

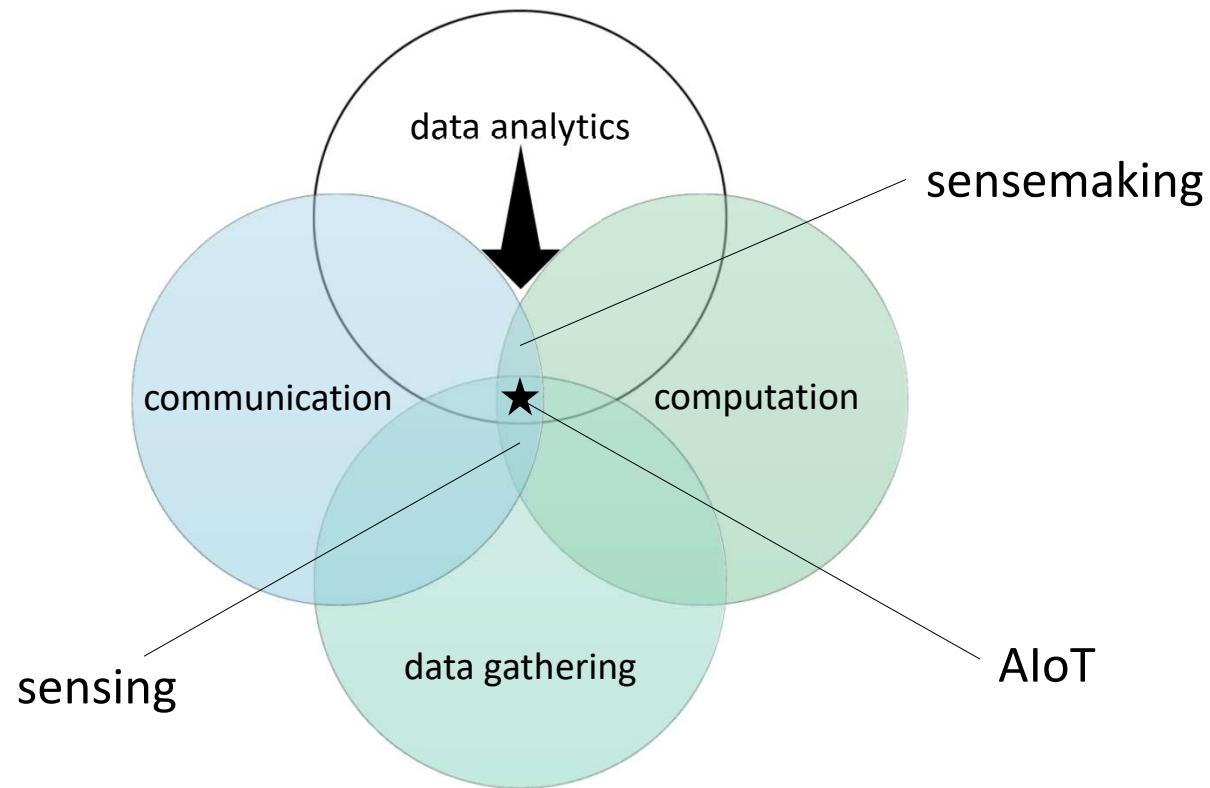
Machine Learning for IoT

A.Y. 2021-2022

Course Info

Prof. Andrea Calimera

About this course

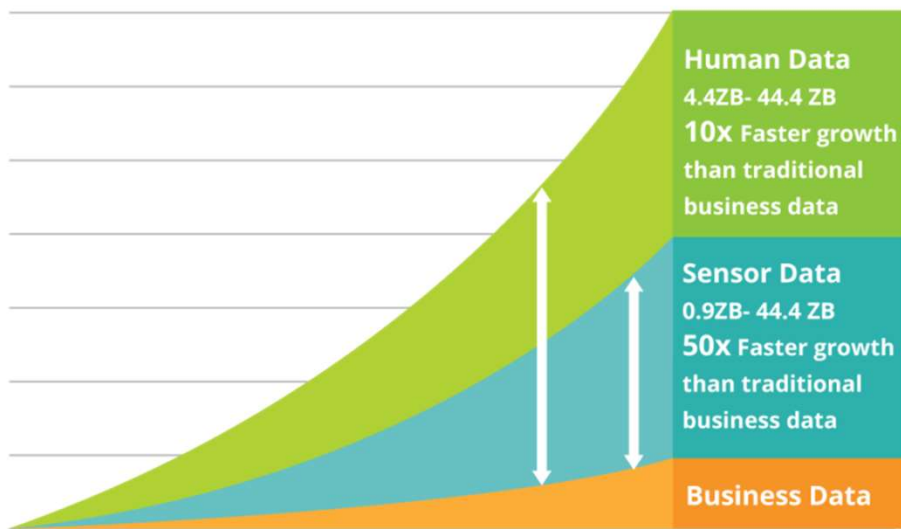


Course objectives

- Learn about “Internet of Things” (IoT) and its peculiarity
 - Hardware devices
 - Software technology
 - Applications and practical use-cases
- Know about the existence of other metrics (that go beyond those used in ML)
 - Extra-functional metrics, like energy, latency, scaling, implementation costs
- Explore the optimization side of the basic building blocks (SW)
 - Sensing: Data collection and communication (Machine-2-Machine communication)
 - Sensemaking: Model training and deployment (efficient processing of inference engines)
- Emphasis on Augmented Intelligence (AI) of things (AIoT)
 - Deep Learning and Deep Neural Networks
 - Resource-driven design/implementation flow: training & inference & deployment

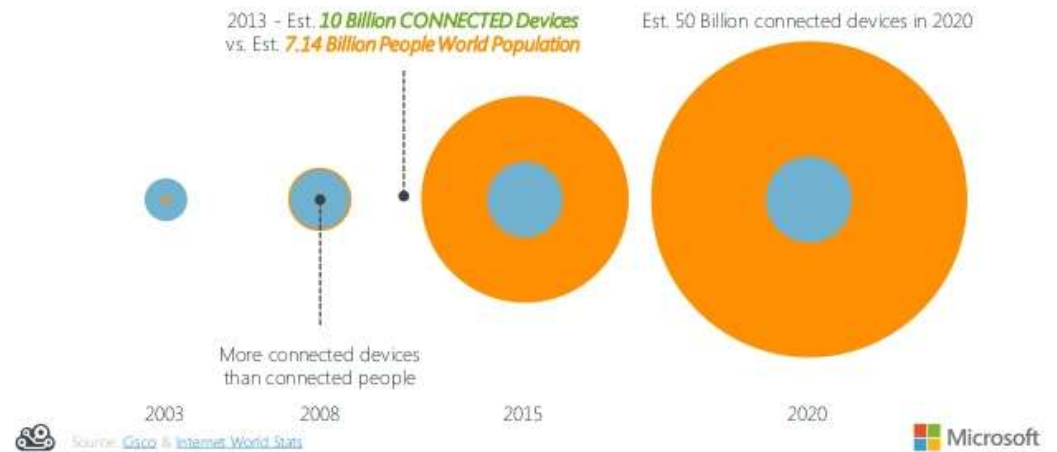
Why this course

- sensor-data is the new oil

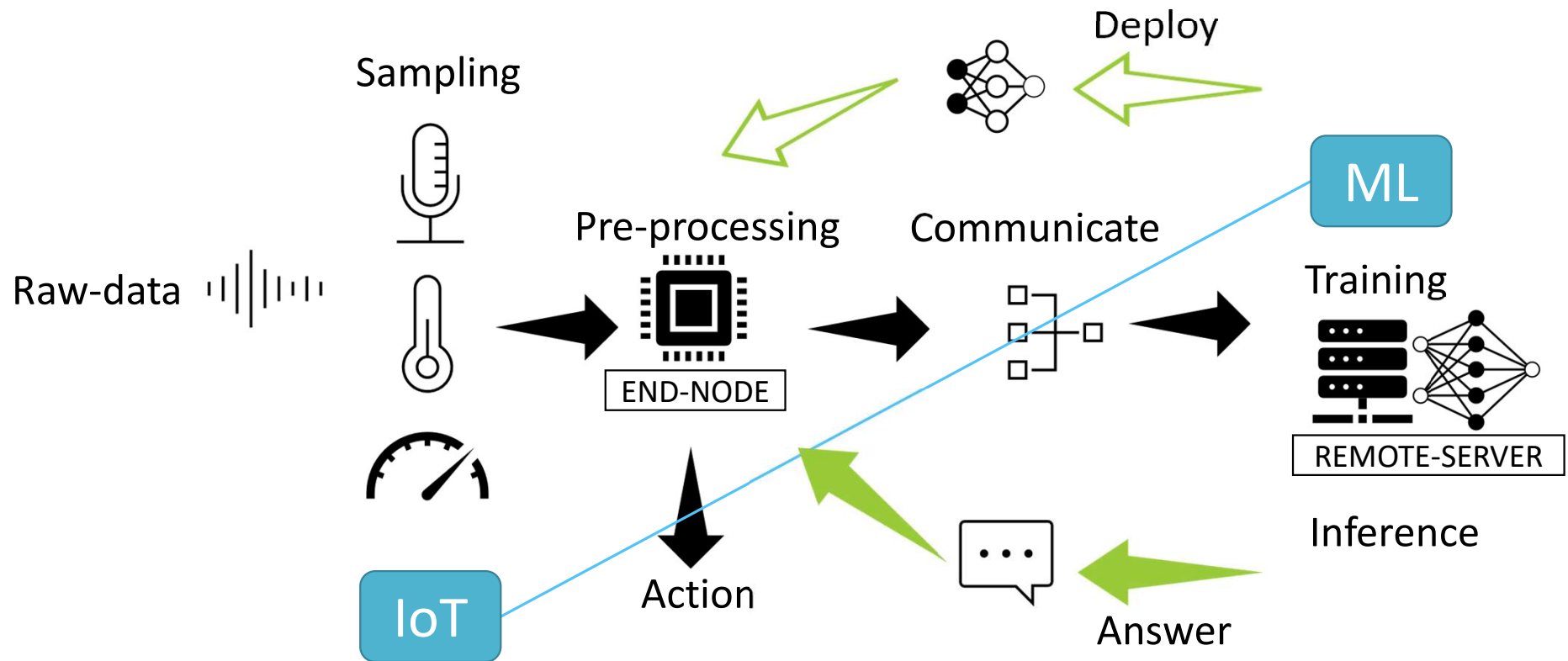


Source: Inside big data

CONNECTED "THINGS" VS PEOPLE



This course in a nutshell



Course Organization and Contents

- Welcome to IoT
 - Lectures
 - IoT definitions, architecture, challenges and use-cases
 - Data life-cycle in the IoT
 - Understand IoT data
 - Getting started:
 - OOP + data-analysis
- Part-I: IoT technologies
 - Lectures
 - HW components and their integration into smart devices
 - Computer architectures, from cloud to edge
 - Performance metrics, beyond accuracy
 - LAB
 - Embedded systems programming
 - Data-gathering and data pre-processing on an end-node

Course Organization and Contents

- Part-II: ML and DL in the IoT
 - Lectures
 - Tensor graph computing
 - An industrial framework: TF and TF-Lite
 - Optimization for ML at the edge
 - LAB
 - DL models and practical use-cases: CNN training and inference on common data-set
 - Deployment on remote servers and edge devices
 - Hardware-driven optimization

Course Organization and Contents

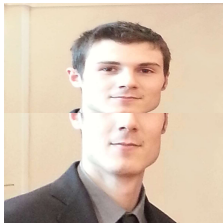
- Part-III: Data Exchange
 - Lectures
 - Communication paradigms and protocols for IoT communications
 - Distributed software platforms: Monolithic vs Microservices design patterns
 - Server computing models
 - LAB
 - Send data and messages from/to edge/remote-servers using industrial protocols
 - MQTT
 - REST
 - Offloading policies for efficient processing of inference engines
 - who, where, how
 - Edge vs remote computing

Instructors



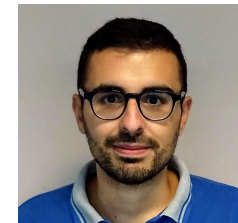
Andrea Calimera – andrea.calimera@polito.it

Edoardo Patti – edoardo.patti@polito.it



Daniele Jahier Pagliari – daniele.jahier@polito.it

Valentino Peluso – valentino.peluso@polito.it



Prerequisites

- Theory and basic concepts of machine-learning and deep-learning in particular
- Software programming theories and tools
- Object-oriented programming
- Basic concepts on computer networks and architectures

Course material

- Slides and notes
 - Available on the course page (portale didattica)
- Reference book
 - None 😞
- Additional material
 - Internet 😊

Timetable

- Lecture
 - Monday 14:30 - 16:00 VR
 - Thursday 14:30 - 17:30 3M
- Lab
 - Tuesday, 13:00 – 16:00 2N
 - Starting from 3rd (or 4th) week (hardware setup)
 - Everybody attending the full 3h slot

Extra (free) slots

MON: 8:30 10:00 11:30 13:00 14:30 16:00 17:30

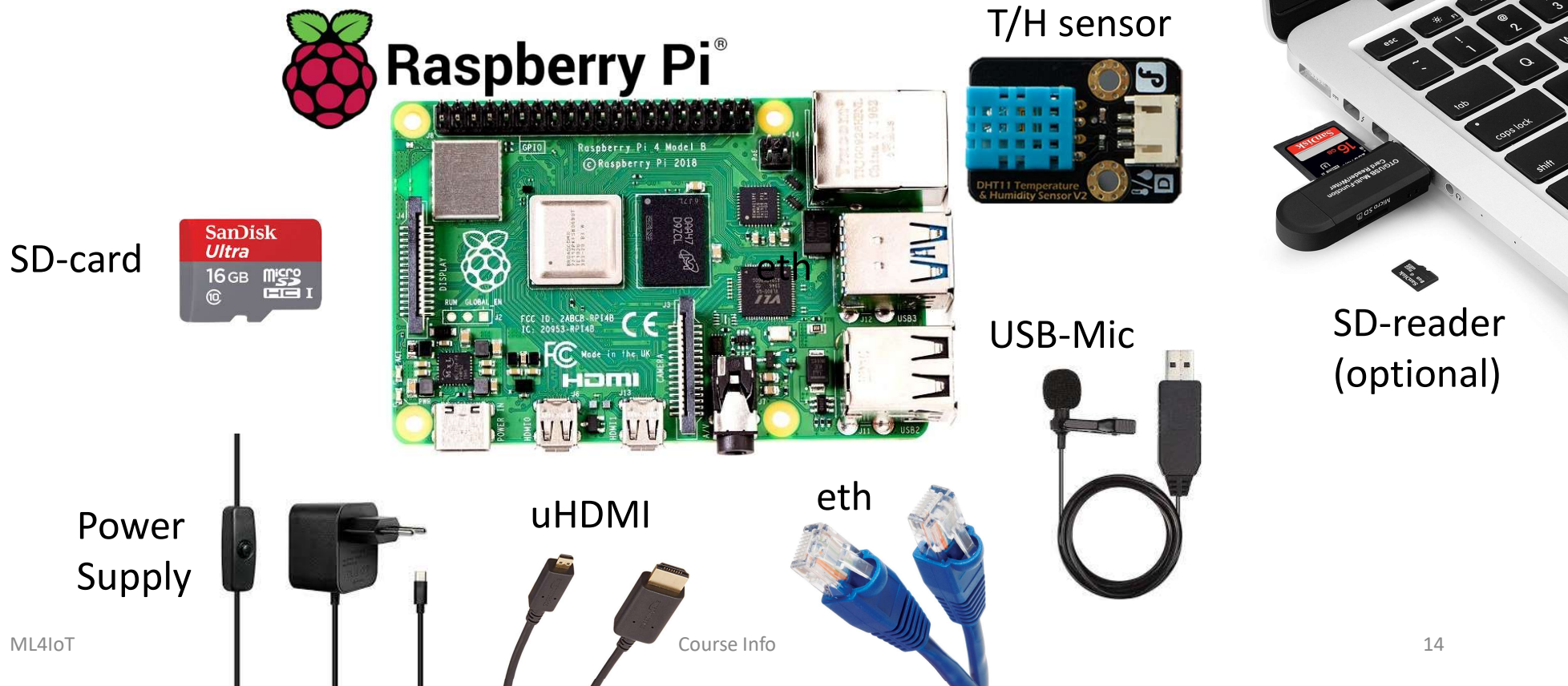
TUE: 8:30 10:00 11:30 13:00 14:30 16:00 17:30

WED: 8:30 10:00 11:30 13:00 14:30 16:00 17:30

THU: 8:30 10:00 11:30 13:00 14:30 16:00 17:30

FRI: 8:30 10:00 11:30 13:00 14:30 16:00 17:30

Lab Equipment: shopping list



Course material: Lab

- Lab sessions run remotely
- Equipment (to buy, unless you already have)
 - Edge-node: Raspberry PI 4 (model B)
 - <https://www.raspberrypi.org/products/raspberry-pi-4-model-b/>
 - Power supply: external PSU 2.5 A
 - https://www.amazon.it/GeeekPi-Raspberry-Alimentatore-Adattatore-Caricabatterie/dp/B07X9GW6N7/ref=sr_1_6?dchild=1&keywords=alimentatore+Raspberry&qid=1632157502&sr=8-6Storage
 - SD card 16GB
 - https://www.amazon.it/Kingston-SDCS2-16GB-microSD-Adattatore/dp/B07YGZHSJS/ref=sr_1_5?mk_it IT=%C3%85M%C3%85%C5%BD%C3%95%C3%91&dchild=1&keywords=sd+16gb&qid=1598595327&s=electronics&sr=1-5
 - USB SD reader (if not available on your PC/Laptop)
 - https://www.amazon.it/Vanja-Adattatore-Computer-Smartphone-Tunzione/dp/B00W02VHM6/ref=sr_1_5?mk_it IT=%C3%85M%C3%85%C5%BD%C3%95%C3%91&dchild=1&keywords=lettore+usb+sd&qid=1598596555&sr=8-5

Lab

- Equipment (to buy)
 - Cables
 - uHDMI
 - https://www.amazon.it/dp/B014l8TVLI/ref=twister_B01AM5SOUK?encoding=UTF8&psc=1
 - Eth
 - https://www.amazon.it/AmazonBasics-Ethernet-velocità-gigabit-connettori/dp/B07ZTR2TZZ/ref=sr_1_3?mk_it_IT=AMAZON&dchild=1&keywords=cavo%2Bether%2Bamazonbasics&qid=1632157694&s=pc&sr=1-3&th=1

Lab

- Equipment (to buy)
 - Digital sensors:
 - Audio
 - USB mic:
https://www.amazon.it/GeekerChip-Condensatore-Omnidirezionale-Compatibile-Intervista/dp/B086PBZFJC/ref=sr_1_5?__mk_it_IT=%C3%85M%C3%85%C5%BD%C3%95%C3%91&crd=1D9GKUZE60JFC&dchild=1&keywords=microfono%2Busb&qid=1598969112&s=electronics&prefix=microfono%2Busb%2Celectronics%2C163&sr=1-5&th=1
 - Adapter (alternative):
https://www.amazon.it/gp/product/B07YCKC1CF/ref=ppx_yo_dt_b_asin_title_o00_s00?ie=UTF8&psc=1
 - Temperature + Humidity
 - <https://www.dfrobot.com/product-174.html>

Exam

- Homework - mandatory
 - 3 main assignments (one for each of the 3 parts)
 - Given during the course
 - Group of 3 people
 - 18pts = 3 * 6pts
- Written test - mandatory
 - Multiple-choice & Open-ended questions + Numerical exercises
 - Score: 12pts
- Alternative to the written test - mandatory (depending on the pandemic situation)
 - Final project (Part-I, -II, -III)
 - Score: 12pts