INTRODUCTION TO THE IOT LABS

LECTURES

- Introduction to IoT Labs
- Introduction to Android Studio
- Lab 1
- Lab 2
- Lab 3
- Seminar 1
- Seminar 2
- Seminar 3
- Seminar 4

GROUPS

- Maximum: 3 students (it means 4, 5,… are not possible!)
- Minimum: 2 students

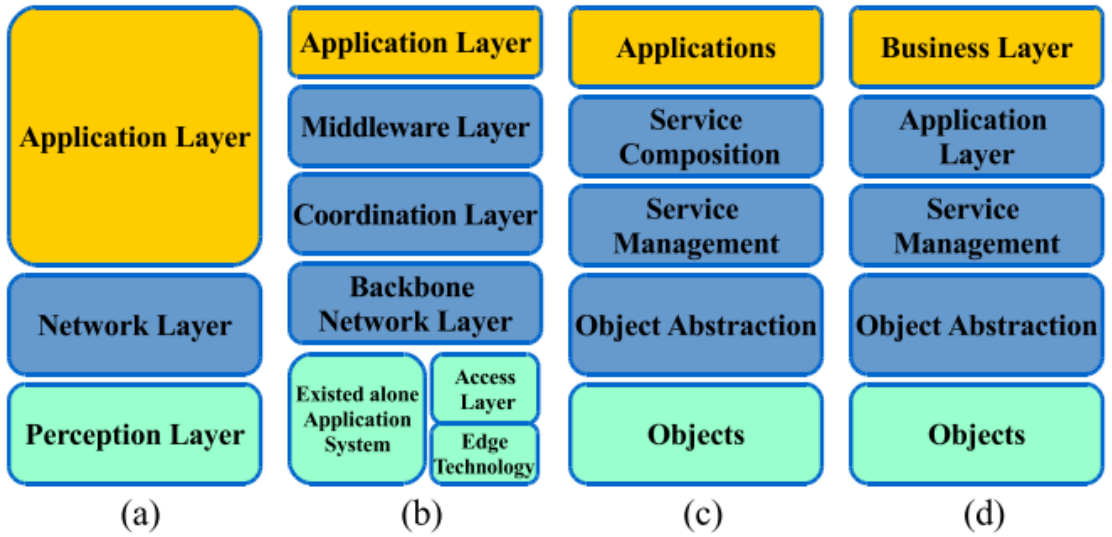
The groups are fixed throughout the labs and final project.

At the end of the course, all the group members might not get the same grade!

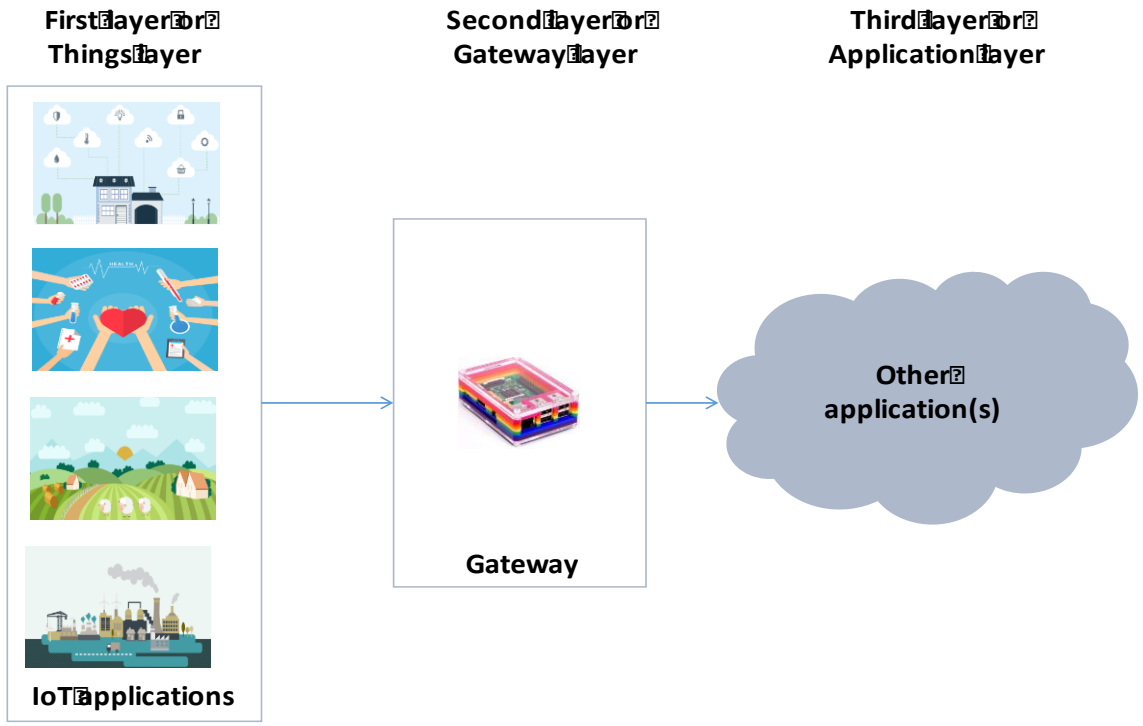
WHAT IS THE PRIMARY OBJECTIVE OF IOT?

- The primary objective of IoT is to connect anything anytime and anywhere.
- IoT devices can be classified into two major categories: resource-constrained devices and resource-rich devices.
- Resource-rich: devices that have the hardware and software capabilities to support the TCP/IP protocol suite
- Resource-constrained: devices that do not have the required resources to support TCP/IP cannot interoperate easily with resource-rich devices that support the TCP/IP suite.

IOT ARCHITECTURE



The IoT architecture. (a) Three-layer. (b) Middle-ware based. (c) SOA based. (d) Five-layer.



LABS' OBJECTIVES

Lab 1:

- To introduce to an IoT application
- To introduce to sensing and actuating
- To configure an IoT gateway though GET-request

Lab 2:

- To create an android app to access things
- To introduce how remotely things can be controlled
- How IoT works
- To give an idea on how to create services for IoT using the **things**

Lab 3:

- How to connect sensors directly to Raspberry Pi
- CircuitPython
- Using libraries for sensors
- MQTT

THERE ARE MANY DIFFERENT SINGEL-BOARDS

- **Raspberry Pi**: singel-board computer
- **Arduino**: single-board microcontroller
- **Jebtson Nano:** single-board microcontroller
- **Micro bit**: single-board microcontroller
- **Teensy**: single-board microcontroller
- **ESP32 / ESP8266**: module board/microcontroller
- + many more (Banana Pi, Asus Tinker board, BeagleBoard, Odroid, Coral Dev board…)

The boards have different properties, and it might limit or increase the complexity of your project!

RASPBERRY PI VS ARDUINO

Raspberry Pi

+ Internet!
+ Bluetooth!
+ SD card for storage
+ Single board *computer*
+ Ports galore: USB, audio, camera, HDMI…

- Not that good for analog input
- Needs more setup (OS)

Arduino

+ Digital AND analog input
+ Cheaper
+ Wearable options!
+ Easy to upload code to

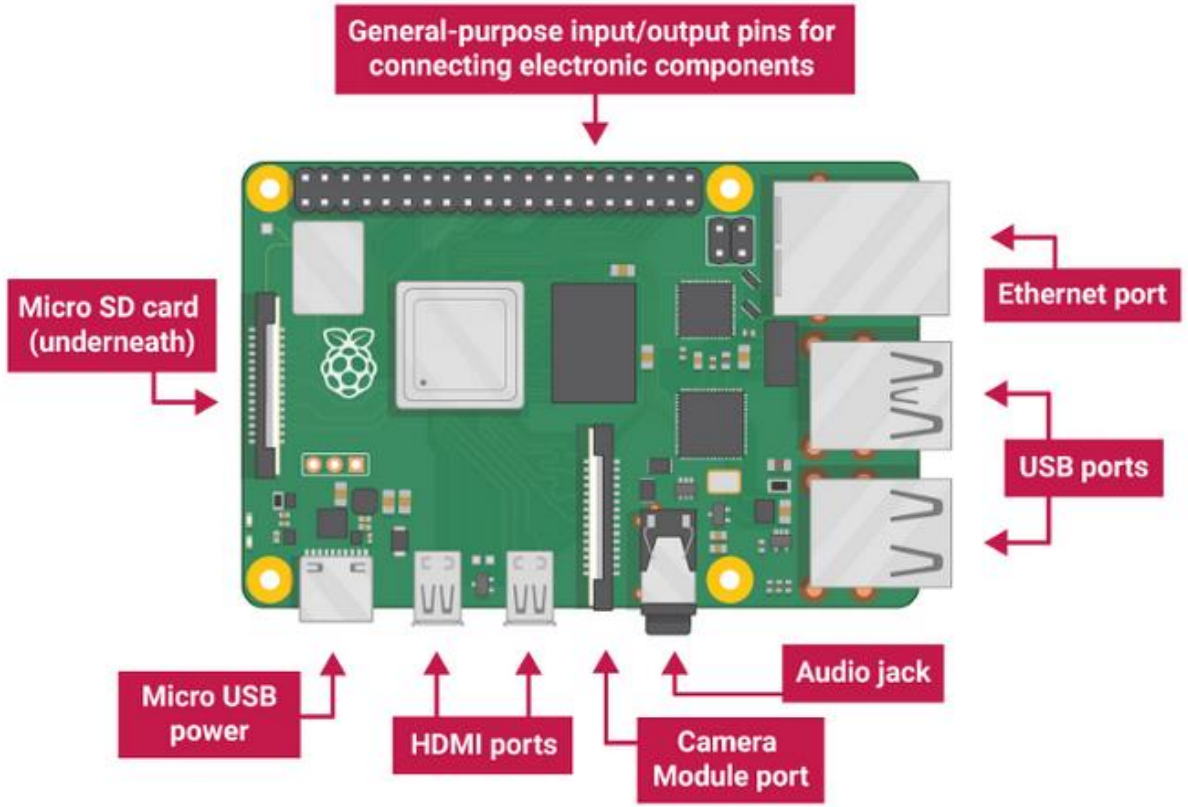
+- Arduino code

- (might) need additional module for internet access
- Limited memory

RASPBERRY PI

- Created by the Raspberry Pi Foundation, in the UK
- First gen Raspberry Pi model B released 2012
- Third best-selling computer brand in the world
- Comes in three models: B, A and zero
- Raspberry Pi 4 released July, 2019
- Recommended OS is Linux based Raspbian
- Recommended price for model B is ~$35

Model	
B	Faster
A	Cheaper
Zero	Smaller



> Source: Raspberry Pi Foundation - https://www.raspberrypi.org/

I WANT TO KNOW MORE!

- Raspberry Pi Foundation: https://www.raspberrypi.org/
- Arduino: https://www.arduino.cc/

Inspiration

- Hackster.io: https://www.hackster.io/
- Instructables: https://www.instructables.com/
- The MagPi: https://www.raspberrypi.org/magpi/
- Adafruit guides: https://learn.adafruit.com/

Shops

- Pimoroni (UK): https://shop.pimoroni.com/
- Adafruit (US): https://www.adafruit.com/
- Seeed (CN): https://www.seeedstudio.com/
- Digi-Key (US/world): https://www.digikey.com/
- Electrokit (SWE): https://www.electrokit.com/
- M.nu (SWE): https://www.m.nu/

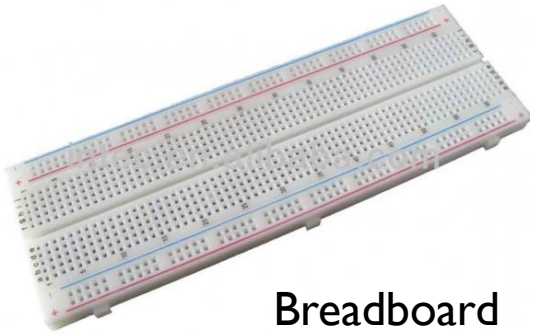
TELLSTICK ZNET

- A transceiver
- It is capable of receiving and transmitting signals from different devices
- A radio frequency transceiver that is connected through ethernet
- Bound to Telldus live account
- Can control things through API / GET-requests to Telldus Live

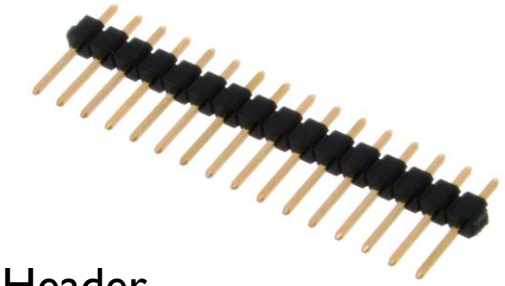
THINGS

- Sensor
  - sensors are used to measure or sense about the environment and provide output based on the measurement or sensing
  - Physical or virtual or logical
  - temperature sensor, motion sensor, pressure sensor, etc.
  - Web service, Twitter, any software agent capable of providing data, etc.
- Actuator
  - actuators are used to affect a situation, i.e. controlling environment.
  - light switch, door lock, window blinds, thermostat, etc.

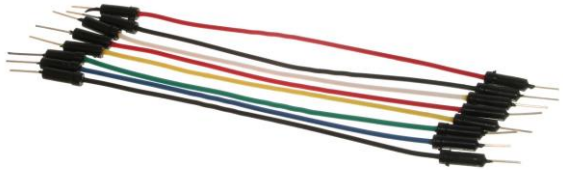
GLOSSARY OF USEFUL ACCESSORIES



Breadboard
Kopplingsdäck

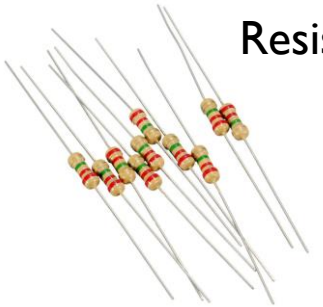


Header
Header, stiftlist/hylslist

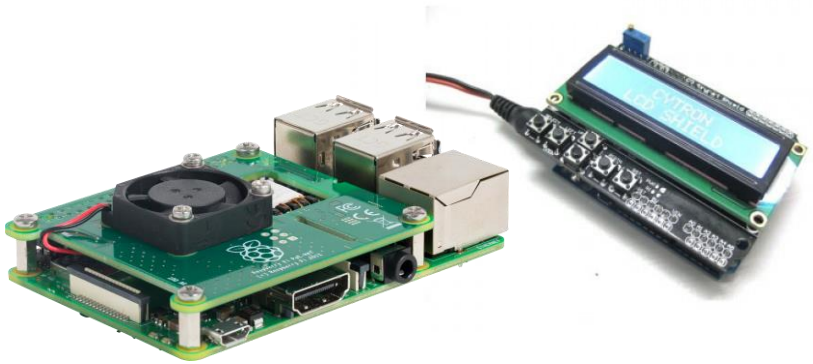


Jumper wires
Kopplingskablar

Solder iron
Lödstation



Resistor



HAT / shield

LAB 1

Sensor

Actuator

Tellstick

User Interface

Raspberry Pi

LAB 1: GOALS

- Learn to setup an IoT gateway
- Learn to communicate with the Tellstick znet/Telldus live with Raspberry Pi
- Sensors automatically communicate with the Tellstick znet through Telldus live. This is already configured.
- Access things' status and control actuation

TO BE DONE DURING LAB 1:

- Create a connection to a Raspberry pi (RPI) through SSH
- Create a script on the RPI based on a template
- Modify the script to receive correct information
- Read data to get information
- Create and modify a script to control a specific actuator

LAB 2

Sensor

Actuator

Tellstick

android

Raspberry Pi

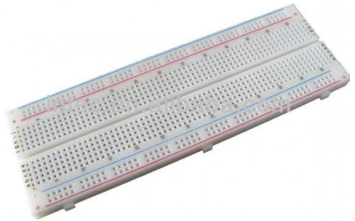
LAB 2: GOALS

- To create an android app for accessing things' status and actuate
- Learn how to create a basic android app
- Learn how to work with the Android Studio
- Learn how to add a external library to an Android project
- How to communicate with the IoT gateway from the app
- How remote access to the IoT things can be achieved

TO BE DONE DURING LAB 2:

- Create and modify scripts on Raspberry Pi
- Create a basic Android application
- Modify the apps layout
- Setup and run the emulator
- Add functionality to be able to connect to the Raspberry pi and use the scripts
- Permissions
- SSH
- Make use of output
- Control actuator and fetch data through the android app

LAB 3



+

+

android

MQTT BROKER

Raspberry Pi

LAB 3

Sensors

- Three available
  - TSL2591: high dynamic range light sensor
  - VCNL4010: Proximity sensor
  - TCS34725: Color sensor
- Are pre-soldered for the lab
- Needs to be connected to a board
- CircuitPython libraries available

LAB 3

CircuitPython

- Based on Python, for microcontroller boards
- Adds hardware supports
- Libraries available for plenty of boards and sensors

LAB 3: GOALS

- How to connect sensors to a Raspberry Pi
- How to use a breadboard
- How to enable I2C and SPI on Raspberry Pi
- To install and use CircuitPython
- How to setup MQTT and publish messages from a Raspberry Pi
- Learn how to create a basic android app that uses MQTT

TO BE DONE DURING LAB 3:

- Enable I2C and SPI communication on the Raspberry Pi, for the sensors
- Connect the sensors (through a breadboard, if needed) to Raspberry Pi
- Download and install needed libraries for CircuitPython
- Create and modify MQTT scripts on Raspberry Pi
- Create a basic Android application
- Modify the apps layout
- Create functionality for MQTT
- Make use of the incoming messages from chosen topic
- Run the emulator
- Fetch data from the sensors to the app

LAB REPORTS

- Individual or same report for all members
- If the latter, be sure to include names of group members
- Everyone needs to submit
- Within one week after the respective scheduled lab
- No need to make the reports complicated!

Additional information be found in the manuals for each lab.

Questions?