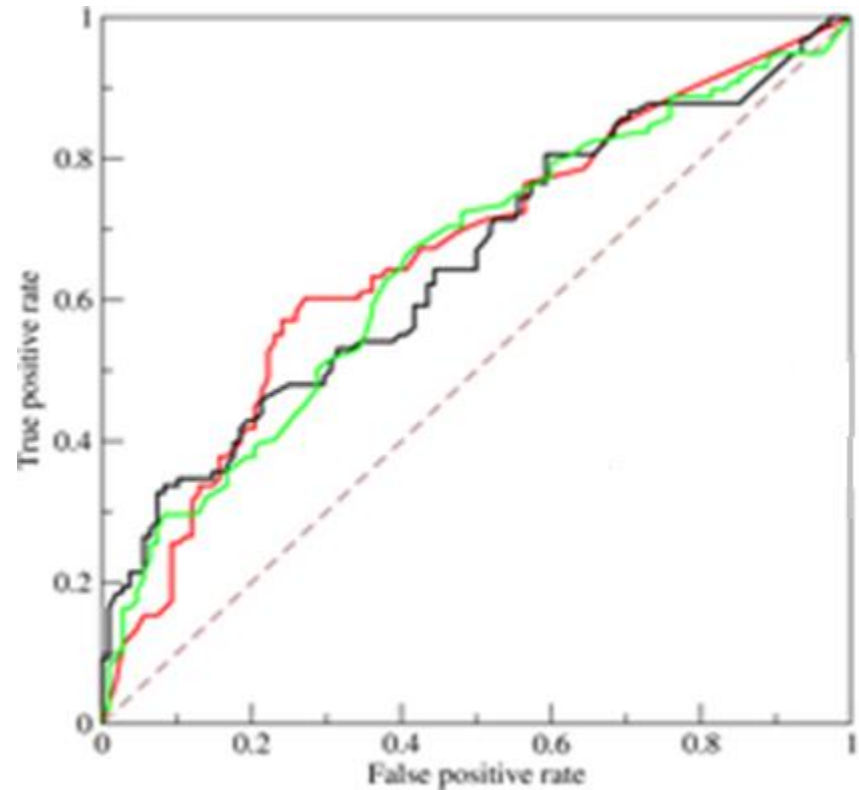


Evaluation of Machine Learning Methods

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❖ Validation methods

- ❑ Cross validation techniques
 - K-fold cross validation
 - Leave one out Cross Validation
- ❑ ROC curve (for binary classifier)
- ❑ Confusion Matrix



Real life applications

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Some real life applications of machine learning:

- ❑ Recommender systems – suggesting similar people on Facebook/LinkedIn, similar movies/ books etc. on Amazon,
- ❑ Business applications – Customer segmentation, Customer retention, Targeted Marketing etc.
- ❑ Medical applications – Disease diagnosis,
- ❑ Banking – Credit card issue, fraud detection etc.
- ❑ Language translation, text to speech or vice versa.

SSB IoE Reference Architecture

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Web/Portal

DashBoard

API

Machine Learning

Event Processing and Analytics

Aggregation / Bus Layer
ESB and Message Broker

Communications
MQTT / HTTP

Devices

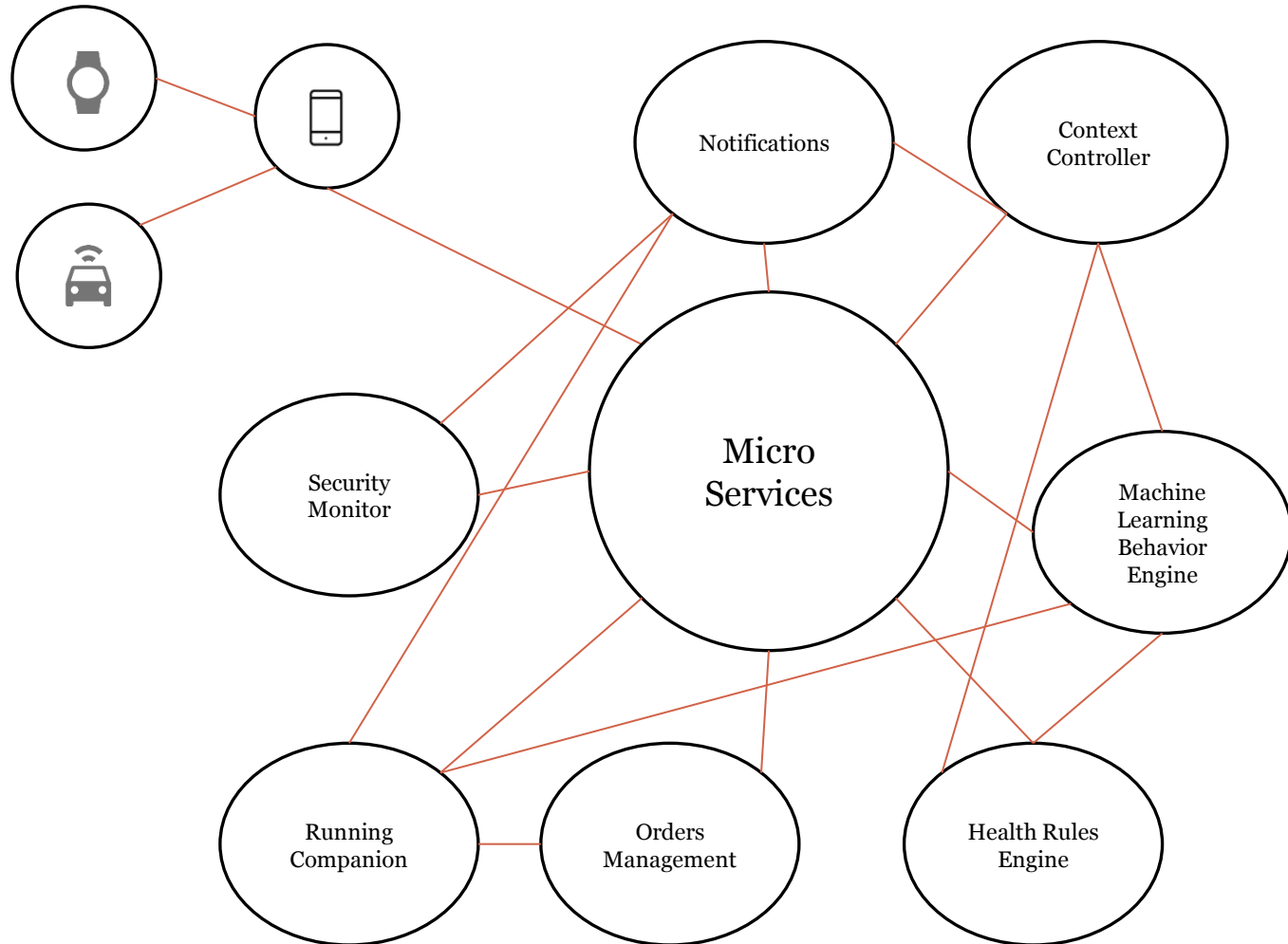


Device Manager

Identity & Access Management

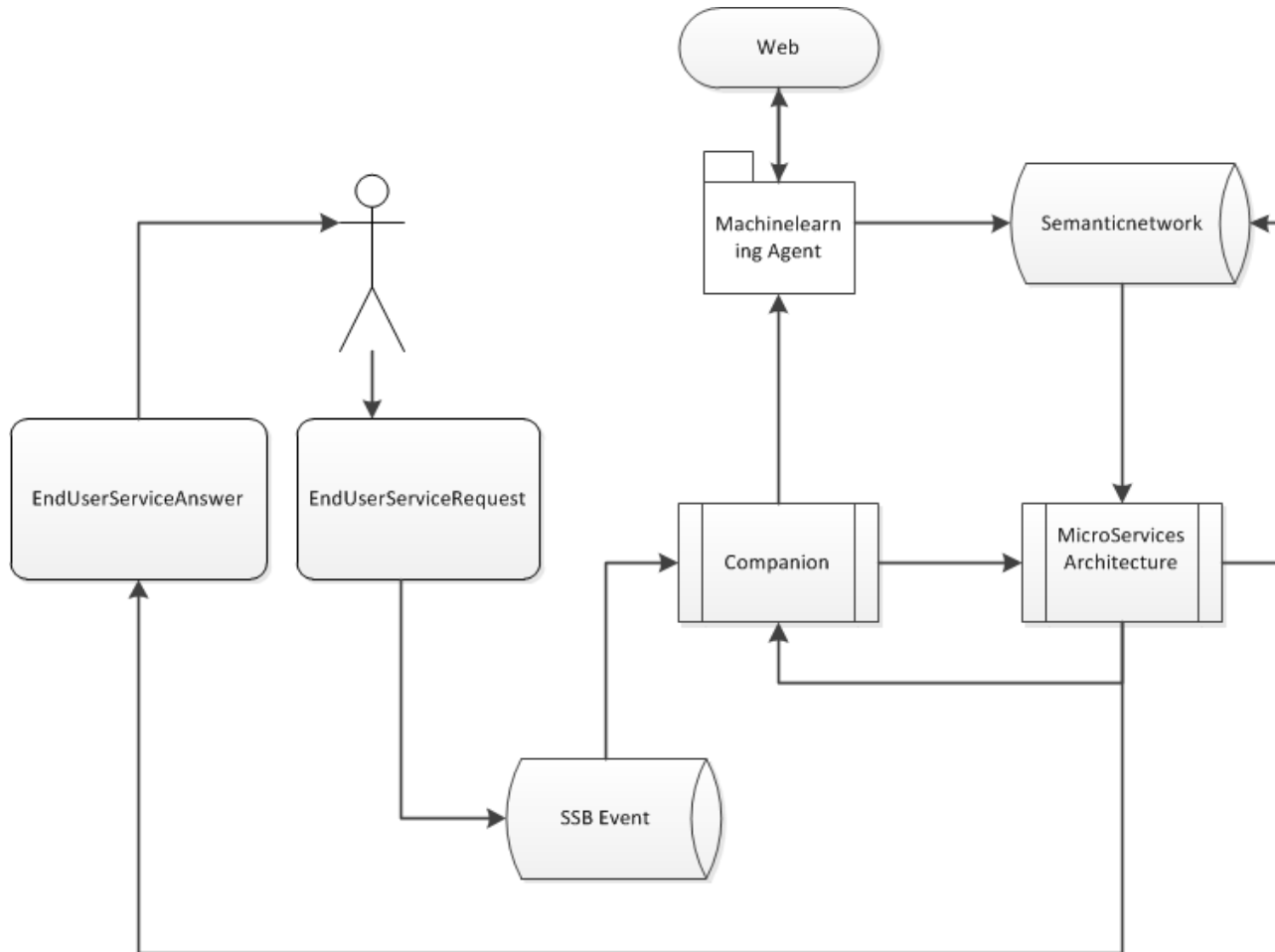
Example of Micro Services Cloud for the IoE

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Integration Machine Learning - MicroServices

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Process Pseudo Code

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1. CompanionRequest: update deep learning parameter on running data
2. ServiceRequest: GenerateReportRunning last week
3. CompanionProcess: Read deep learning parameter
4. CompanionProcess: Decides using rules
5. CompanionProcess: Call microservices chain
6. MicroserviceProcess: prepares report pdf format
7. MicroserviceProcess: Send push msg to enduse with report link

Process Pseudo Code

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Summary

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- Microservices are an effective approach to orchestrate services in the cloud.
- Machine Learning is a set of tools to extract meaning from Big Data as Microservices were not written with huge processing in mind. They must be smart and speedy.
- Industries can have huge benefits from this approach.

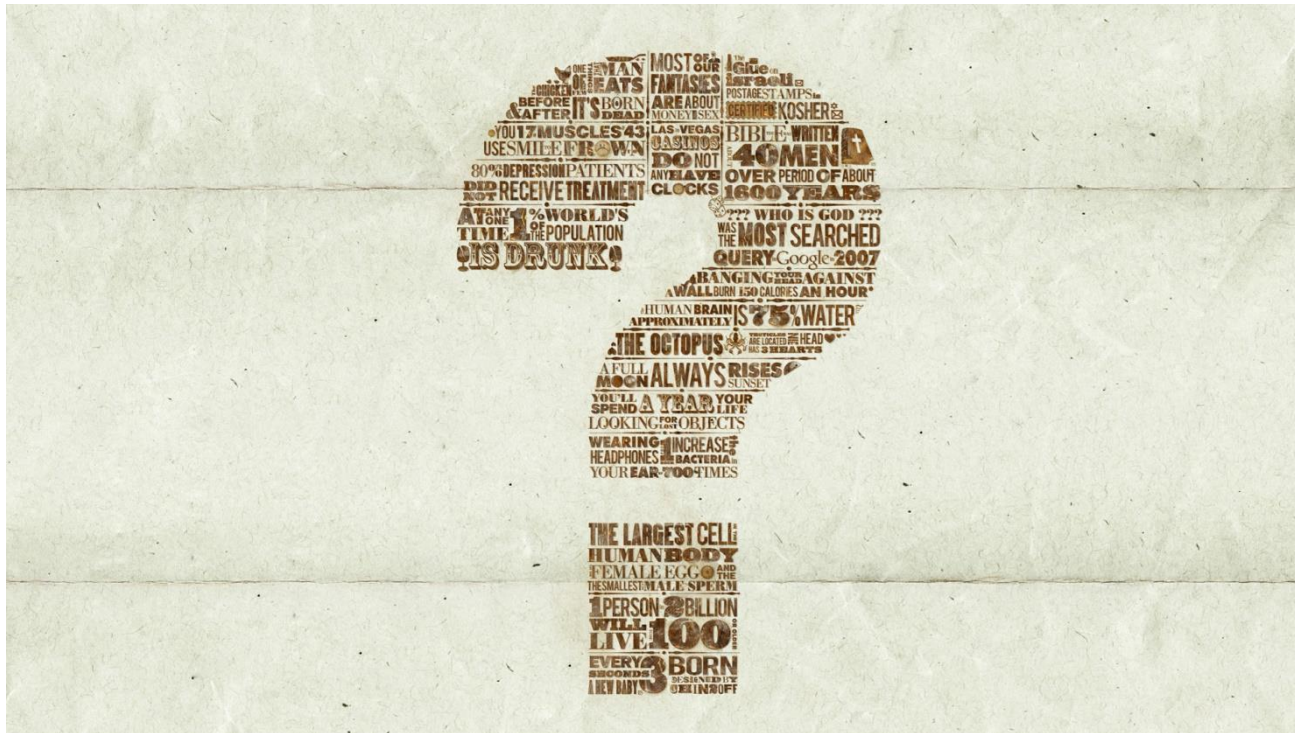


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QUESTIONS?