FIWARE Global Summit 10

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Connecting Minds, Driving Smart Solutions

18-19 September, 2024

Naples, Italy

#FIWARESummit24

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INFINITI MONDI NAPOLI INNOVATION CITY

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Getting value out of context data

ML for health

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Agenda

1. Introduction to AI concepts: ML, DL, MLOps
2. Presentation of Smart Health use case: Skin diseases detection
3. Data processing, model selection and metrics
4. Integration w/ FIWARE: Architecture, interactions, entities and subscriptions
5. Demonstration
6. Automatizing tasks: levelling up the use case
7. Summary

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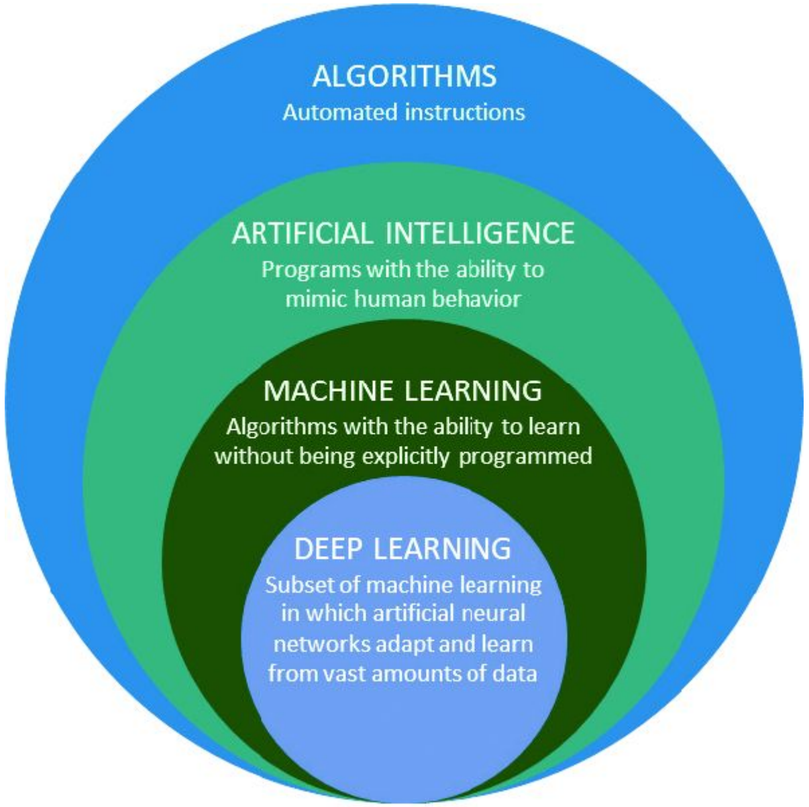
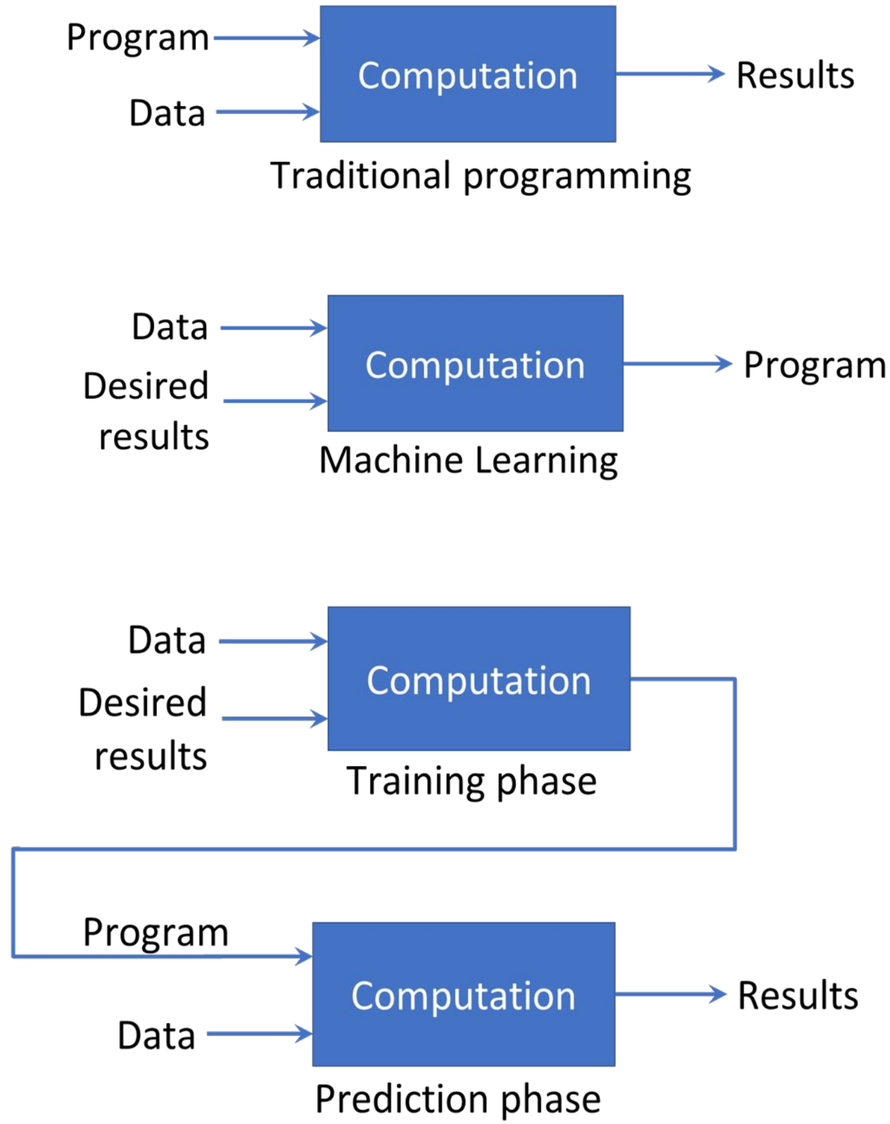
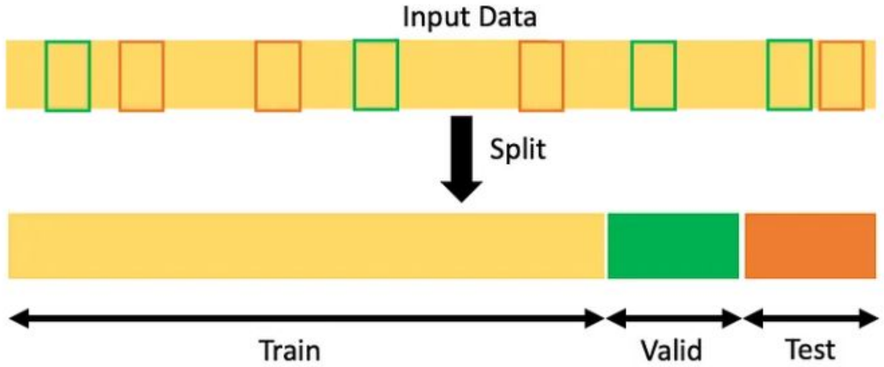
AI Concepts


ALGORITHMS
Automated instructions
ARTIFICIAL INTELLIGENCE
Programs with the ability to mimic human behavior
MACHINE LEARNING
Algorithms with the ability to learn without being explicitly programmed
DEEP LEARNING
Subset of machine learning in which artificial neural networks adapt and learn from vast amounts of data

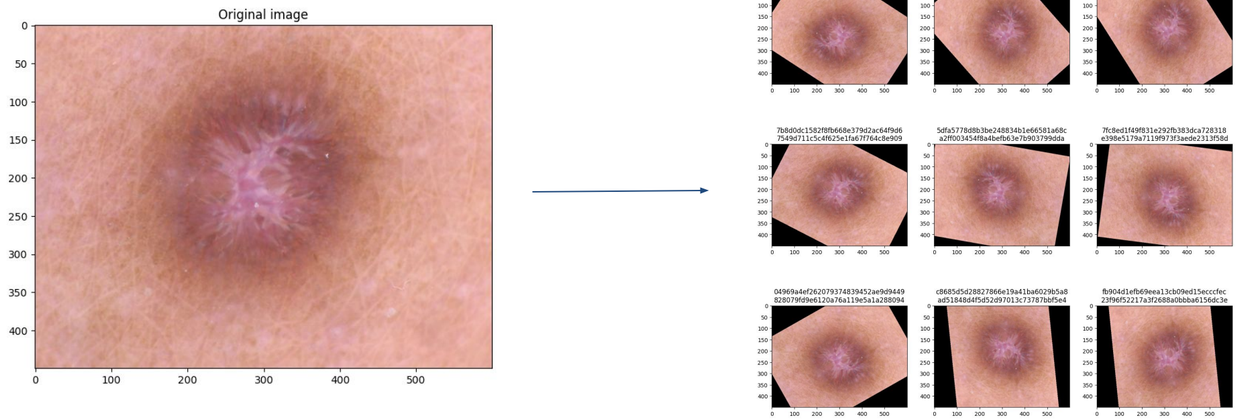

Program
Data
Computation
Results
Traditional programming
Data
Desired results
Computation
Program
Machine Learning
Data
Desired results
Computation
Training phase
Program
Data
Computation
Results
Prediction phase

AI Concepts: Train a ML model

- Data processing (cleaning, selection, creation), model: selection, assessment and deployment
- Train, validation and test:



- Data augmentation:



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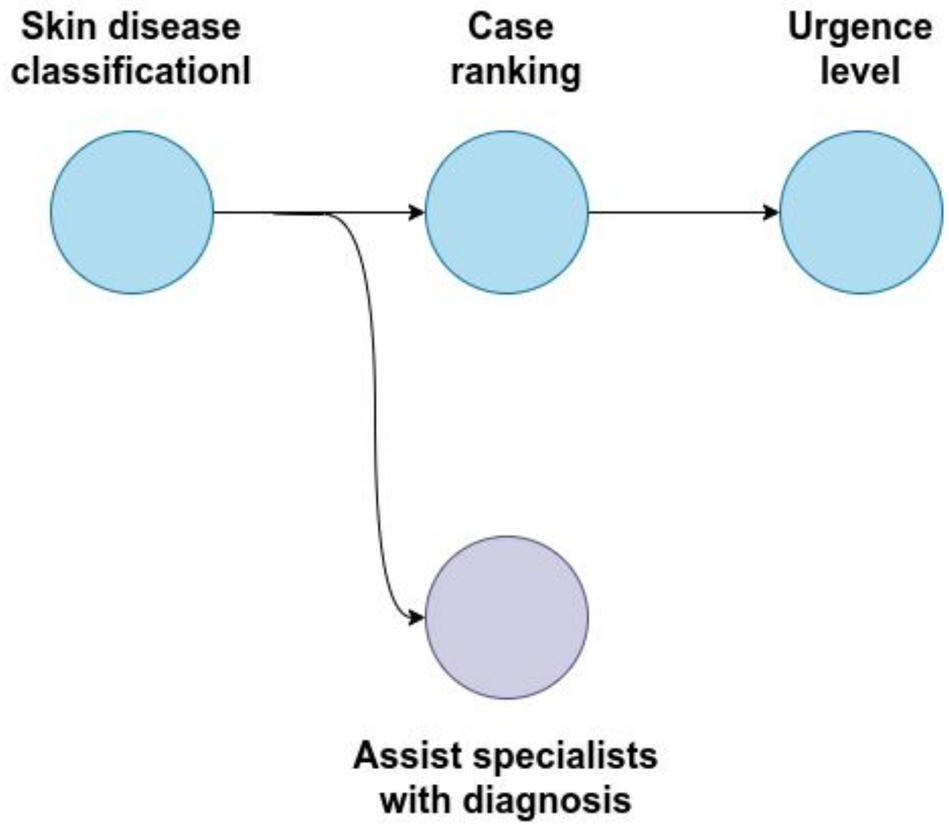
Smart Health use case

- **Disclaimer**: Not to replace the dermatologist **but** to **assist** a physician and expert dermatologist

- Scenario: Imagine living in a city where the appointment with a dermatologist might take **between 2-3 months** in general and **up to 4 months or more** in peak seasons

Early detection phase and fast appointment scheduling



- App to **help physician** to have an **educated diagnosis** about what the skin disease might be:
  - If the result is not good → the app can **schedule an appointment** with the dermatologist ASAP
  - If the result seems ok, *they still can make an appointment* but **lowering the priority**

- Allow to **detect a severe disease** in a **early stage**, maximizing the chances of recovering

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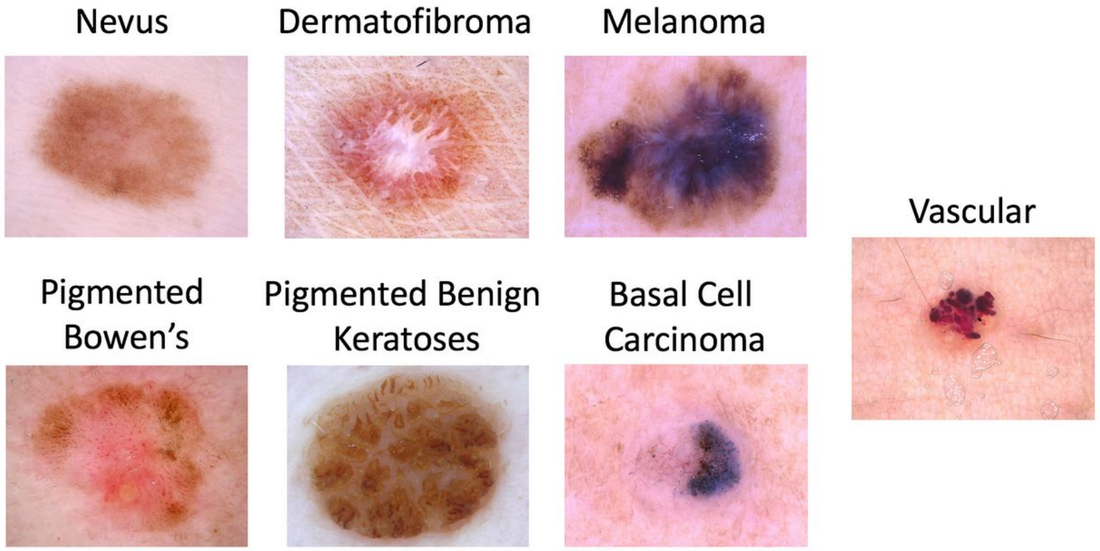
HAM10000 dataset

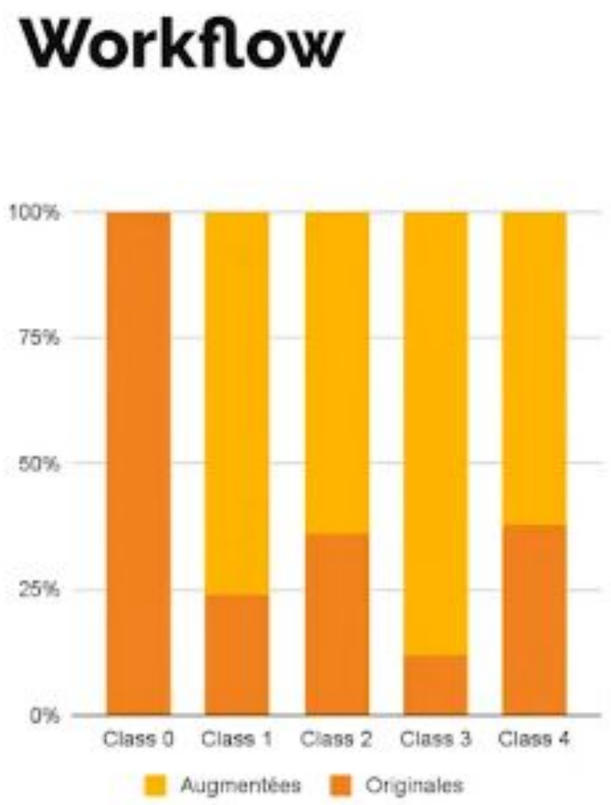
	lesion_id	image_id	dx	dx_type	age	sex	localization
2	HAM_0000118	ISIC_0027419	bkl	histo	80	male	scalp
3	HAM_0000118	ISIC_0025030	bkl	histo	80	male	scalp
4	HAM_0002730	ISIC_0026769	bkl	histo	80	male	scalp
5	HAM_0002730	ISIC_0025661	bkl	histo	80	male	scalp
6	HAM_0001466	ISIC_0031633	bkl	histo	75	male	ear
7	HAM_0001466	ISIC_0027850	bkl	histo	75	male	ear
8	HAM_0002761	ISIC_0029176	bkl	histo	60	male	face
9	HAM_0002761	ISIC_0029068	bkl	histo	60	male	face
10	HAM_0005132	ISIC_0025837	bkl	histo	70	female	back
11	HAM_0005132	ISIC_0025209	bkl	histo	70	female	back
12	HAM_0001396	ISIC_0025276	bkl	histo	55	female	trunk
13	HAM_0004234	ISIC_0029396	bkl	histo	85	female	chest
14	HAM_0004234	ISIC_0025984	bkl	histo	85	female	chest
15	HAM_0001949	ISIC_0025767	bkl	histo	70	male	trunk
16	HAM_0001949	ISIC_0032417	bkl	histo	70	male	trunk

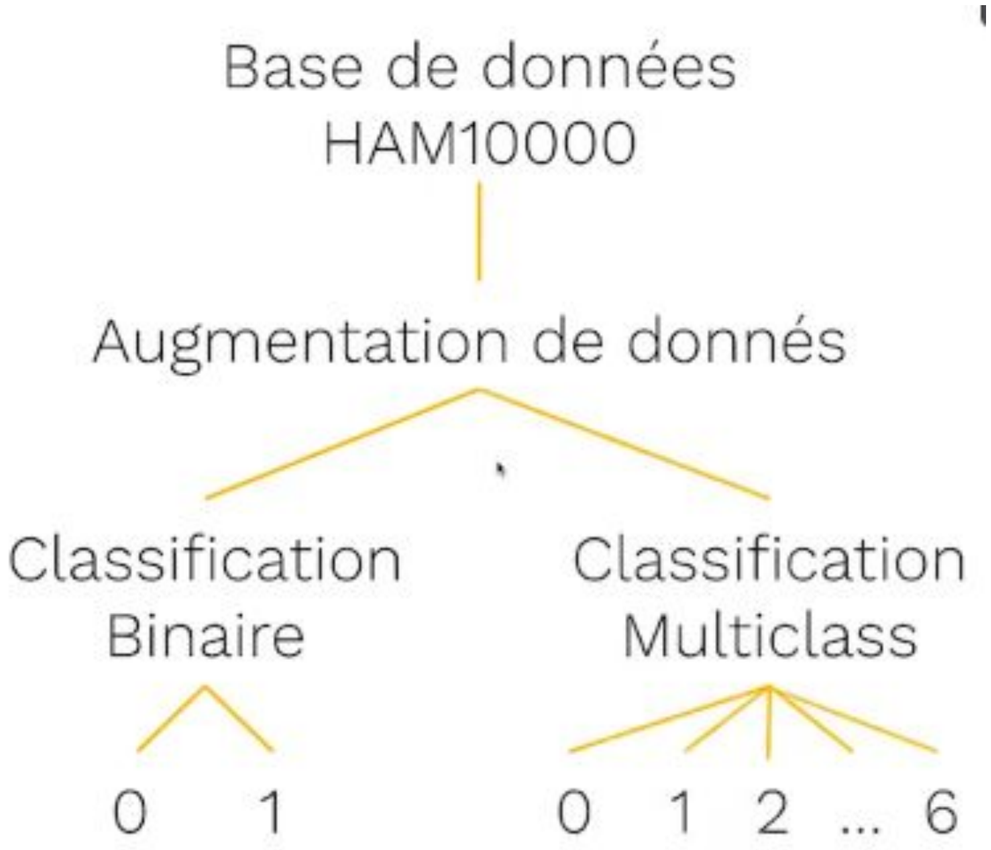


Paper: https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/DBW86T

The HAM10000 dataset, a large collection of multi-source dermatoscopic images of common pigmented skin lesions

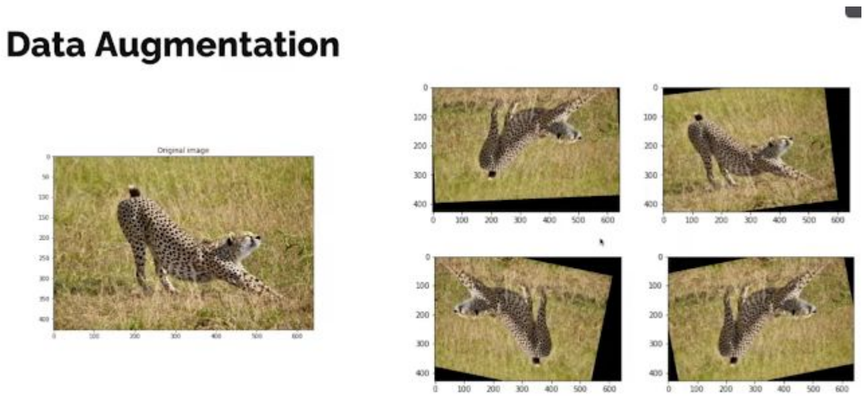
Data processing

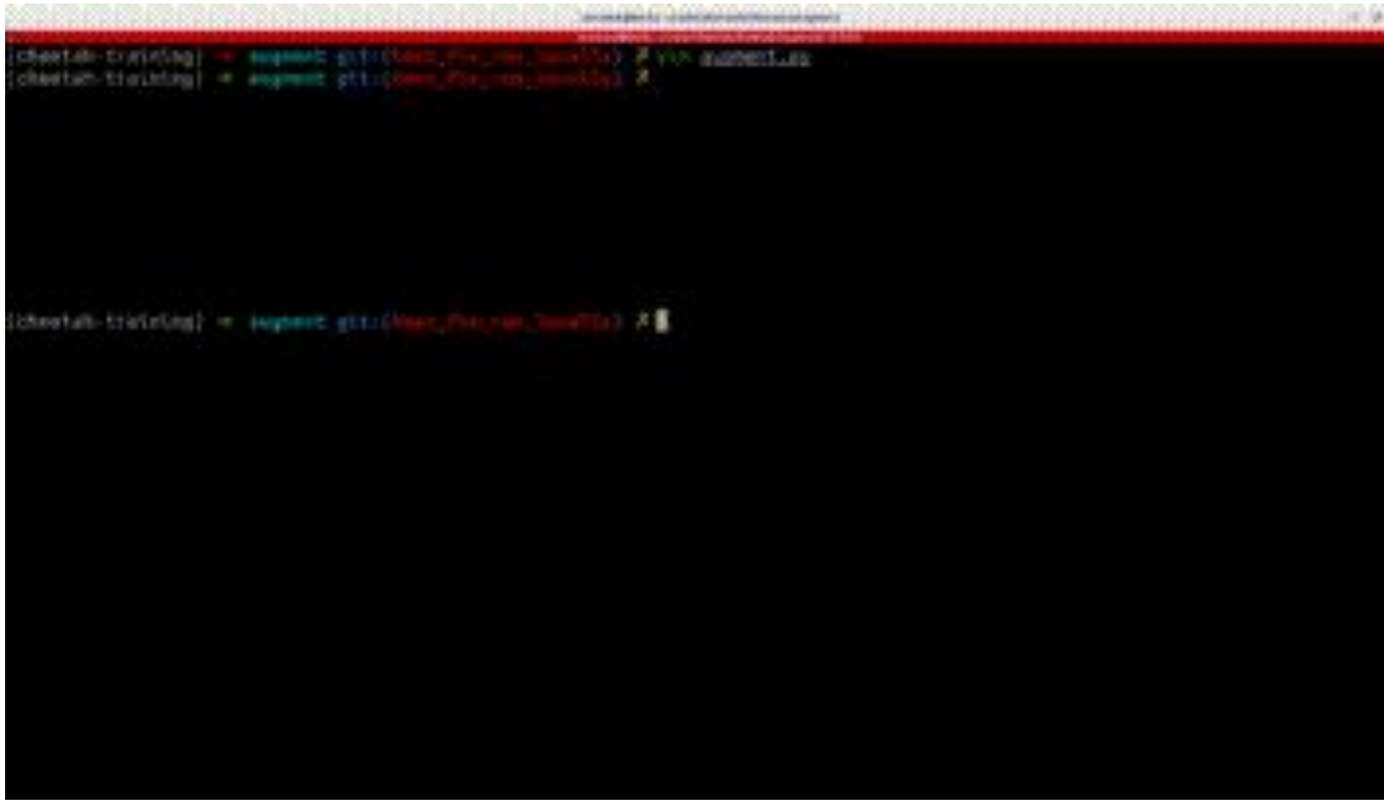




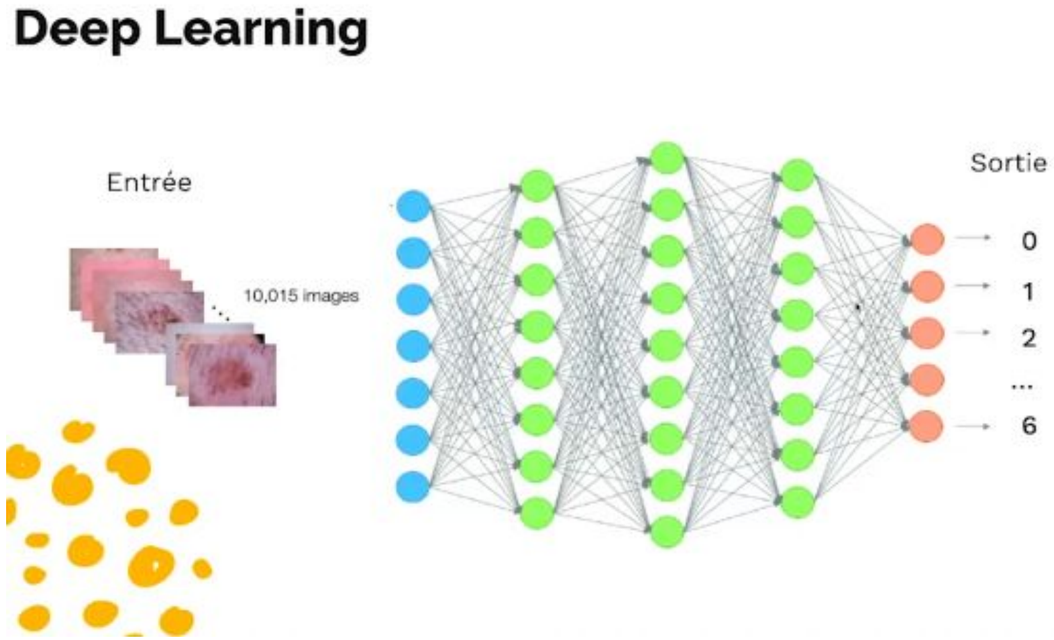

```
Entrée [20]: df.dx.value_counts()

Out[20]: nv       6705
         mel      1113
         bkl      1099
         bcc       514
         akiec     327
         vasc      142
         df        115
         Name: dx, dtype: int64
```

Data augmentation

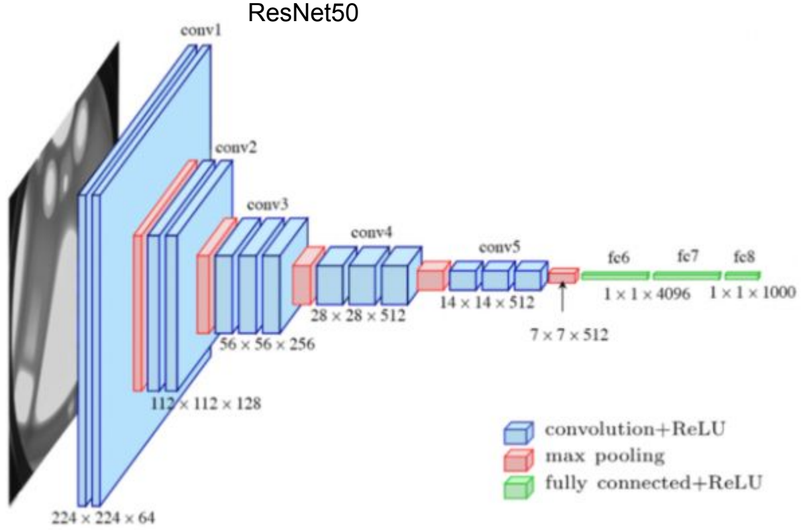




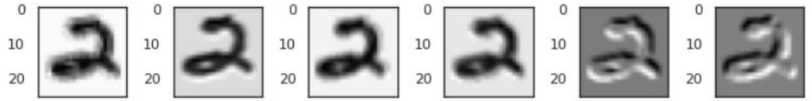
Model selection



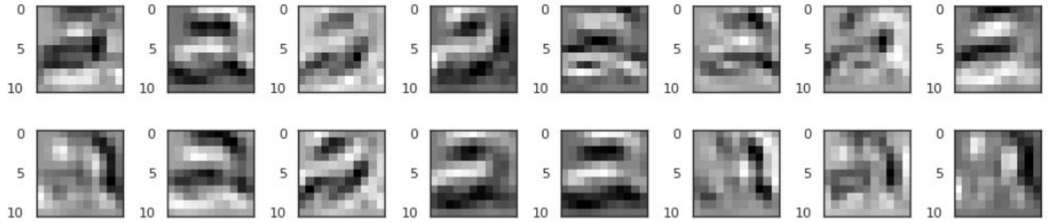
ResNet50



convolution layer 1



convolution layer 2



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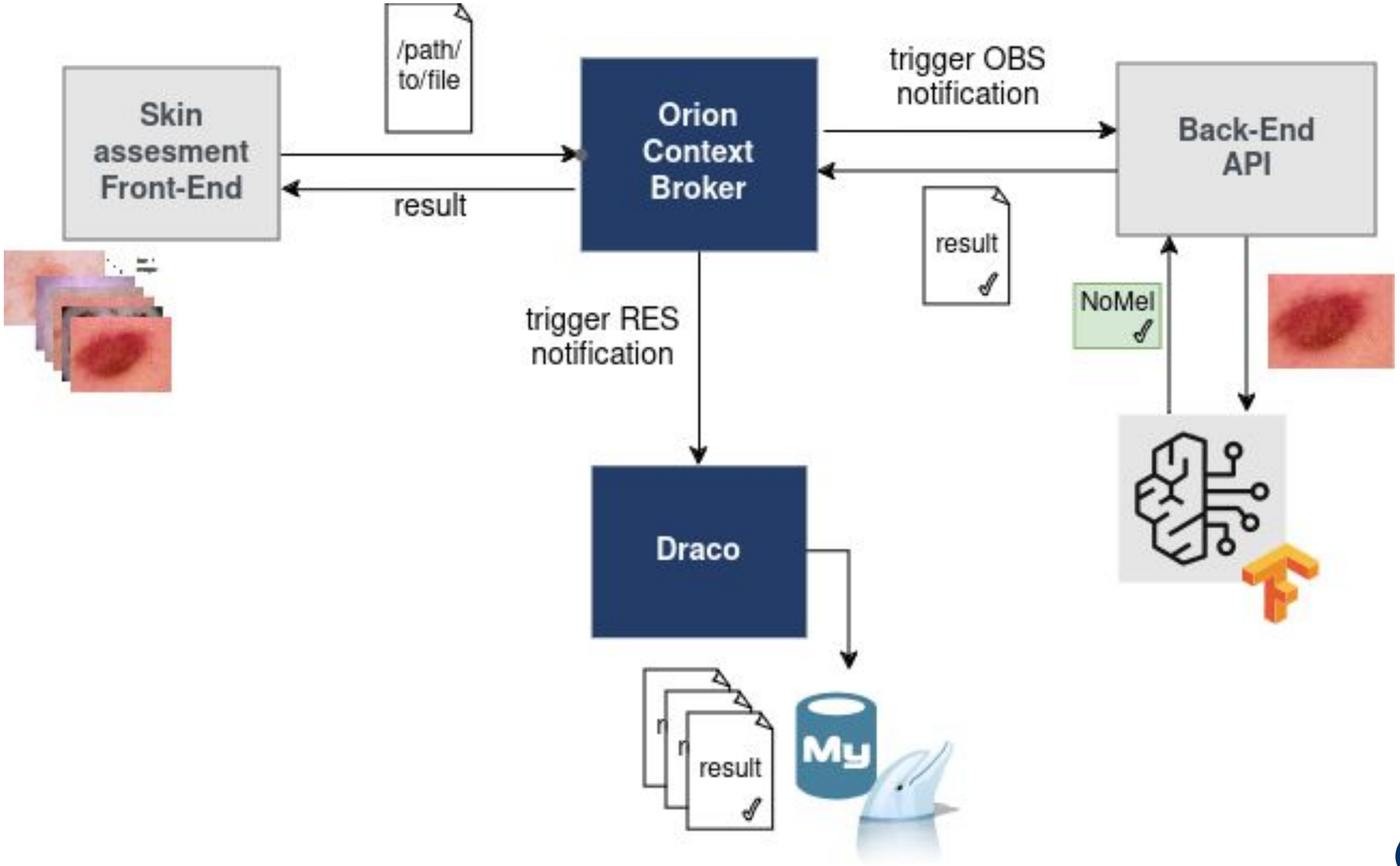
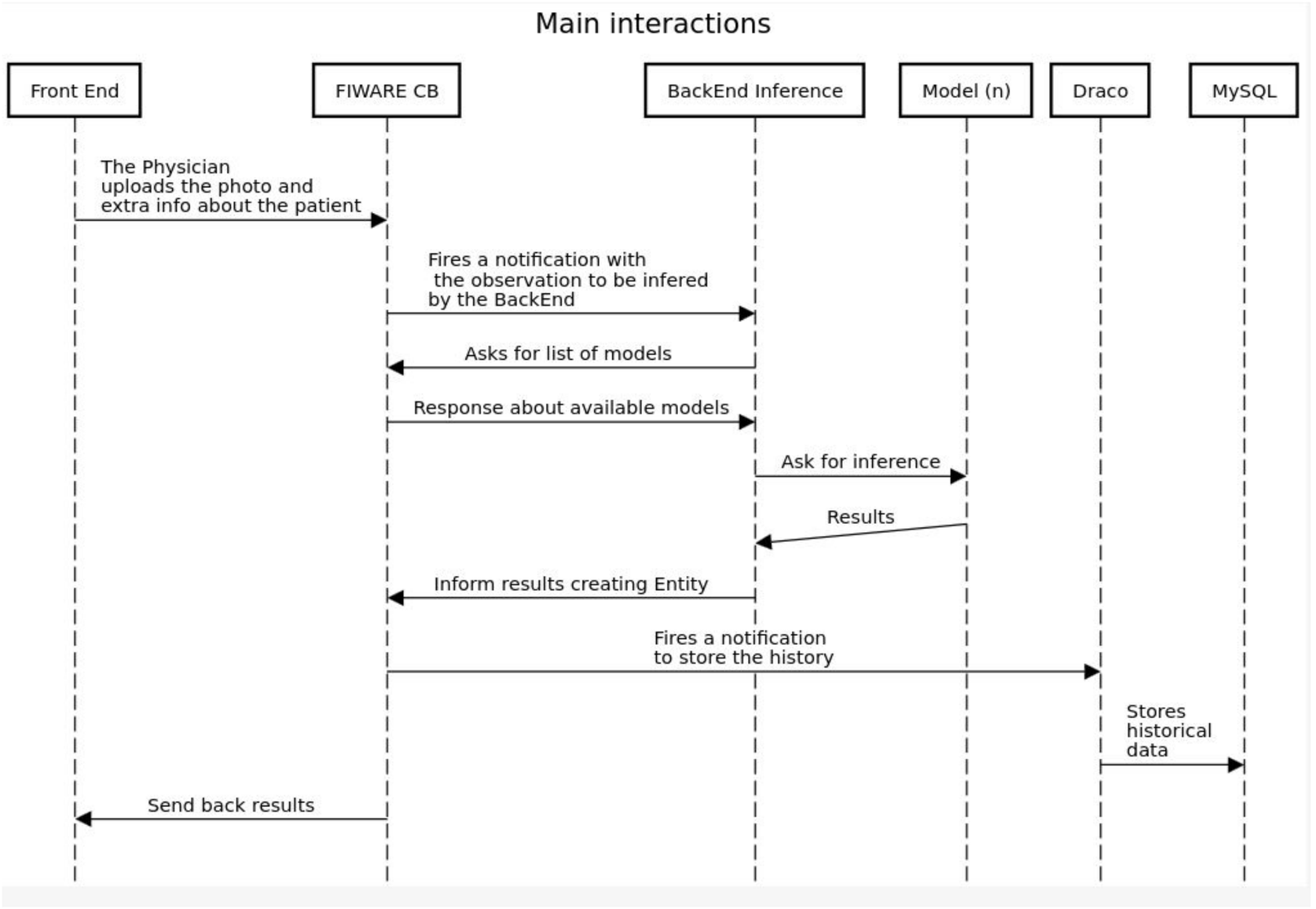
Architecture in FIWARE



Interactions with components in FIWARE



Entities and subscriptions

Entities:

MLModel: describes the model, how was trained, dataset used, algorithm, accuracy, etc.
1 for Binary case - 1 for multiclass case

Ex:
`urn:ngsi-ld:MLModel:CNNSkinAnalyzer:multiclass:001,`
`urn:ngsi-ld:MLModel:CNNSkinAnalyzer:binary:001`

MLProcessing: describes an observations that is being precessed by a MLModel or has the prediction of a MLModel
It has a “ref” to MLModel. For example, a user photo that is/was analyzed by an algorithm, in created using this entity

Ex:
`urn:ngsi-ld:MLProcessing:001`

Dataset: describes a dataset

Ex: `urn:ngsi-ld:Dataset:HAM10000`

Subscriptions:

SubscriptionQuery:

- urn:ngsi-ld:SubscriptionQuery:MLModel:
  - Subscribes to every model creation
- urn:ngsi-ld:SubscriptionQuery:MLProcessing:
  - Subscribes to every observations being inferred by a model or a result of an inferred

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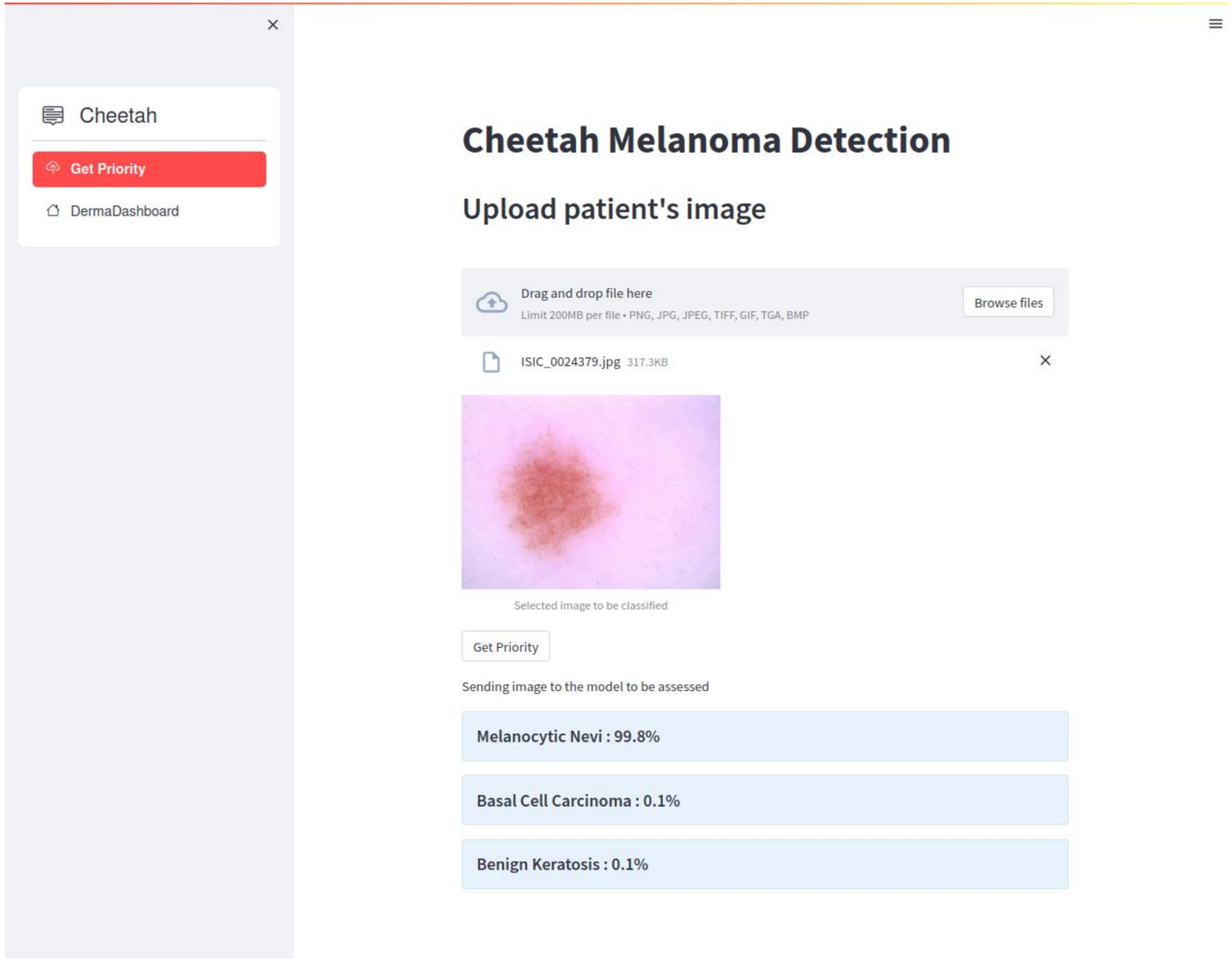
Demo


Cheetah
Get Priority
DermaDashboard
Cheetah Melanoma Detection
Upload patient's image
Drag and drop file here
Limit 200MB per file • PNG, JPG, JPEG, TIFF, GIF, TGA, BMP
Browse files
ISIC_0024379.jpg 317.3KB
Selected image to be classified
Get Priority
Sending image to the model to be assessed
Melanocytic Nevi : 99.8%
Basal Cell Carcinoma : 0.1%
Benign Keratosis : 0.1%

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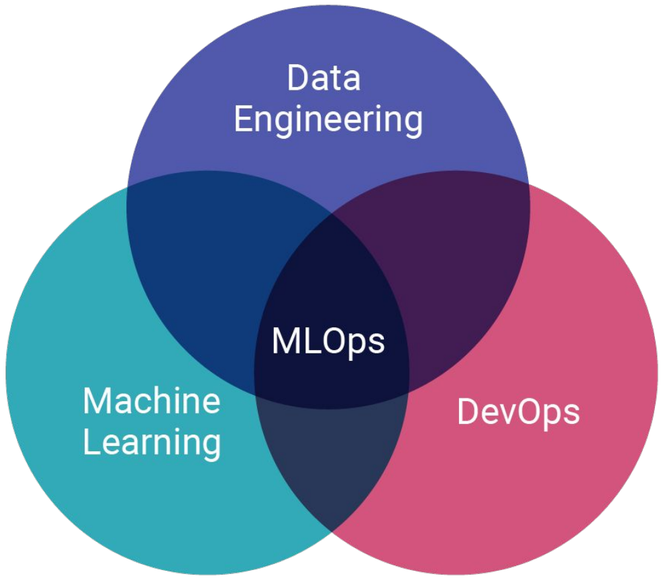
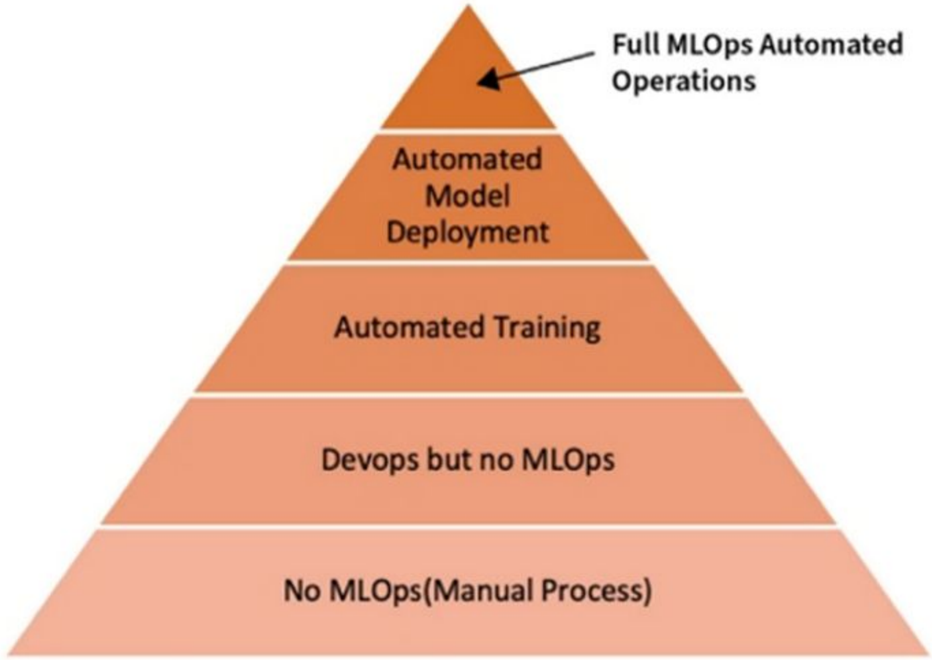
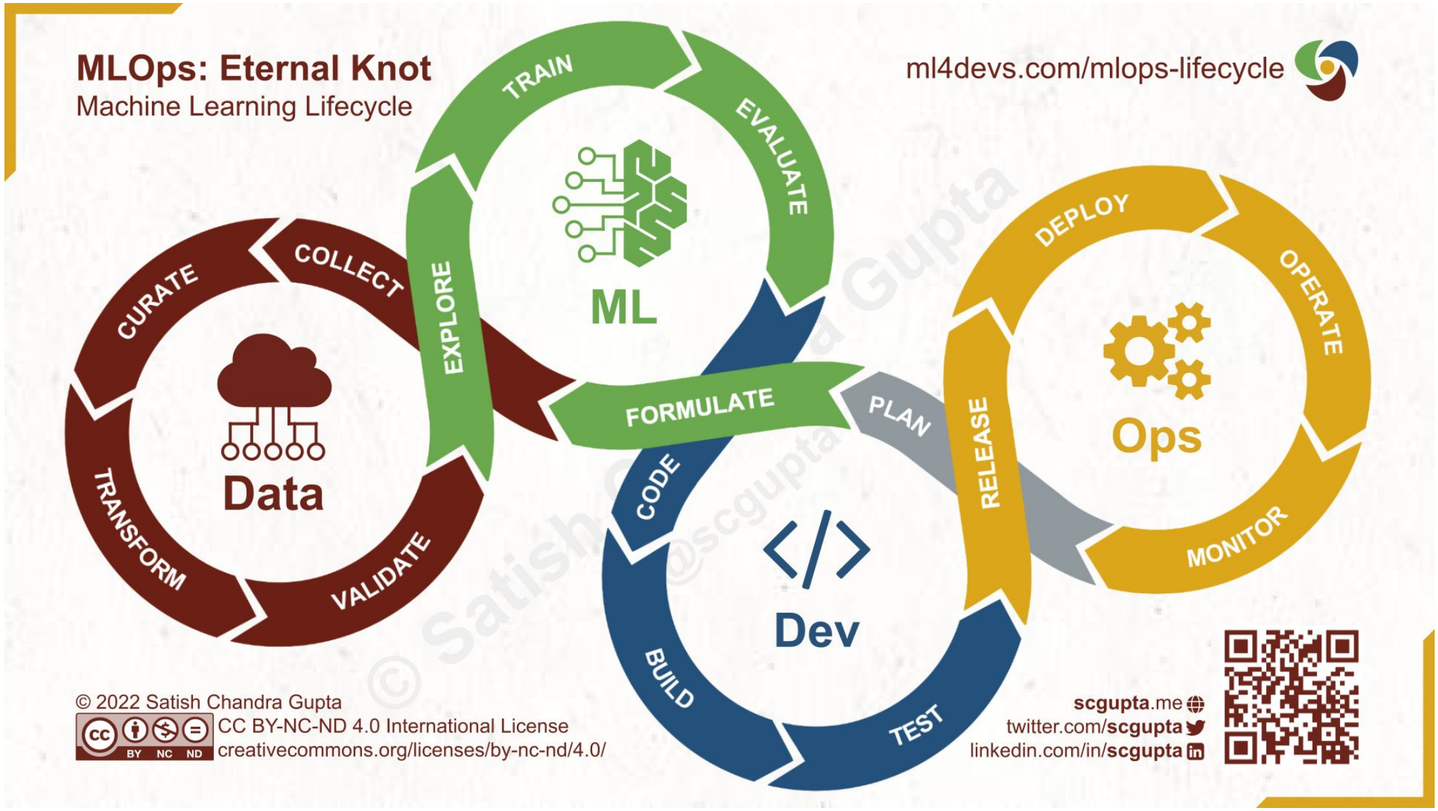
Automatizing the solution: MLOps



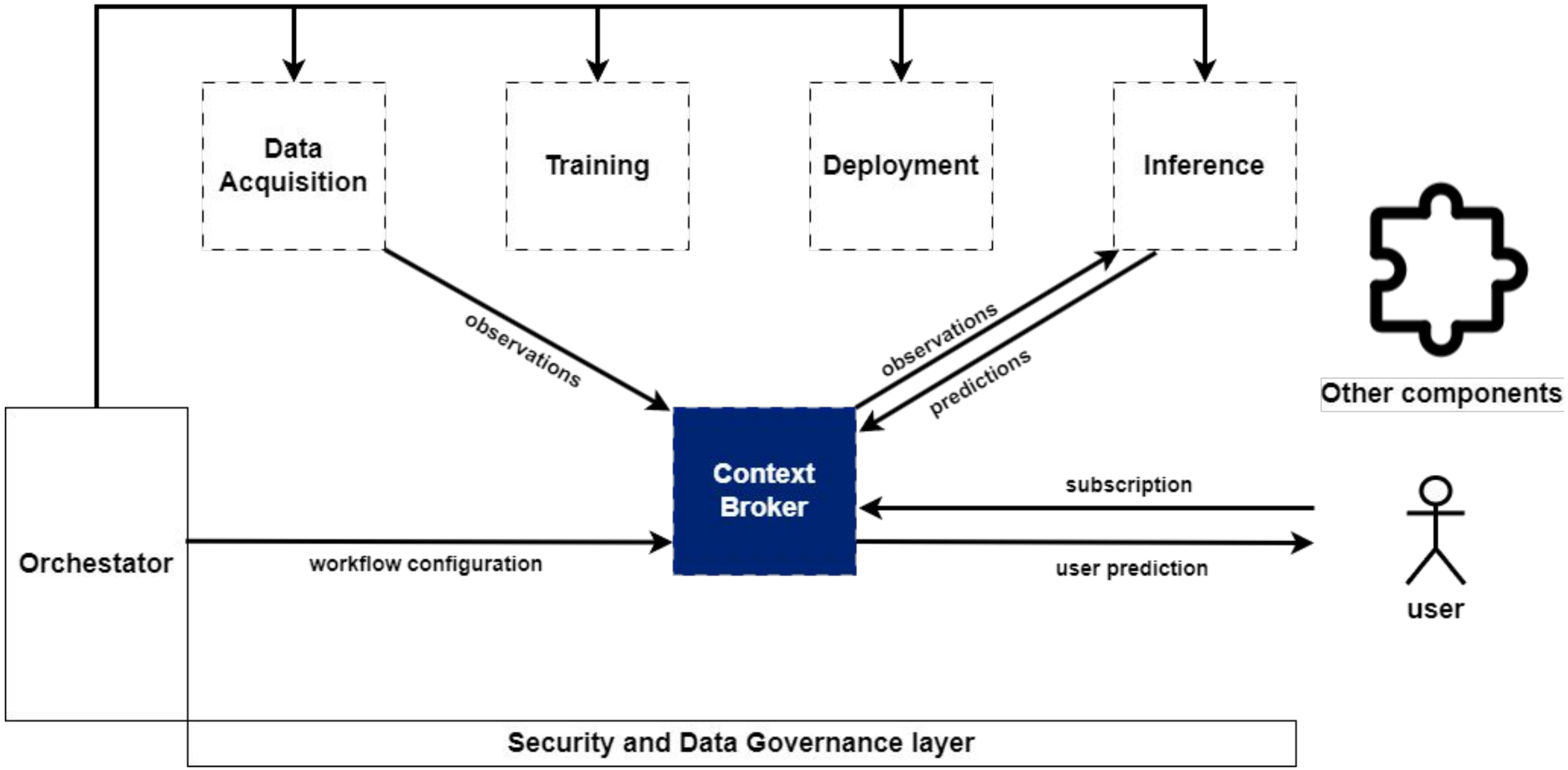


A typical ML lifecycle

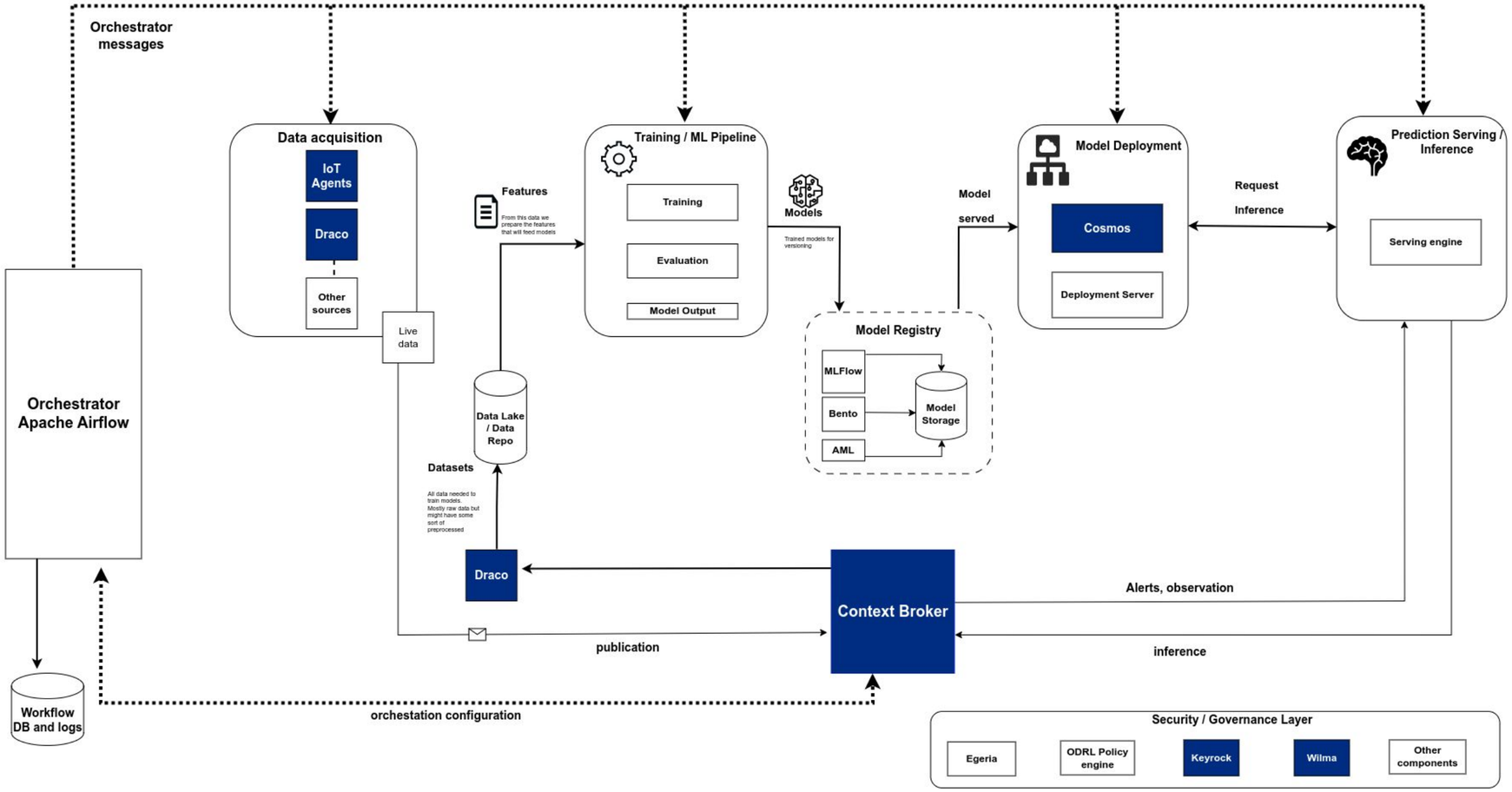
- **A Data Scientist**
  - Get and clean up data
  - Prepare and train a ML model
- **An IT person**
  - Package and deploy the ML model
- **An end user**
  - Discover the available ML models (with respect to privacy)
  - Ask to use one or more of them (and optionally pay for it)
  - Get real time data (predictions, outliers,…) from a ML model



Automatizing the solution: MLOps



Automatizing the solution: MLOps



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Summary - Key Concepts and Use Case

- Introduction to AI Concepts:
  - Machine Learning (ML), Deep Learning (DL), MLOps:
    - Overview of data processing, model training, and deployment.
    - Emphasis on the importance of train, validation, and test sets.

- Smart Health Use Case:
  - Skin Disease Detection App:
  - Designed to assist physicians by providing early skin disease detection.
  - Reduces wait time for dermatology appointments, especially in high-demand seasons.

Summary - Technical Integration and Automation

- Data and Model Insights:
  - Machine Learning (ML), Deep Learning (DL), MLOps:
    - Dataset: HAM10000 dataset for skin lesion analysis.
    - Model Selection: ResNet50 architecture for image classification.
    - Data Augmentation: Enhanced data variability for better training outcomes.

- Integration with FIWARE:
  - Architecture & Entities: Use of MLModel and MLProcessing entities to describe the model and results.
  - Subscriptions: Real-time updates on model creation and inferences using NGSI-LD.

- MLOps Automation:
  - Lifecycle: Automated deployment, monitoring, and scaling of ML models integrated into FIWARE.

Resources

- Repository with code and slides:
  - https://github.com/dncampo/FGS2024_ML-training/tree/main

- Repository with ML Models, data augmentation, notebooks:
  - https://github.com/dncampo/cheetah

- HAM10000 dataset:
  - https://api.isic-archive.com/collections/212/
  - https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/DBW86T
  - https://arxiv.org/pdf/1803.10417

- MLOps in FIWARE example:
  - Document architecture (WIP): https://docs.google.com/document/d/1Emy3QyD1So4ODoi5bZLMI888bibBpJ3dGuuF-7dNpXw/edit
  - https://docs.google.com/document/d/1Emy3QyD1So4ODoi5bZLMI888bibBpJ3dGuuF-7dNpXw/edit?usp=sharing

  - Parking example: https://github.com/ging/fiware-mlops-parking

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Contact: David CAMPO

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