**Internet of Things**

**Short Summary, edit 2026**

**This course introduces general concepts of the Internet of Things,
and among the vast spectrum of choices focuses on**

**- environmental and energy related IoT**
**- low Power IoT**
**- LPWAN / LoRaWAN**
**- Open Spectrum**

**The course takes a network centric view, with strong emphasis on non-proprietary and accessible technology stacks.**
**Hands-on experience is prioritized, to the extent possible.**
**Learning outcomes however will be applicable broadly across other subdomains of IoT.**

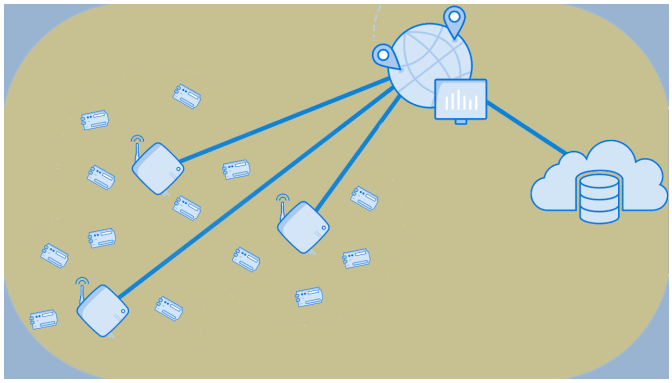
**Target audiences:**
**- Students and faculty in Computer Science and related**
**- IT professionals**

**Prerequisites:**
**- General understanding of IT & networks**
**- Experience in programming C and/or python a plus**

**The course can be adapted to divergent target groups, including entry level.**

**Modules / Lectures:**

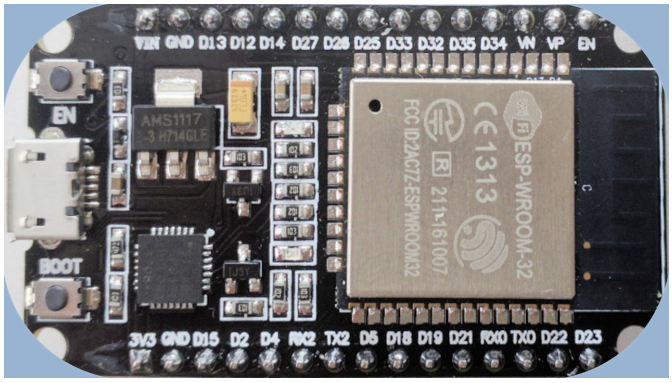
## 01 – Introduction, System Design & Architecture



**Definition, History, Context**
**Approaches & Architectures**

***Exercise:***
***Mapping & scoping IoT opportunities***

## 02 - Embedded systems & programming




**Operating systems**
**Constraints**
**Components**
**HW architectures**

***Exercise:***
***First steps on ESP32***

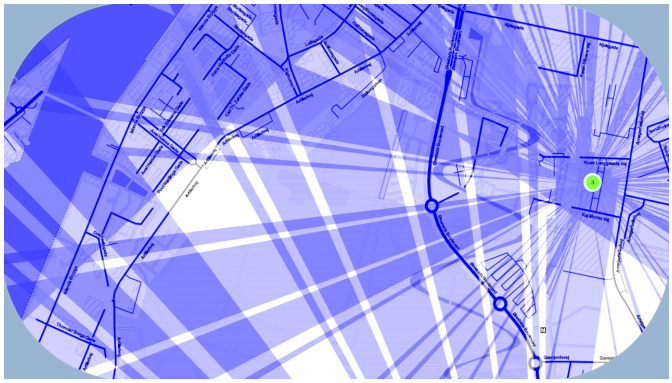
## 03 – Sensing



**Physics foundations**
**Terminologies & types**
**Market overview**

***Exercise:***
***Reading GPS and I2C sensors on ESP32***

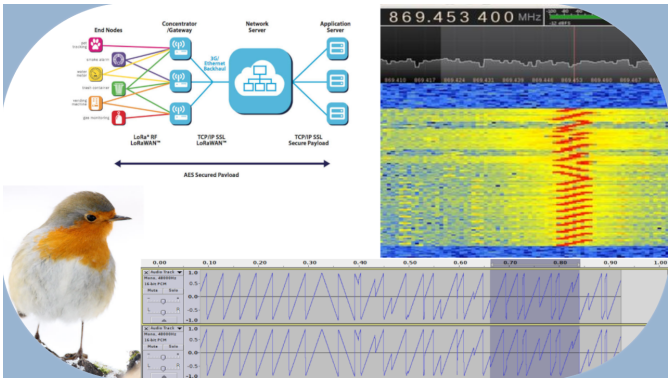
## 04 - Networking I – Overview



**Network technologies for IoT**
**Requirements & characteristics**

***Exercise:***
***Sending sensor data over Wi-Fi and MQTT***

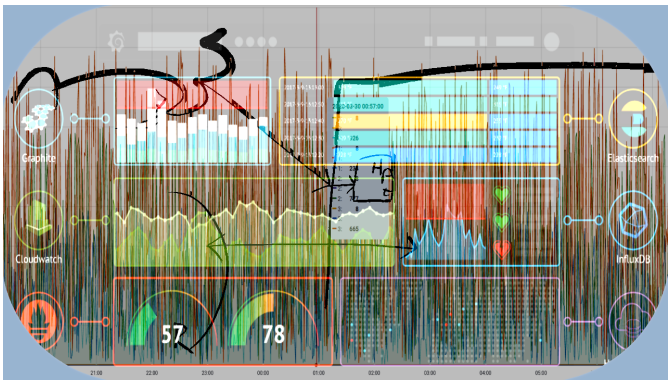
## 05 - Networking II - LPWAN & LoRaWAN




**LPWAN characteristics**
**Technology overview**
**LoRa & LoRaWAN**
**The Things Network**

***Exercise:***
***Sending sensor data over LoRaWAN***

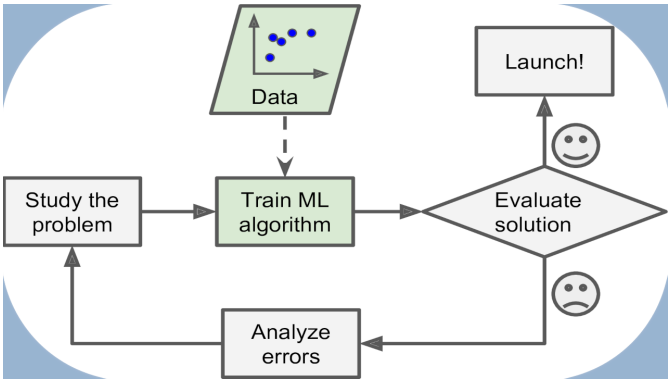
## 06 - Data stacks, management and visualization




**Timeseries databases**
**TIG stack**
**Node-Red, Telegraf, Influx, Grafana**
**Mapping with Leaflet**

***Exercise:***
***Integration TTN – data stack***

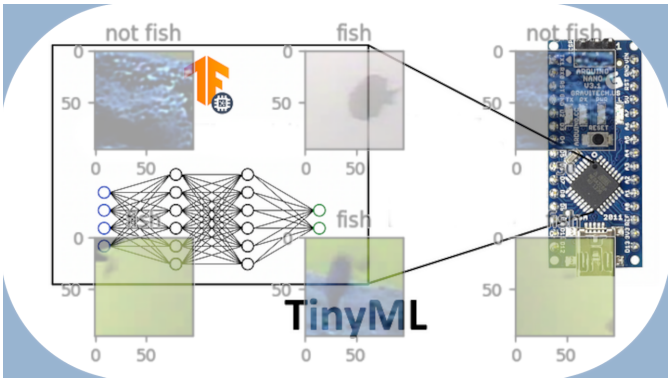
## 07 - Data analytics: ML basics




**Foundations of ML**
**Basic concepts**

***Exercise:***
***ML introdcution on Jupyter notebook***

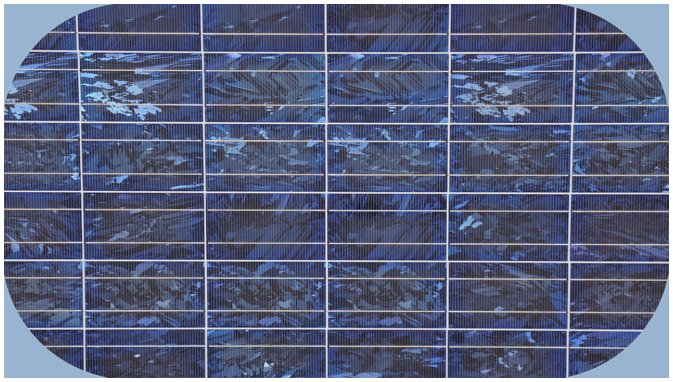
## 08 - Edge computing & TinyML




**From ML to TinyML**
**Embedded ML**
**EdgeImpulse**

***Exercise:***
***Deploying TinyML on mobile phone and ESP32***

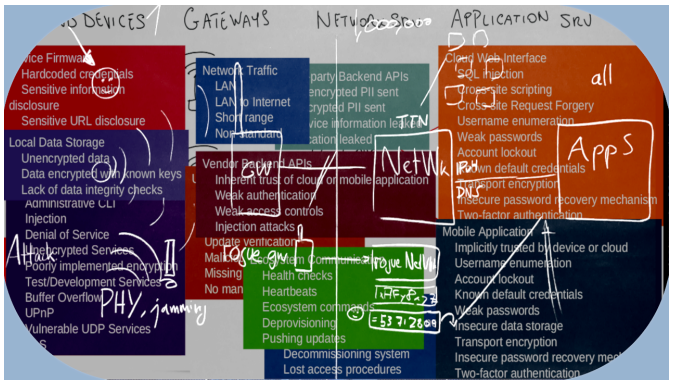
## 09 – Energy & Sustainability



**Relation IoT – Energy**
**IoT and SDGs**
**Footprint and Sustainability of IoT**
**IoT practice in solar energy**

***Exercise:***
***Estimating IoT Footprints***
***Monitoring solar with ESP32***

## 10 – IoT Security




**General security principles**
**IoT specific vulnerability**
**OWASP framework**
**Hardware impacts on security**

***Exercise:***
***Attacking own system***
***Analysis of attack surfaces***

## 11- Industry Guest Talk



**(Depending on location, organisation)**

***Exercise:***
***Q&A with Industry guest***

## 12 - IoT & Ethics



**IoT and impact of data**
**Privacy, GDPR,**
**IoT and environmental responsibility**

***Exercise:***
***Impact evaluation of example IoT systems***

## 13 - Space IoT- Satellites in Communication and Earth Observation

**Roles of (small) satellites as IoT nodes/observation units and as communication hubs**
**LoRa and SmallSats**

***Exercise:***
***Satellite tracking and prediction***
***Live Satellite connection (where feasible)***

