# Course Introduction

## Ambient intelligence

Fulvio Corno

Politecnico di Torino, 2018/2019

http://bit.ly/polito-ami

# Basic information

- Title: **Ambient Intelligence**

- Code: 01QZPxx

- Year: 3, Semester: 2

- Credits: 6

- Language: English (almost…)

http://bit.ly/polito-ami

*Tattoo this!*

# This is the Ambient Intelligence course

Ambient intelligence

# AmI is… Projects

Ambient Intelligence

# AmI is... Teams

# AmI is…Technology

# AmI is... Tools
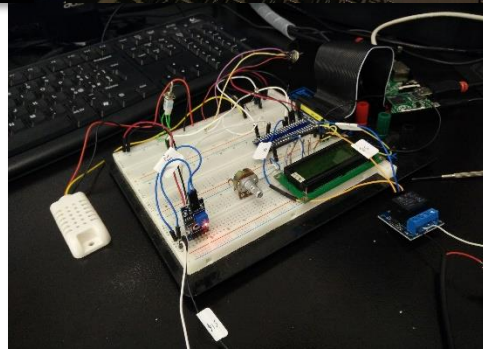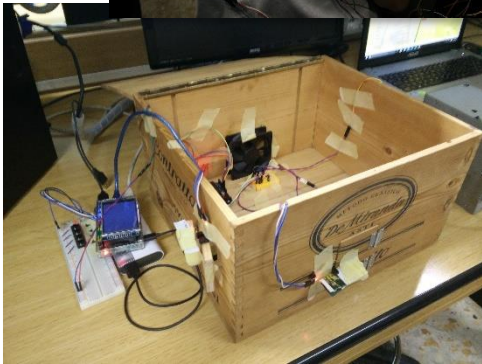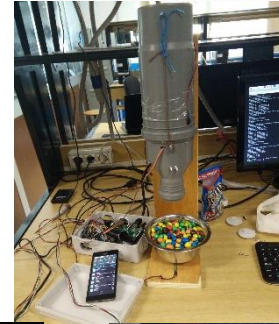
Ambient intelligence

# AmI is... Startups

Ambient intelligence
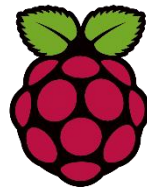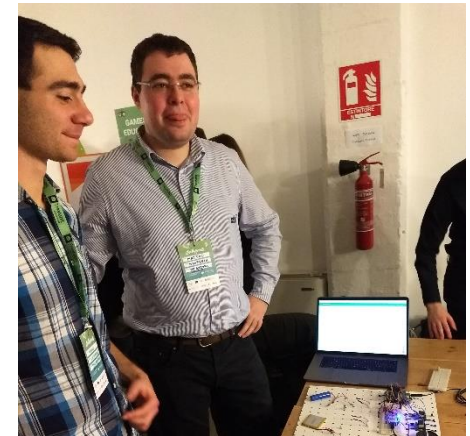
# AmI is... Outreach

# Summary

- Goals and contents

- Organization

- Resources

- Exam

- Previous projects and Showcase

Course Introduction

# GOALS AND CONTENTS

# Goals

- Designing and realizing environments that enrich the user experience and help householders in their activity

- Adopting a feature-driven design methodology, targeting open and reusable solutions

- Integrating existing devices and existing home- and building- automation systems (don't reinvent the wheel)

- Really building a (simple) working AmI system, in a multi-disciplinary team

# Definitions

- "An **Ambient Intelligence** system is a digital environment that proactively, but sensibly, supports people in their daily lives"

- "An **Intelligent Environment** is one in which the actions of numerous networked controllers (controlling different aspects of an environment) is orchestrated by self-programming pre-emptive processes (e.g., intelligent software agents) in such a way to create an interactive holistic functionality that enhances occupants experiences."

# Reference architecture

# Reference architecture

Ambient intelligence
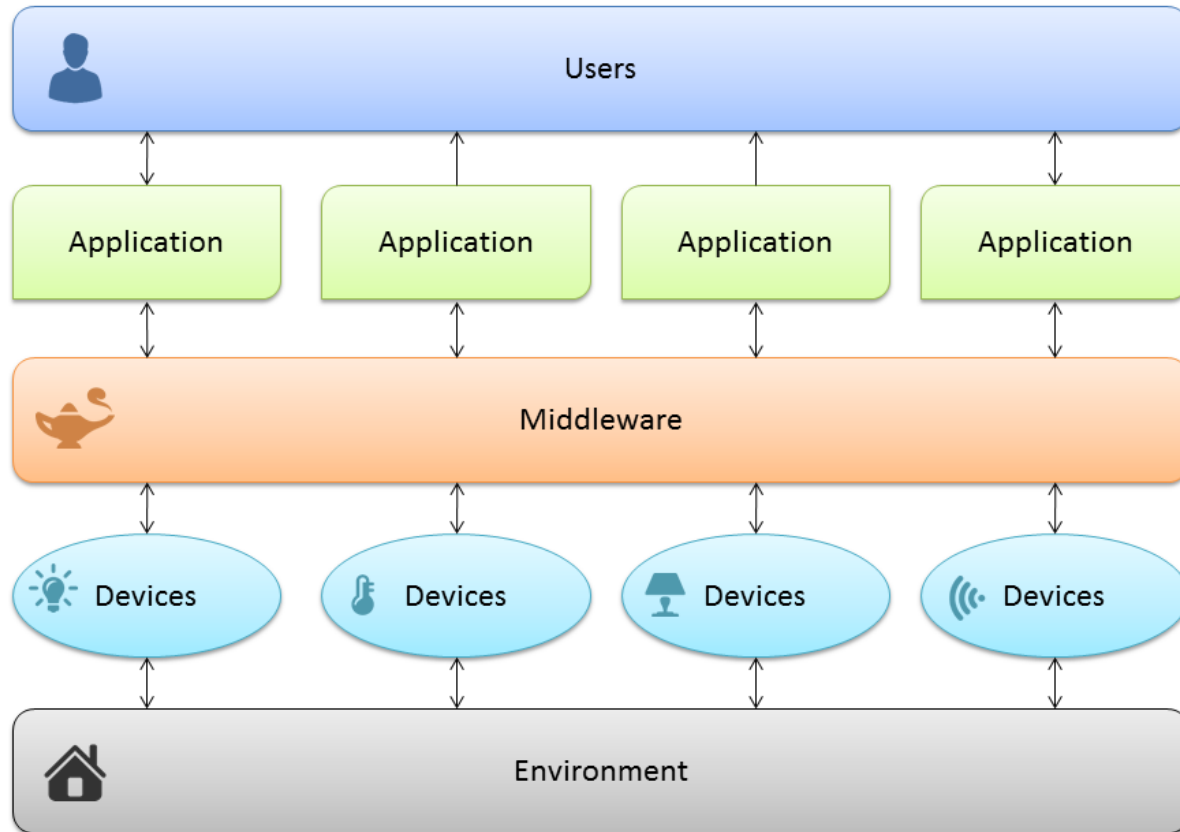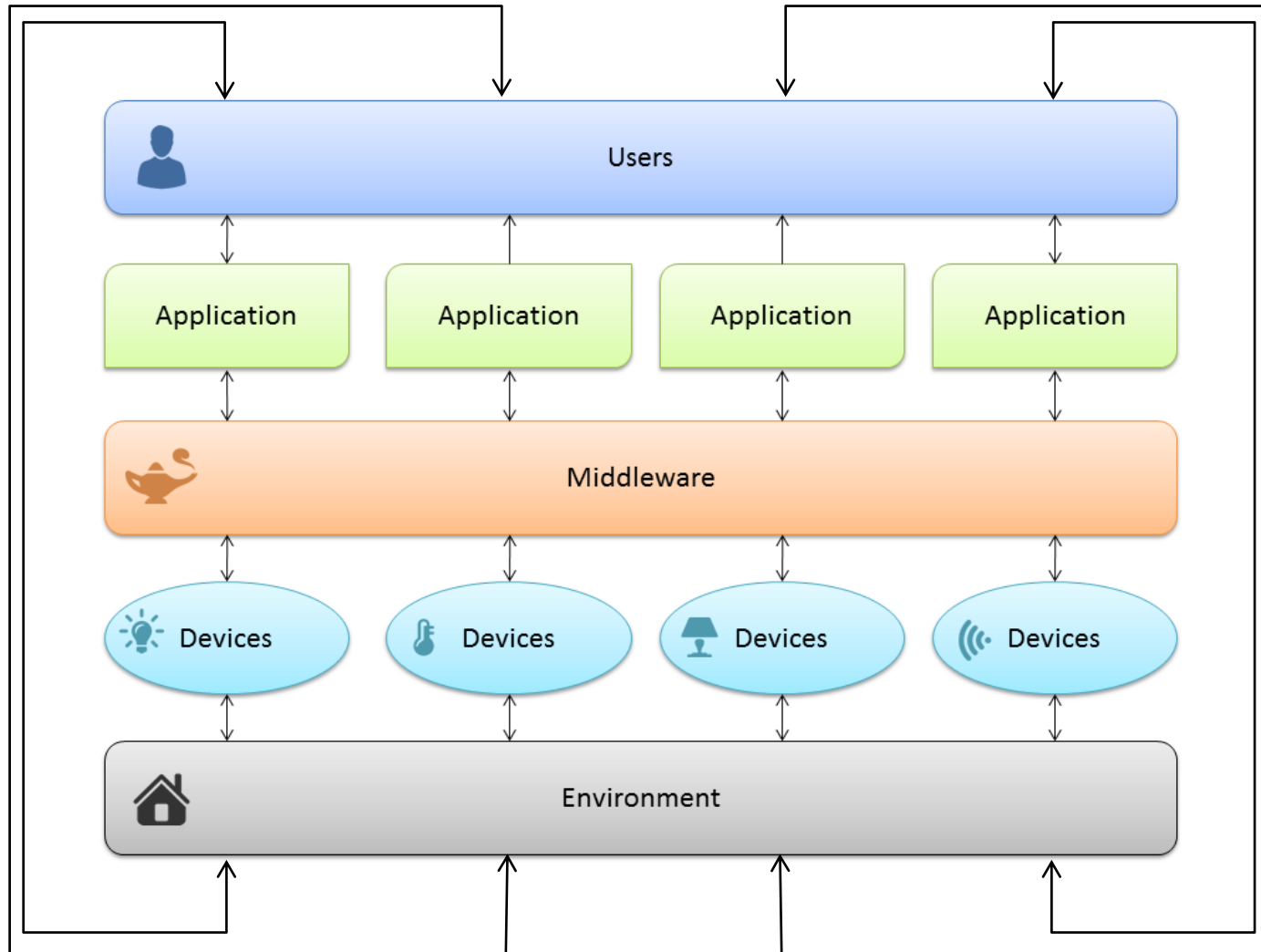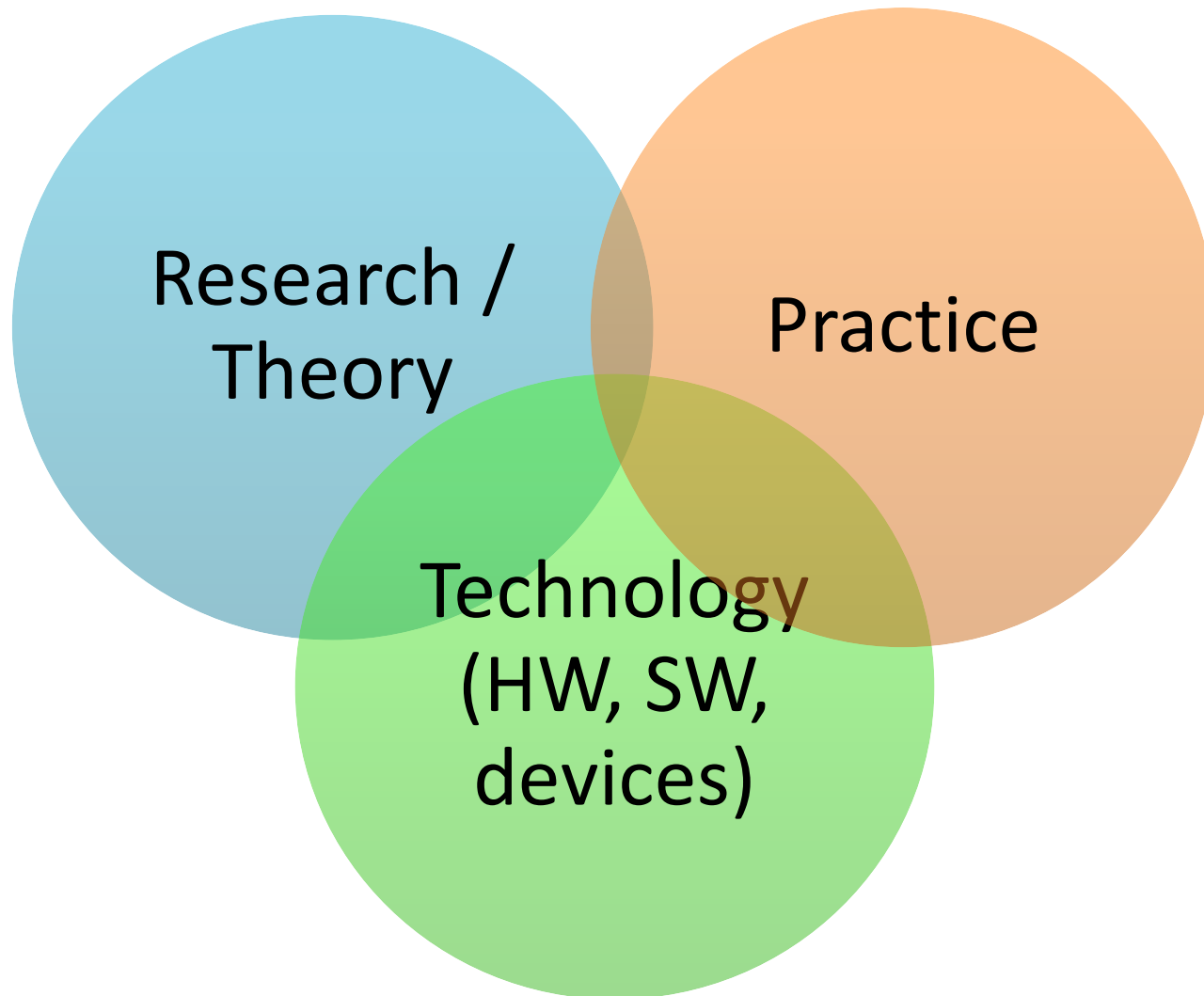
# Main contents

- AmI definitions, applications, systems: taxonomy and market overview

- Feature-driven design methodology

- Enabling technologies: Linux, hardware boards, Python, Web

- Some off-the-shelf automation technologies

- Rapid prototyping and development

- Group work (supervised and free)

# Approach



Research / Theory

Practice

Technology (HW, SW, devices)

# Approach

- Mix of
  - Theory
  - Technology overview
  - Practical information
  - Hands-on experience
  - Group work
  - Industry information
  - Application areas

- Main focus
  - Practical approach
  - Sound design methodology
  - Open and reusable solutions

- *Learning to design and build a (working) AmI solution*

Course Introduction

# ORGANIZATION

# Teachers

- Fulvio Corno <fulvio.corno@polito.it>

- Luigi De Russis <luigi.derussis@polito.it>

- Alberto Monge Roffarello <alberto.monge@polito.it>

- Politecnico di Torino, Dipartimento di Automatica e Informatica

- ~20 hours each, mixed Lecture / Exercise / Lab

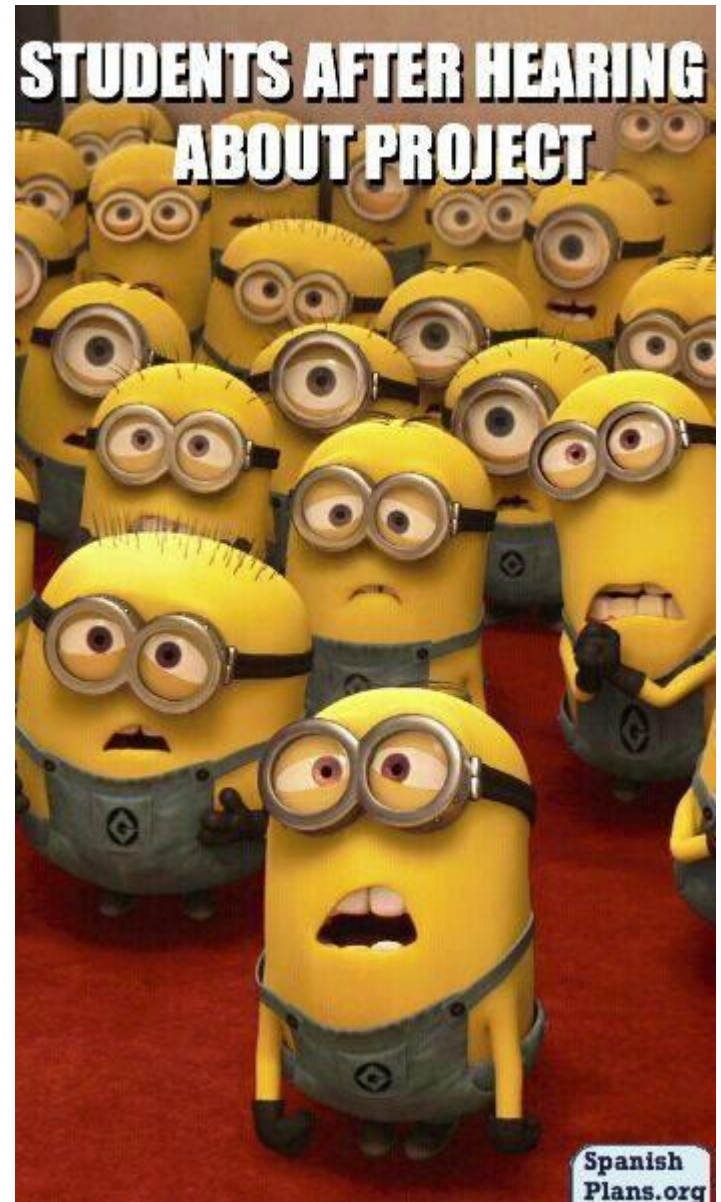# Schedule

- Monday
  - 14:30-16:00
    - LADISPE
    - Room 2I
  - 16:00-17:30
    - LADISPE
    - Room 2I

- Thursday
  - 17:30-19:00
    - Room 8I

> Updated week-by-week schedule with slides, readings, … on the course website ("Schedule" section)

# The Lab

- LADISPE

- Essential part of the course (the most important)

- Real smart home hardware and IoT devices

- 50% assigned exercises

- 50% supervised group work

- Group work

# The Skewed Schedule

| Week | Classes | Exercises | Group Work |
|------|---------|-----------|------------|
| 1 | 1 | | |
| 2 | 3 | | |
| 3 | 1 | 1 | 1 |
| 4 | 2 | 1 | |
| 5 | 2 | 1 | |
| 6 | 2 | 1 | |
| 7 | 1 | 2 | |
| 8 | 2 | 1 | |
| 9 | 2 | | 1 |
| 10 | 1 | 1 | 1 |
| 11 | 1 | | 2 |
| 12 | | 1 | 2 |
| 13 | | 1 | 2 |
| 14 | | 1 | 2 |

- Non-uniform distribution of hours
- Decreasing impact of classes
- Moving from Classes to Exercises (in class, in lab)
- Increasing time for supervised GW

# Students (about you…)

Ambient intelligence
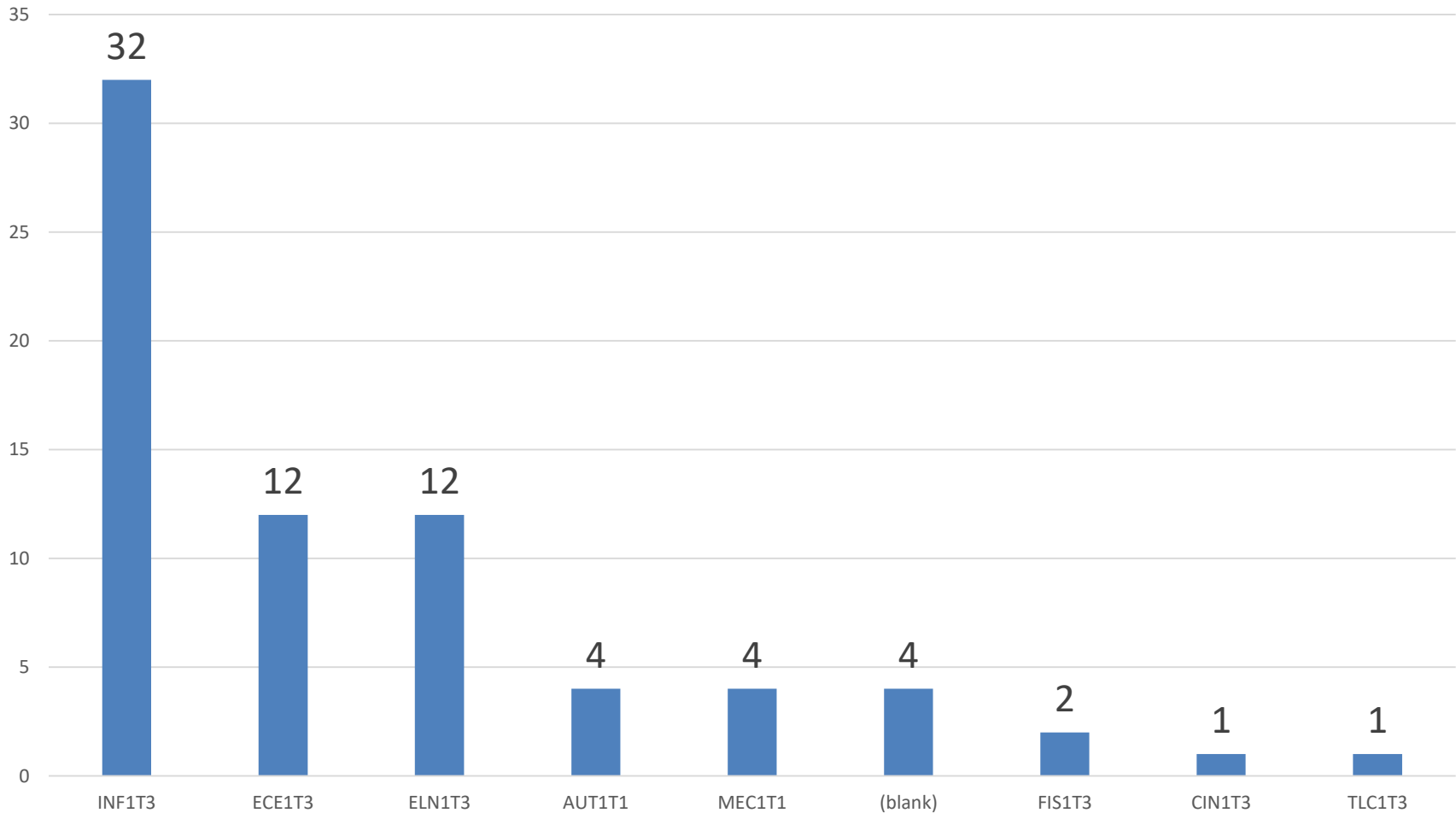
# Skills
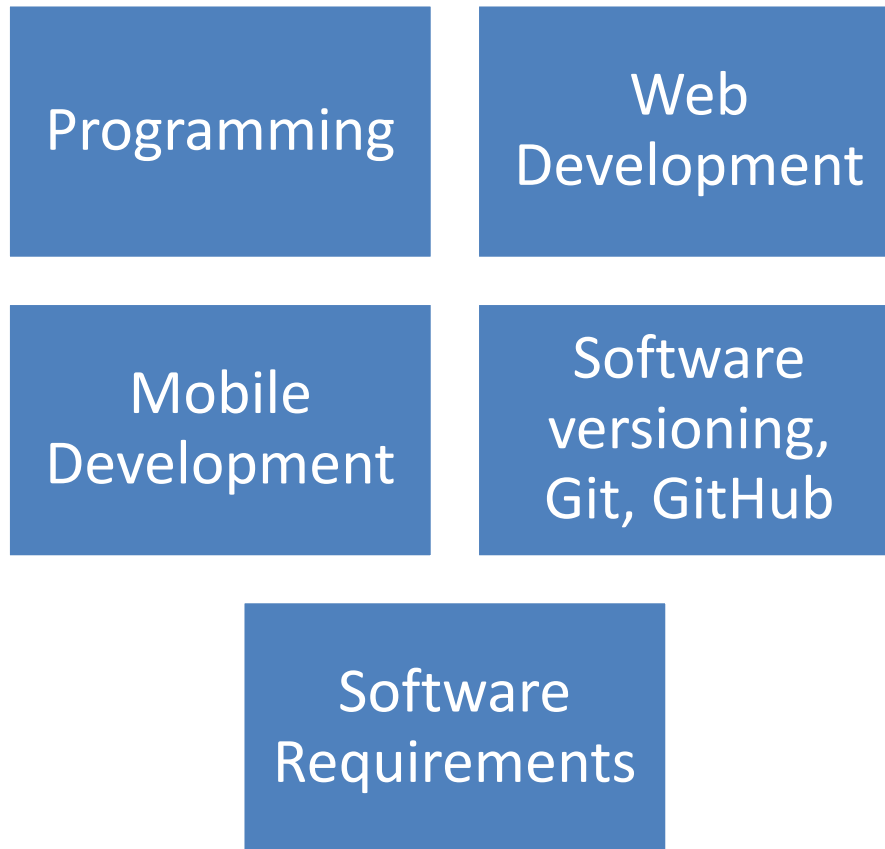
- How many of you are familiar with…?

| Programming | Web Development |
|---|---|
| Mobile Development | Software versioning, Git, GitHub |

Software Requirements

# Languages

- What languages are you familiar with?

| C | Java | HTML |
|---|------|------|
| Assembler | PHP | C++ |
| Python | JavaScript | C# |
| Bash | SQL | Matlab |
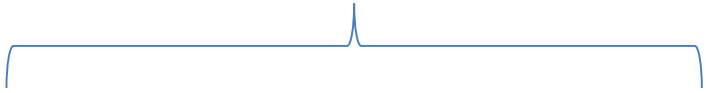
# Languages

- What languages are you familiar with?

| | | |
|---|---|---|
| C | Java | HTML |
| Assembler | PHP | C++ |
| Python | JavaScript | C# |
| Bash | SQL | Matlab |

# Don't worry... we'll get there

From initial survey

| Topic | Low (1-2) | Average (3) | High (4-5) | Projects |
|---|---|---|---|---|
| Programming (in general) | 13.21% | **41.51%** | 35.85% | 14/14 |
| Web Architectures | **58.49%** | 16.98% | 15.09% | 13/14 |
| Mobile development | **83.02%** | 3.77% | 3.77% | 8/14 |
| Source Control management | **86.79%** | 1.89% | 1.89% | 14/14 |
| Software requirements specification | **75.47%** | 11.32% | 3.77% | 14/14 |
| Python | **86.79%** | 0.00% | 3.77% | 14/14 |
| HTML/CSS | **67.92%** | 13.21% | 9.43% | 14/14 |
| JavaScript | **81.13%** | 5.66% | 3.77% | 12/14 |
| Java | **73.58%** | 11.32% | 5.66% | 8/14 |
| C | 13.21% | 18.87% | **58.49%** | 3/14 |

At exam-time

Course Introduction

# **RESOURCES**

# Course website

- http://bit.ly/polito-ami
- All lecture slides
- All exercise material (texts, solutions, examples, …)
- Required readings and deadlines
- Exams
- News and notices (official)
- Detailed (tentative) schedule
- Lecture video recordings
- Reference papers, links, …

# Additional on-line resources

- **Facebook** group, for open discussion and information exchange: https://www.facebook.com/groups/**polito.ami/**

- Video Lectures on **YouTube** https://www.youtube.com/playlist?list=PLqRTLlwsxDL_NpGpbp0dD5aI-tBXSxfiJ

- Collaboration on Google **Drive**

- Projects on **GitHub**: https://github.com/AmI-2019

- Communication with teachers and among groups via **Slack** App at https://polito-ami-2019.slack.com
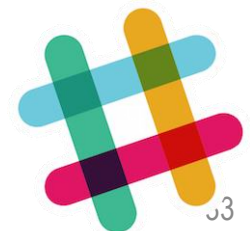
# Internal Communication

- All contacts with teachers **must** take place on **Slack**
  - e-mail messages will not be considered
- The **#general** channel is reserved to <u>official</u> communications by the teachers.
- The **#discussion** channel is for questions, requests, ideas, etc. by any student. Teachers will <u>read</u> and <u>respond</u>.
- The **#random** channel is for <u>free discussion</u> among students.
- Groups of students may create *private channels* for collaborating on their project

# Development

- All development (labs, projects, websites) on GitHub
  - Use it! Really! Continuously!
- Create a GitHub account
  - Choose a nickname that may last forever (don't use the "matricola" number)
  - Register with a @studenti.polito.it address, you may get free private repositories (request on https://education.github.com)
- Per-project repositories will be created in AmI-2019
  - If you need further repositories, please ask
- Always commit your intermediate work
- Will give a "reading" about git/GitHub

# Study material

- No suitable textbook for the whole course

- Teachers' slides
- Required readings
- Lecture videos

- Suggested books for some of the topics
- Suggested papers
- On-line technical documents

# Required software (cross-platform!)

- Python 3.6+ - https://www.python.org/downloads/
- Pycharm Professional - https://www.jetbrains.com/pycharm/
  - Register with your student e-mail for a free license
- Git - https://git-scm.com/
- MariaDB - http://mariadb.org/

➢ Bring your laptop to the classes!
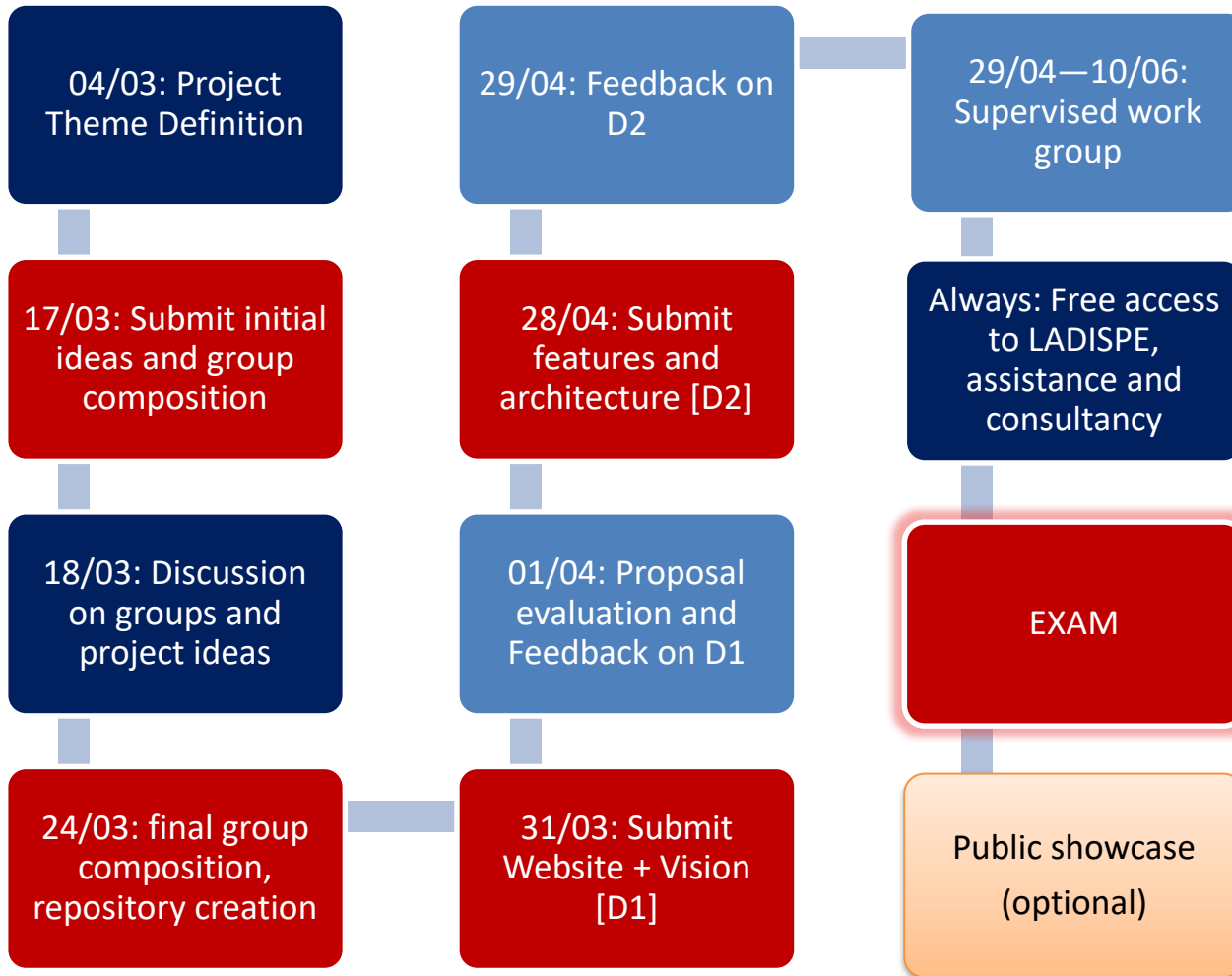
Course Introduction

# EXAM

# Goal and rationale

- The exam should assess the capability to design and develop some AmI functionality
- Multiple skills and disciplines are needed in the process
- The course is highly lab-intensive
- A sound design process must be coupled with the capacity to deliver a working system
- You are close to graduation
- Some of you need to return to their home universities

# Exam rules

- The **exam** consists in **the evaluation of the Group Work** that is assigned during the course
  - Documents uploaded on-line
  - Presentation given at the exam date
- Work groups must be formed at the beginning of the course
- Topics are proposed by the group and approved by the teachers
- Many lab hours are devoted to group work development
  - LADISPE may be used in additional hours
- Ideally, developed **during** the course

# Work Group Development Process



| | | |
|---|---|---|
| 04/03: Project Theme Definition | 29/04: Feedback on D2 | 29/04—10/06: Supervised work group |
| 17/03: Submit initial ideas and group composition | 28/04: Submit features and architecture [D2] | Always: Free access to LADISPE, assistance and consultancy |
| 18/03: Discussion on groups and project ideas | 01/04: Proposal evaluation and Feedback on D1 | EXAM |
| 24/03: final group composition, repository creation | 31/03: Submit Website + Vision [D1] | Public showcase (optional) |

# The exam (or, how to get 30+)

- Evaluation of documents (submitted in advance)
  - Project web site
    - Deliverable D1 (vision)
    - Deliverable D2 (features and architecture)
    - Presentation video
  - Project sources on GitHub

- Oral exam
  - Presentation + Demo (20 minutes)
  - Discussion (5 minutes)

- Individual contribution must emerge from the presentation

# First steps

- Identify a Working Group (WG)
  - 3 or 4 students
  - Possibly, with mixed skills
  - Avoid all-non-programmers groups
- Start developing ideas
  - The first two weeks' classes will give you suggestions, seeds, pointers, …
  - Interact with the teachers

# Tips and suggestions

- Start sooner than later
  - Really!
- Don't aim too high
  - Modular features
- Seek interaction
  - Ask for feedback and suggestion
  - ...and listen to them
- Exploit the LAB hours
  - Proposed labs, Supervised WG, Free hours, ...

Course Introduction

# PROJECT EXAMPLES

# Past projects

| Year | Theme | URL |
|---|---|---|
| 2015 | Smart "Cittadella Politecnica" (smart university campus) | https://ami-2015.github.io/ |
| 2016 | Health and Well-Being | https://ami-2016.github.io/ |
| 2017 | Sustainability | https://ami-2017.github.io/ |
| 2018 | Living Spaces | https://ami-2018.github.io/ |

# 2017 showcase



**AmIcook**

Whenever you are hungry, with AmIcook you can easily organize a meal or join one. It will count how many partecipants will attend the meal, furthermore it will decide and dispense the optimal amount of ingredients needed for the pasta.
Then, it controls the stove and notifies the users when the meal is ready.

Authors:
Samuele Battaglino
Davide Cota
Roberto Monelli
Arian Nowbahari

Implemented with:
Arduino Uno, sensors, a stepper motor, a smart plug, a server and an Android App

Cook automatically pasta, shared meals, save food, save time

https://ami-2017.github.io/AmIcook/

POLITECNICO DI TORINO
Dipartimento di Automatica e Informatica
Ambient Intelligence Student Showcase 2017
http://bit.ly/polito-ami
Treatabit powered by I3P



**NICE Bins**

Waste production is constantly increasing in urban areas, leading to waste abandon and untidy neighborhoods. NICE Bins makes the habit of waste classification easier and fun for residents and allows faster notification of waste abandon.

Chen Yun
Ma Qiang
Medina Francesco
Seijas P. Xileny
Zafar Taha

Arduino, Raspberry Pi, Alexa API

waste, classification, speaking bins

https://ami-2017.github.io/NICE-bins/

POLITECNICO DI TORINO
Dipartimento di Automatica e Informatica
Ambient Intelligence Student Showcase 2017
http://bit.ly/polito-ami
Treatabit powered by I3P

# 2017 showcase

# 2016 showcase winners



**Safety Mama**

SafetyMama helps women to attain a peaceful pregnancy. It collects and monitors data pertaining to their phisical well-being and tries to make them feel unstressed. She receives notification about her stress status and daily activity through a mobile application. If she is stressed, and at home, the Home Relaxation System starts automatically.

Lorenzo Meli
Maurizio Pinna
Gianna Pistillo
Marco Viadana

Adopted tecnologies
Raspberry Pi+RaZberry
Z-Wave
Philips Hue Lamp
Android Application

Keywords:
Stress Detection, Automatic presence recognition, Daily steps' control

http://ami-2016.github.io/SMa/

POLITECNICO DI TORINO
Dipartimento di Automatica e Informatica
Ambient Intelligence
Student Showcase 2016
http://bit.ly/polito-ami
Treatabit powered by I3P



**Emergency Quest**

Description
The goal of the EQ is to give support to people with a disease like dementia or Alzheimer, making them able to continue living at home by themselves

Giovanni C. Monna
Stefano Codazzo
Itzel Barreto

relaxing process

avoiding dangerous situations with prerecorded messages

notification on perimeter trespassing

Adopted technologies

Keywords: room station ▪ bracelet ▪ caregiver ▪ map ▪ notifications ▪ agitation detection ▪ mobile application

https://ami-2016.github.io/EQ/

POLITECNICO DI TORINO
Dipartimento di Automatica e Informatica
Ambient Intelligence
Student Showcase 2016
http://bit.ly/polito-ami
Treatabit powered by I3P



**Study Station**

*Study Station* is a system thought as a *wearable device* that avoids health issues caused by wrong postures maintained over time. Benefits interest all users that want to keep the body relaxed even after long periods of sitting.

Giacomo Borraccini
Gabriele Ciravegna
Fabio Cofano
Andrea Coluccio

Adopted technologies
Arduino
Accelerometers
Light Sensor

General Behavior

Keywords: Study Station Project, wearable technology, wearable device, Health and Well-Being, Biomedical

http://ami-2016.github.io/StSt/

POLITECNICO DI TORINO
Dipartimento di Automatica e Informatica
Ambient Intelligence
Student Showcase 2016
http://bit.ly/polito-ami
Treatabit powered by I3P

# 2015 showcase winners



**MARCO POLI** — Student Showcase

Description
Giving everyone the opportunity to enhance their own campus experience is our mission. With MarcoPoli, students receive smart suggestions about the best places where to go. Moreover, stakeholders can monitor and gather statistics about the whole structure, or they can get sponsored on the platform. Avoid stress, avoid chaos: embrace MarcoPoli!

Riccardo Cappuzzo
Roberto Marturano
Luca Mezzatesta

Adopted technologies
HTML5, jQuery, JavaScript, CSS3, RaspberryPi

Keywords: crowd detection • temperature • noise • maps • smart • responsive • place finder • expandable • adaptable

http://ami-2015.github.io/MarcoPoli

Ambient Intelligence: technology and design 2015 edition
http://bit.ly/polito-ami
POLITECNICO DI TORINO — Dipartimento di Automatica e Informatica
TreataBit

---

**Well Cleaned** — Student Showcase

Description
W.C. is a mobile application that allows users to check on the Politecnico map where all the bathrooms are located and to see their condition in terms of toilet paper, trash and soap.

Alessandro Gaballo
Christian Palmiero
Eugenia Spano
Federico Fallace

Adopted technologies
Proximity sensors
Raspberry Pi 2
Phonegap
Google Maps APIs

Keywords: campus map, real time information, bathroom, student, cleaning staff member, notification, schedule

http://ami-2015.github.io/well-cleaned

Ambient Intelligence: technology and design 2015 edition
http://bit.ly/polito-ami
POLITECNICO DI TORINO — Dipartimento di Automatica e Informatica
TreataBit

---

**MyBikePlace** — Student Showcase

Description
MyBikePlace is a bike-parking managing system able to communicate with users through a dedicated mobile app. It suggests comfortable places for your bikes and protects them.

Marco Cornelio
Michele di Girolamo
Tommaso Laterza
Damian Maiorano

Adopted technologies
Raspberry
Android OS
MySQL
Pressure sensors
GPS localization
NFC detection

Keywords: efficient environment, safer bike-parking, tool-free

http://ami-2015.github.io/MyBP

Ambient Intelligence: technology and design 2015 edition
http://bit.ly/polito-ami
POLITECNICO DI TORINO — Dipartimento di Automatica e Informatica
TreataBit

# Ambient Intelligence?

| Project | Sensitive | Responsive | Adaptive | Transparent | Ubiquitous | Intelligent |
|---|---|---|---|---|---|---|
| EasyPark | ** | *** | * | *** | ** | * |
| ItsYourTurn | *** | ** | ** | *** | * | ** |
| MarcoPoli | *** | ** | *** | *** | *** | ** |
| MyBikePlace | ** | * | * | ** | ** | * |
| NeverLate | ** | ** | ** | *** | *** | ** |
| NoNoise | ** | * | * | *** | ** | * |
| Smart Make Your Bag | ** | * | *** | ** | ** | * |
| SmartClassSchedule | * | * | ** | ** | *** | ** |
| TrackDown | *** | ** | ** | ** | *** | ** |
| WC Info | ** | * | * | *** | * | * |
| Well Cleaned | *** | ** | ** | *** | * | ** |
| Adaptive Online Radio | ** | *** | *** | *** | ** | * |
| MyGuide | ** | ** | * | ** | * | * |
| PoliRoute | * | *** | *** | ** | *** | ** |

# Questions?

**01QZP AMBIENT INTELLIGENCE**

Fulvio Corno

fulvio.corno@polito.it

# References

- "Intelligent Environments: A manifesto", Augusto et al., *Human-centric Computing and Information Sciences* 2013, 3:12, http://www.hcis-journal.com/content/3/1/12

# License