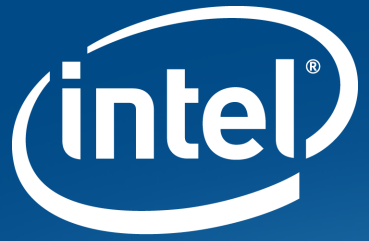


Software

Visions of clouds: Intel® and AWS*

Martin Kronberg – Technical Evangelist

Outline

- Intro
- Intel IoT Overview
- AWS Overview
- CV at the Edge
- CV in the Cloud
- Demo!

Computer Vision– Edge

- Basic Detection
- Programmatic
- Fast

Computer Vision– Cloud

- Metadata
- Machine Learning
- Heavy Resource Requirements
- Slower
- Less fine control

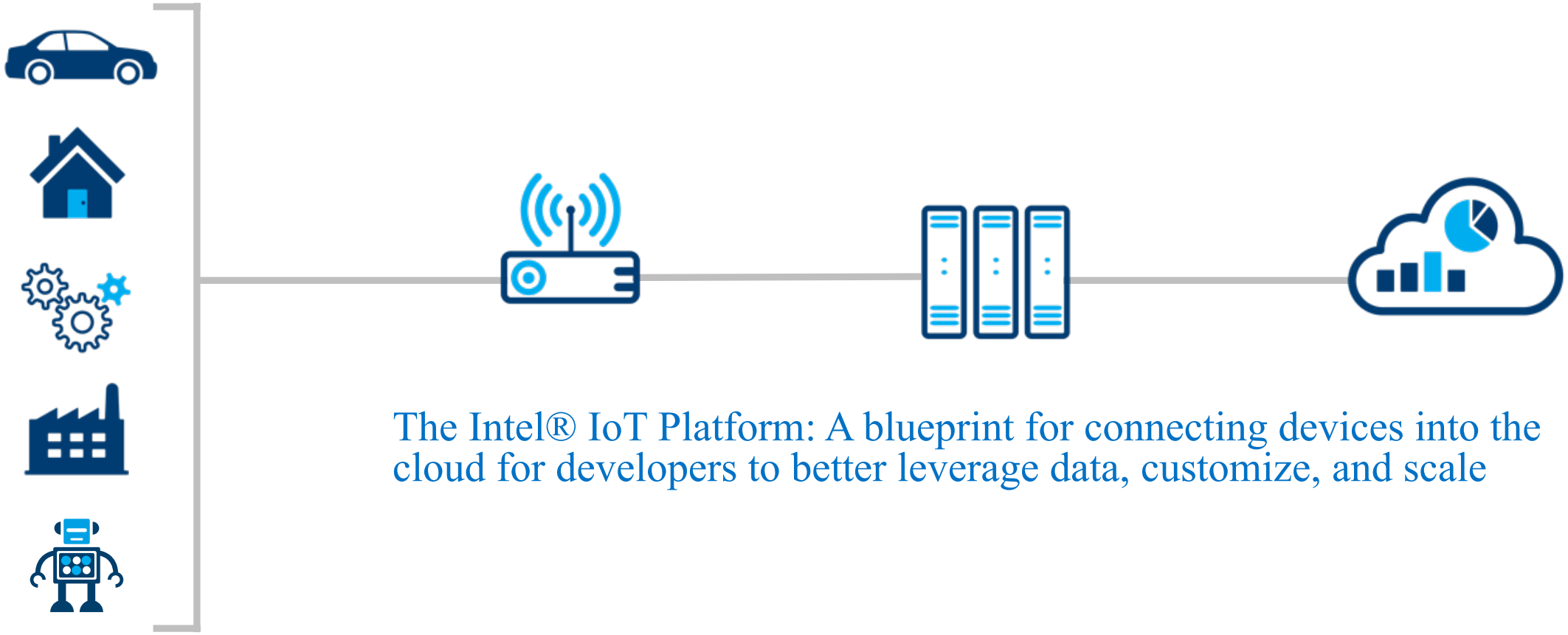
Put it Together!

Intel IoT Overview

Intel® Architecture Powers

Endpoints, Gateways, Networks, and Cloud

THINGS (ENDPOINTS) | GATEWAY | NETWORK (DATA CENTER) | CLOUD-BASED ANALYTICS



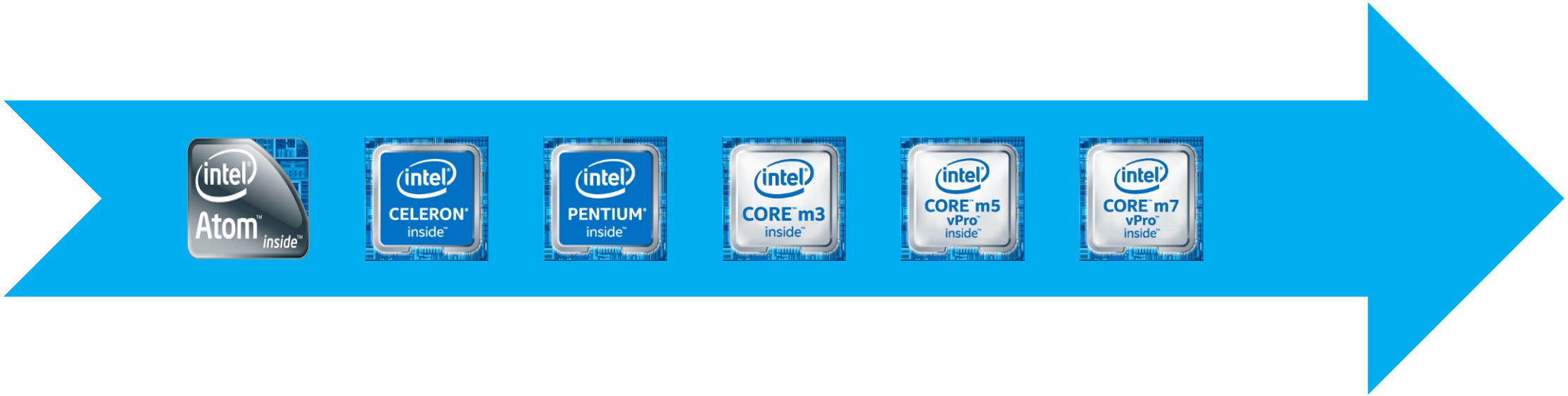
The Intel® IoT Platform: A blueprint for connecting devices into the cloud for developers to better leverage data, customize, and scale

Intel® NUC Gateway

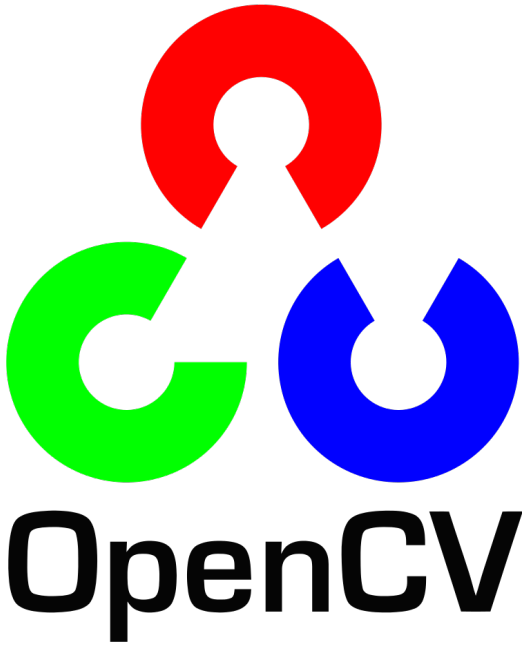
- Scalable
- Open Source
- Wide Range of Specifications

Scalable Processing

- From Intel® Atom® to Intel® Core™ i7
- Get just the right amount of compute power at the edge



Open Source Technology



MRAA

MRAA – I/O Library

Supports Intel, non-Intel (community added) MCU boards, UNIX boards and IoT Gateways

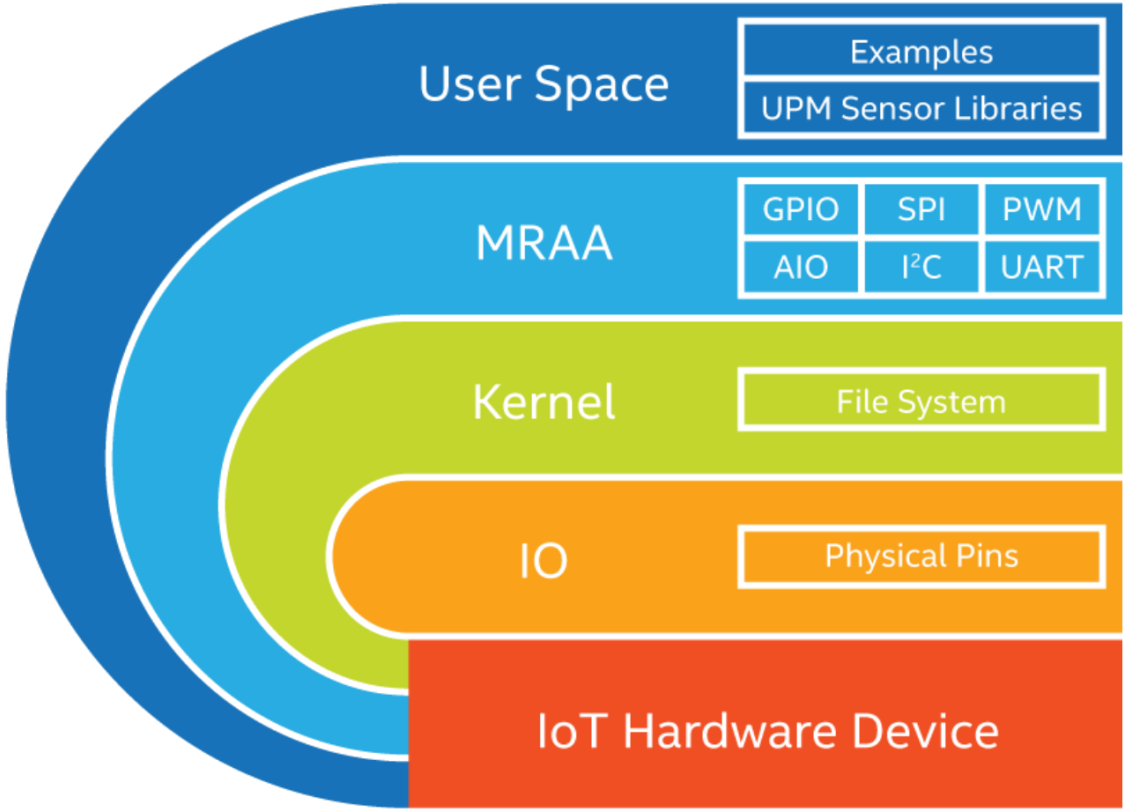
Simple I/O protocol control for:

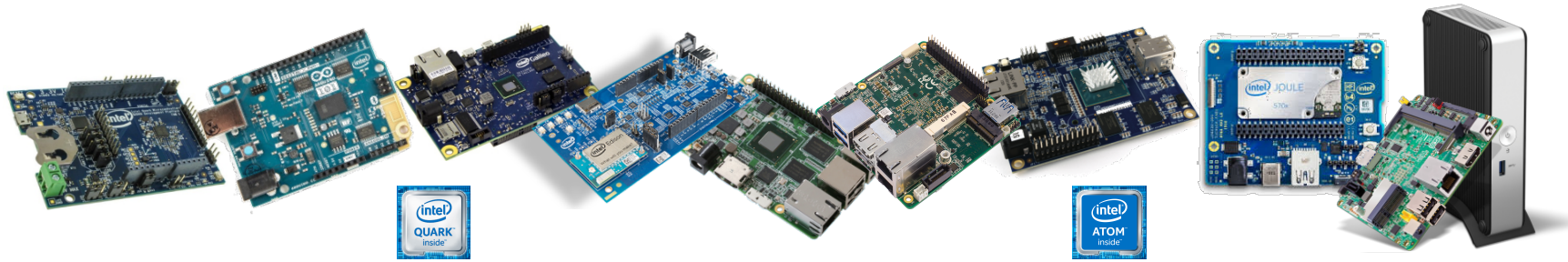
- GPIO
- Analog (AIO)
- PWM
- SPI
- I²C
- UART
- 1-Wire
- Firmata

Open source on GitHub:

http://mraa.io

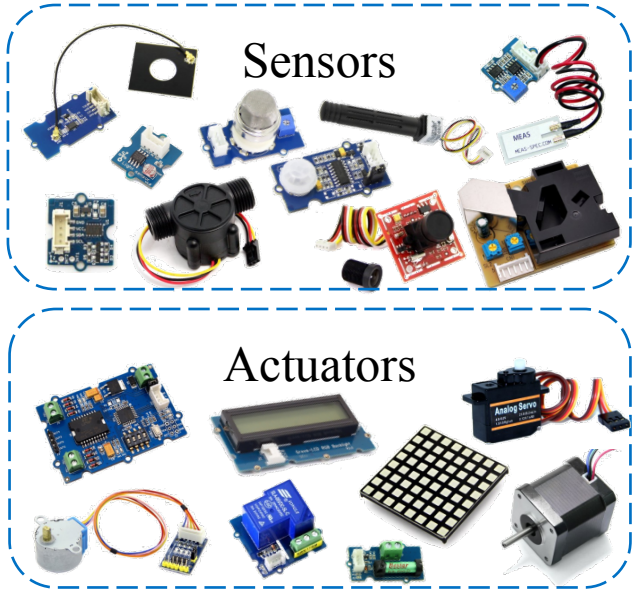
Typical stack on UNIX systems:

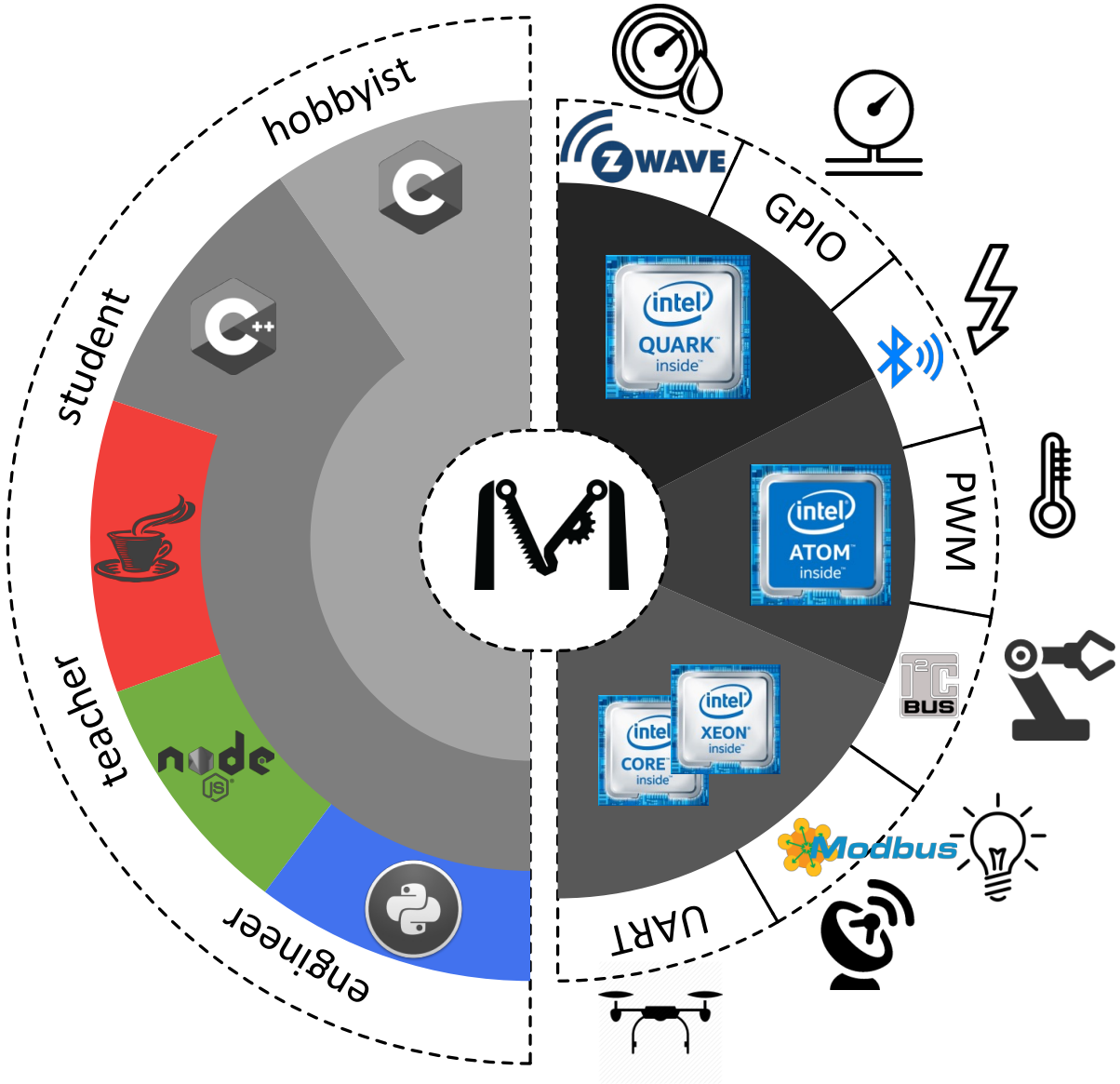




UPM – Sensor Library

Software suite for sensors, actuators, radios and protocols





Open source, Intel maintained, community supported:

http://upm.mraa.io

Code Samples

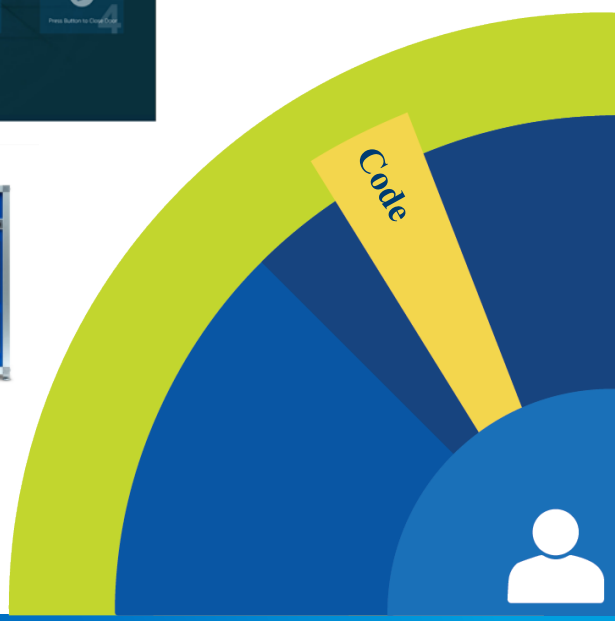
Write your own or reuse sample code & packages for your own projects.

- Code snippets
- Mini projects
- End to end solutions

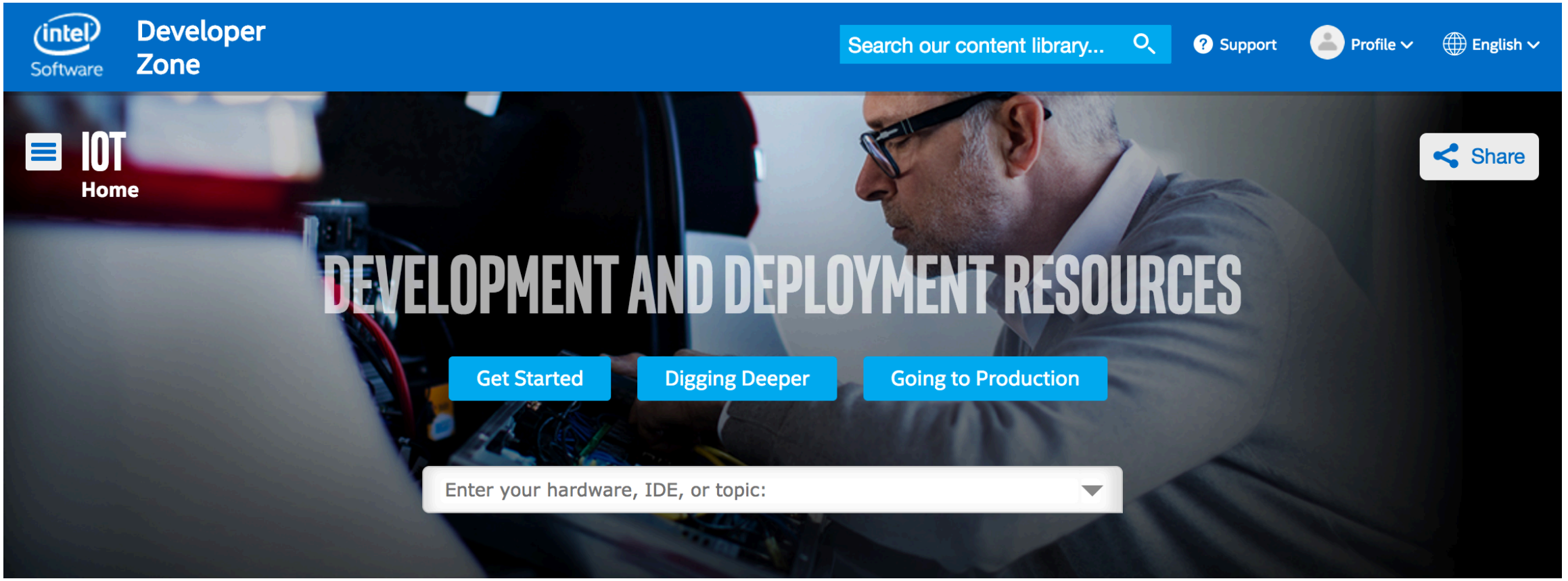
End-to-end Reference Implementations

- Transportation
- Smart Home
- Retail

GitHub



Intel Developer Program: Software.intel.com/iot



AWS Overview

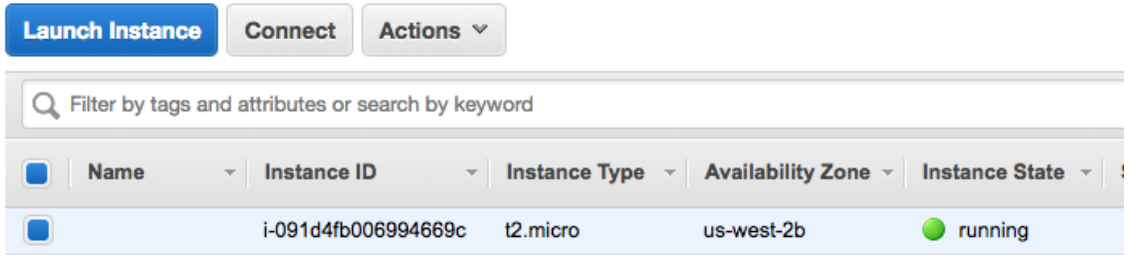
AWS* - On Demand Cloud Computing

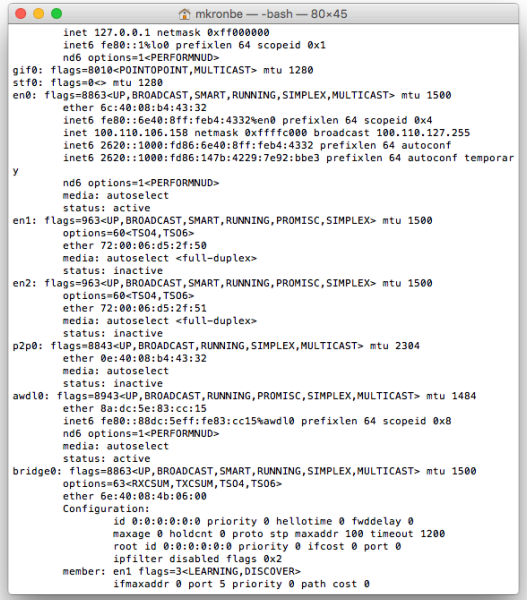
- Virtual Machines
- Compute
- Database
- Analytics
- AI
- IoT

AWS EC2

Quickly deploy preconfigured or custom VM

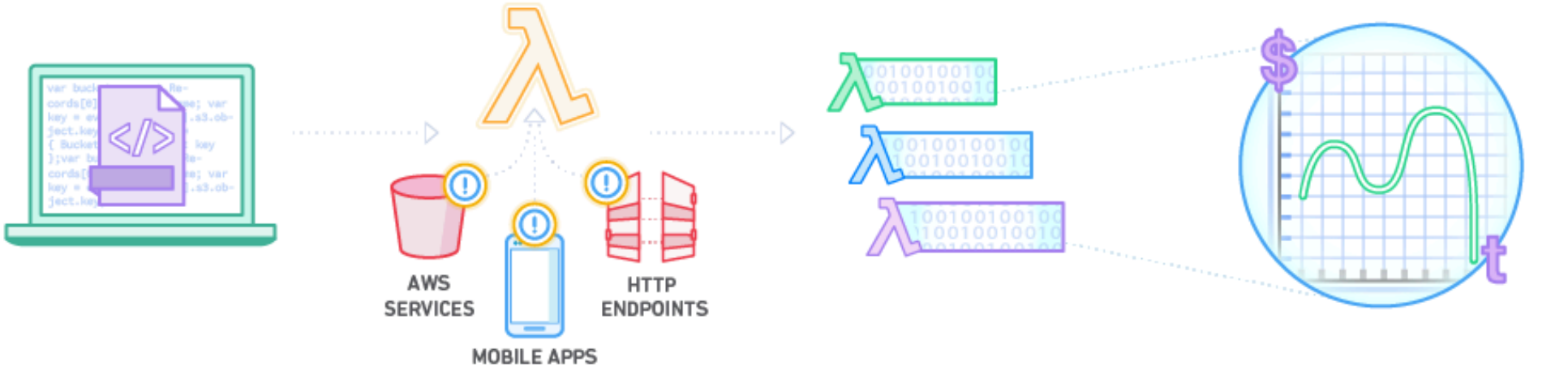
Scale with load





AWS* Lambda

Serverless compute in the cloud



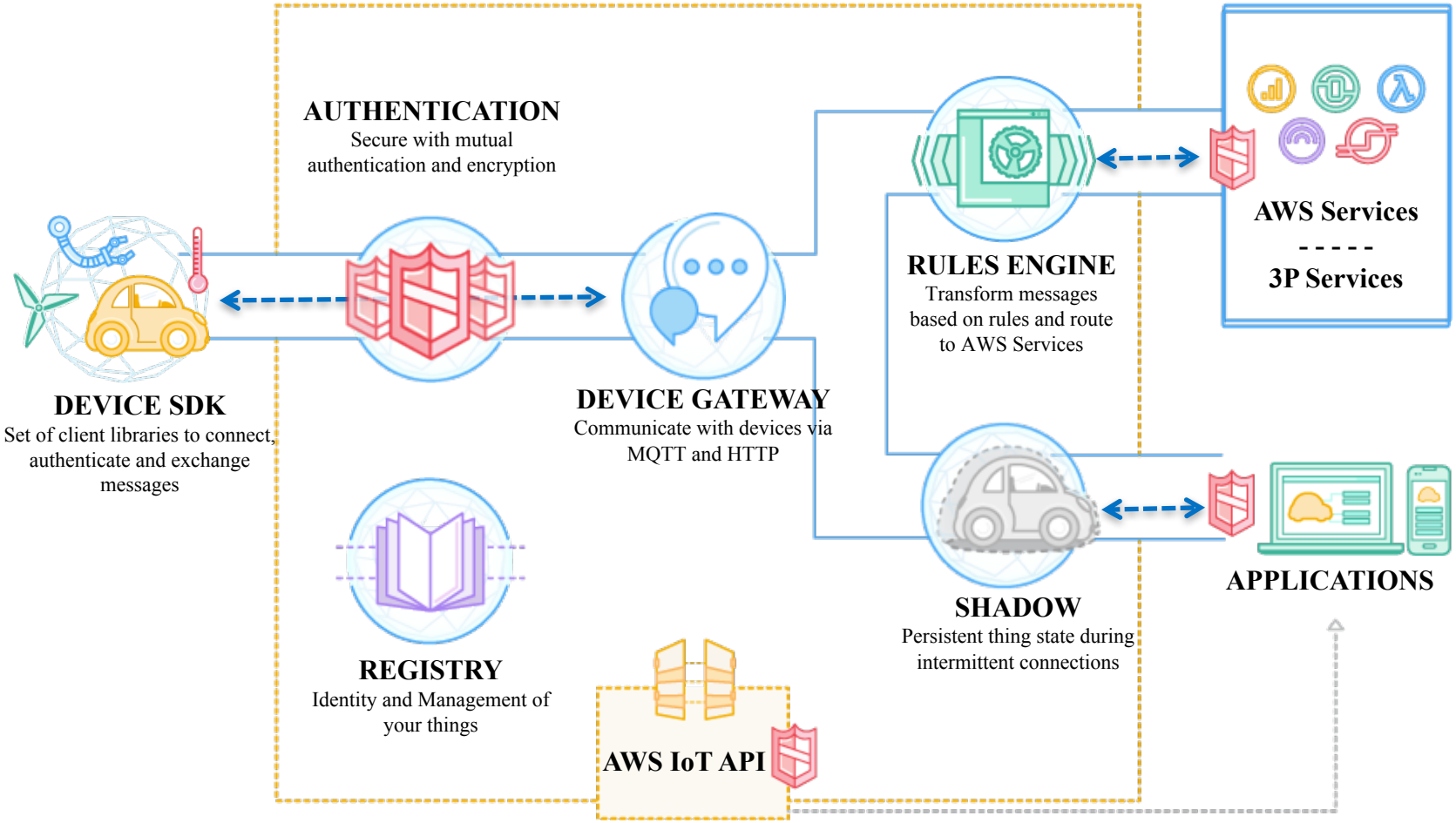
Upload your code to AWS Lambda

Set up your code to trigger from other AWS services, HTTP endpoints, or in-app activity

Lambda runs your code only when triggered, using only the compute resources needed

Pay just for the compute time you use

AWS IoT


AUTHENTICATION
Secure with mutual authentication and encryption
DEVICE SDK
Set of client libraries to connect, authenticate and exchange messages
DEVICE GATEWAY
Communicate with devices via MQTT and HTTP
RULES ENGINE
Transform messages based on rules and route to AWS Services
AWS Services
- - - - -
3P Services
REGISTRY
Identity and Management of your things
AWS IoT API
SHADOW
Persistent thing state during intermittent connections
APPLICATIONS

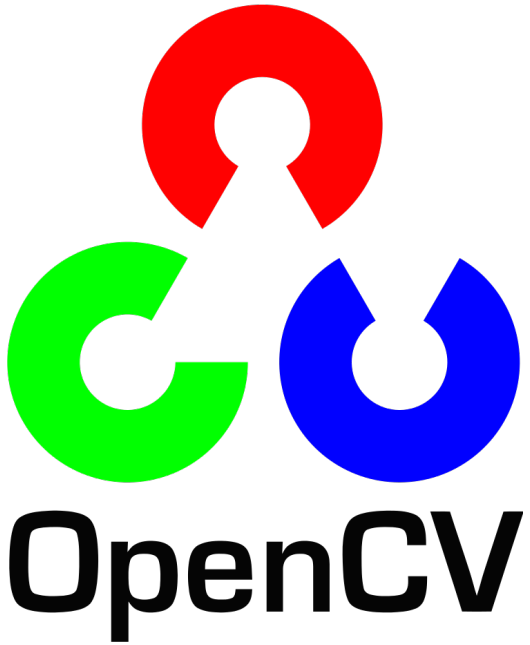
Computer Vision at the edge – Open CV

Overview

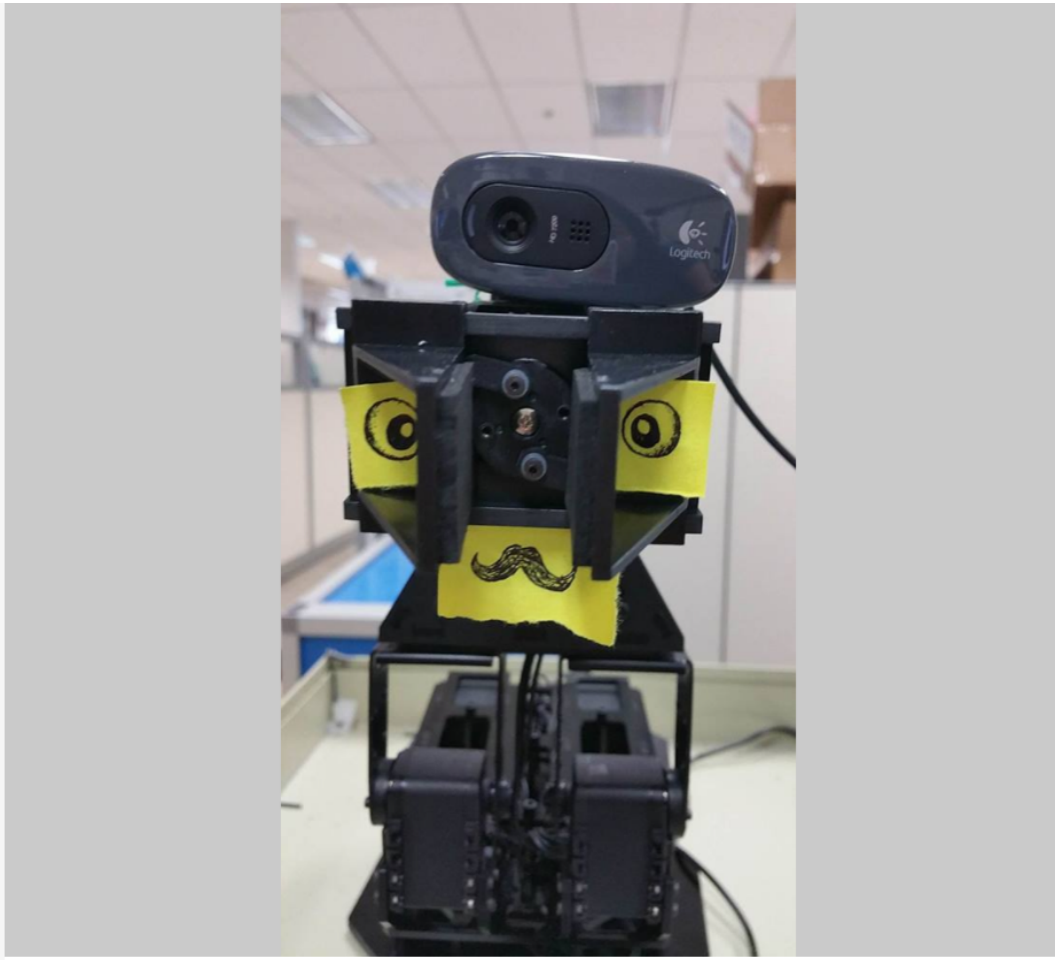
- Open Source Computer Vision C++ Framework
- Created by Intel in 1999
- Large and Active Developer Community

https://www.learnopencv.com/install-opencv3-on-ubuntu/

http://docs.opencv.org/master/d7/d9f/tutorial_linux_install.html



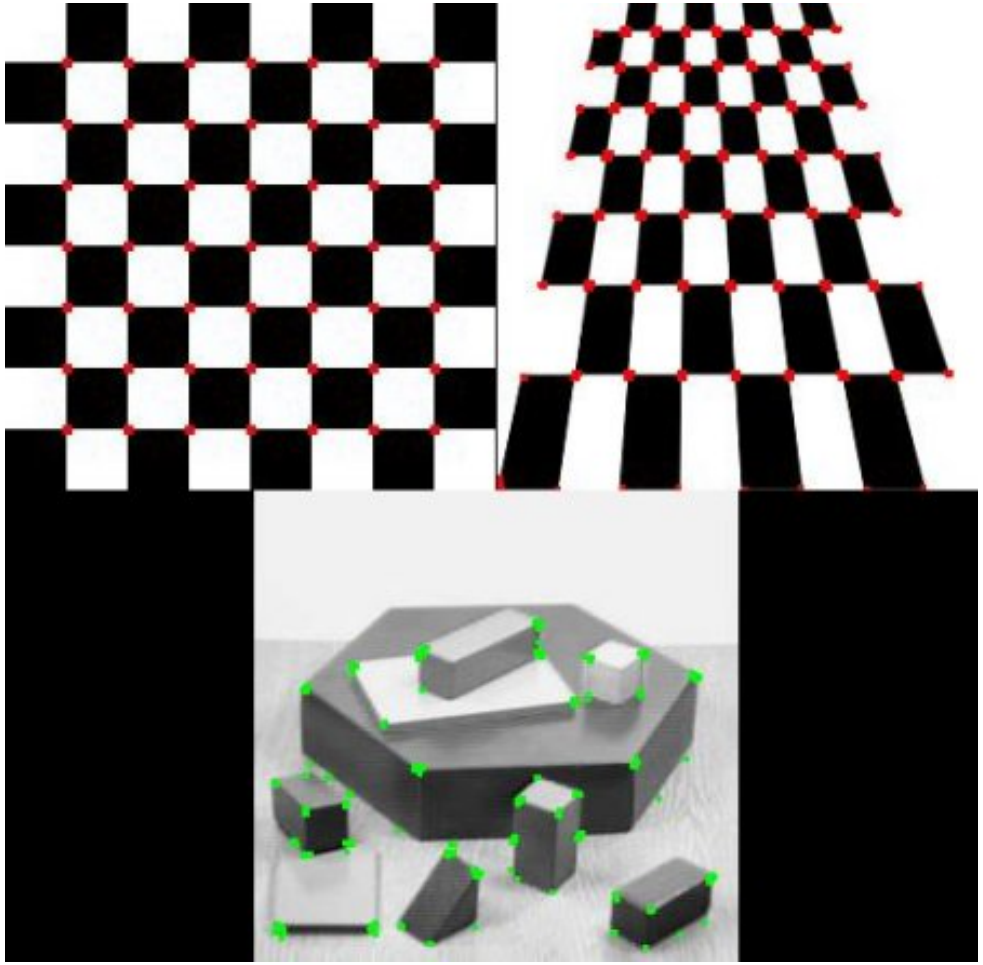
Open CV Uses



- Image Transformation
- Edge Detection
- Facial Recognition
- Gesture Recognition
- Mobile Robotics
- Motion Tracking

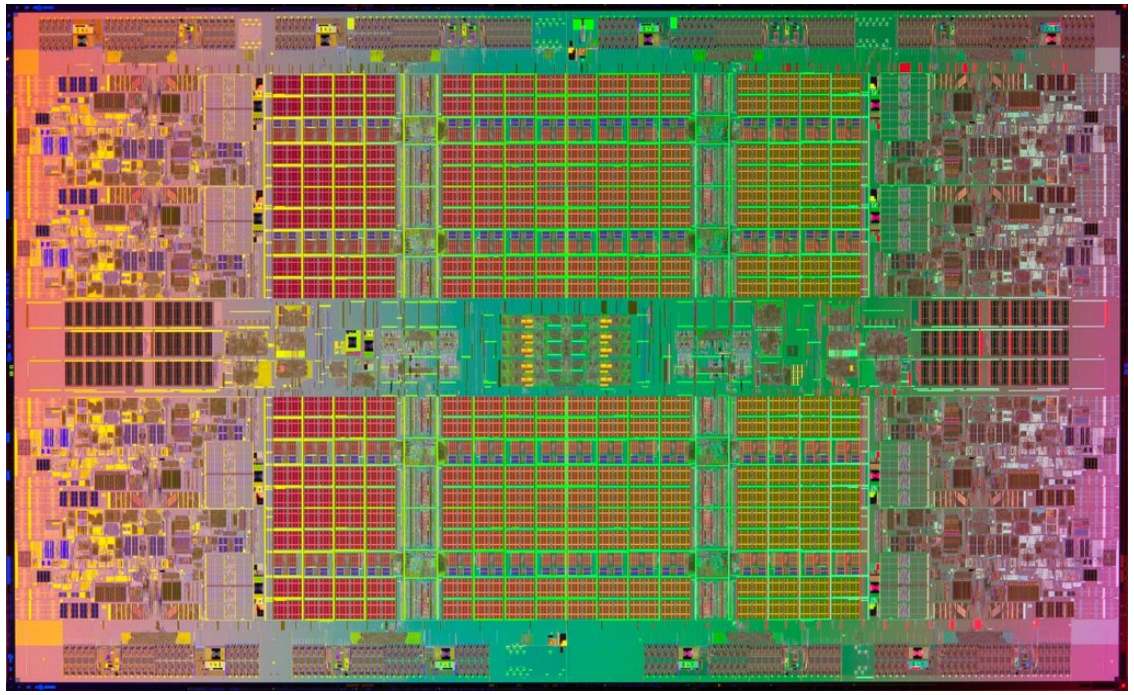
Sample Code – Find Corner

```python
import cv2
import numpy as np

filename = 'chessboard.jpg'
img = cv2.imread(filename)
gray = cv2.cvtColor(img,cv2.COLOR_BGR2GRAY)

gray = np.float32(gray)
dst = cv2.cornerHarris(gray,2,3,0.04)

#result is dilated for marking the corners, not important
dst = cv2.dilate(dst,None)

# Threshold for an optimal value, it may vary depending on the image.
img[dst>0.01*dst.max()]=[0,0,255]

cv2.imshow('dst',img)
if cv2.waitKey(0) & 0xff == 27:
    cv2.destroyAllWindows()
```



Hardware Requirements

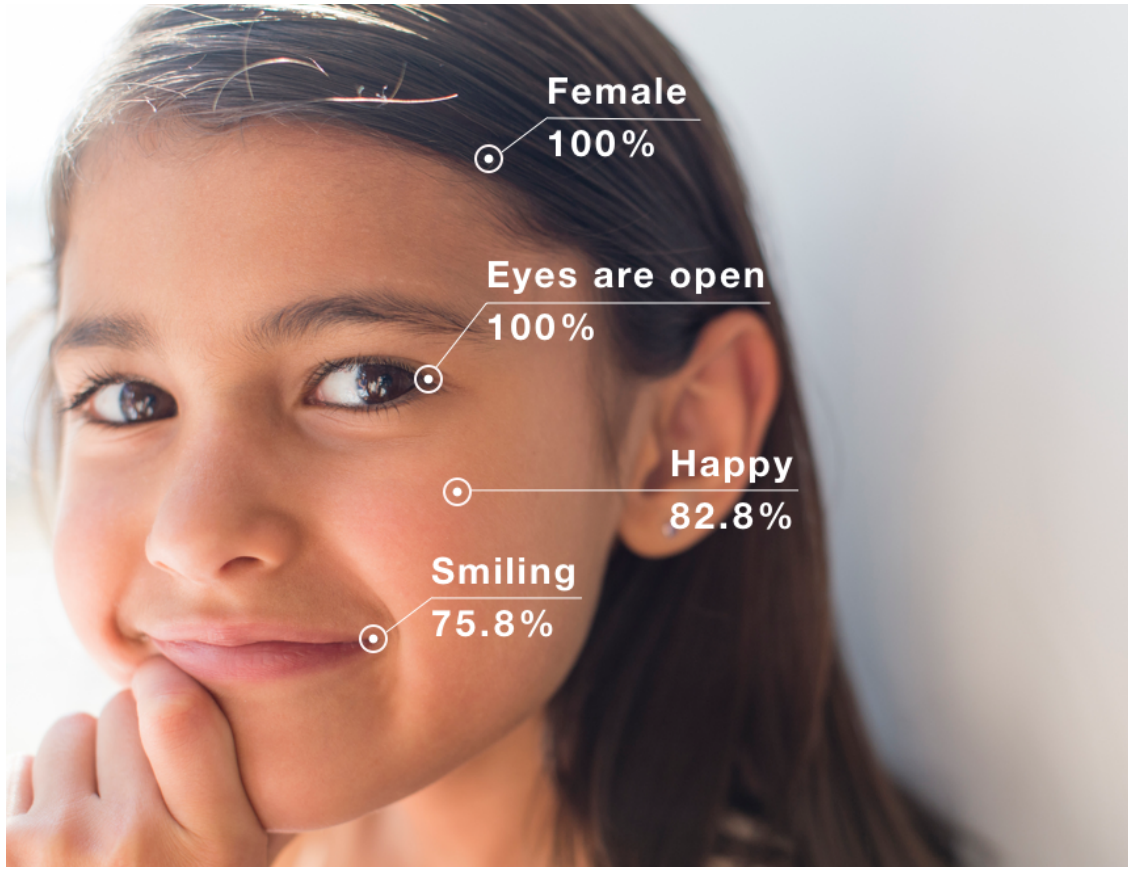
- Open CV can be CPU intensive
- Open CV can be RAM instensive



Computer Vision in the Cloud – Rekognition

Overview

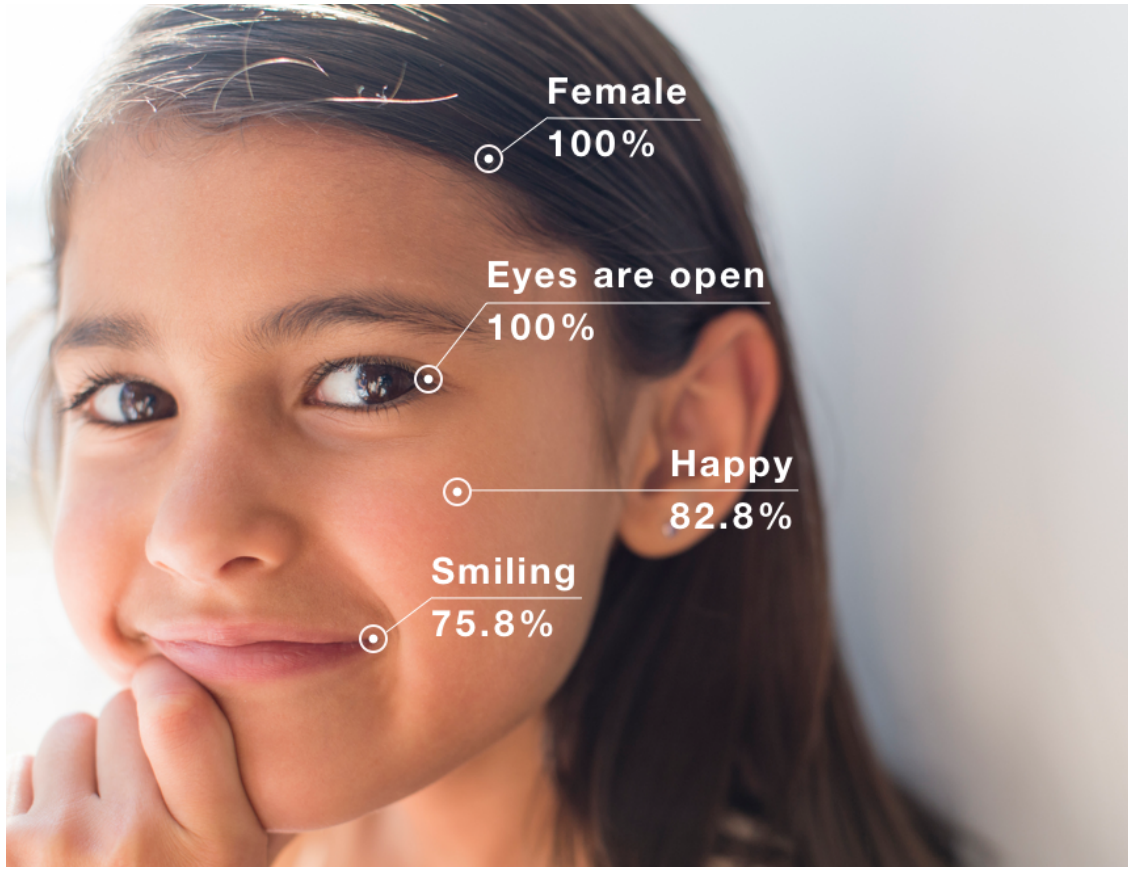
- AWS image analysis service
- Introduced Q4 2016
- Uses deep learning algorithm



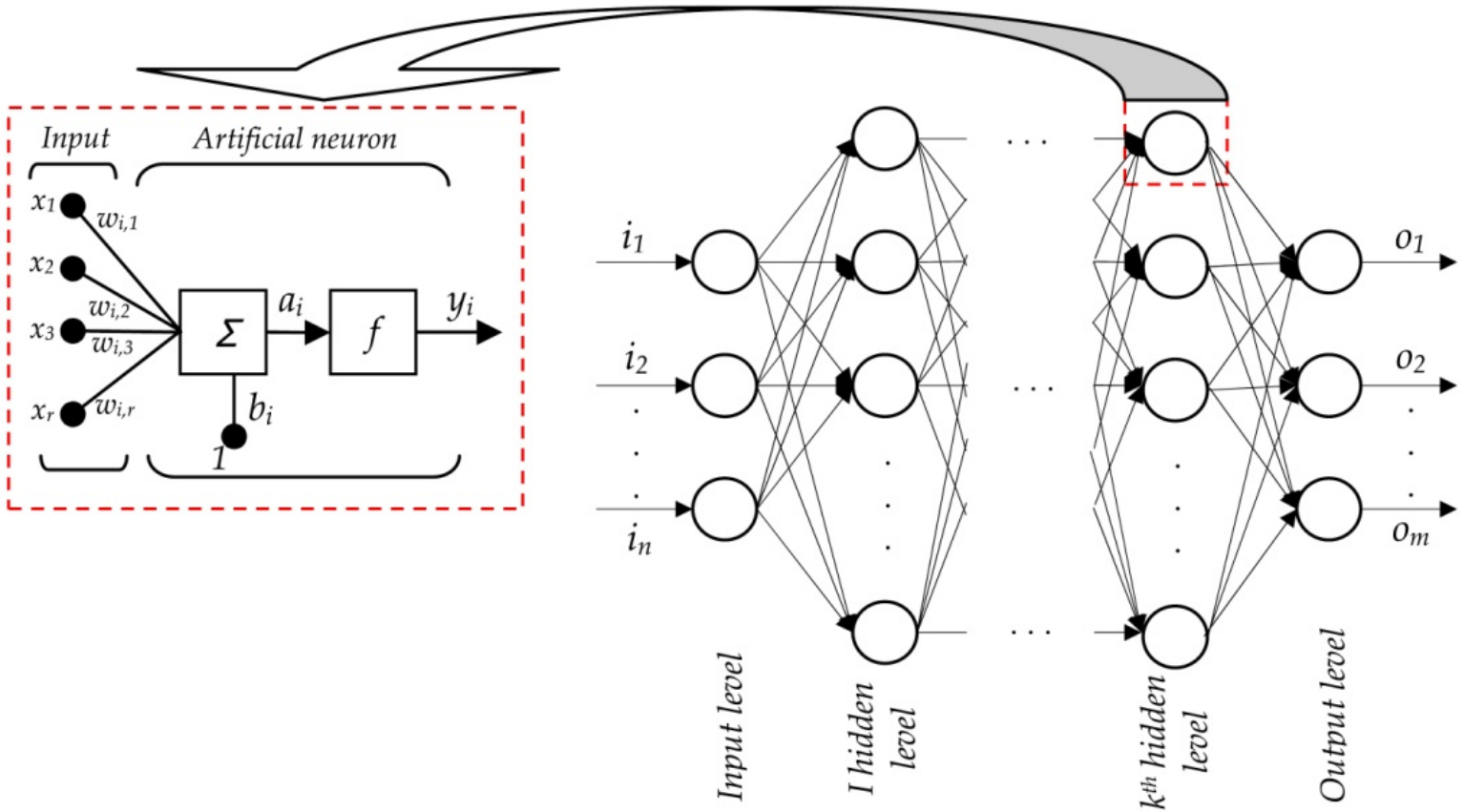

ANALYSIS:
234654 453
654334 450 16
245261 865 26
453665 766 46
382856 863 09
356878 544 04
664217 985 89
254346 956 32
SCAN MODE 43894
SIZE ASSESSMENT
ASSESSMENT COMPLETE
FIT PROBABILITY 0.99
RESET TO ACQUISITION
MODE SPEECH LEVEL 78
PRIORITY OVERRIDE
DEFENSE SYSTEMS SET
ACTIVE STATUS
LEVEL 23479 23 MAX
MATCH

Overview

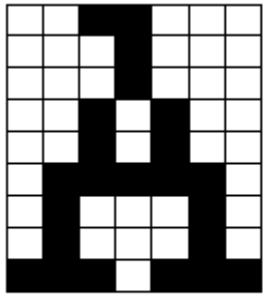
- AWS image analysis service
- Introduced Q4 2016
- Uses deep learning algorithm



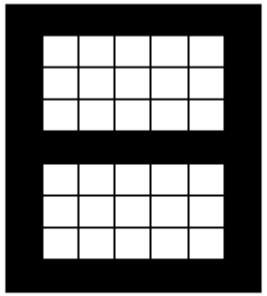
Deep Learning / Neural Networks



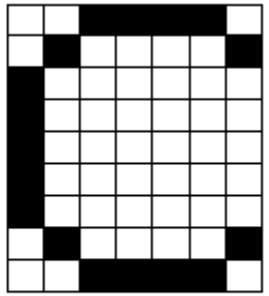
ABCs



The Letter 'A'



The Letter 'B'



The Letter 'C'

- 7x9 pixel images of A B or C
- 63 input nodes – 1 for black pixel 0 for white pixel
- 3 output nodes – A, B, or C

Training?

Math – Basically the chain rule with partial derivatives

Summary: the equations of backpropagation

$$\delta^L = \nabla_a C \odot \sigma'(z^L) \tag{BP1}$$

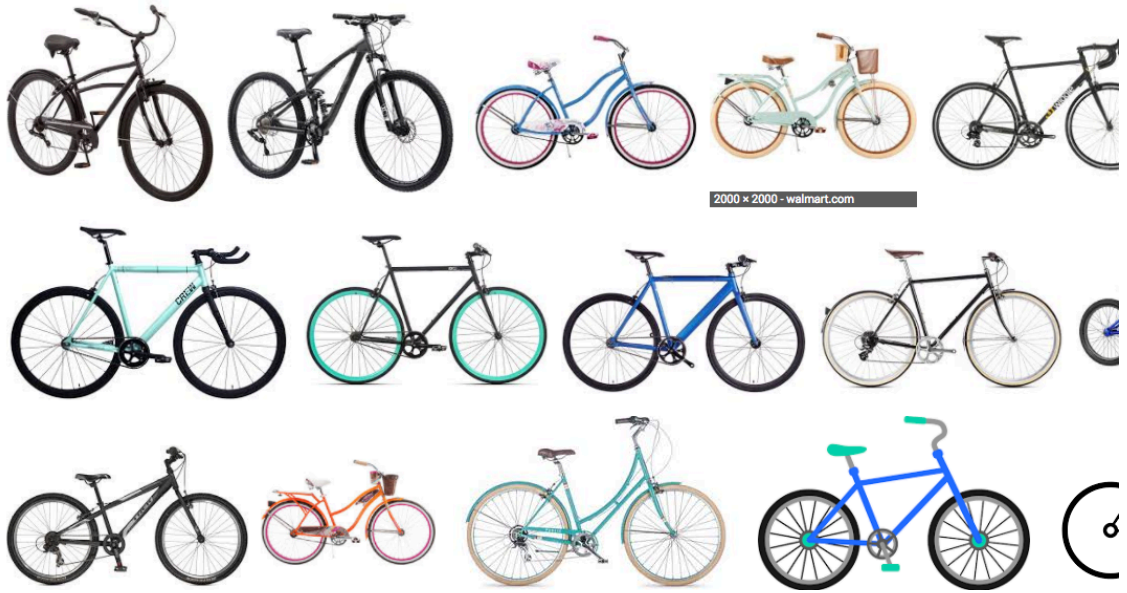
$$\delta^l = ((w^{l+1})^T \delta^{l+1}) \odot \sigma'(z^l) \tag{BP2}$$

$$\frac{\partial C}{\partial b^l_j} = \delta^l_j \tag{BP3}$$

$$\frac{\partial C}{\partial w^l_{j\,k}} = a^{l-1}_k \delta^l_j \tag{BP4}$$

Trained Data

- To be successful a neural network needs a massive amount of *trained* data
- Trained Data = Image + Label
- ~10,000 images to train a network



"BIKE"

Result

Results

Human	99.2%
People	99.2%
Person	99.2%
Bicycle	97.6%
Bike	97.6%
Vehicle	97.6%
Plaid	59.3%

Show less

Request

Response

Edge + Cloud demo!

Take Video

OpenCV

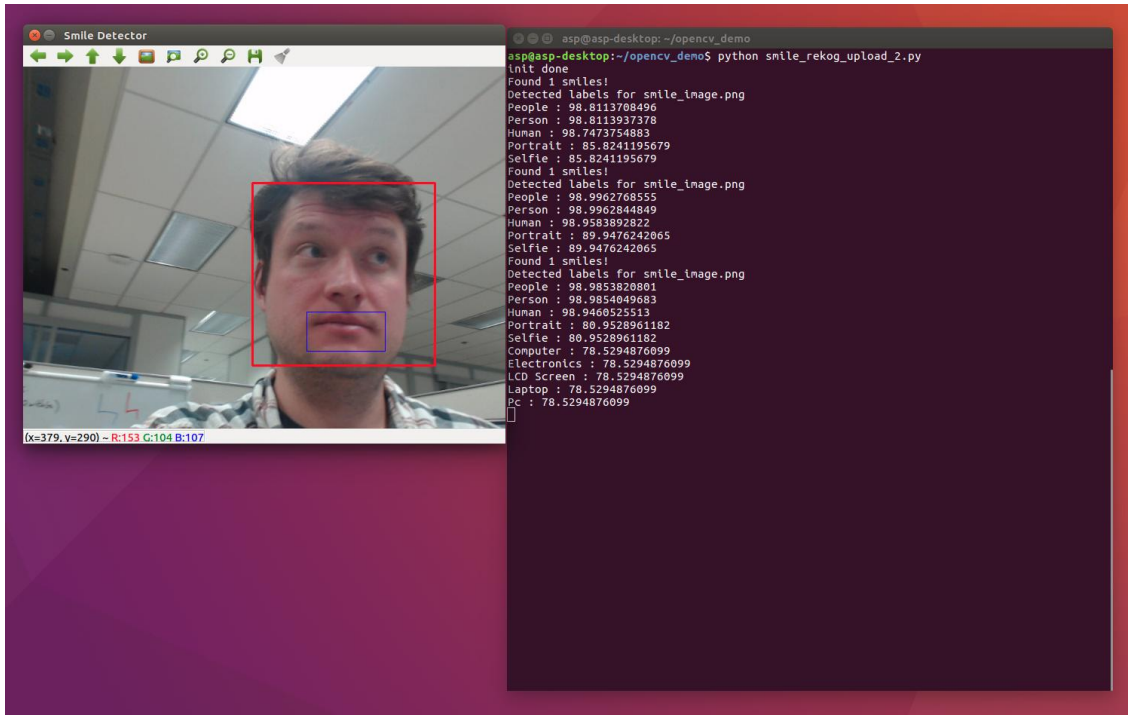
- Track Face
- Detect Smile
- Connect to AWS

AWS

S3 + Rekognition

- Store Image
- Return Analysis

Results!



- OpenCV can track faces in real time
- Rekogntion can report back with what it thinks is in the image

Questions?