

IoT Engineering

o: Syllabus

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(Unless noted otherwise)

Slides: tmb.gr/iot-o

Overview

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

What you can expect from this course.

What is expected from you.

Hello

Thomas Amberg ([@tamberg](#)), Software Engineer.

"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

Which modules did you finish already?

Which languages can you write code in?

Which semester are you in right now?

Reply here*: tmb.gr/iot-baseline

*Redirects to a Google Form, no login required.

Module *iot*

15 * 3 = 45 hours of lessons, including hands-on.

+ 13 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 2022 — class 5ibb1

19.09. Introduction to the Internet of Things

26.09. Microcontrollers, Sensors & Actuators

03.10. Sending Sensor Data to IoT Platforms

10.10. Internet Protocols, HTTP and CoAP

17.10. Local Connectivity with Bluetooth LE

24.10. Raspberry Pi as a Local IoT Gateway

31.10. Messaging Protocols and Data Formats

07.11. Long Range Connectivity with LoRaWAN

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Lessons 2022/23 — class 5ibb1 (ff.)

14.11.	Dashboards and Apps for Sensor Data	19.12.	From Prototype to Connected Product
21.11.	Rule Based Integration of IoT Devices	26.12.	No class
28.11.	Project week	02.01.	No class
05.12.	Voice Control for Connected Products	09.01.	Assessment
12.12.	Raspberry Pi as an IoT Edge Device	16.01.	Demo Day

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.

There is no Modulschlussprüfung (MSP).

Assessment

90 minutes, closed book, written assessment.

1 A4 sheet of handwritten notes allowed.

No other material (slides, books, ...).

No communication (phone, ...).

Here are example assessments: [FS19](#), [HS19](#), [HS21](#).

Team project

2 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.

Both 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](https://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.

*Return 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
thomas.amberg@fhnw.ch

Thanks for your time.