IoT Engineering
0: Syllabus

Slides: tmb.gr/iot-0

Overview

The *syllabus* makes sure you know what's up:

What you can expect from this course.

What is expected from you.

Hello

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"Prof. of Internet of Things" at FHNW since 2018.

Founder of Yaler, secure remote access for IoT.

Organising an open IoT Meetup group in Zürich.

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Language

Slides are in English.

In class we speak German.

You can write German or English.

Gar kein Englisch? Kontaktieren Sie mich.

Programming language

On microcontroller devices we will use (Arduino) C.

On Raspberry Pi, backend and client, you choose:

Java*, Javascript or Python (for your own code).

Examples will be in Javascript with Node.js.

*Bluetooth libraries might not be available.

Baseline

Who visited oop1, oop2, or a Web-related module?

Who can write code in C, Javascript or Python?

Who is in below 3rd, above 4th semester?

Module *iot*

14 * 3 = 42 hours of lessons, including hands-on.

+ 16 hours of private study (reading or video).

+ 32 hours (per person) IoT team project.

=> 90 hours per person.

=> 3 ECTS credits.

Learning targets

Understanding IoT systems and their fundamental concepts, including the acquisition, transport and visualisation of sensor measurements, as well as integration with 3rd-party systems or services.

Developing the software part, without electronics*, of an end-to-end IoT system based on IoT platforms.

*But including embedded programming.

Lessons 2025 — class 5ibb1

15.09. Introduction to the Internet of Things

22.09. Microcontrollers, Sensors & Actuators

29.09. Sending Sensor Data to IoT Platforms

06.10. Internet Protocols, HTTP and CoAP

13.10. Local Connectivity with Bluetooth LE

20.10. Raspberry Pi as a Local IoT Gateway

27.10. Messaging Protocols and Data Formats

03.11. Long Range Connectivity with LoRaWAN

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Lessons 2025 — class 5ibb1 (ff.)

10.11.	Dashboards and Apps for Sensor Data	01.12.	From Prototype to Connected Product
17.11.	Rule Based Integration of IoT Devices	08.12.	Assessment
24.11.	Voice Control for Connected Products	15.12.	Demo Day
Skip	~~Raspberry Pi as an IoT Edge Device~~	23.12.	No class

Learning target assessment

A mandatory, written assessment of 90 minutes.

A graded team project, due on *Demo Day*, 0 am.

Counting 50% each for the overall performance.

The final grade will be rounded to one-tenth.

Assessment

90 minutes, closed book, written assessment.

1 A4 sheet of handwritten notes allowed.

No other material (slides, books, …).

No communication (phone, …).

Example assessments: HS19, HS21, HS22, HS23, HS24.

Team project

3 person teams, building an IoT system.

32 hours of work per person, 1 prototype.

10' presentation of the project at *Demo Day*.

Project source code and setup steps on GitHub.

All team members are able to explain the project.

Details follow. Here's an example project.

Team project code

GitHub repo with the following parts:

1) Embedded code / microcontroller firmware.

2) Glue Code used on the gateway or "in the cloud".

3) App or Web UI code, or IoT platform setup steps.

GitHub repo URL will be provided.

Team project presentation

1) Use-case.

2) Reference model.

3) Short, one slide interface docs.

4) Issues you faced, how you solved them.

+ Live demo of end-to-end IoT prototype.

Slides to be submitted as PDF.

Team project prototype demo

Working end-to-end prototype, "device to cloud".

1) Sensor input on a IoT device triggers an event.

2) The event / measurement shows up online.

3) The event triggers actuator output*.

*Same or separate device, details are up to you.

Plagiarism

Unfortunately has to be mentioned, sanctions apply.

From *Betrug und Plagiate bei Leistungsnachweisen*:

"Wer in Arbeiten im Rahmen des Studiums Eigen- und Fremdleistung nicht unterscheidet, wer plagiiert, macht sich strafbar." - M. Meyer

Using 3rd-party code? Make it clear, check license.

Lessons

You will need a laptop with admin rights.

There will be quite some hardware involved.

Content of slides and hands-on will be assessed.

Slides come as PDF with many links, to learn more.

Hands-on sessions

"Be excellent to each other", asking / helping is OK.

Google (DDG.co, ...) error messages to fix issues.

Copying blindly does not lead to new insight.

Reading other people's code helps a lot.

Slides, code & hands-on materials

https://github.com/tamberg/fhnw-iot

01/

README.md → Slides, Hands-on

02/

Arduino/ESP8266_Blink/ESP8266_Blink.ino

…

Hands-on and project results

https://github.com/fhnw-iot-5ibb1

fhnw-iot-work-01	Repo template w/ link
fhnw-iot-work-01-USER	Repo fork per user
README.md	Hands-on exercise
my_result.ino	"Private", tutor & user

Why GitHub? Professional tool and reliable backup.

Why a repo per lesson? Easier than updating forks.

Communication

Communication via Teams, Invite by email.

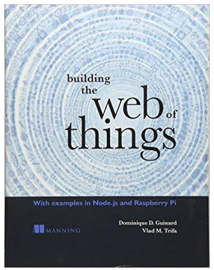
General	Questions and announcements.
Random	Off-topic, random posts.
Arduino	Arduino questions.
…	More channels.

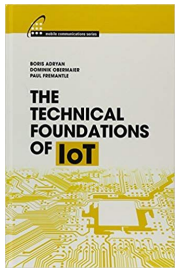
Books on IoT

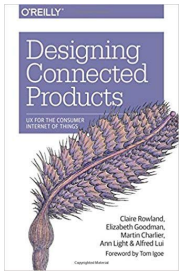
A book is not required for this course.

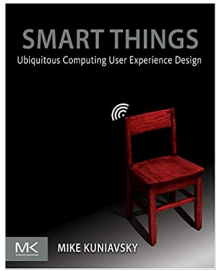
We will read individual articles on demand.

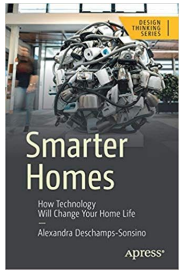
The Wiki has a list of books on a range of topics.

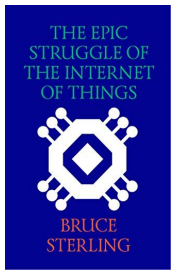


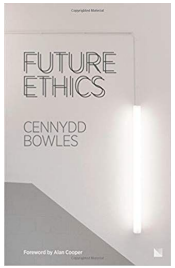


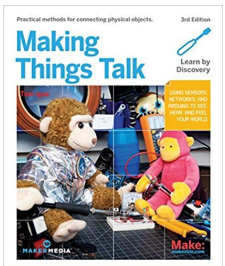


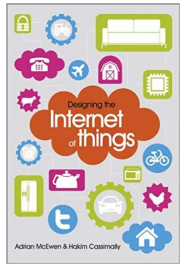












Tools

Terminal (MacOS) or *cmd* (Windows).

Arduino IDE, text editor, e.g. *nano*.

C (easy parts), Java, JS, Python.

Code version control with *git*.

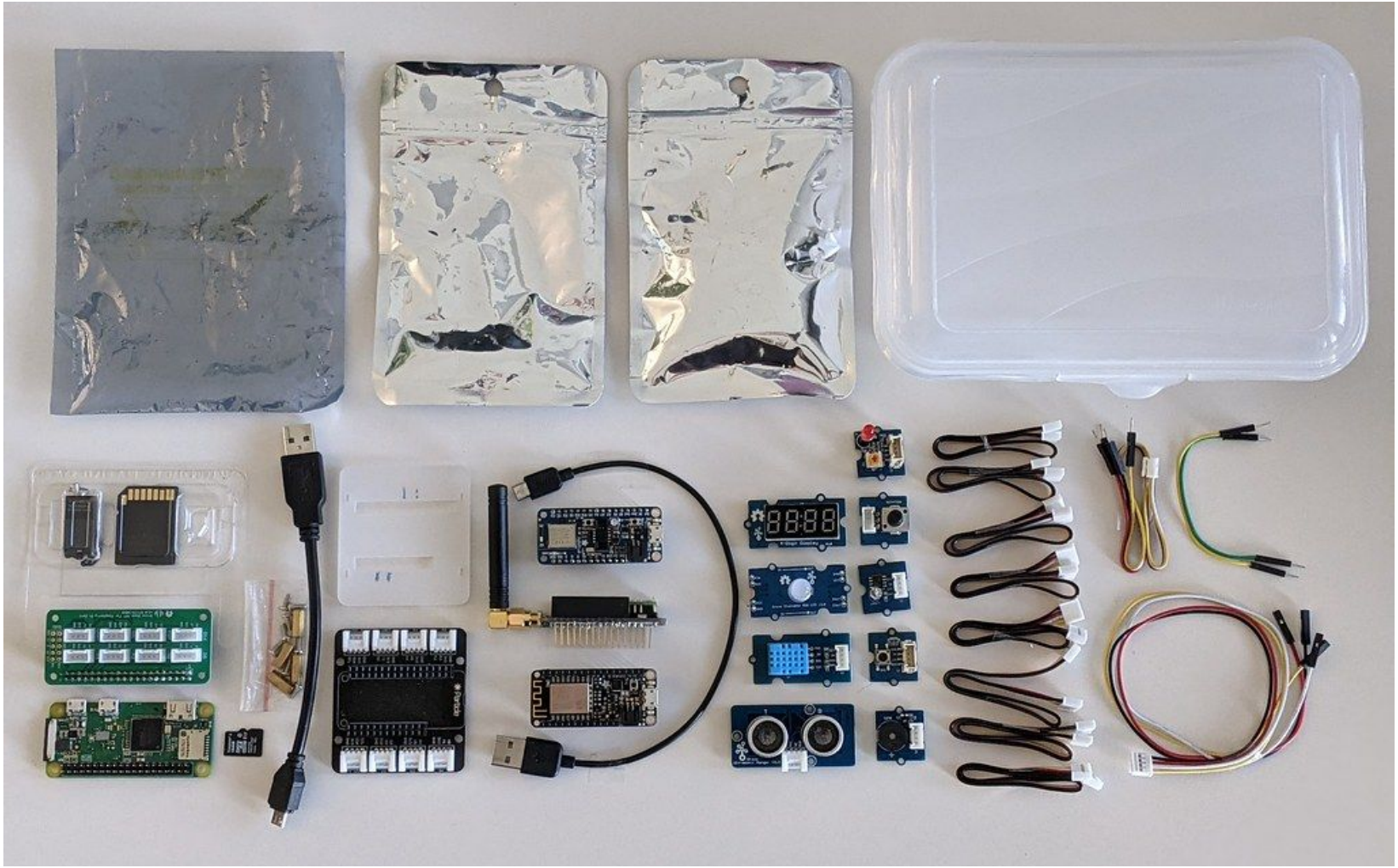
Simple tools, no "magic" => deep understanding.

Hardware

The course is based on the following hardware:

Raspberry Pi Zero W	Linux, I/O, Wi-Fi, BLE
Feather Huzzah ESP8266	Microcontroller, Wi-Fi
Feather nRF52840 Express	Microcontroller, BLE
FeatherWing RFM95W	Extension, LoRaWAN
Grove Sensors & Actuators	Plug & play

Why? Here's some background.



Logistics

The hardware will be lent* to you for the semester.

Handle electronics with care, touch edges only.

Do keep the silver protection packaging.

Please return the complete kit.

*To be returned after demo day.

Motivation

I'm highly motivated to provide the best experience.

Hardware takes a lot of trial and error to master.

If something does not work, try again, twice.

It's worth the effort, IoT is here to stay.

Feedback or questions?

Write me on Teams or email

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Thanks for your time.