# PyData Venice

## Venerdì 19 Aprile 2024

## in presenza e in streaming

## alle ore 19:00

**#OpenCV #UseCases**

Astro Pi - ESA project

Elia Ernesto Stellin
Programmatore Junior
@ Emme informatica Srl

Detection PoC

Alessandra Bilardi
Data / Automation Specialist
@ Corley Cloud

**@PyDataVenice #15 #Meetup #PyData**

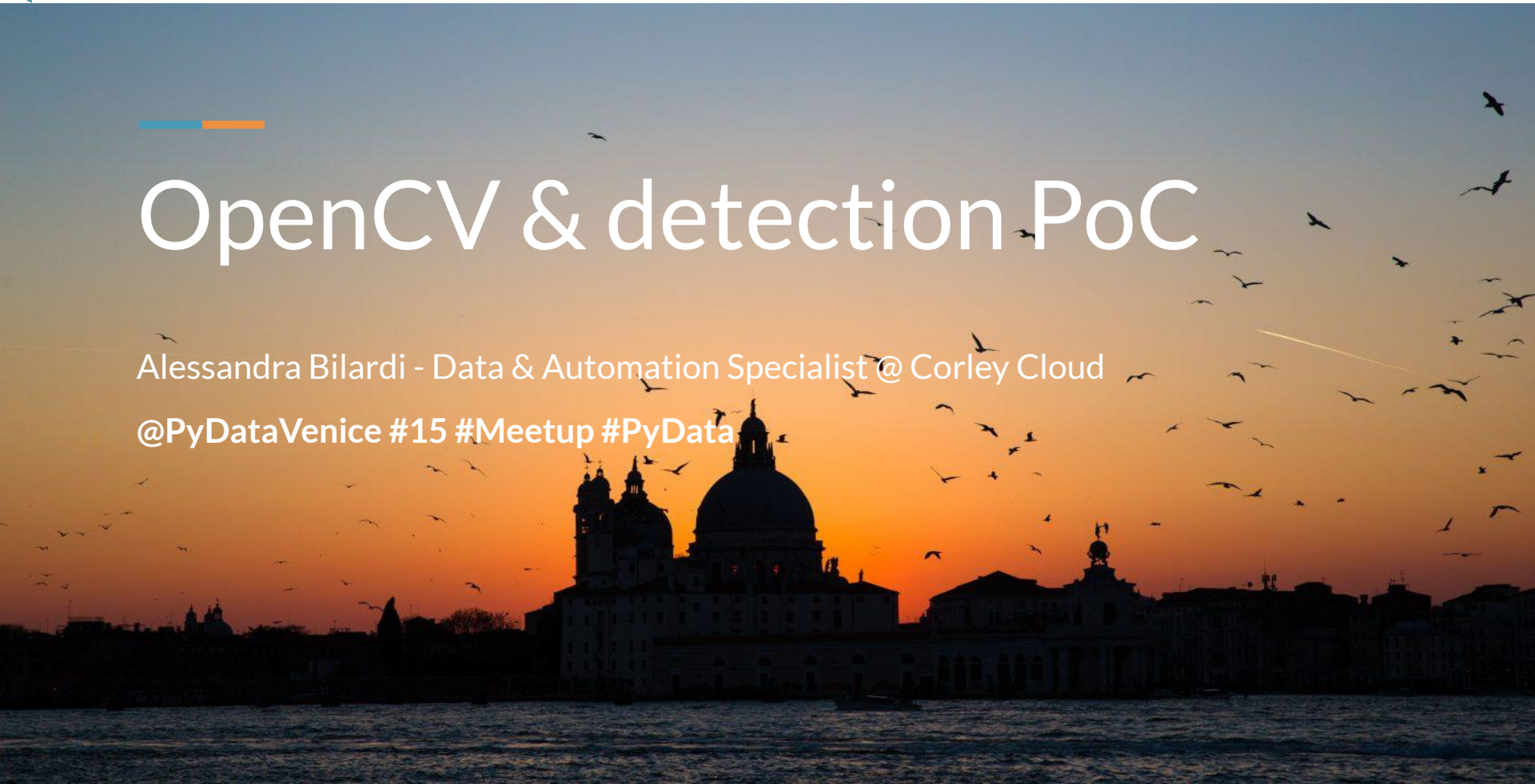
# Promotori di PyData Venice #15


corley

# Agenda

Speech
Prossimo incontro
Spritz

PyData



# 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)

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

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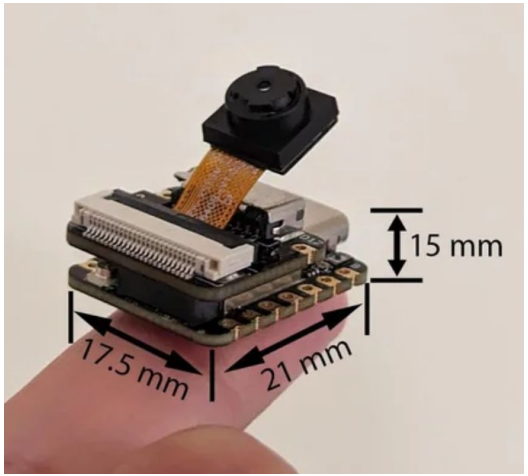
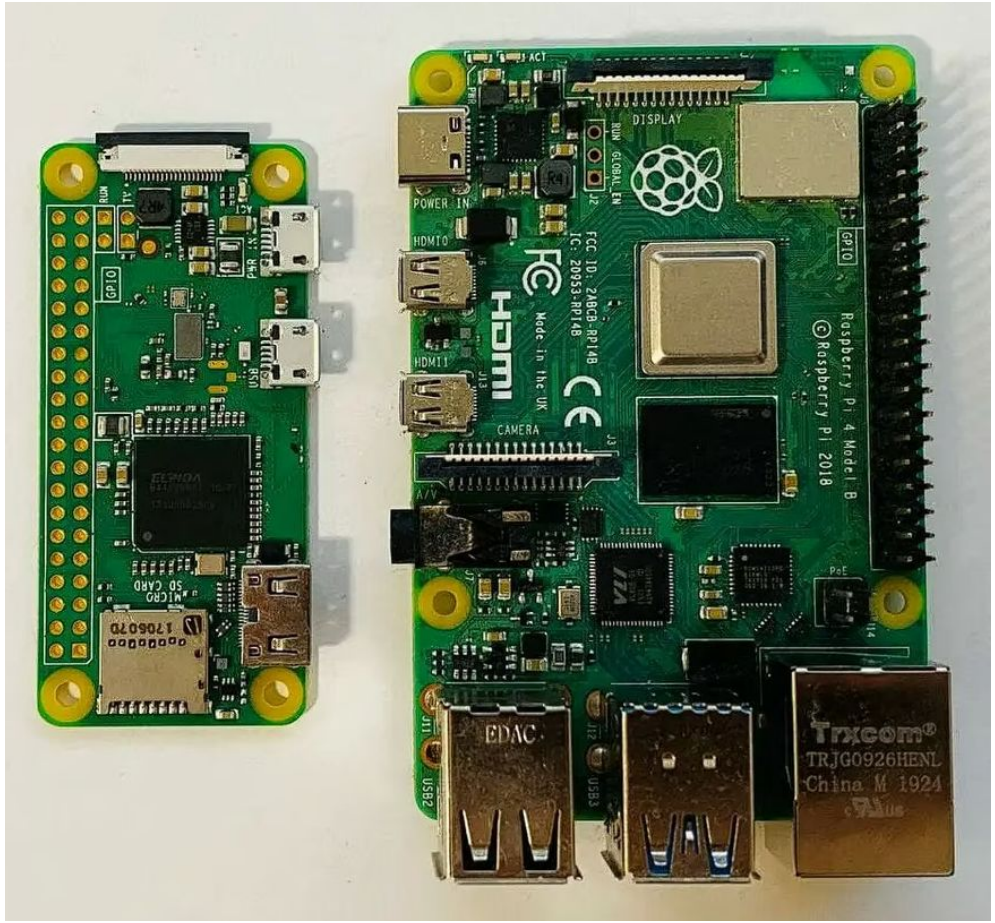
# OpenCV resources

- 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


15 mm
17.5 mm
21 mm

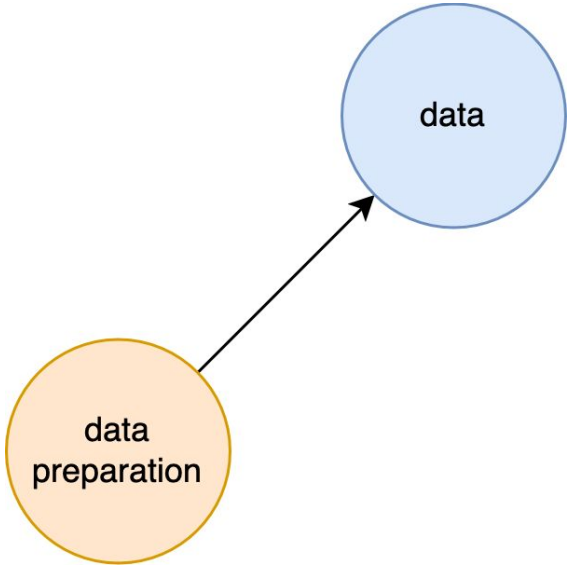

DISPLAY
POWER IN
HDMI0
HDMI1
CAMERA
EDAC
Trxcom
TRJG0926HENL
China M 1924
Raspberry Pi 4 Model B
©Raspberry Pi 2018

# What can OpenCV run on ? What's ready ?

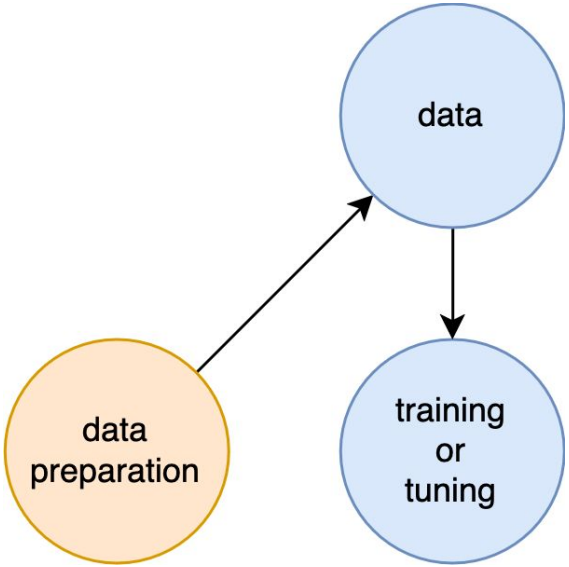
- https://towardsdatascience.com/installing-opencv-on-raspberry-pi-3-b-46ab17a9fc5a
  - https://linuxize.com/post/how-to-install-opencv-on-raspberry-pi/
  - https://www.instructables.com/Face-and-Eye-Detection-With-Raspberry-Pi-Zero-and-/
  - https://github.com/ArduCAM/RPI-Pico-Cam
  - https://github.com/joachimBurket/esp32-opencv
    - 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/Mjrovai/OpenCV-Face-Recognition
  - https://github.com/medsriha/real-time-face-recognition

# Basics of machine learning

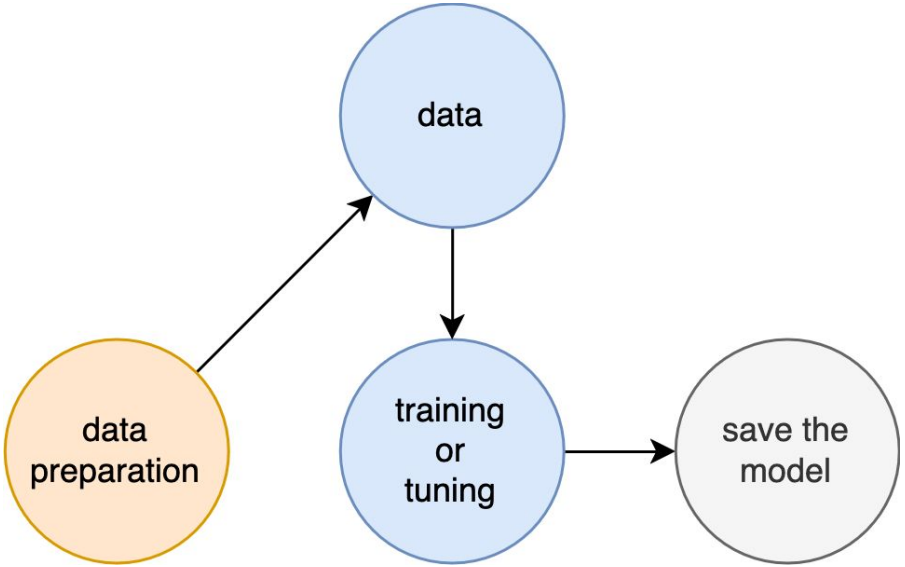
# ABC



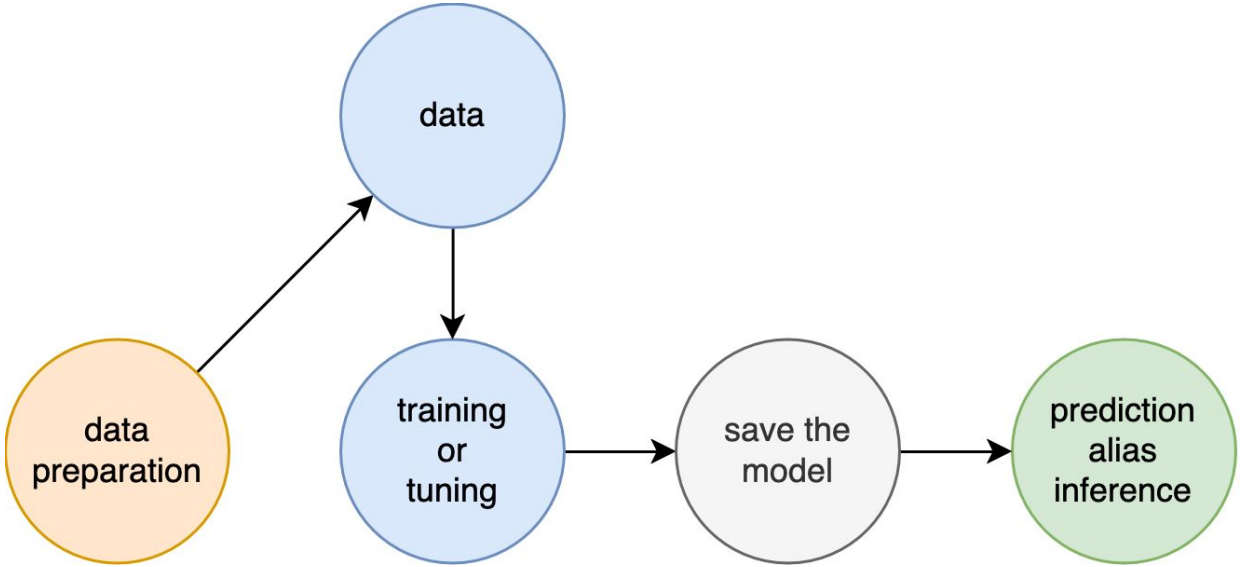
# ABC



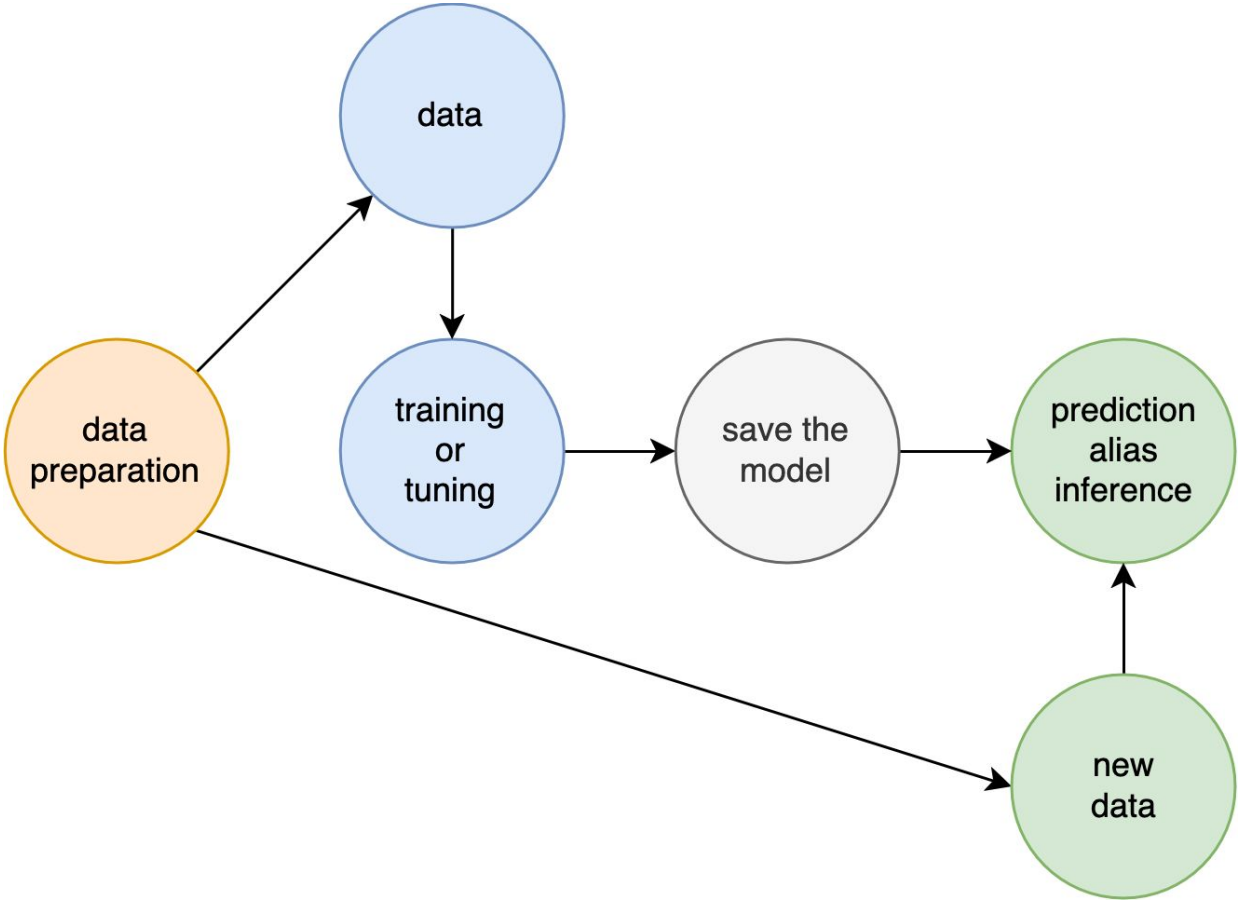
# ABC



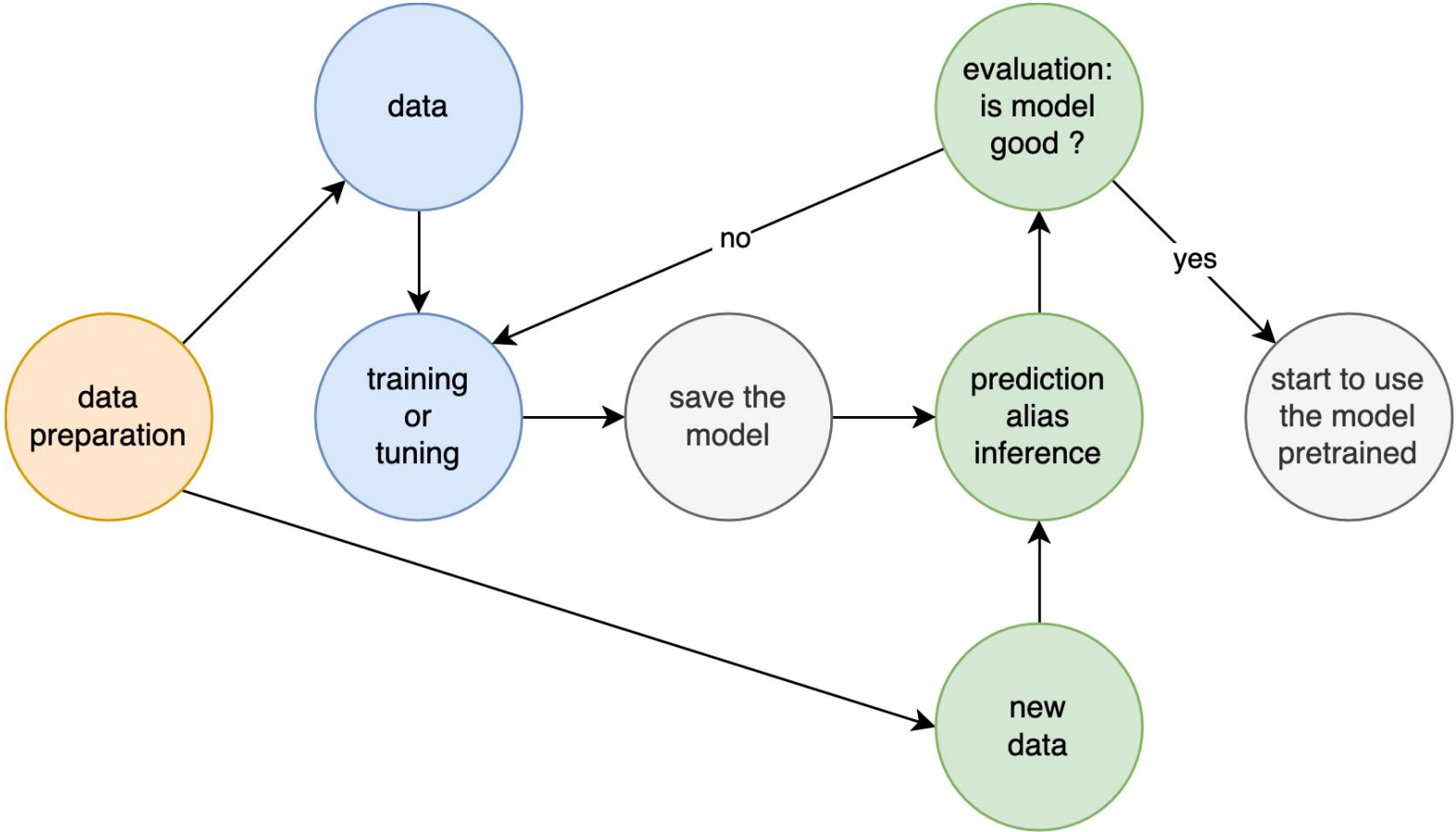
# ABC


data
data preparation
training or tuning
save the model
prediction alias inference

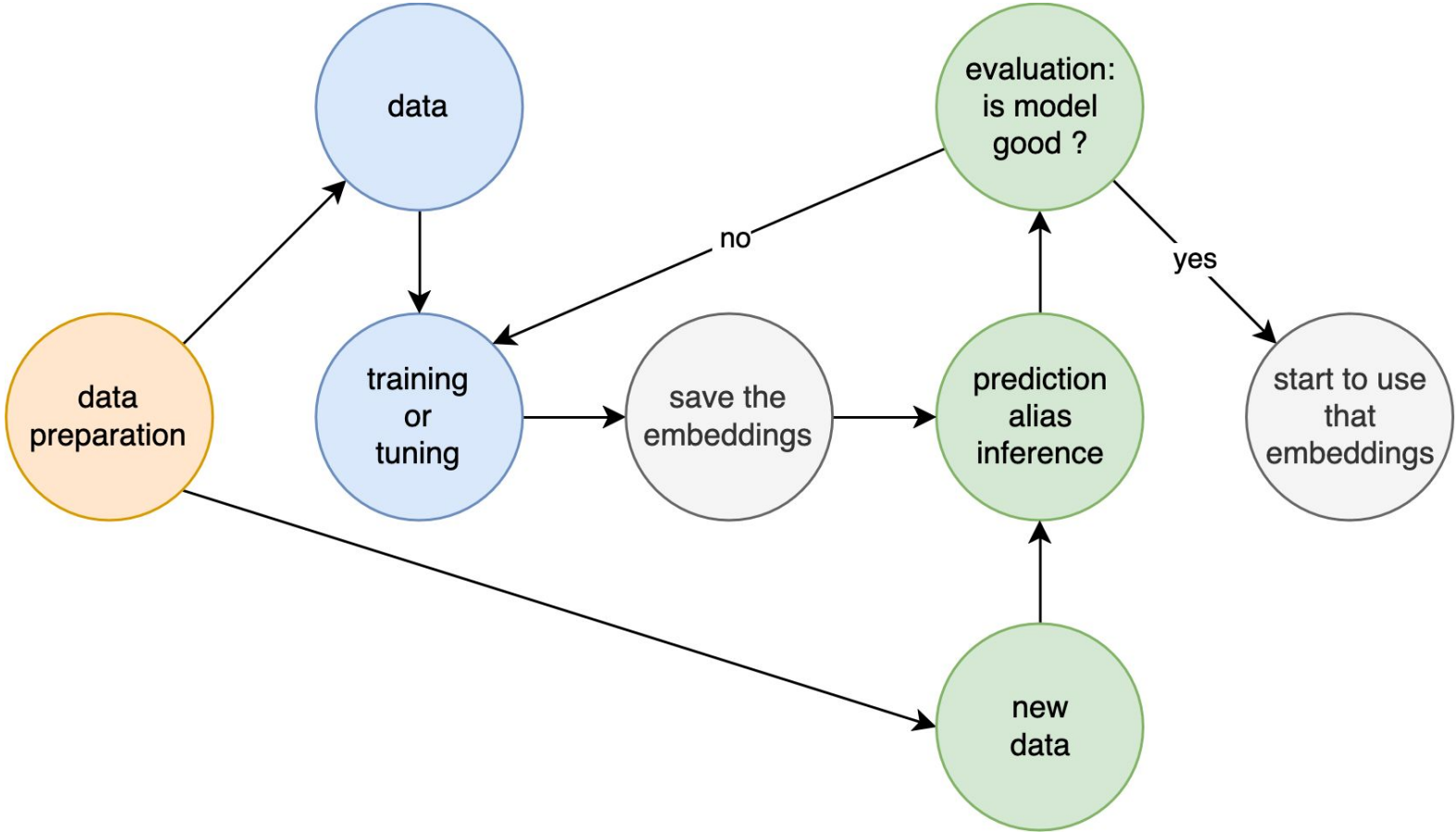
# ABC


data
data preparation
training or tuning
save the model
prediction alias inference
new data

# ABC

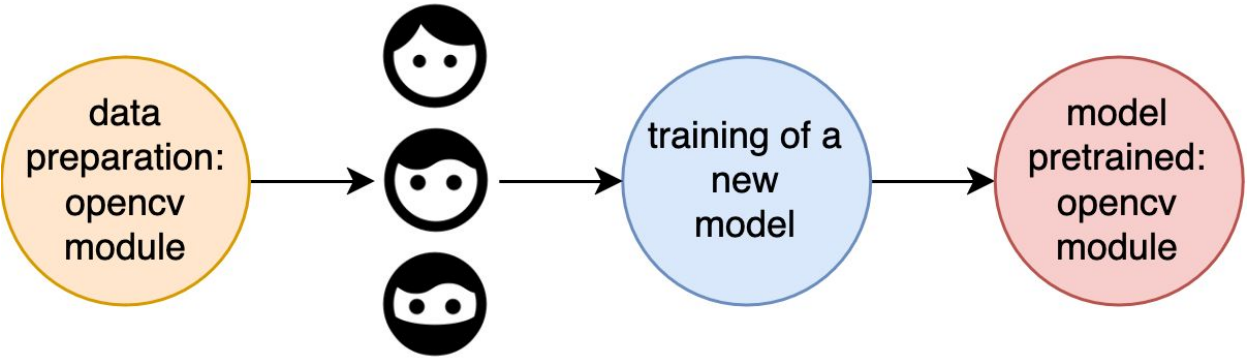

data
evaluation:
is model
good ?
no
yes
data
preparation
training
or
tuning
save the
model
prediction
alias
inference
start to use
the model
pretrained
new
data

# ABC

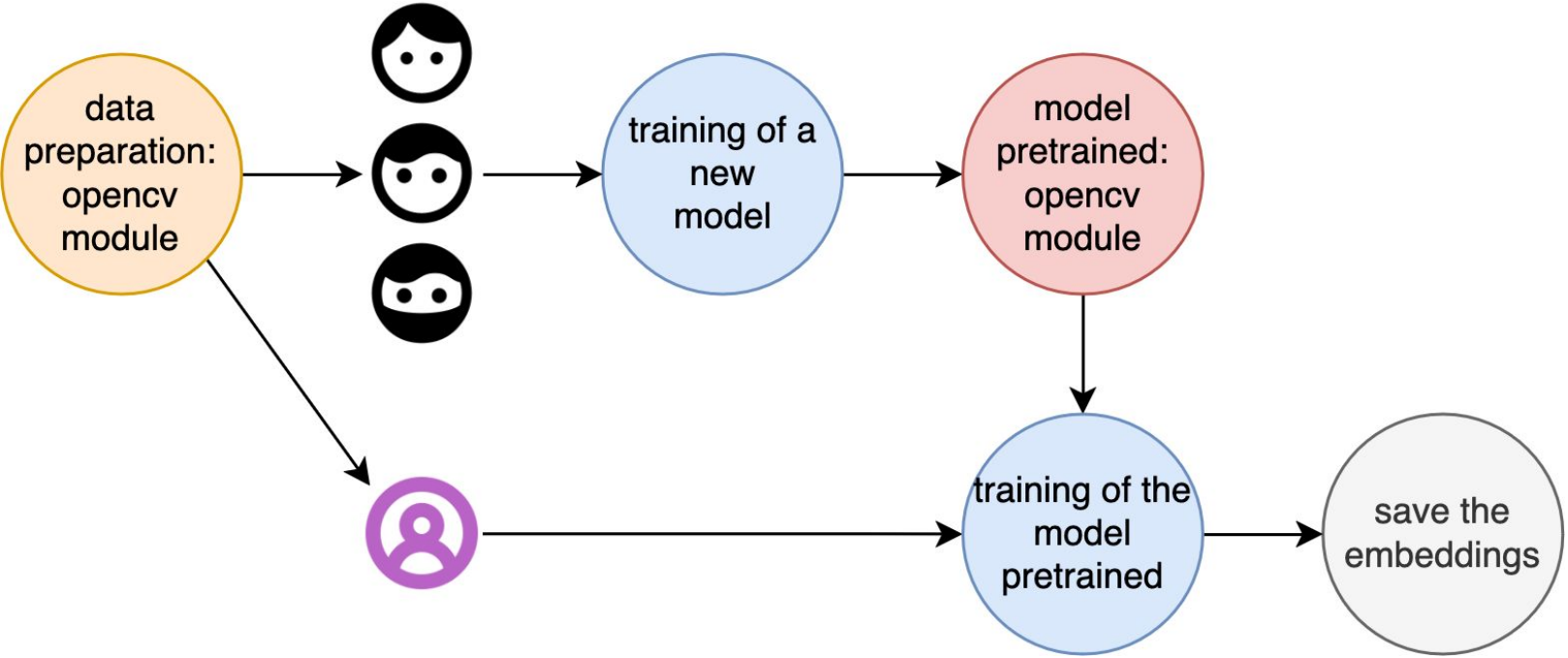

data
evaluation:
is model
good ?
no
yes
data
preparation
training
or
tuning
save the
embeddings
prediction
alias
inference
start to use
that
embeddings
new
data

# Face recognition

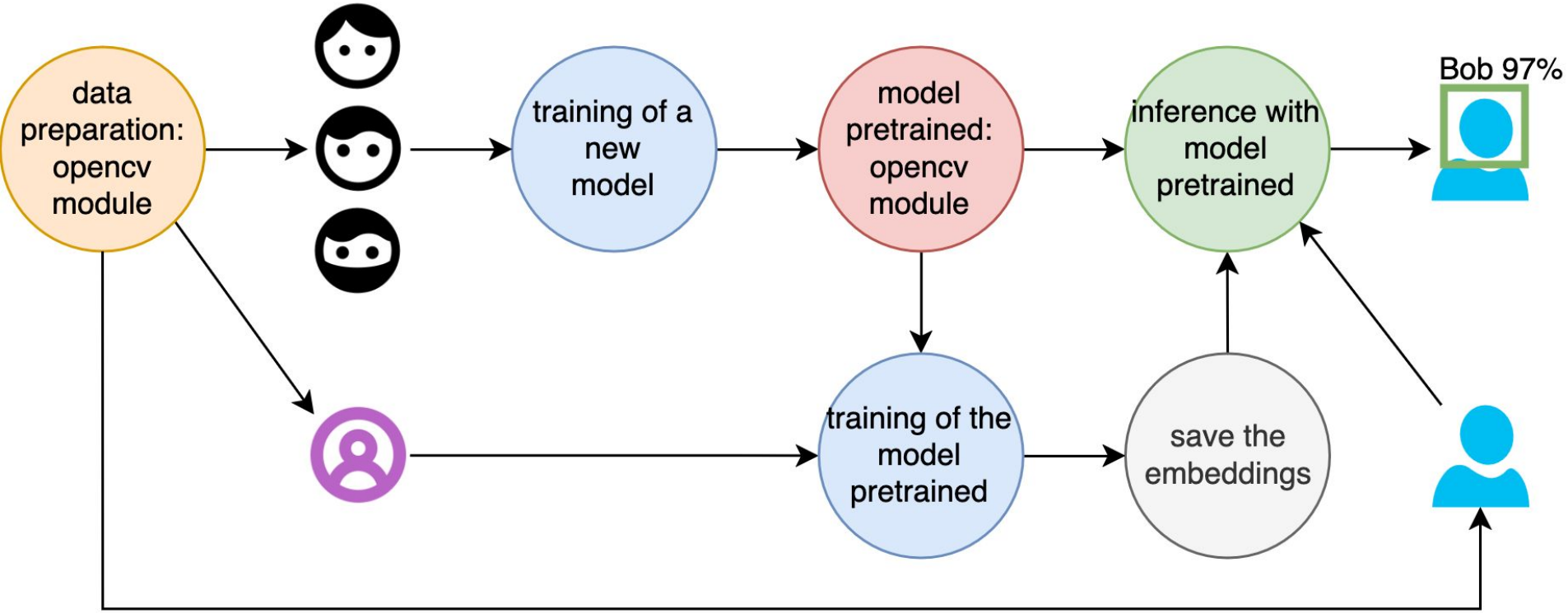
# ABC - Face recognition



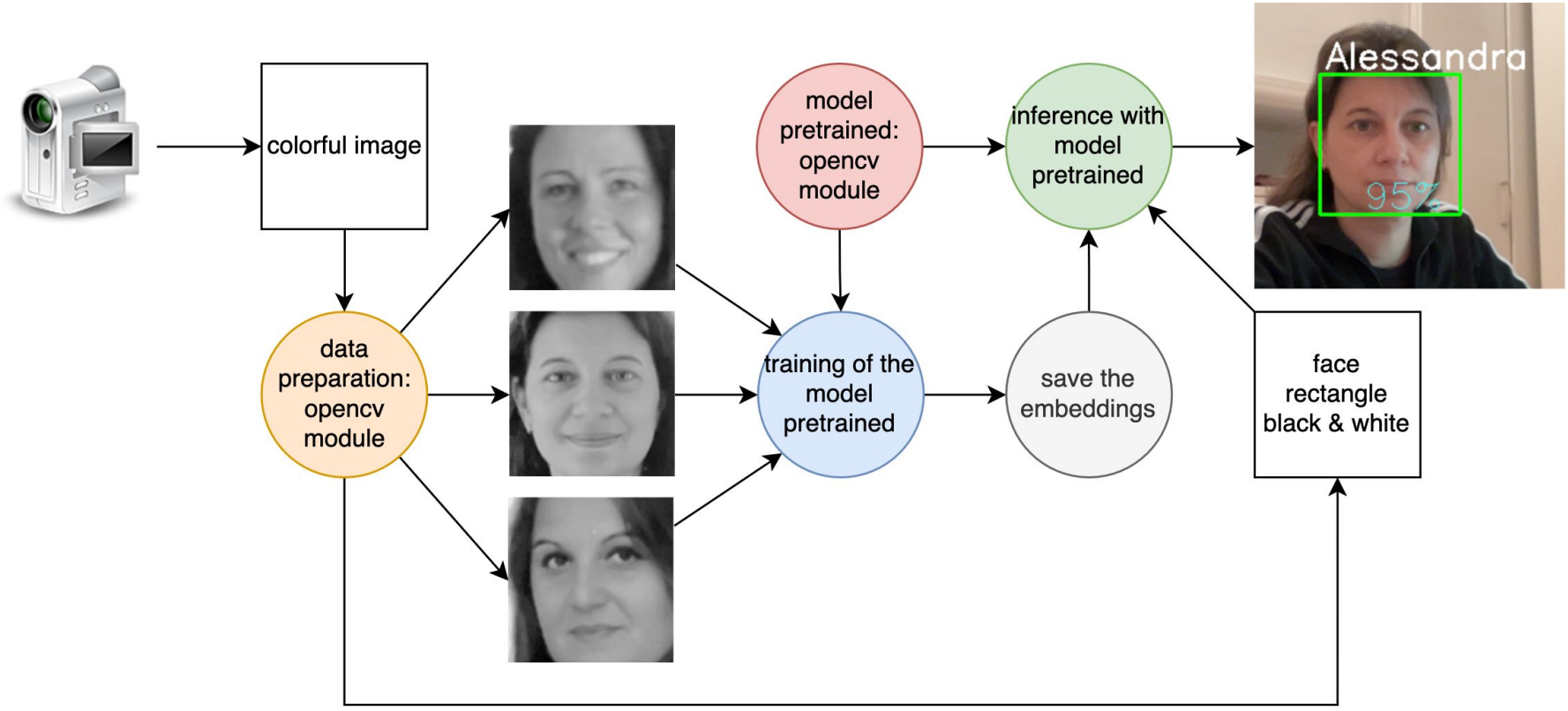
# ABC - Face recognition



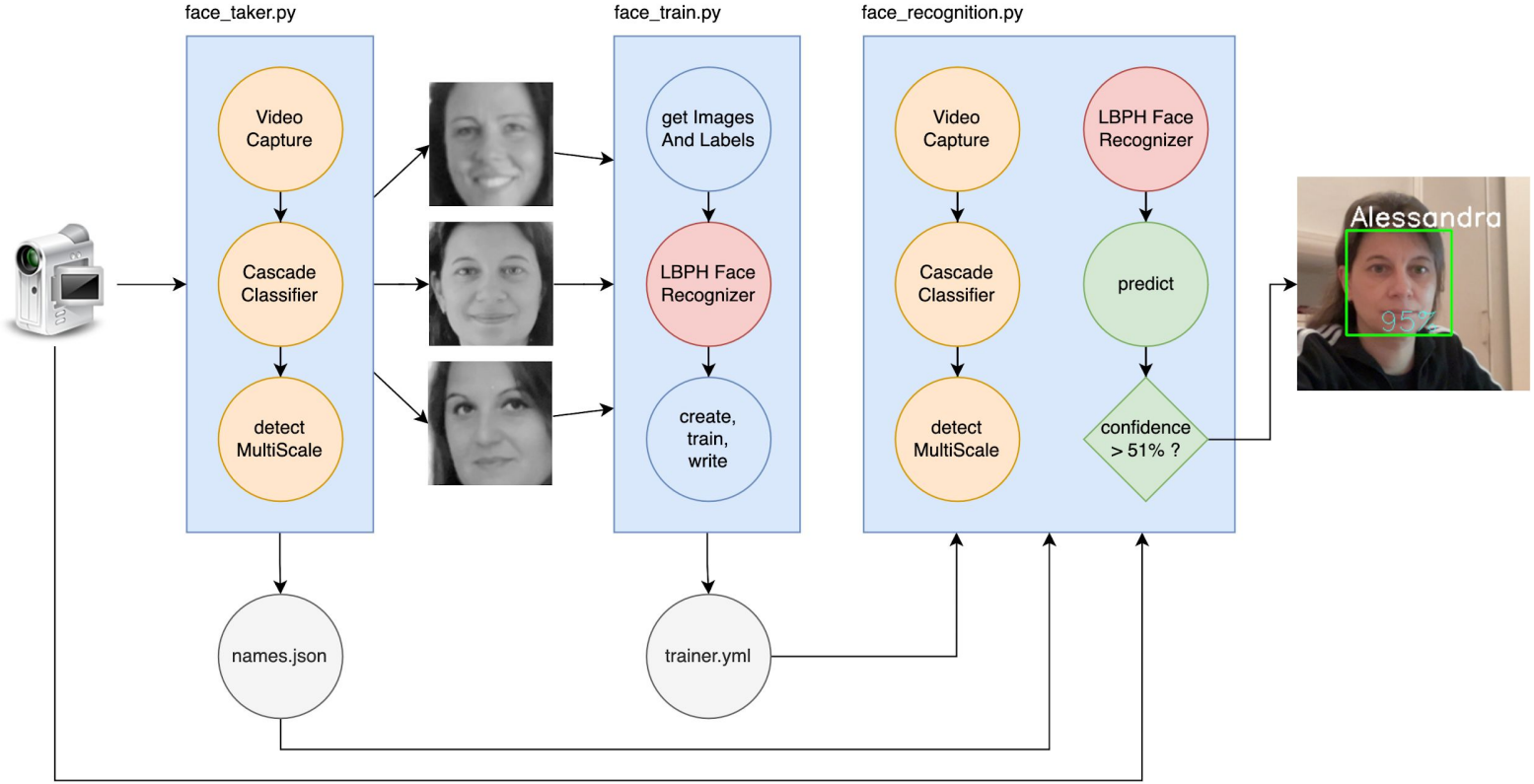
# ABC - Face recognition



# Face recognition



# Face recognition



PyData

# 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.,
             0., 0., 0., 0., 0., 0., 0., 0., 1.56250000e-02, 0., 0.,
             1.56250000e-02, 0., 0., 0., 0., 0., 0., 0., 0., 0.,
             1.56250000e-02, 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
             0., 0., 0., 0., 0., 0., 1.56250000e-02, 0., 0., 0., 0., 0.,
             0., 0., 1.56250000e-02, 0., 0., 0., 0., 0., 0.,
             1.56250000e-02, 0., 0., 0., 0., 1.56250000e-02, 0.,
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             0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
             0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
             0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
             0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
             3.12500000e-02, 0., 0., 0., 0., 3.12500000e-02, 0.,
```
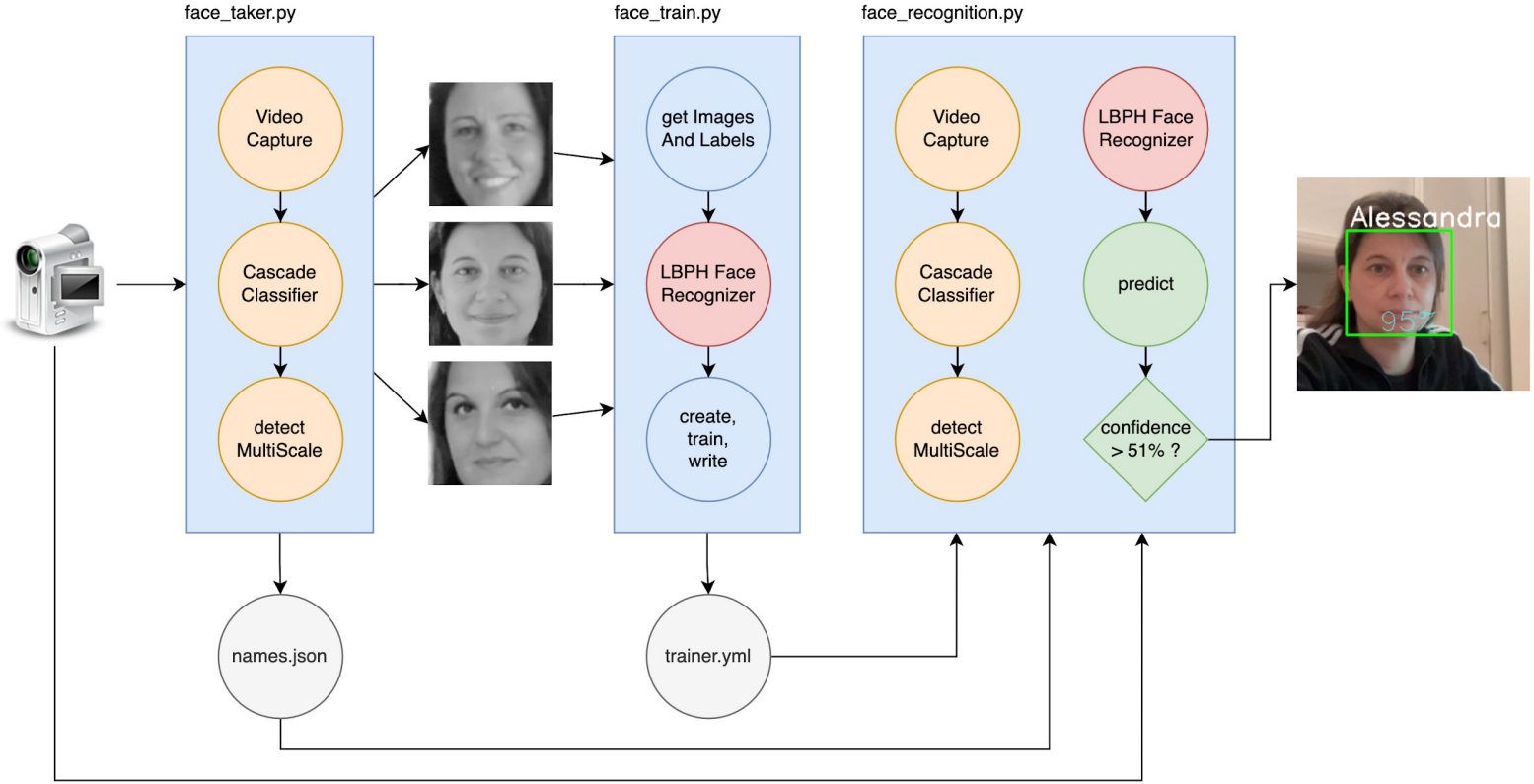
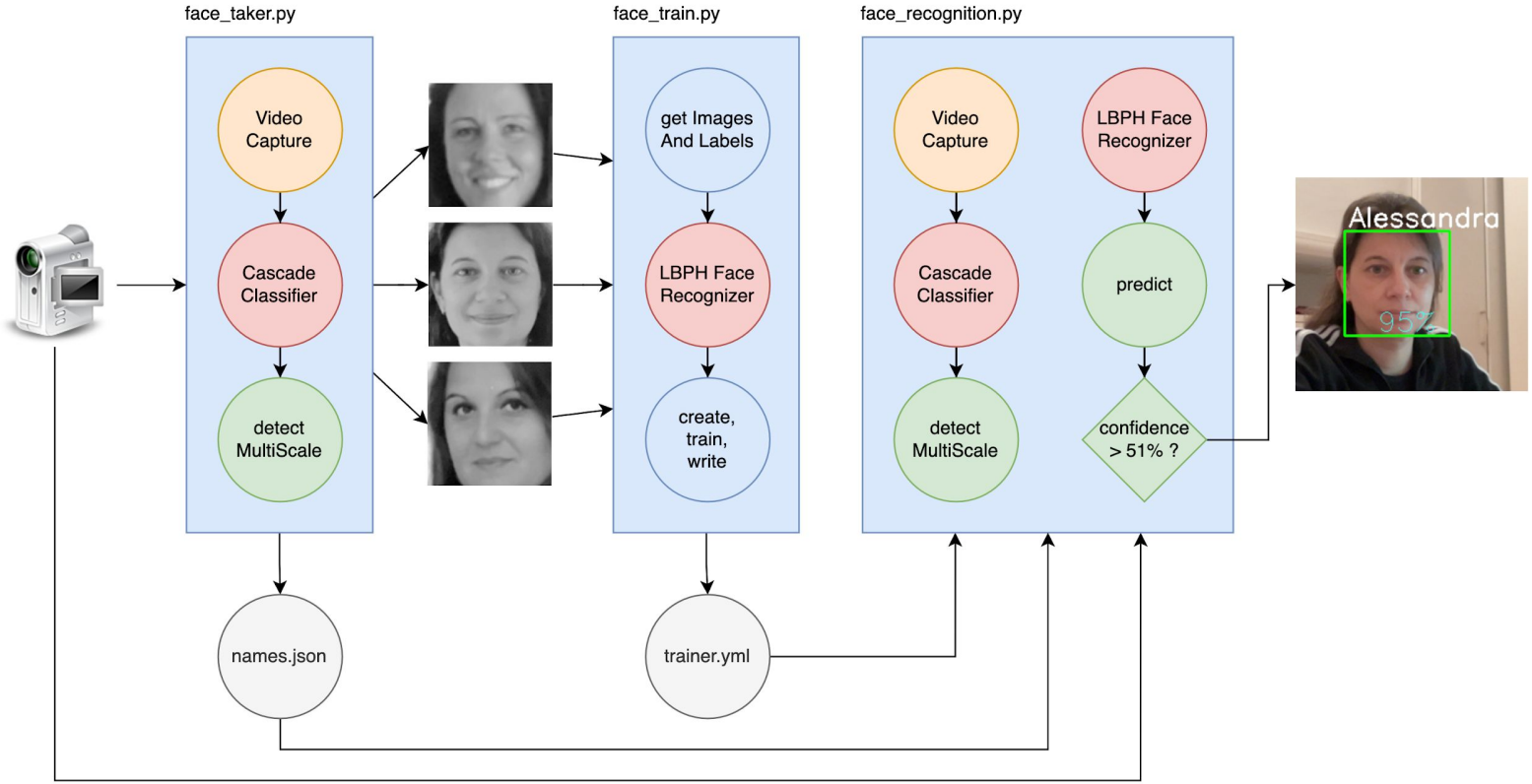

# Face recognition

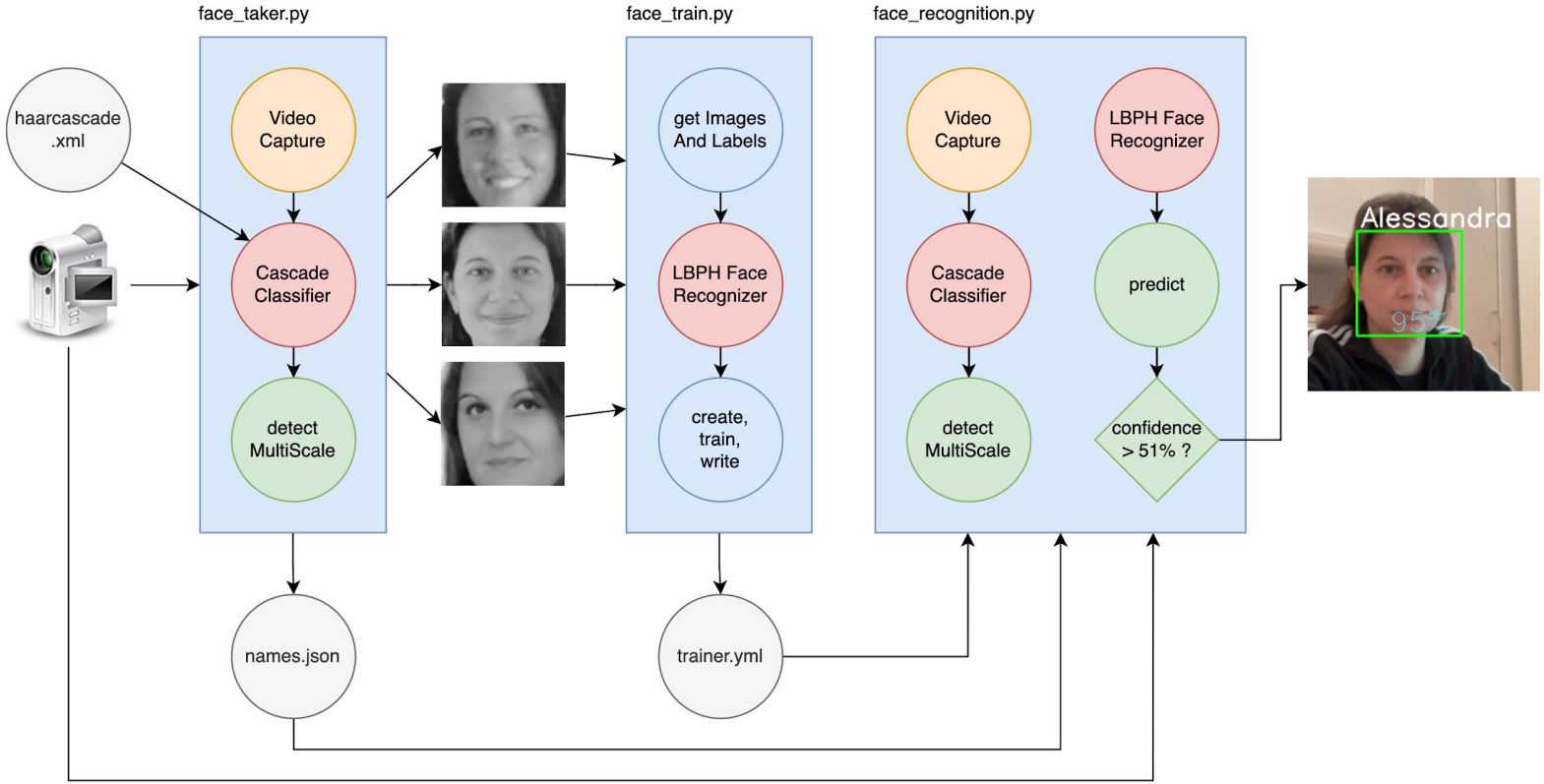


PyData

# Face recognition



# Face recognition



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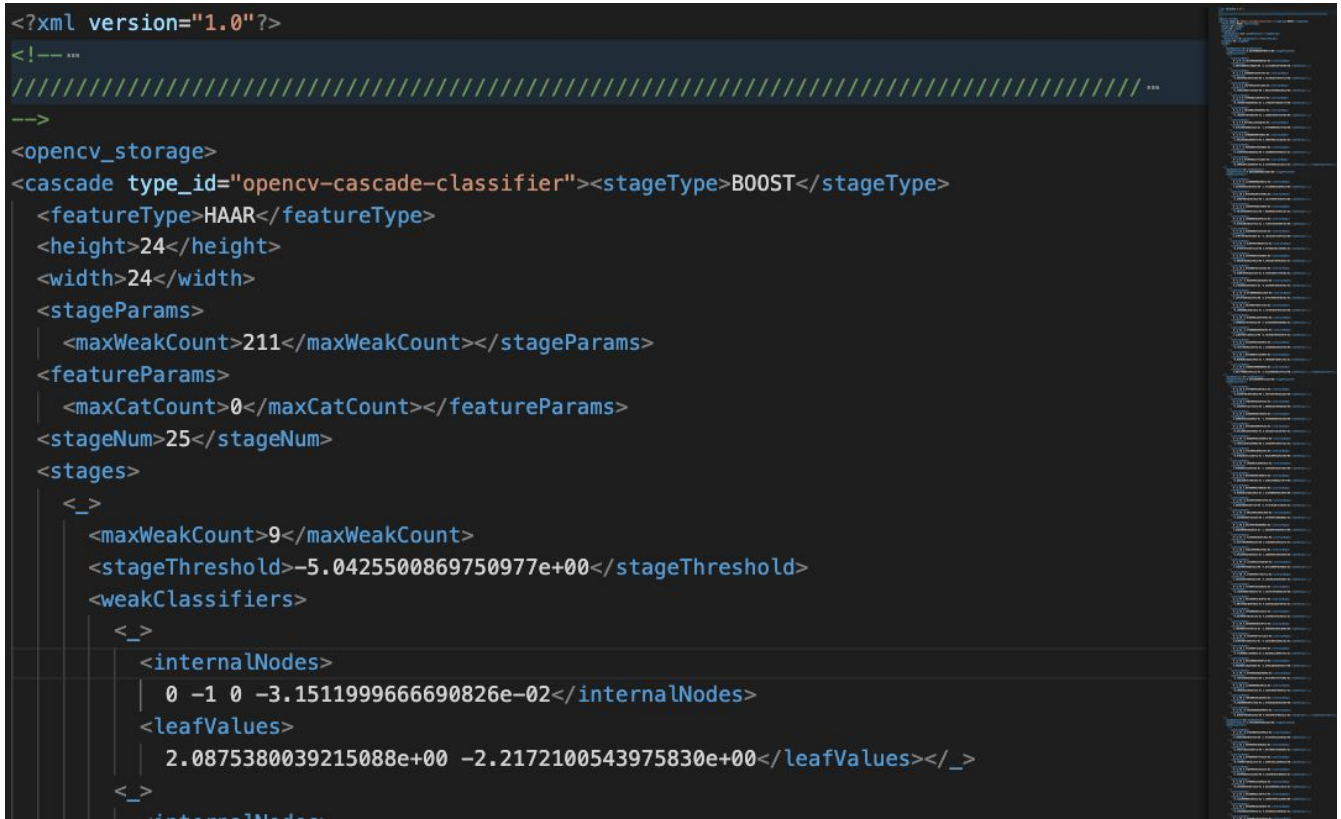
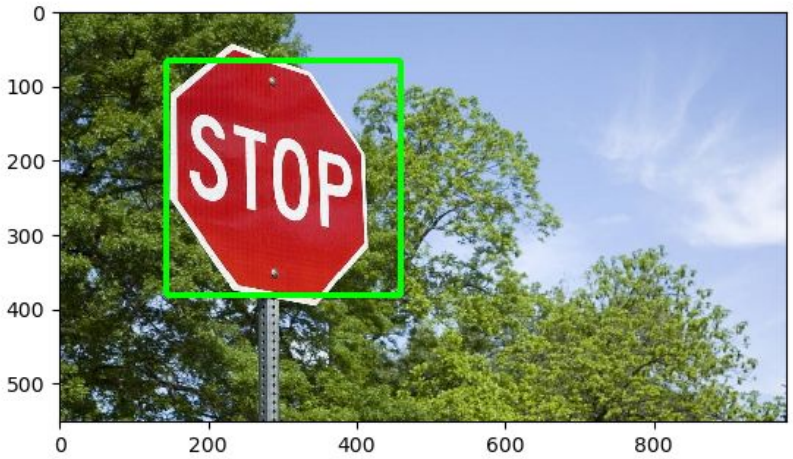
# Embeddings - haarcascade_frontalface_default.xml



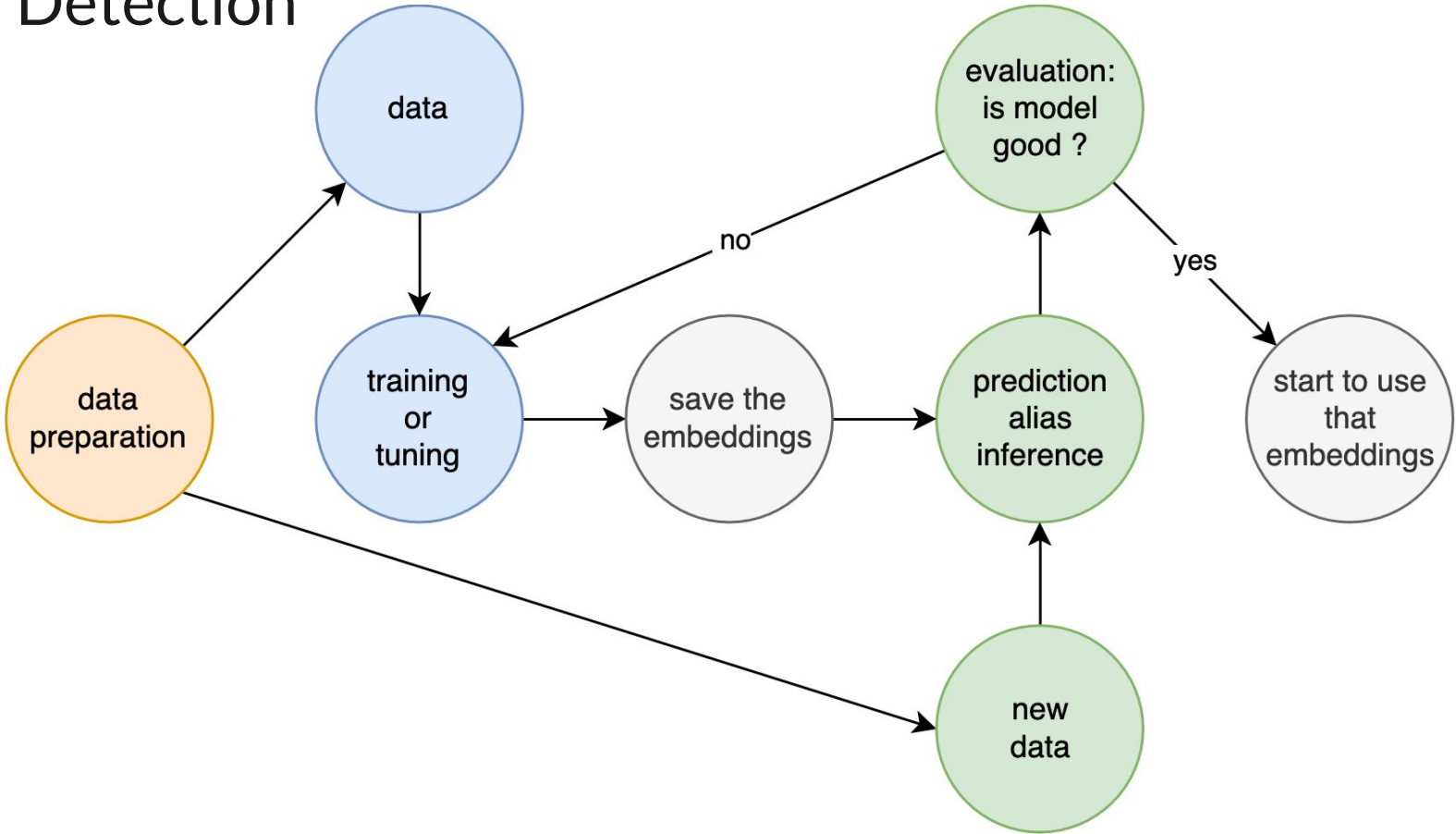
# Object detection

# Object detection

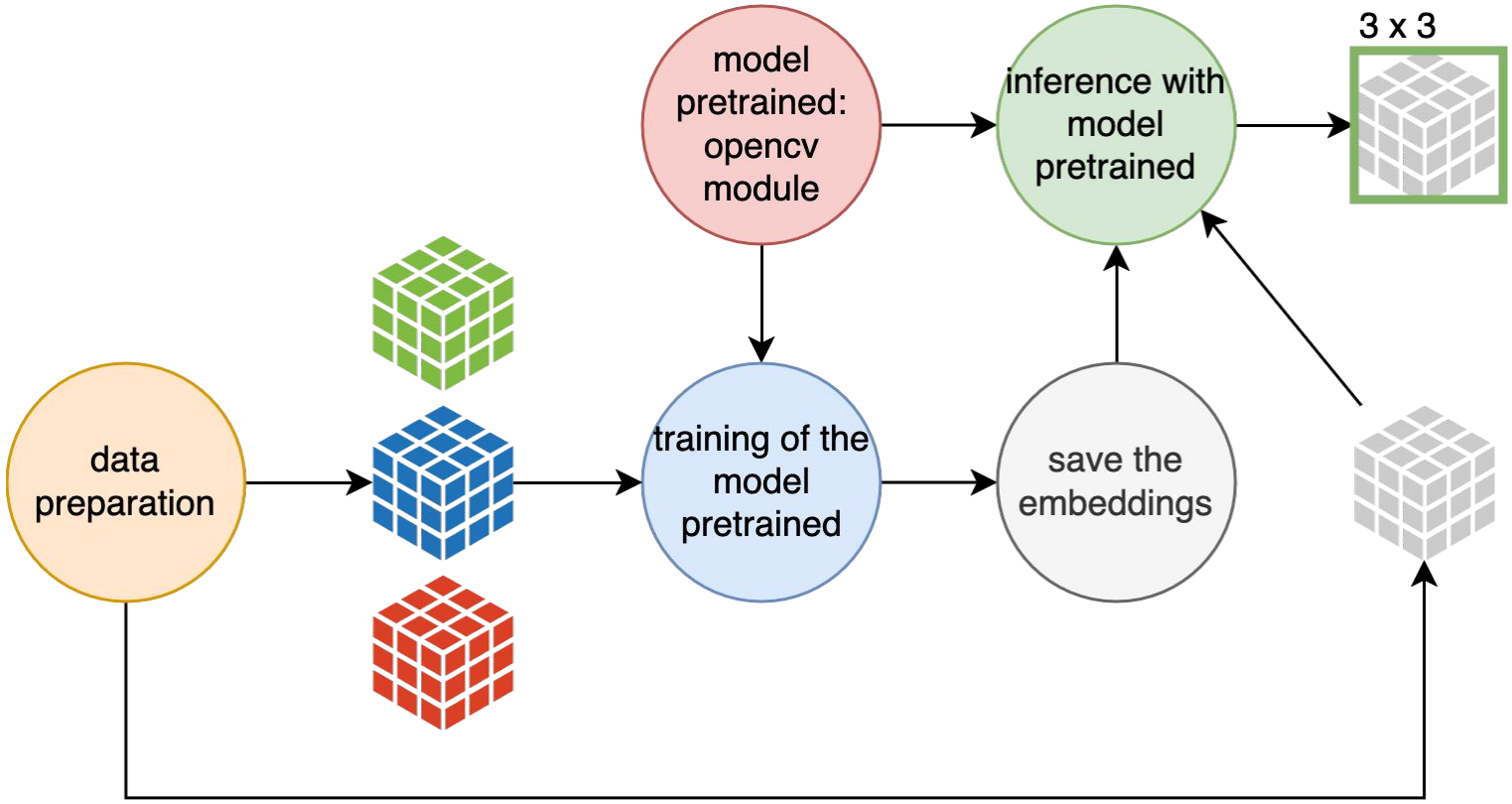



https://www.geeksforgeeks.org/detect-an-object-with-opencv-python/

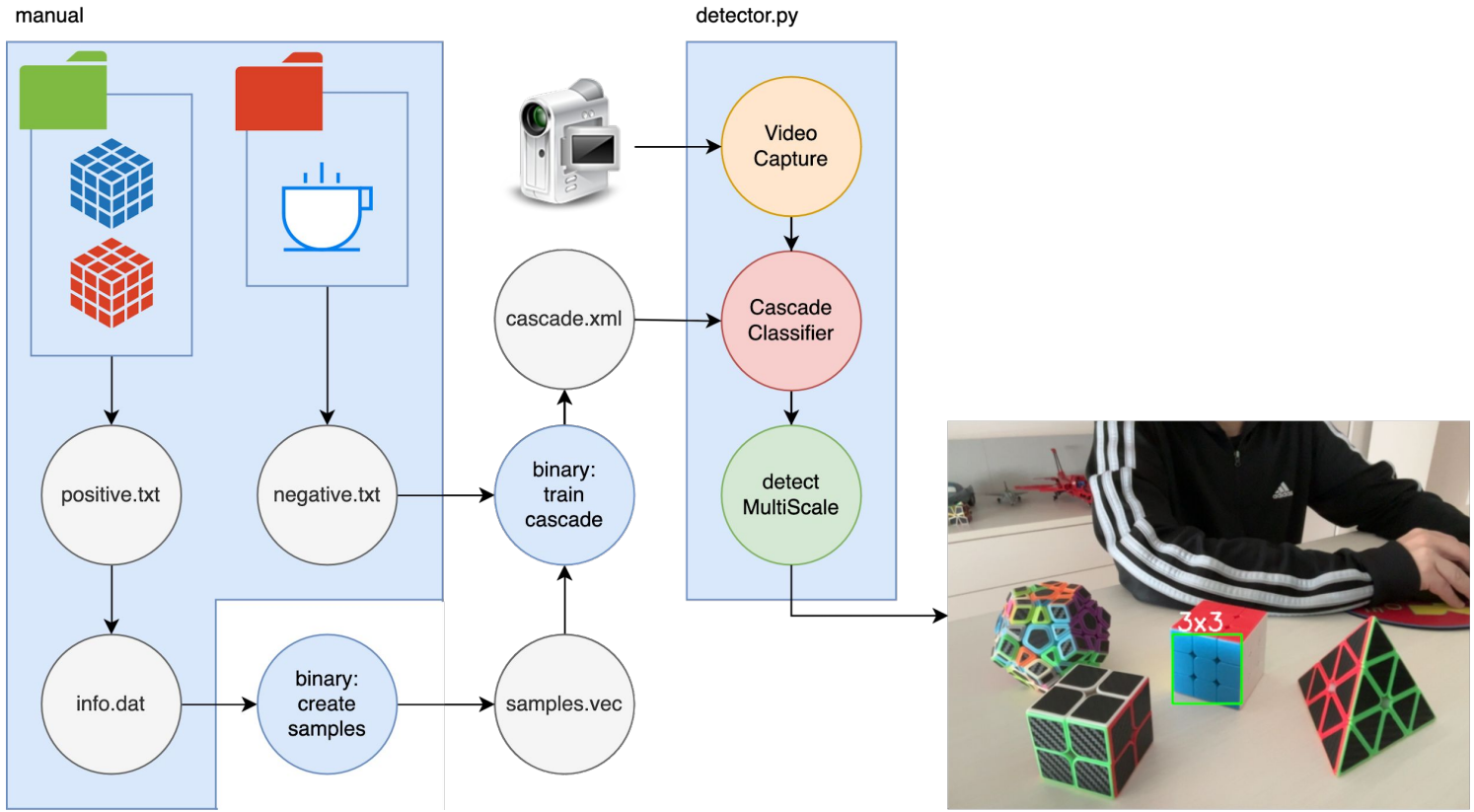
# ABC - Detection



# 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<br>cv2 + numpy |  |
| Create embeddings for own faces - trainer.yml |  |
| Use embeddings for face detection - haarcascade.xml |  |
| Create embeddings for object detection - 3x3.cascade.xml |  |

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# 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

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# 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

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# Thanks for listening.

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