



Venerdì 19 Aprile 2024
in presenza e in streaming
alle ore 19:00

#OpenCV #UseCases

@PyDataVenice #15 #Meetup #PyData



Astro Pi - ESA project

Elia Ernesto Stellin
Programmatore Junior
@ Emme informatica Srl



Detection PoC

Alessandra Bilardi
Data / Automation Specialist
@ Corley Cloud

Promotori di PyData Venice #15



Agenda

Speech

Prossimo incontro

Spritz





OpenCV & detection PoC

Alessandra Bilardi - Data & Automation Specialist @ Corley Cloud

@PyDataVenice #15 #Meetup #PyData

Agenda

OpenCV

Basics of machine learning

Face recognition

Object detection

Take away

OpenCV

—

may

open source

with you

OpenCV History

Details	Year
First alpha version	2000
1.1 version	2008
2.2 version, first version on GitHub	2010
non-profit foundation OpenCV.org for support	2012
3.1 version, Intel acquires Itseez	2016
Kickstarter campaign for the OpenCV AI Kit	2020
4.4 version, OpenCV launched OpenCV.ai	2020

OpenCV Applications

- 2D and 3D feature toolkits
- Egomotion estimation
- Facial recognition system
- Gesture recognition
- Human-computer interaction (HCI)
- Mobile robotics
- Motion understanding
- Object detection
- Segmentation and recognition
- Stereopsis stereo vision: depth perception from 2 cameras
- Structure from motion (SFM)
- Motion video tracking
- Augmented reality
- Boosting
- Decision tree learning
- Gradient boosting trees
- Expectation-maximization algorithm
- k-nearest neighbor algorithm
- Naive Bayes classifier
- Artificial neural networks
- Random forest
- Support vector machine (SVM)
- Deep neural networks (DNN)

OpenCV Applications

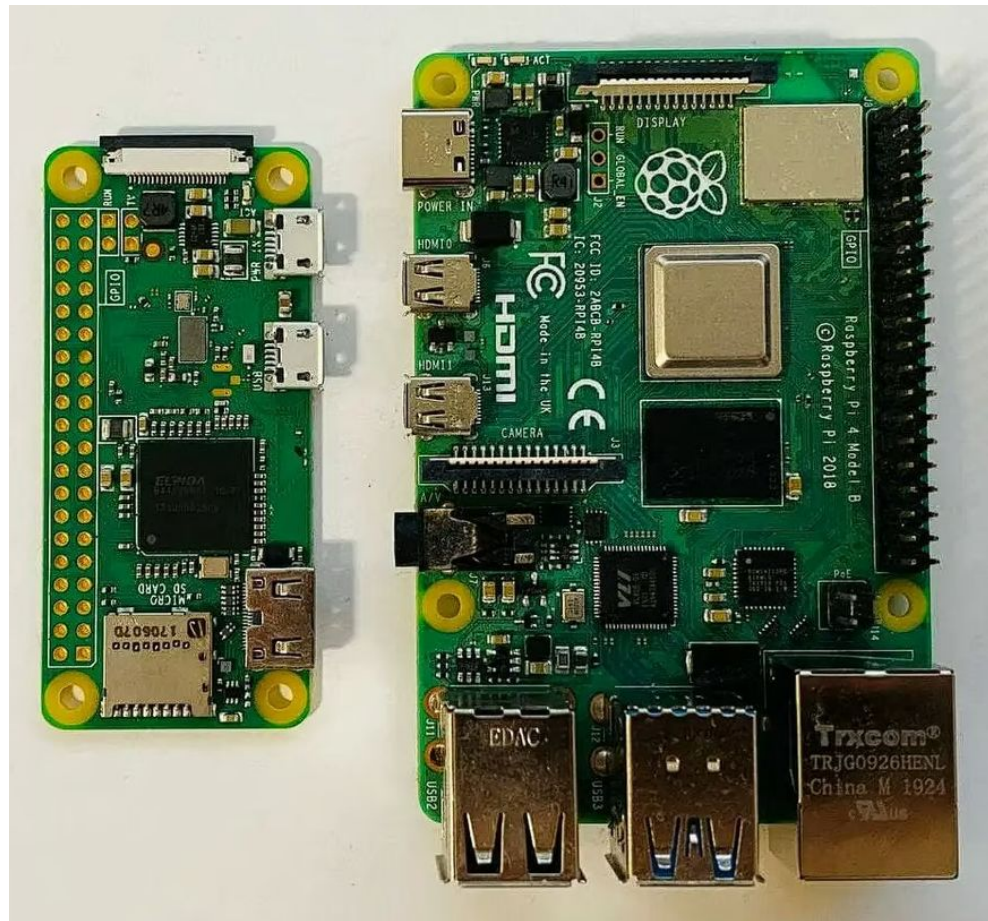
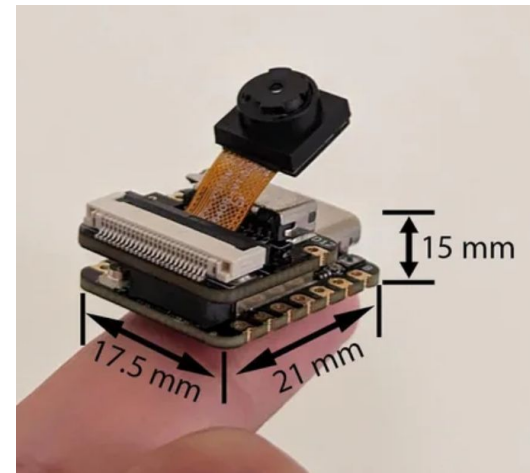
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OpenCV resources

- <https://opencv.org/>
 - [Get Started](#)
 - [GitHub](#) & [Wiki](#)
 - [Documentation](#)
 - [Forum](#)
 - [Courses](#)
- <https://www.opencv.ai/>
 - consulting
- <https://roboflow.com/>
 - object detection
- <https://developer.opencv.fr/>
 - face recognition

Devices

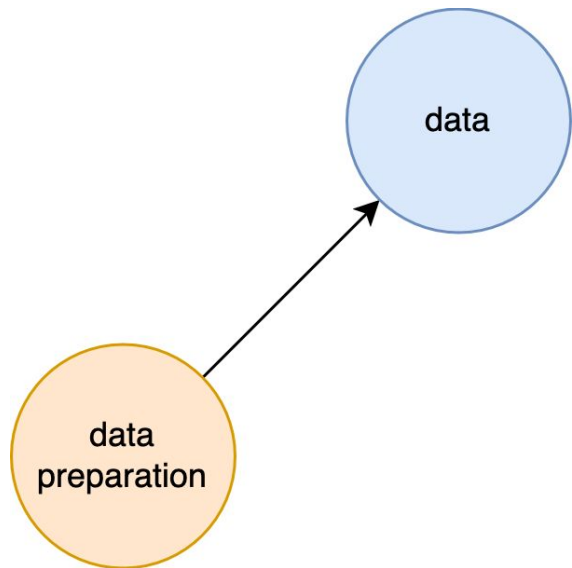


What can OpenCV run on ? What's ready ?

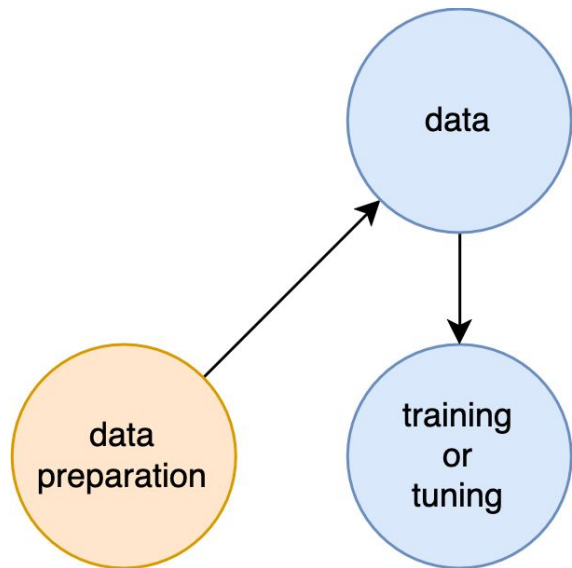
- <https://towardsdatascience.com/installing-opencv-on-raspberry-pi-3-b-46ab17a9fc5a>
 - <https://linuxize.com/post/how-to-install-opencv-on-raspberry-pi/>
 - <https://www.instructables.com/Face-and-Eye-Detection-With-Raspberry-Pi-Zero-and-/>
 - <https://github.com/ArduCAM/RPI-Pico-Cam>
 - <https://github.com/joachimBurket/esp32-opencv>
 - <https://github.com/kwrazi/esp32-opencv>
 - <https://github.com/0015/ESP32-OpenCV-Projects>
- <https://how2electronics.com/esp32-cam-based-object-detection-identification-with-opencv/>
 - <https://github.com/arunponnusamy/cvlib>
 - <https://github.com/Mirovai/OpenCV-Face-Recognition>
 - <https://github.com/medsriha/real-time-face-recognition>

Basics of machine learning

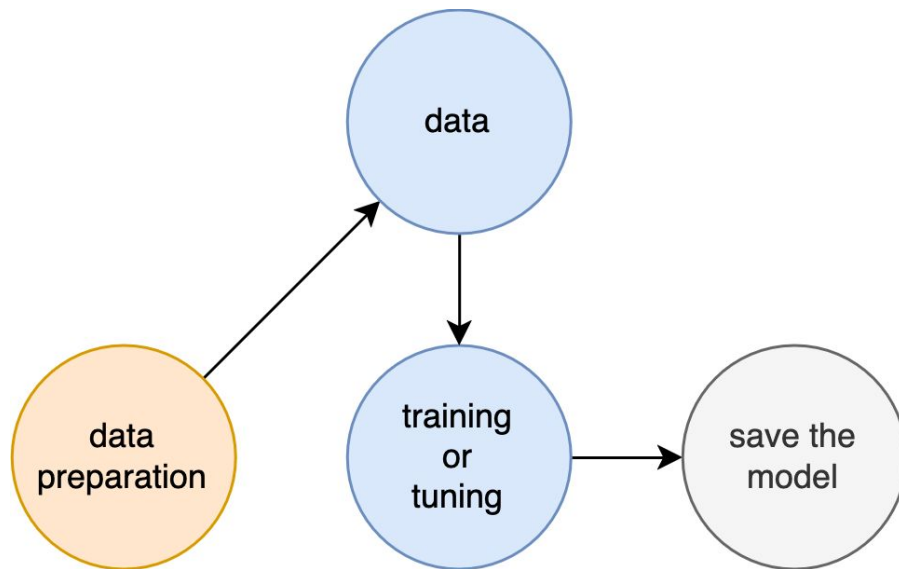
ABC



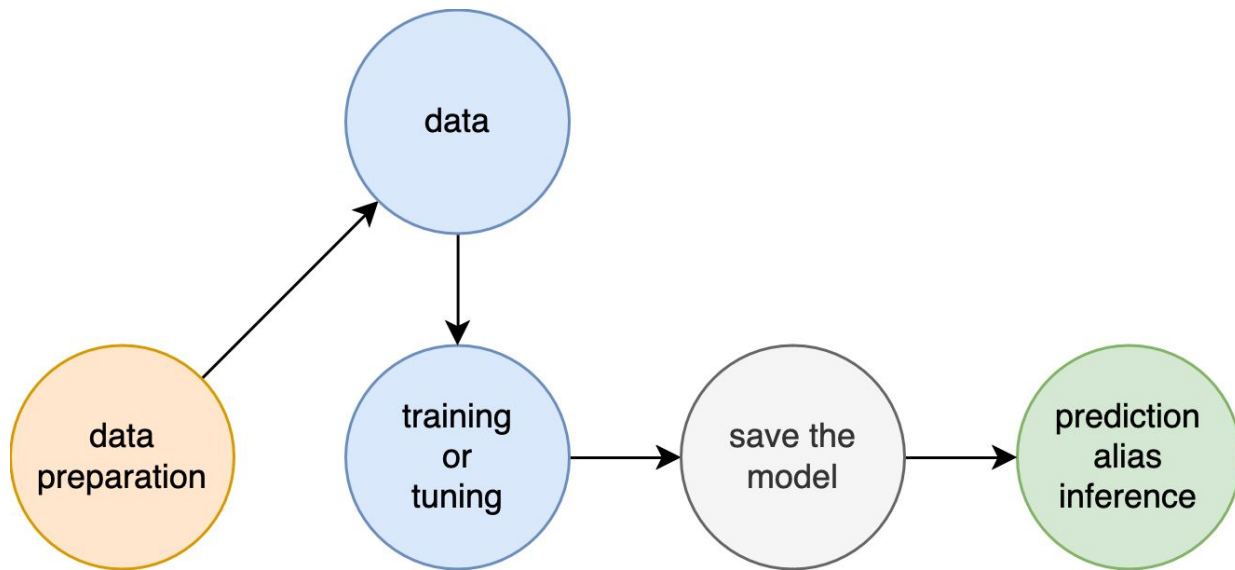
ABC



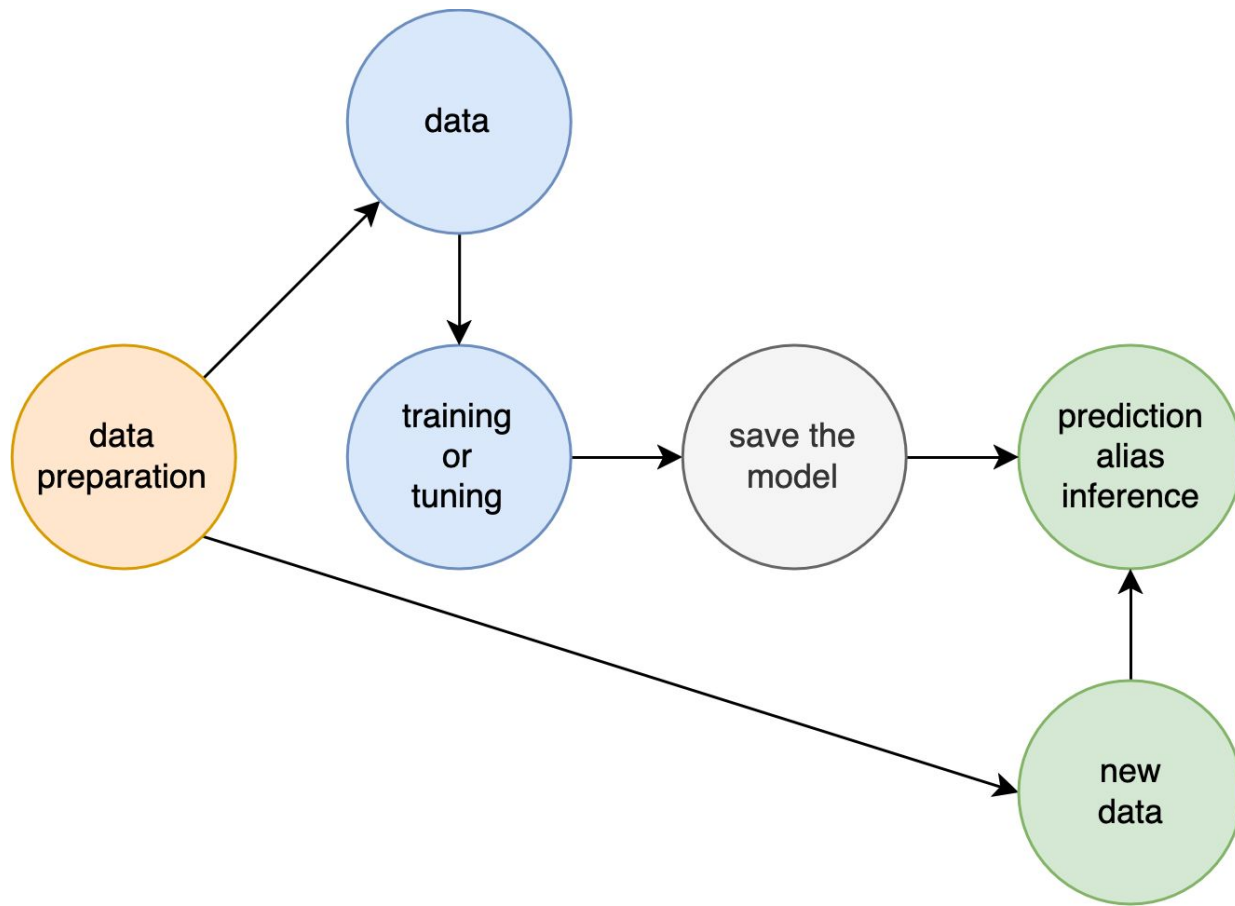
ABC



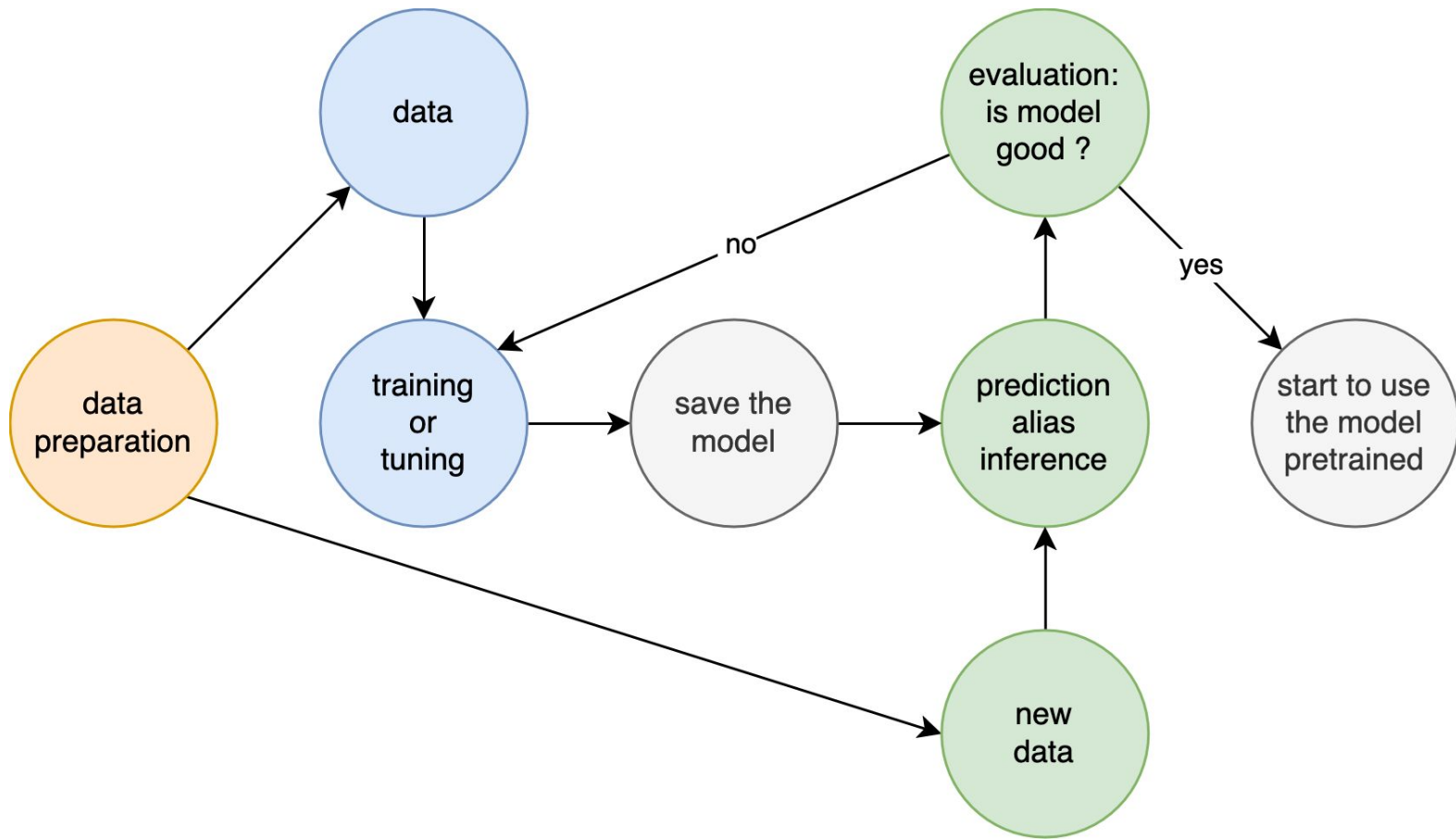
ABC



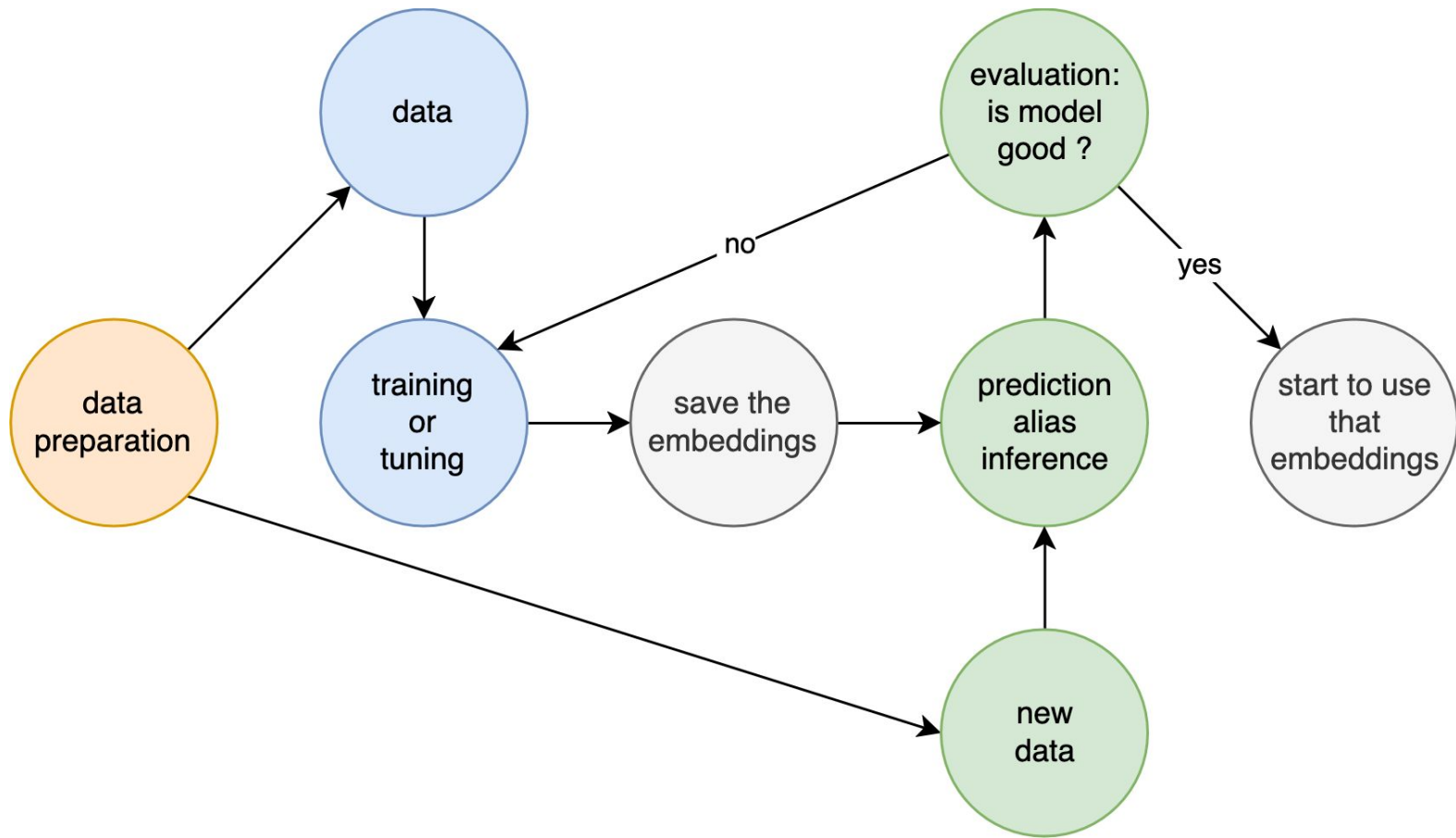
ABC



ABC

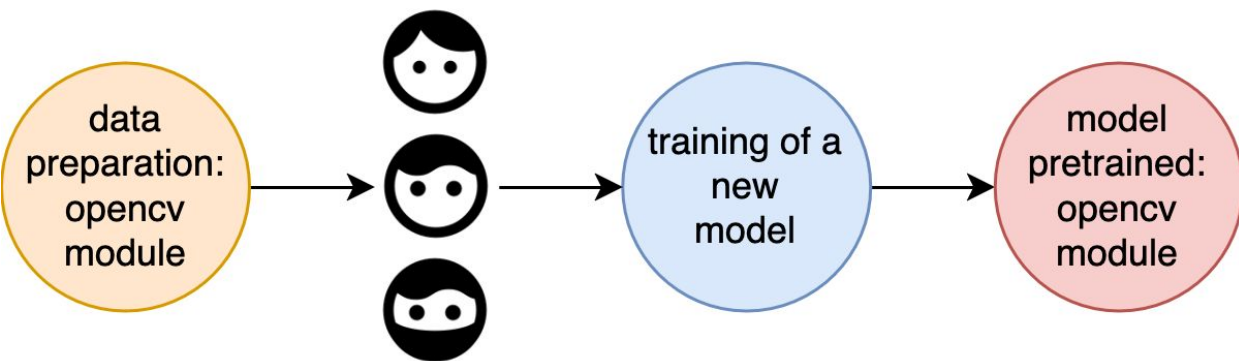


ABC

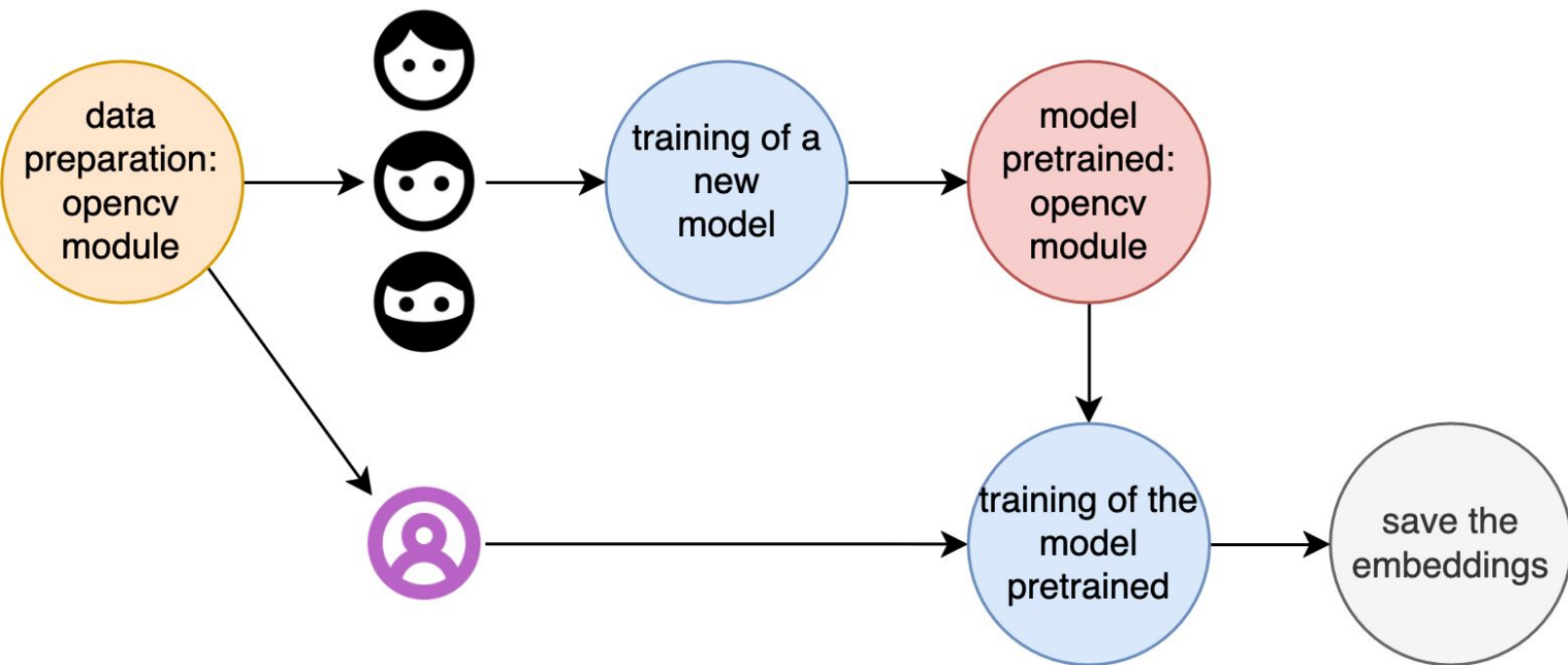


Face recognition

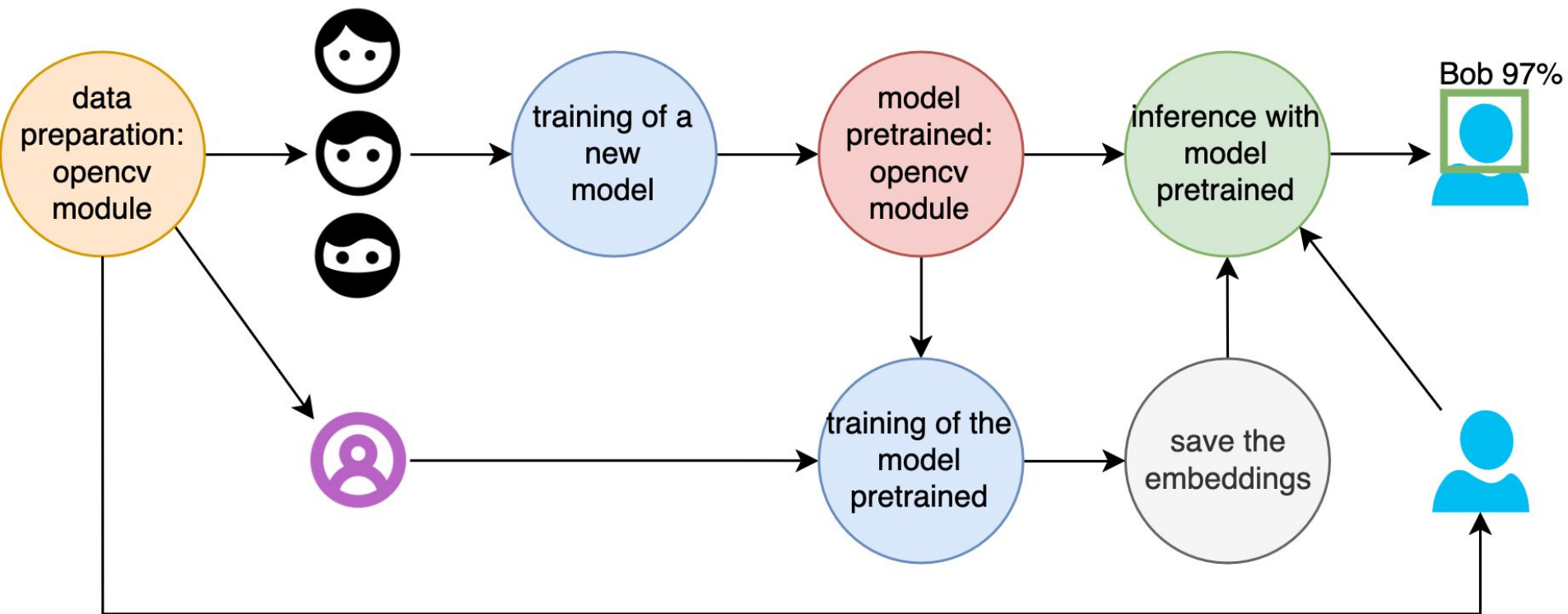
ABC - Face recognition



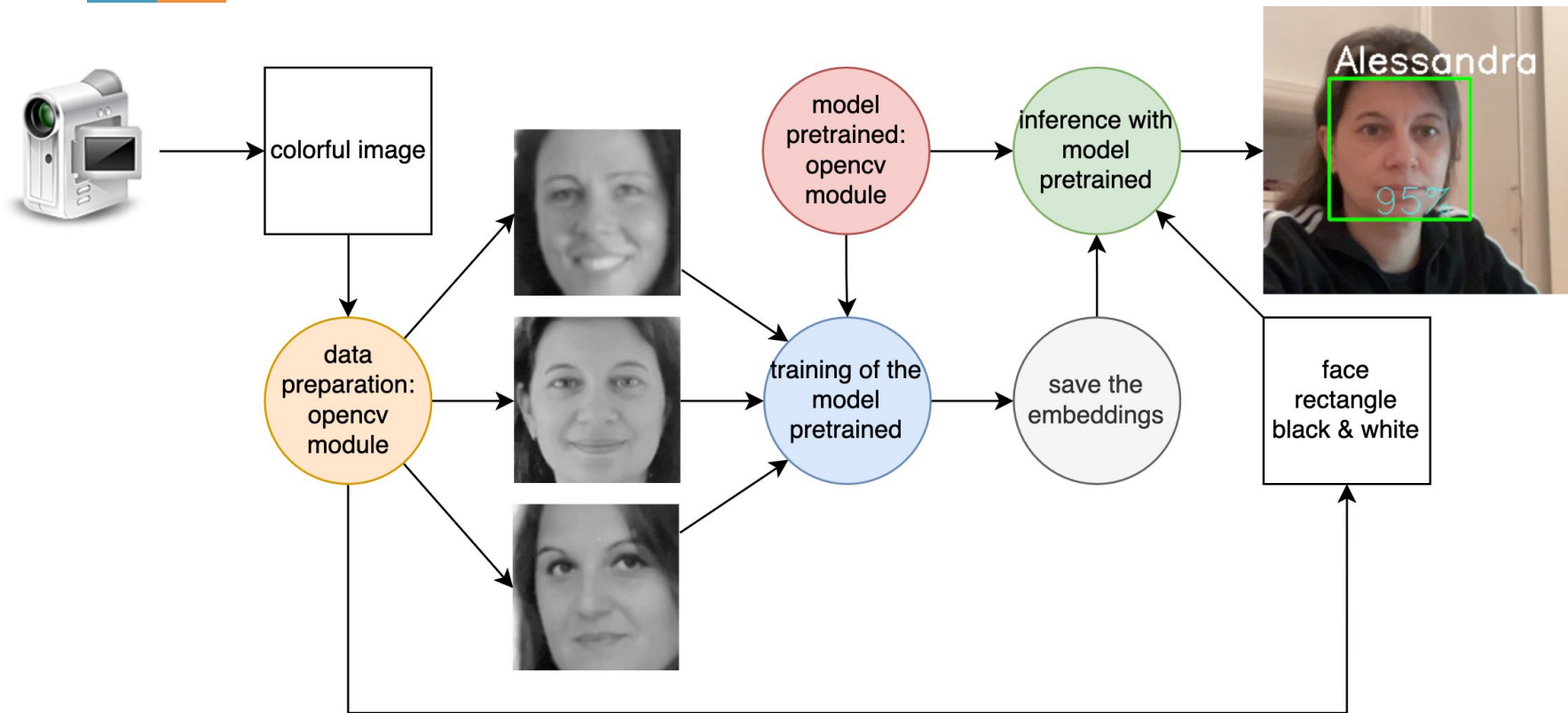
ABC - Face recognition



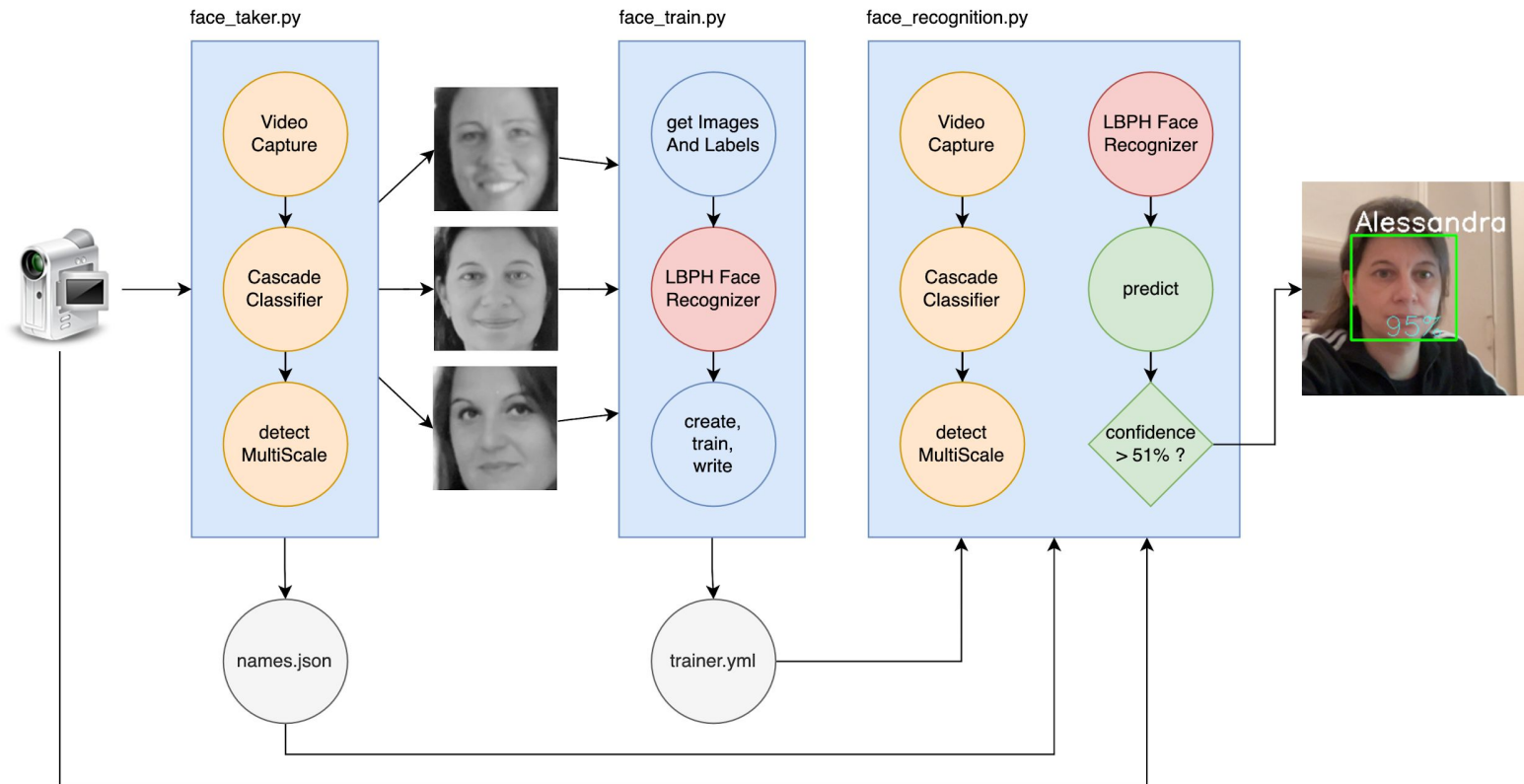
ABC - Face recognition



Face recognition



Face recognition



Embeddings - trainer.yml

%YAML:1.0

opencv_lbphfaces:

threshold: 1.7976931348623157e+308

radius: 1

neighbors: 8

grid_x: 8

grid_y: 8

histograms:

- !!opencv-matrix

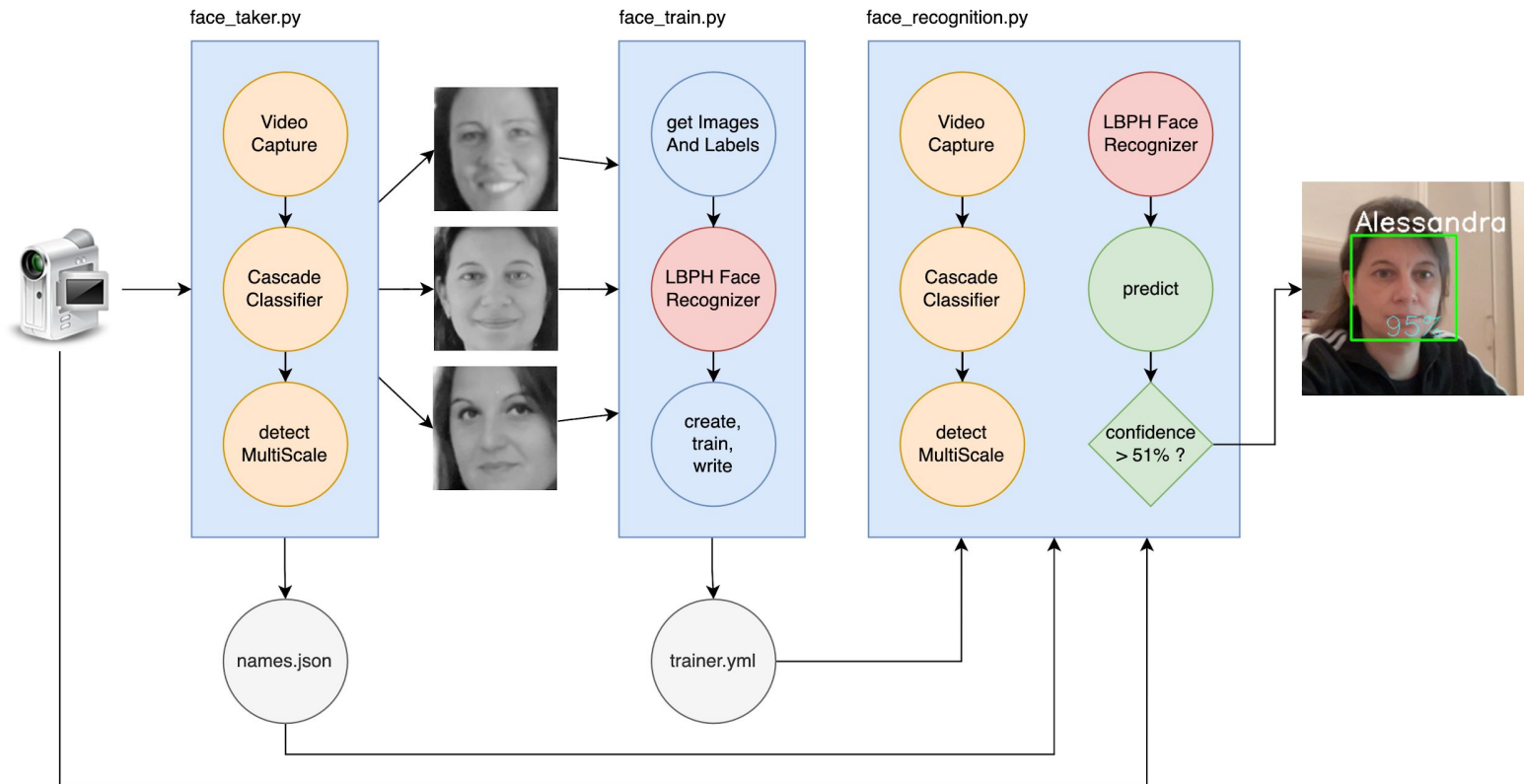
rows: 1

cols: 16384

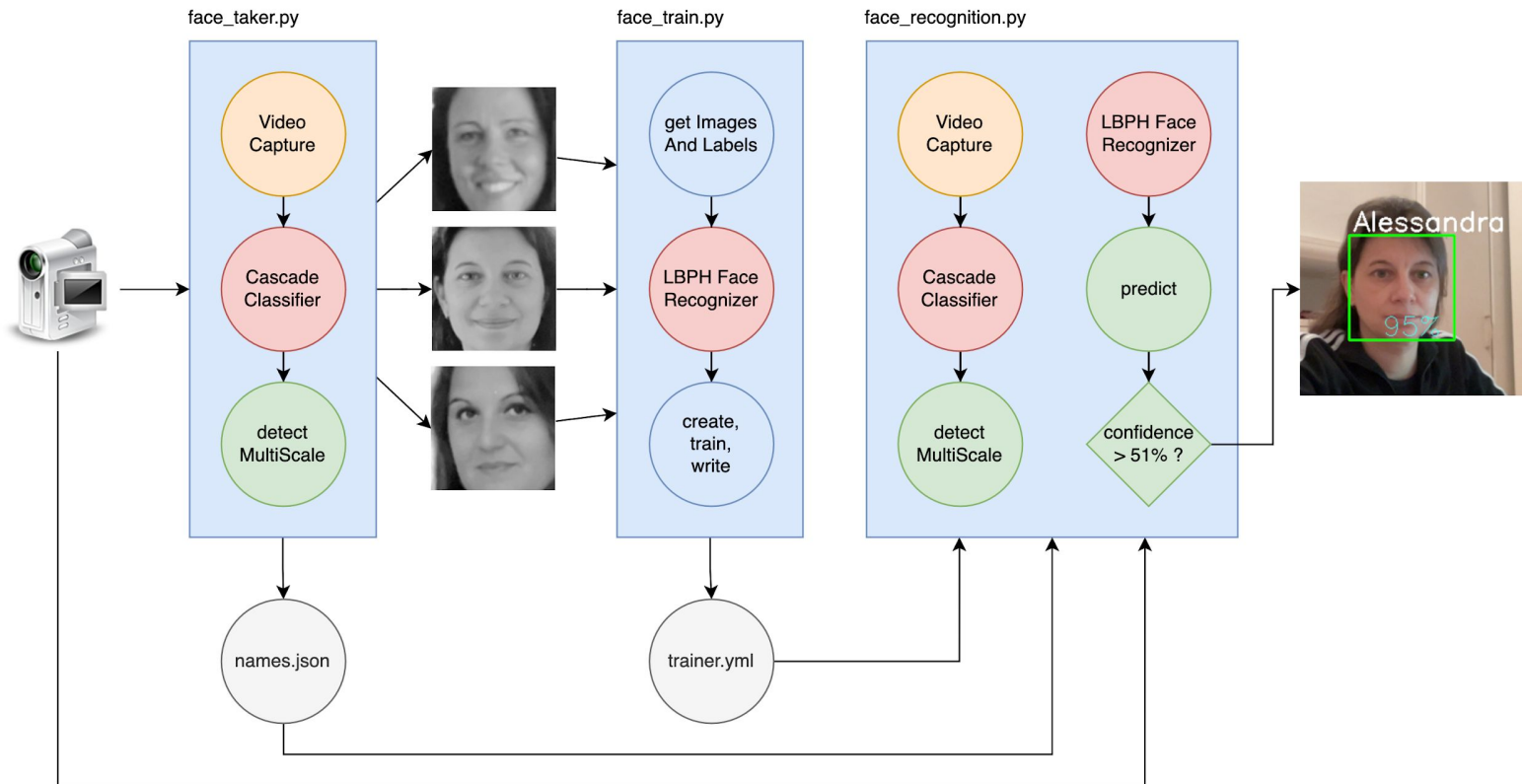
dt: f

data: [0., 1.56250000e-02, 0., 0., 1.56250000e-02, 0., 0., 0.,
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1.56250000e-02, 0., 0., 0., 0., 1.56250000e-02, 0.,
1.56250000e-02, 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
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0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
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1.56250000e-02, 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,

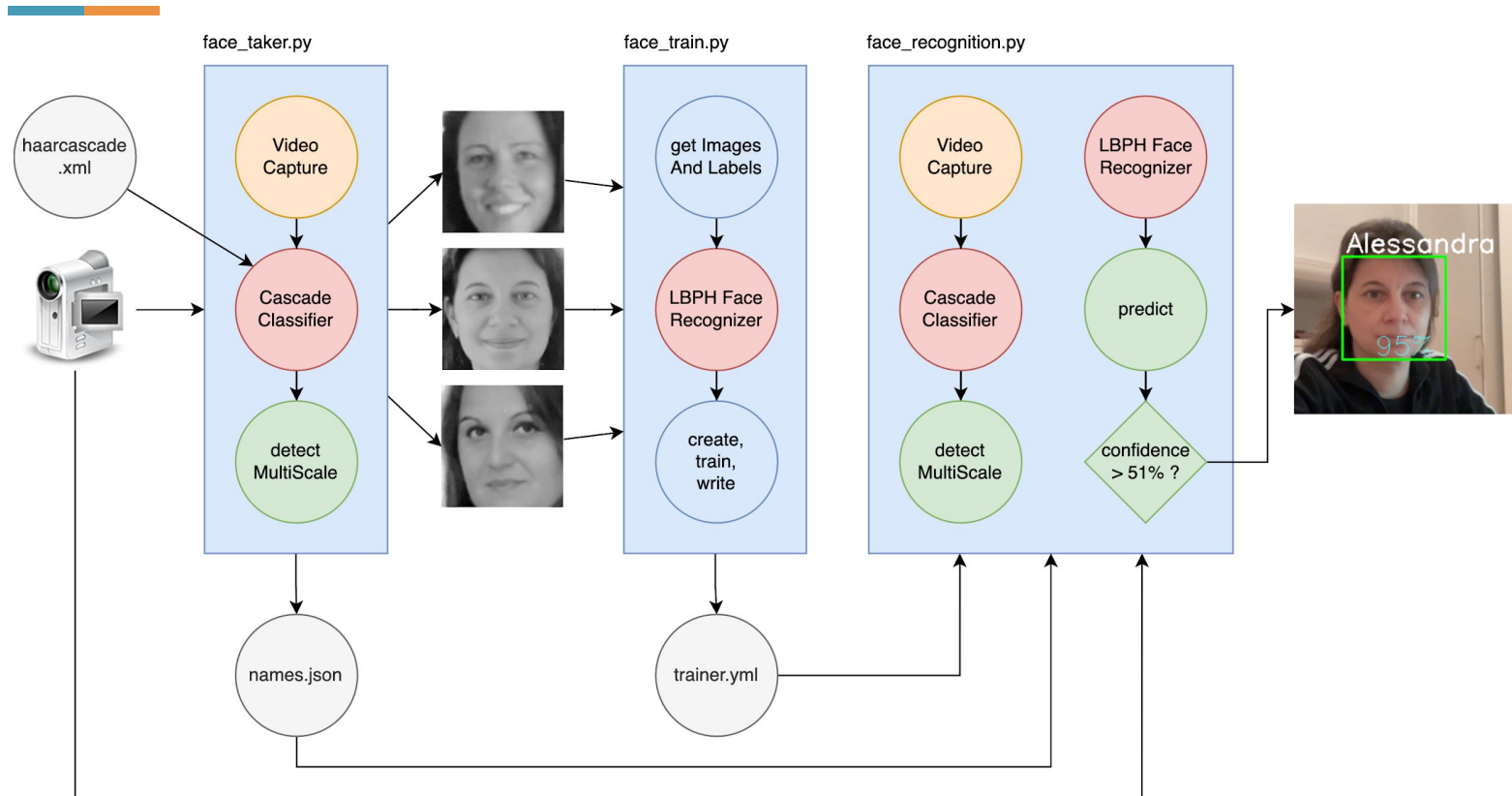
Face recognition



Face recognition



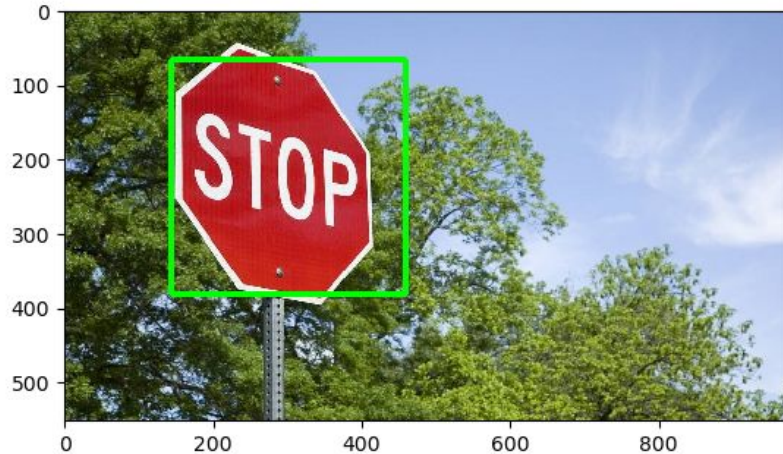
Face recognition



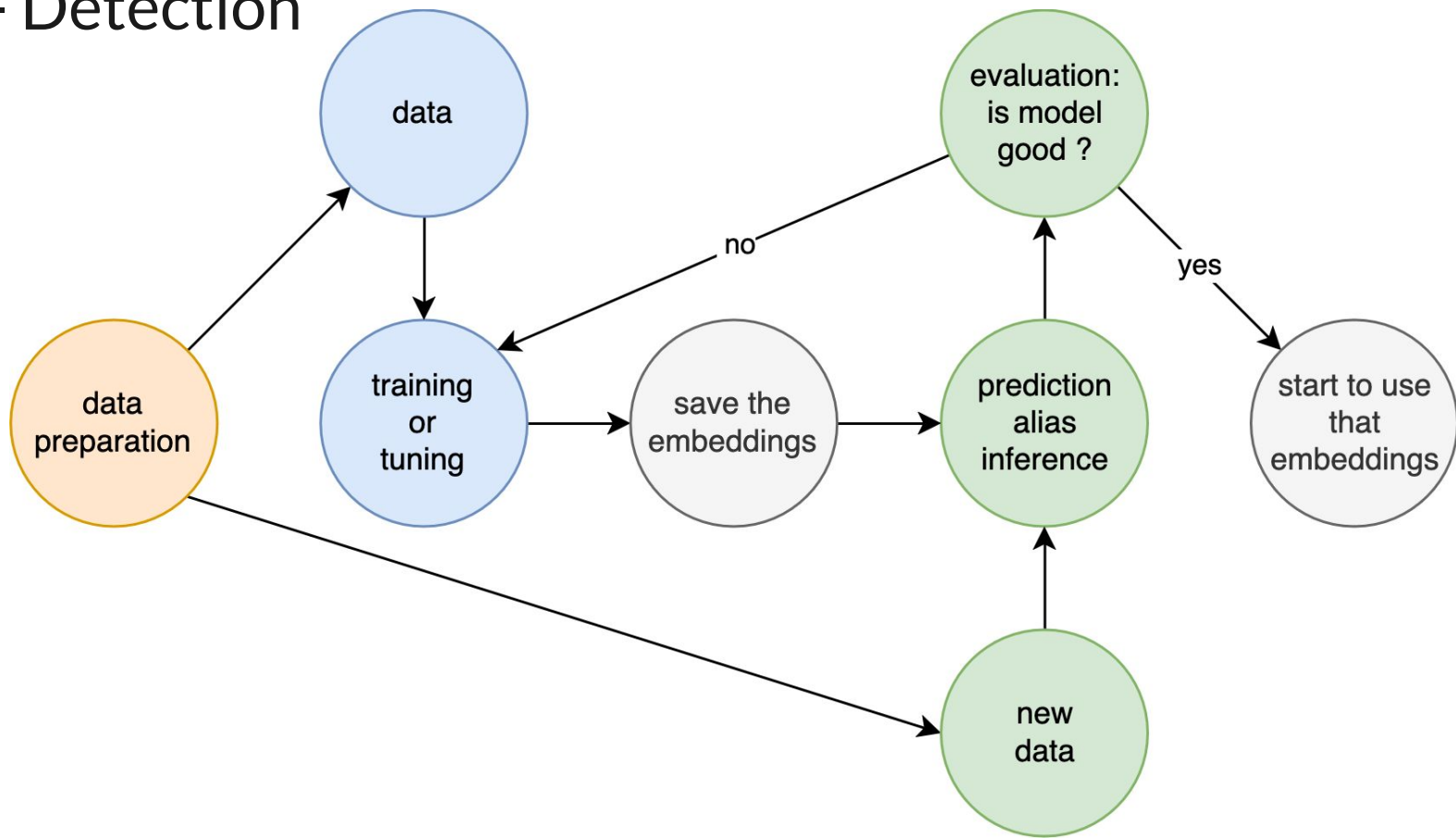

```
<?xml version="1.0"?>
<!-- ...
////////////////////////////////////
-->
<opencv_storage>
<cascade_type_id="opencv-cascade-classifier"><stageType>BOOST</stageType>
  <featureType>HAAR</featureType>
  <height>24</height>
  <width>24</width>
  <stageParams>
    <maxWeakCount>211</maxWeakCount></stageParams>
  <featureParams>
    <maxCatCount>0</maxCatCount></featureParams>
  <stageNum>25</stageNum>
  <stages>
    <_>
      <maxWeakCount>9</maxWeakCount>
      <stageThreshold>-5.0425500869750977e+00</stageThreshold>
      <weakClassifiers>
        <_>
          <internalNodes>
            0 -1 0 -3.1511999666690826e-02</internalNodes>
          <leafValues>
            2.0875380039215088e+00 -2.2172100543975830e+00</leafValues></_>
        <_>
          <internalNodes>
```


Object detection

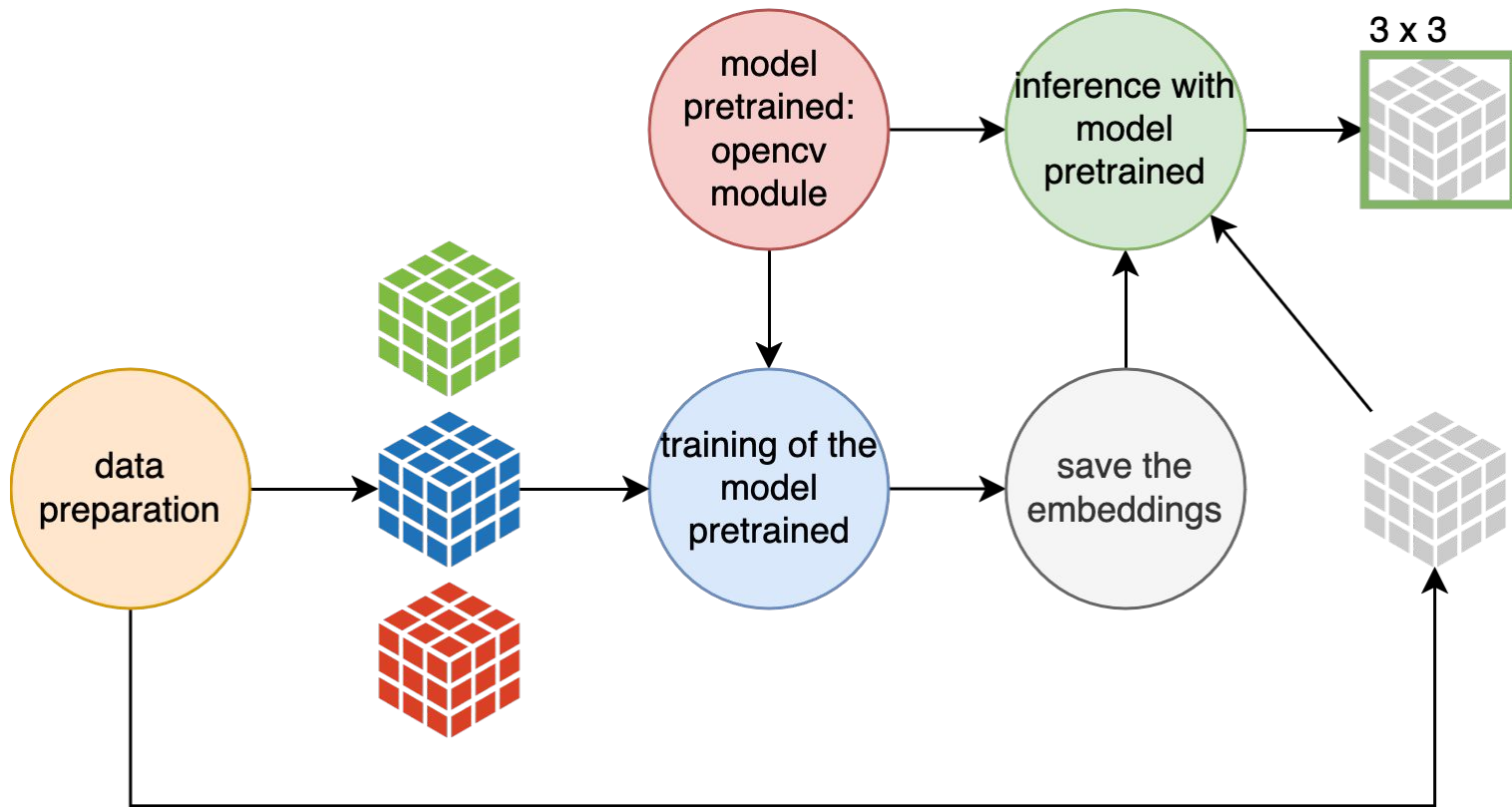
Object detection



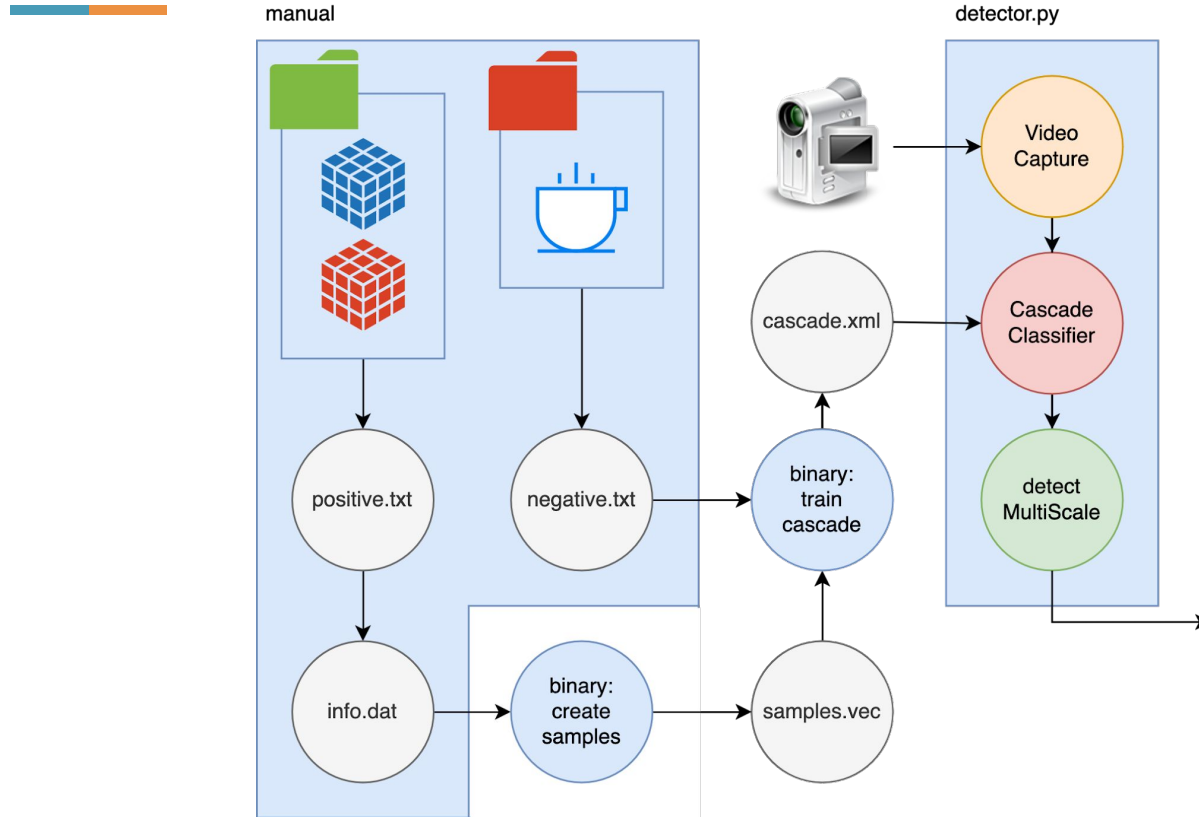
ABC - Detection



ABC - Detection



Object detection







Take away

Where does it work ?

Resources	Laptop	Raspberry 3	Raspberry Zero	Raspberry Pico
software	macOS	Raspberry PI OS	Raspberry PI OS	MicroPython / C
OS storage	500GB	microSD	microSD	264KB
RAM	8GB	1GB	512MB	2MB
cv2 + numpy	112MB + 56MB	✓	✓	✗
trainer.yml	3.3MB / user	✓	✓	✗
haarcascade.xml	1MB	✓	✓	✗
3x3.cascade.xml	20K	✓	✓	✓

Is OpenCV for everyone ?

Action	Difficulty
Installation of python packages cv2 + numpy	
Create embeddings for own faces - trainer.yml	
Use embeddings for face detection - haarcascade.xml	
Create embeddings for object detection - 3x3.cascade.xml	



Take away

- OpenCV Object Detection
 - also on [ESP32](#)
 - but not yet on [RPI Pico](#)
 - by [dnn module](#)
- OpenCV Cascade Classifier
 - [haar cascade](#) for [FR PoC](#)
 - [how to create haar cascade](#)



Questions ?

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Astro Pi - ESA competition

Elia Ernesto Stellin - Programmatore Junior @ Emme informatica Srl

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Questions ?

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Prossimo incontro



- giovedì 27 giugno ore 19:00

Proposte





Thanks for listening.

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