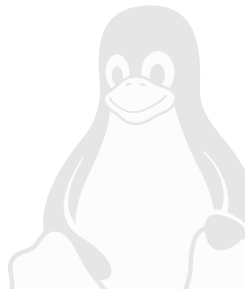# Embedded Systems
Image Processing using Free Software Platforms

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Outline

- Computer Vision and Image Processing Definitions
- Usage of Embedded Systems (and OS) in Applications
- Some Intensive Computation Capable SoC Devices
- Free computer Vision Platforms
- Implementing An Offline Image Processing Example Application
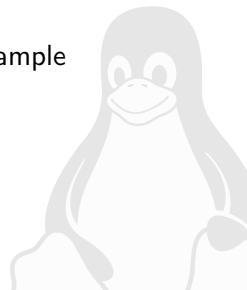- Implementing A Real-Time Computer Vision Example Application

Image Processing and Computer Vision definition

Image Processing

What is **Image Processing**?
   The **analysis** and **manipulation** of a **digitized** image, especially in order to improve its quality.

Computer Vision

What is **Computer Vision**?
   Computer vision is the science that aims to give a similar, if not better, capability to a machine or computer. Computer vision is concerned with the **automatic extraction**, **analysis** and **UNDERSTANDING** of useful information from a single image or a sequence of images.

IP and CV: The main applications

IP and CV typical applications:

- Image enhancement
- Classification and Pattern-Rocognition
- Feature extraction
- Multi-scale signal analysis
- Projection (3D)
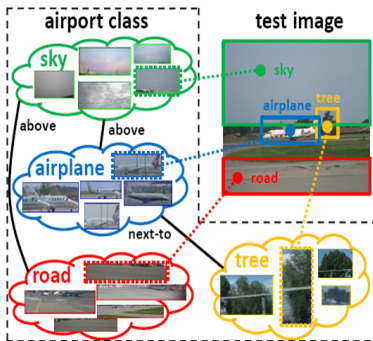
Why **Embedded Systems**?

Image Processing needs **computation**

- An image is a Matrix set
- Image **feature extraction** needs lots of calculations
- This amount of processing needs to be managed.
- Both supervised and unsupervised machine learning **NN** algorithms need a lot of computation.

It is **not** just about processing!

There are some other tasks:

- Image acquisition
- Image files, results and ... should be saved
- Monitoring upon system tasks
- Result/Image transportation
- Video output

## Image processing is not only **Image enhancement**

- Image enhancement is more about calculations...
- But IP is not just IE!!! :—
- An FPGA or any other HDL inscribed device can handle parallel processing, even REAL-TIME ones!.
- But what about some other tasks, like **Unsupervised CLASSIFICATION**?
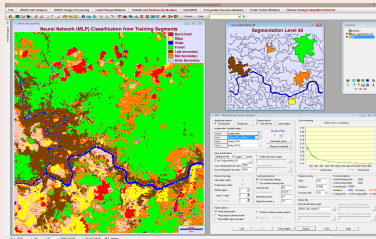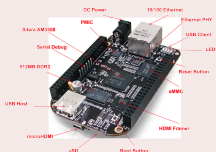
Embedded Systems as a solution

-Using of Embedded systems is not the only way.

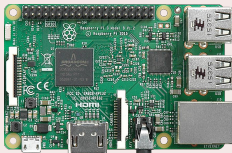-Advantages of having OS
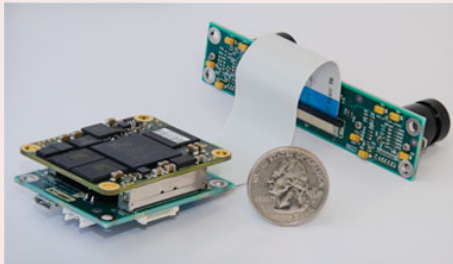
How to use an embedded system?

Linux based devices:

-RPi family, based on ARM Cortex-A Broad-com ICs
-Intel Family SoC devices: Intel Joule, Galileo and Edison
-Beagle Bone Black

Windows 10 IoT core based devices:

-RPi on the top: ;)

Free and **POWERFULL** computer vision platform openCV!

openCV

It is free.
Can be used on IOS, Windows and Linux

centering

OPENCV
(OPEN SOURCE
COMPUTER VISION)

OpenCV is released under a BSD license and hence it's free for both academic and commercial use. It has C++, C, Python and Java interfaces and supports Windows, Linux, Mac OS, iOS and Android. OpenCV was designed for computational efficiency and with a strong focus on real-time applications. Written in optimized C/C++, the library can take advantage of multi-core processing. Enabled with OpenCL, it can take advantage of the hardware acceleration of the underlying heterogeneous compute platform. Adopted all around the world, OpenCV has more than 47 thousand people of user community and estimated number of downloads exceeding 9 million. Usage ranges from interactive art, to mines inspection, stitching maps on the web or through advanced robotics.