



POLITECNICO
DI TORINO



e-Lite

Course Introduction

Ambient intelligence

Fulvio Corno

Politecnico di Torino, 2017/2018



<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

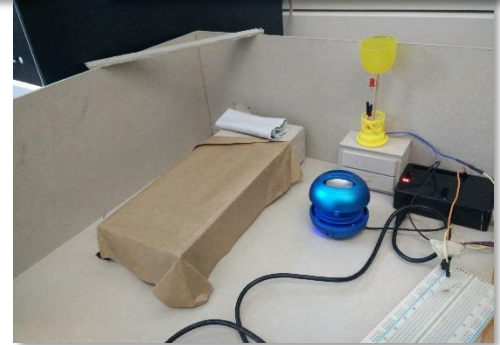
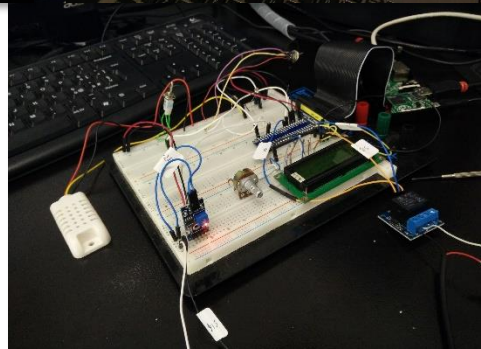
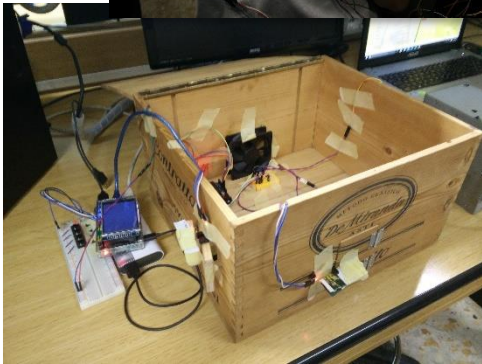
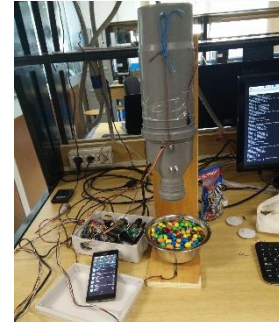
Aml is... Projects



Aml is... Teams



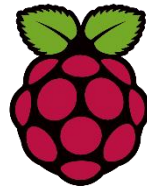
Aml is...Technology



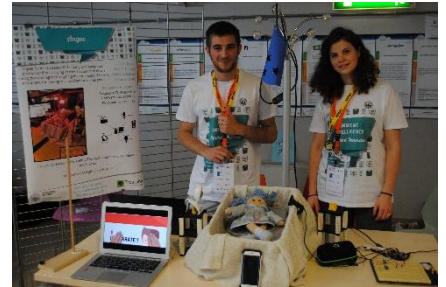
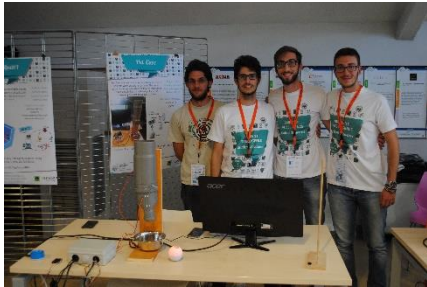
2017/2018

Ambient intelligence

Aml is... Tools



Aml is... Showcase



Aml is... Startups



Aml is... Outreach



Summary

- Goals and contents
- Organization
- Resources
- Exam
- Previous projects and Showcase



Course Introduction

GOALS AND CONTENTS

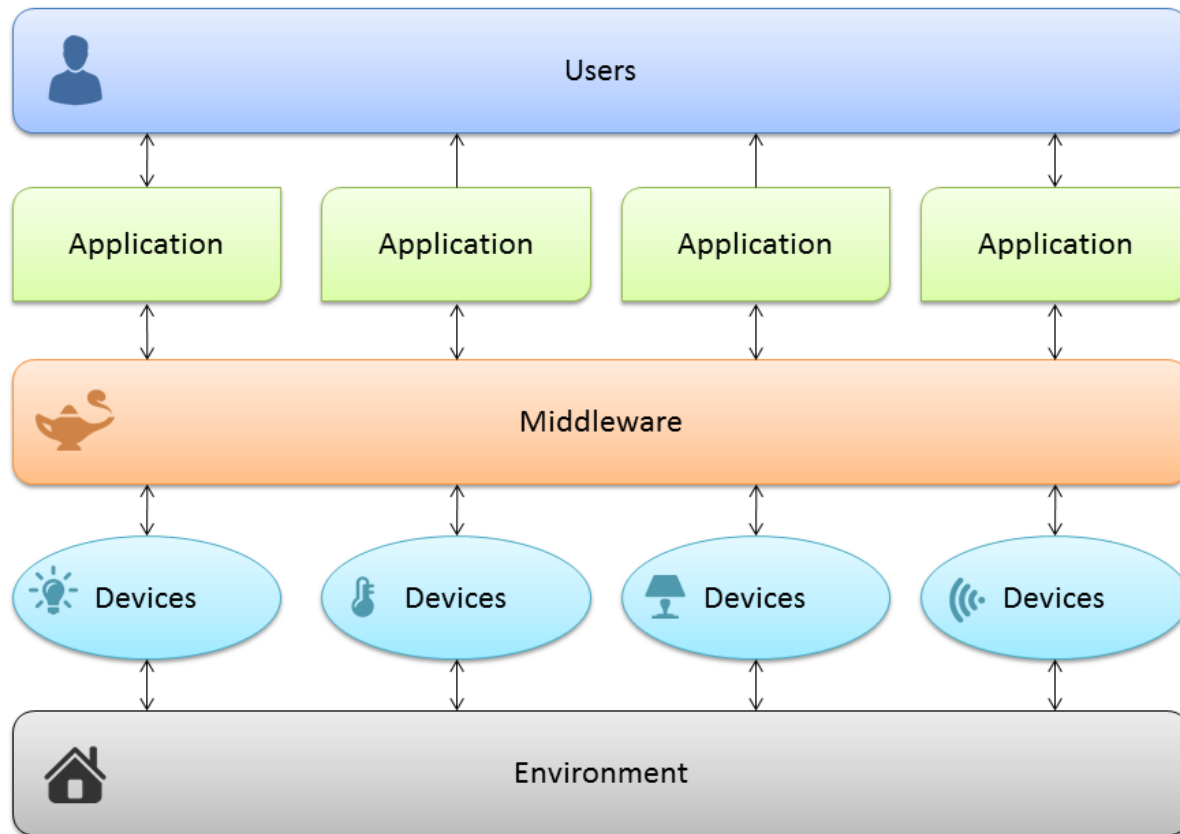
Goals

- 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 Aml system, in a multi-disciplinary team

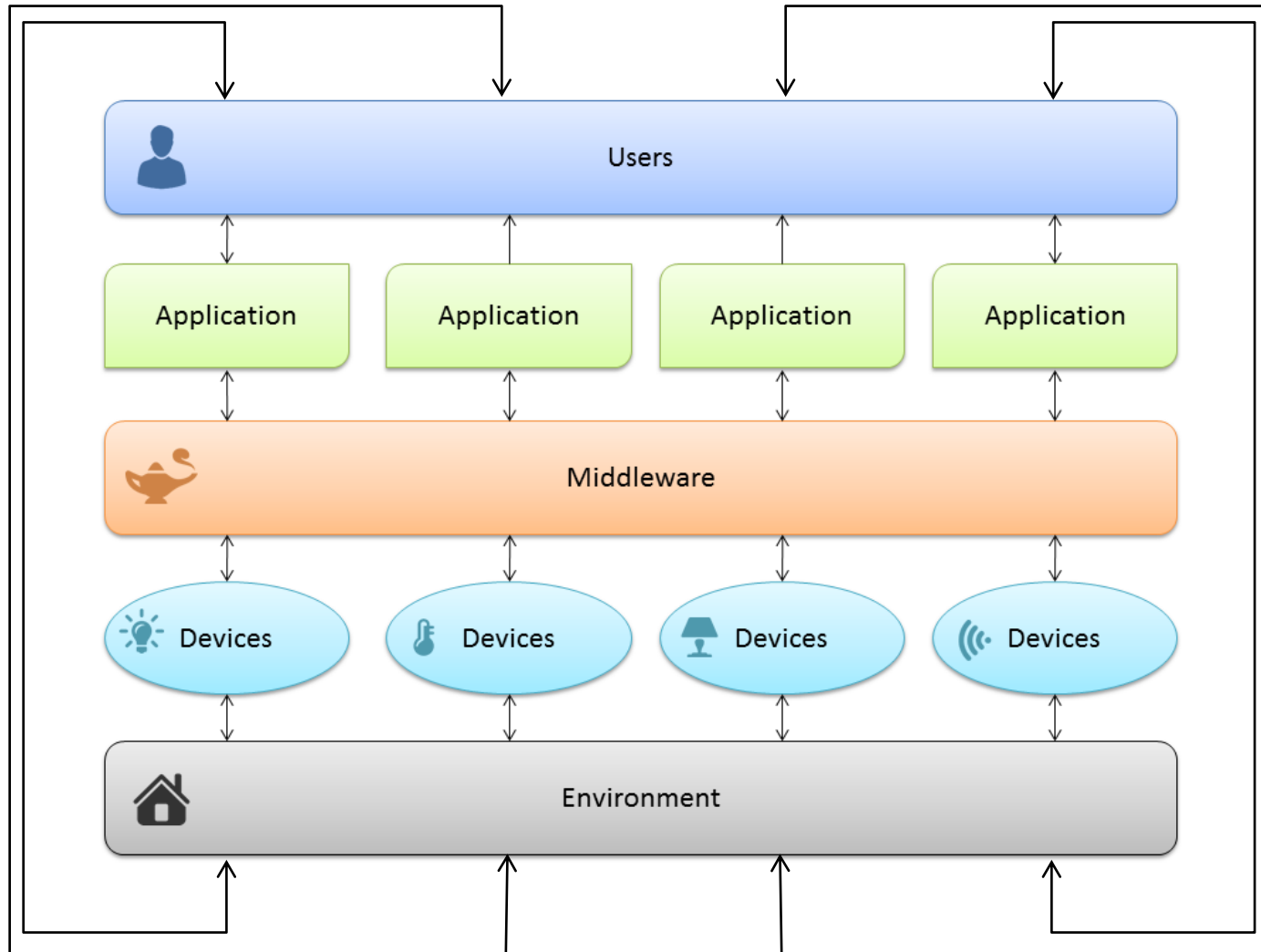
Definitions

- “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



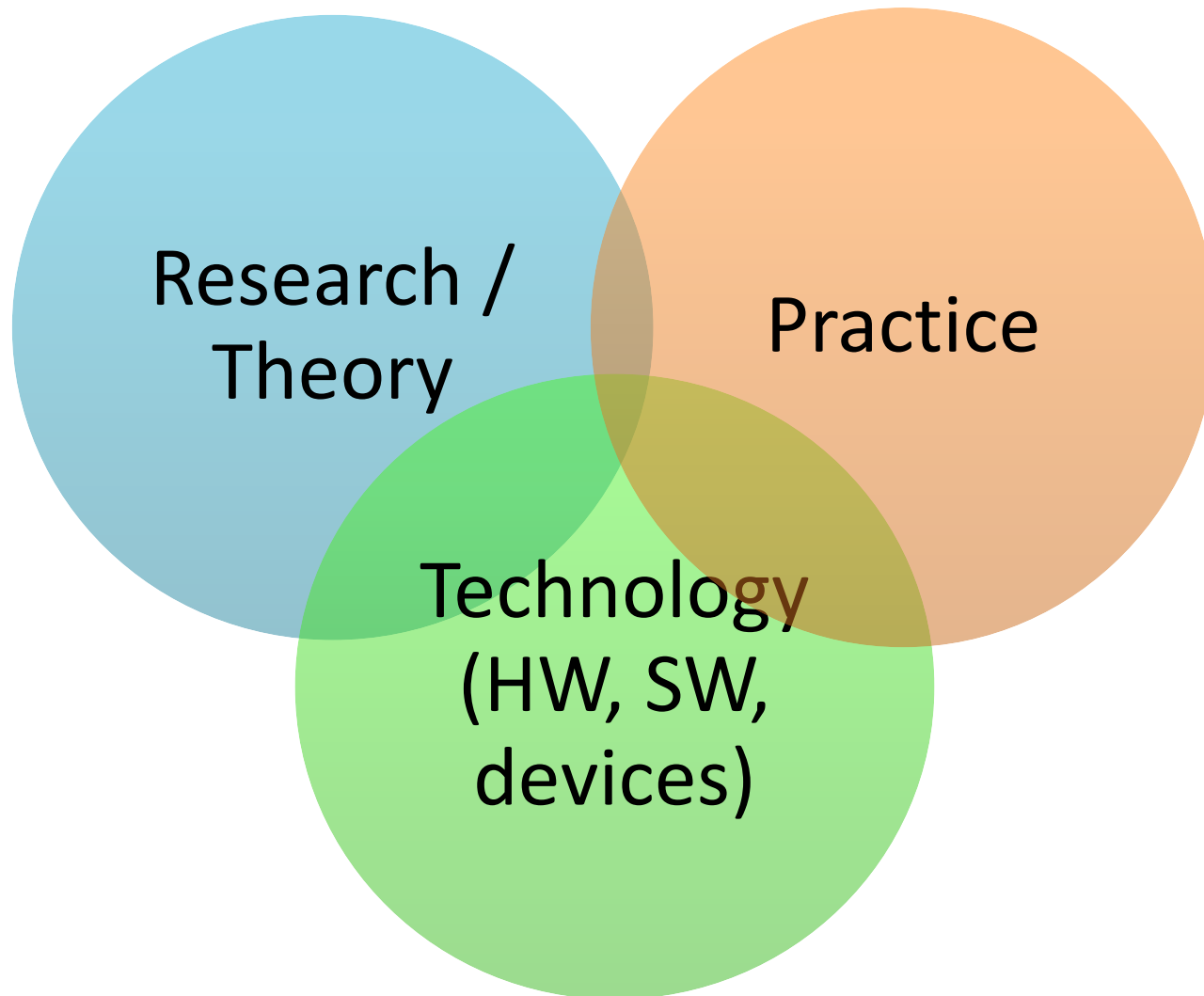
Reference architecture



Main contents

- Aml 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



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) Aml 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

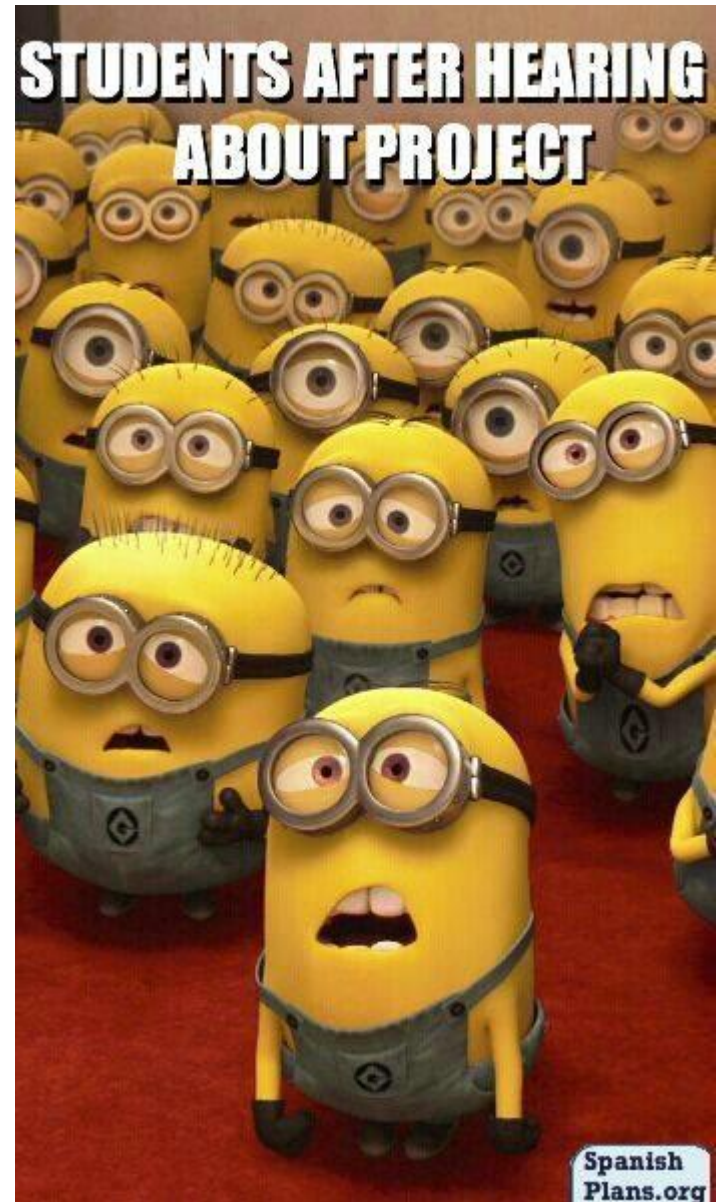
- Monday
 - 14:30-16:00
 - LADISPE
 - Room 8l
 - 16:00-17:30
 - LADISPE
 - Room 8l
- Thursday
 - 17:30-19:00
 - Room 8l

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



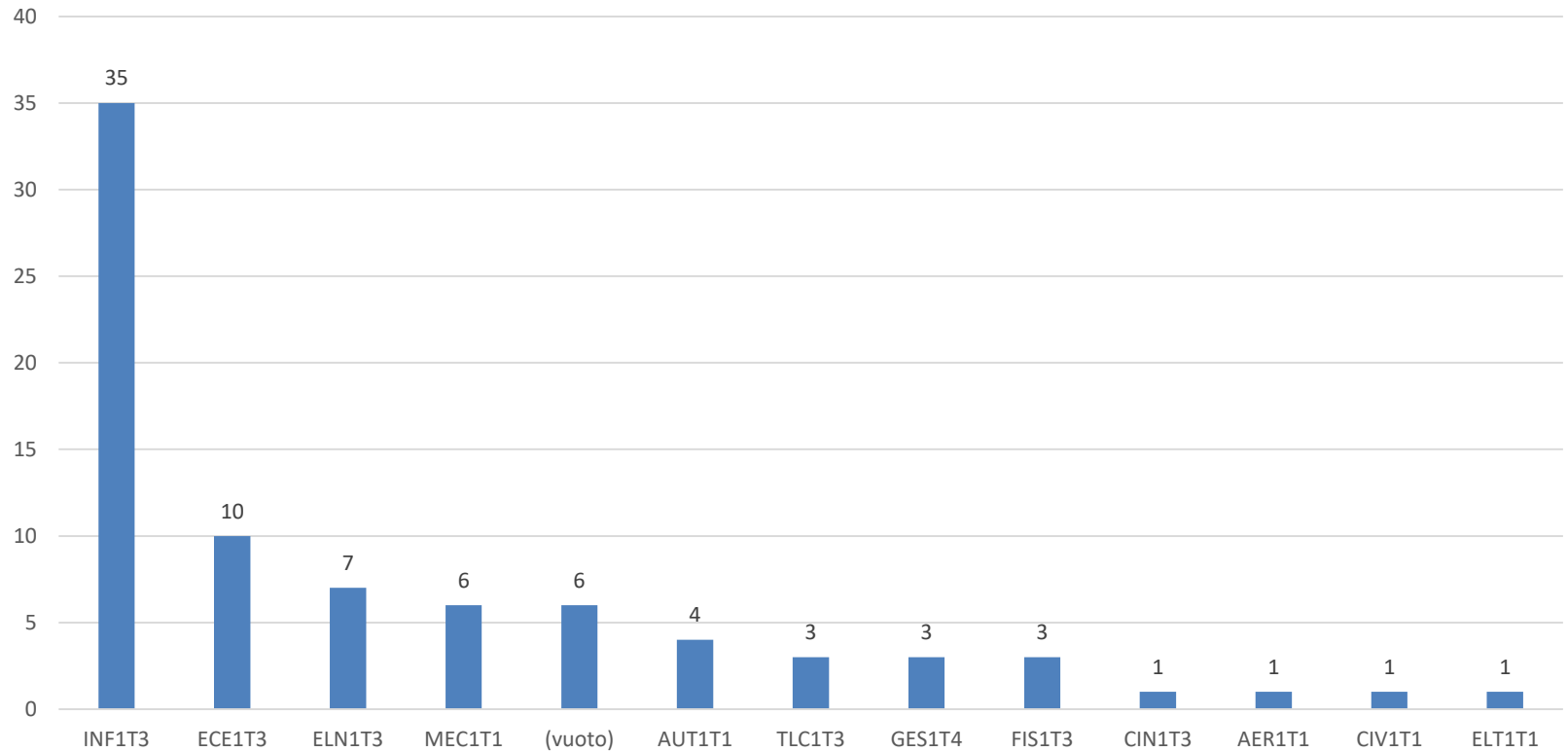
The Skewed Schedule



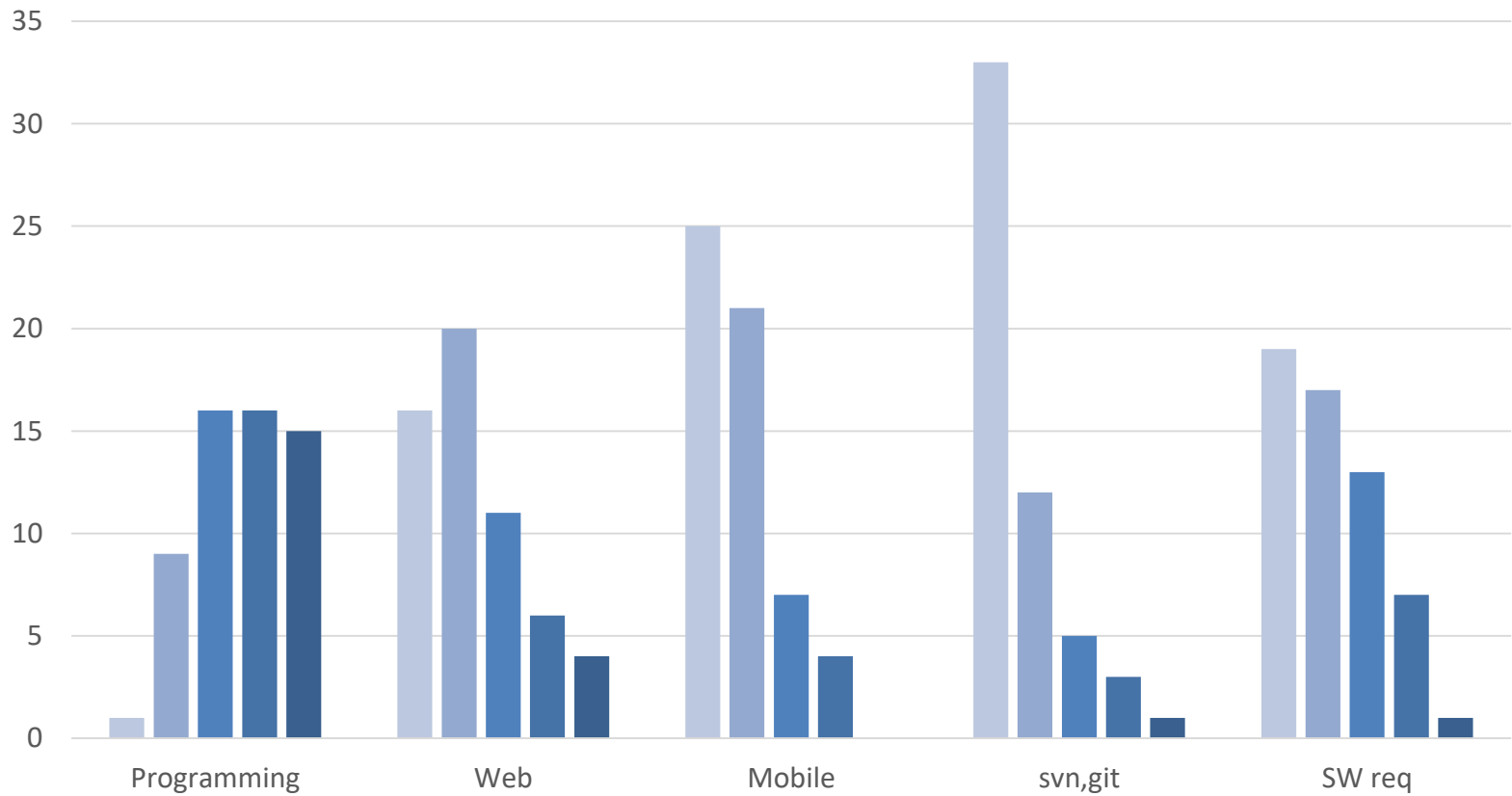
Week	Classes	Exercises	Group Work
1	1		
2	3		
3	1	1	1
4	2	1	
5	2	1	
6	2	1	
7	1	2	
8	2	1	
9	2		1
10	1	1	1
11	1		2
12		1	2
13		1	2
14		1	2

- 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...)

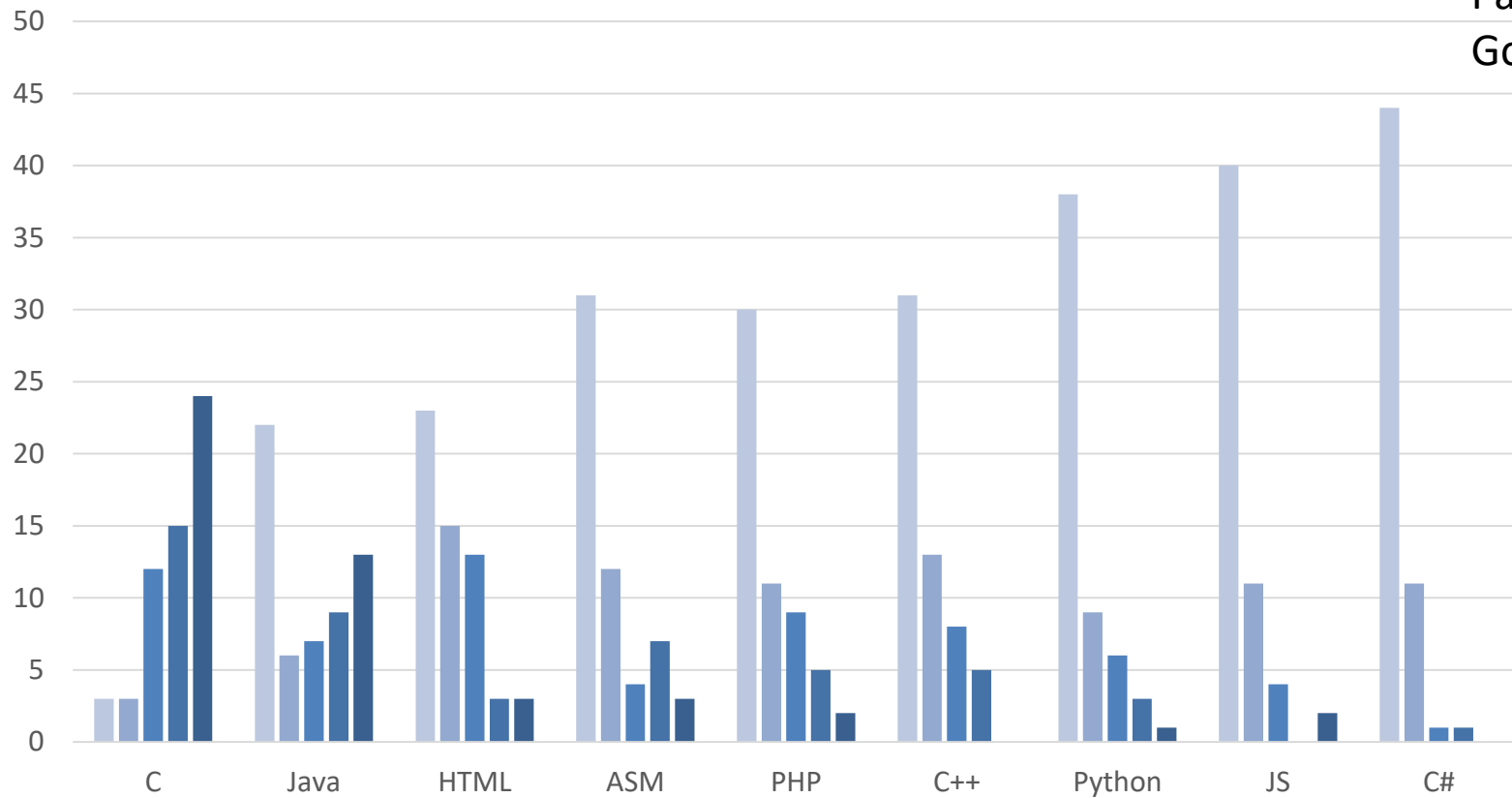


Skills



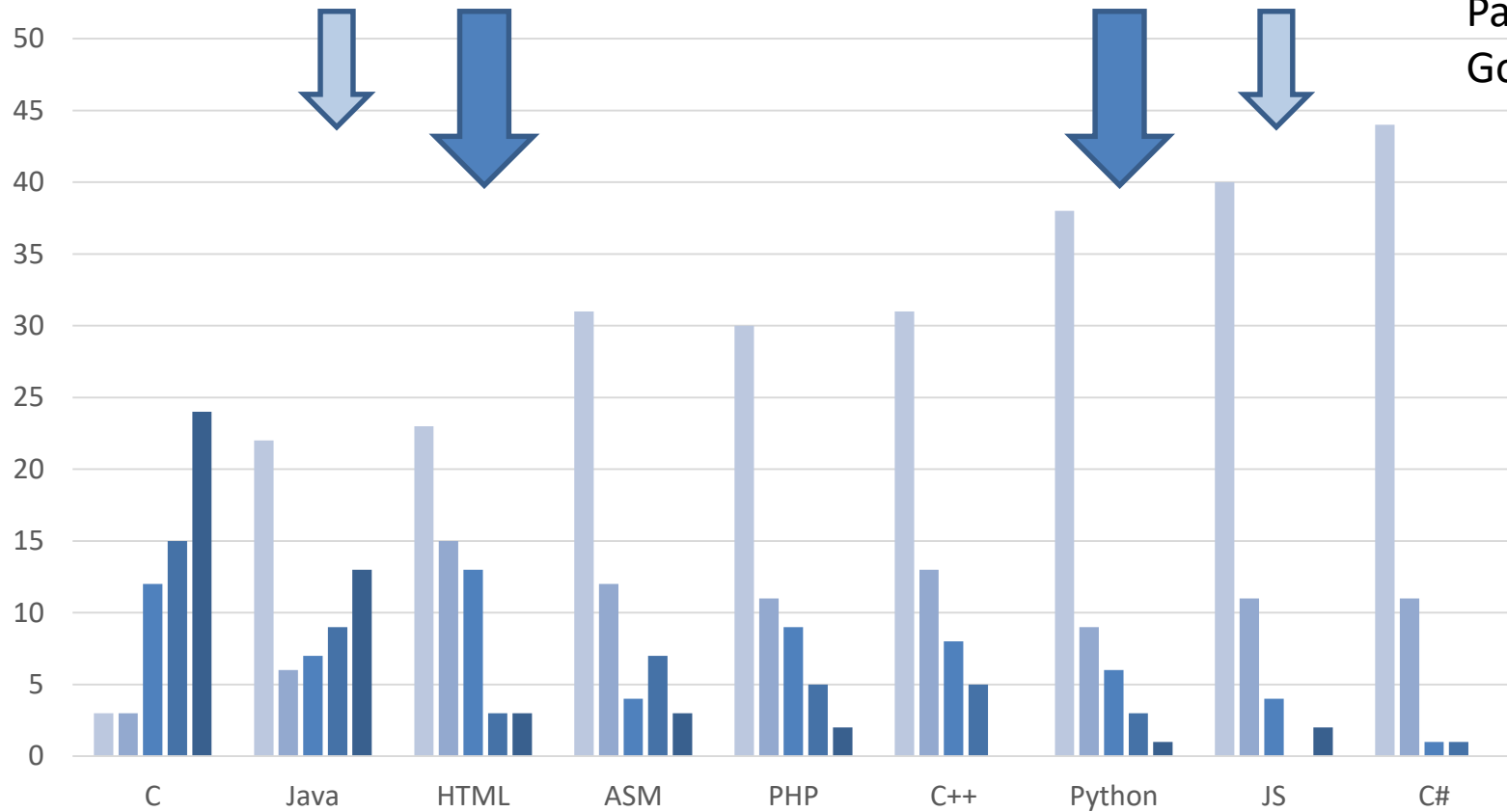
Languages

Others:
SQL, Bash,
Matlab, Awk,
Kotlin, VB,
Pascal, Ruby,
Go, Perl



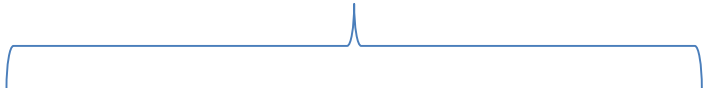
Languages

Others:
SQL, Bash,
Matlab, Awk,
Kotlin, VB,
Pascal, Ruby,
Go, Perl



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

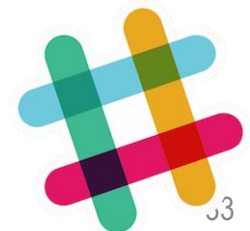
RESOURCES

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=PLqRTLlwsxDL8fUcY2Y54sITILyJcTySpC>
- Collaboration on **Google Drive**
- Projects on **GitHub**:
<https://github.com/Aml-2018>
- Communication with teachers and among groups via **Slack App** at <https://polito-ami-2018.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 official communications by the teachers.
- The **#discussion** channel is for questions, requests, ideas, etc. by any student. Teachers will read and respond.
- The **#random** channel is for free discussion 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 Aml-2018
 - 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
- Requested 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

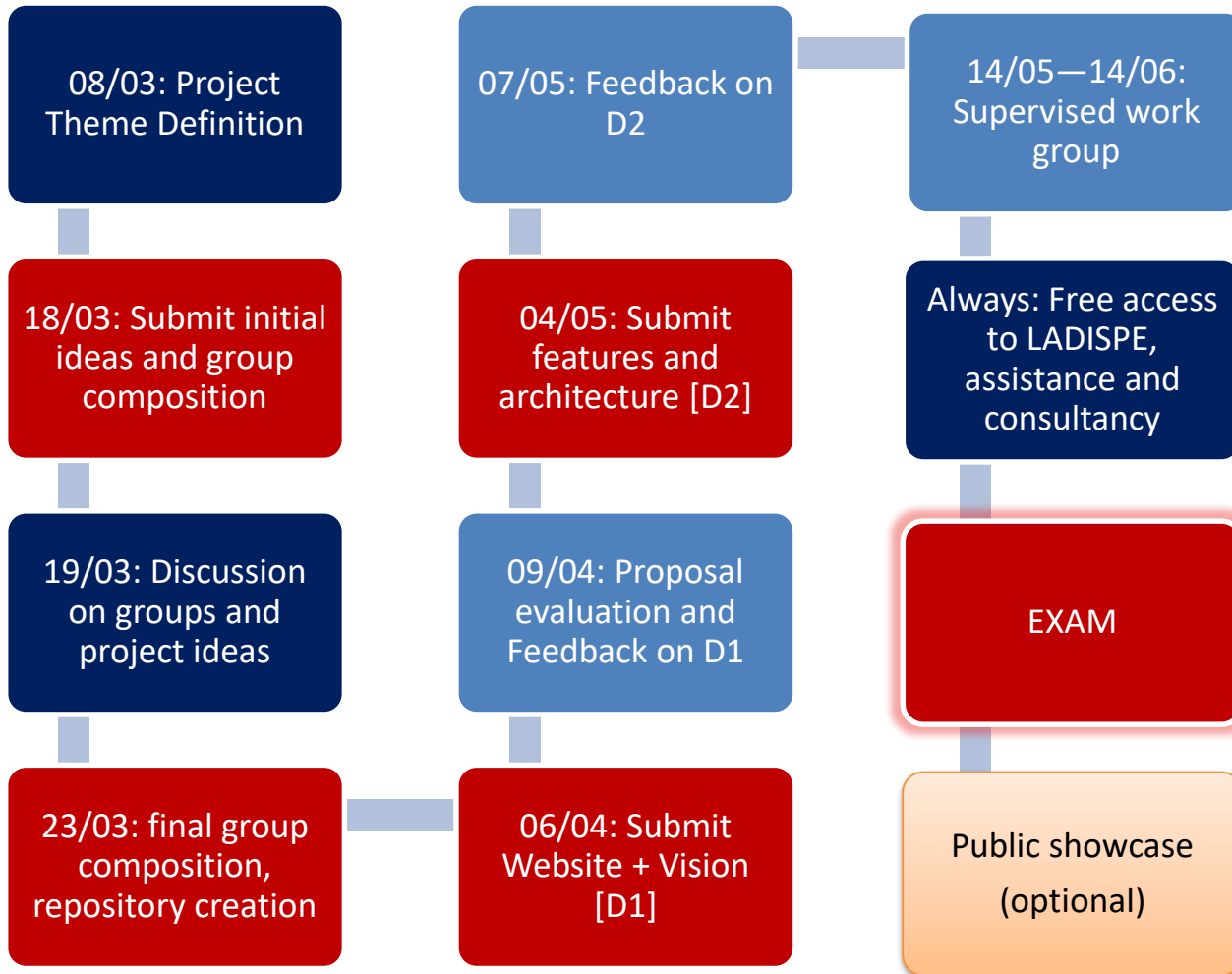
Goal and rationale

- The exam should assess the capability to design and develop some Aml 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



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/

2017 showcase



Amlcook

Whenever you are hungry, with Amlcook you can easily organize a meal or join one. It will count how many participants 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/Amlcook/>



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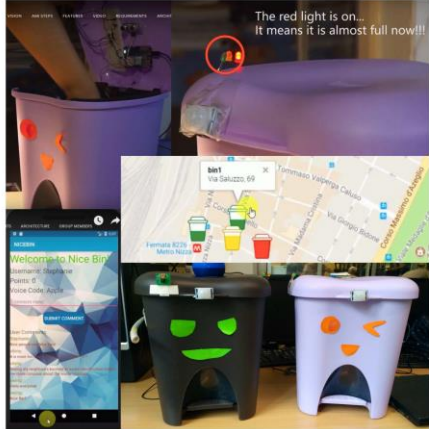
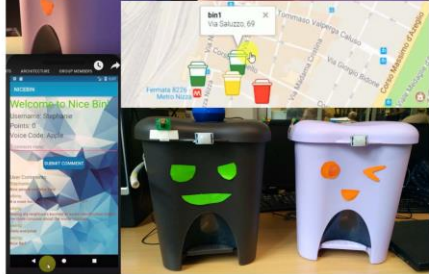
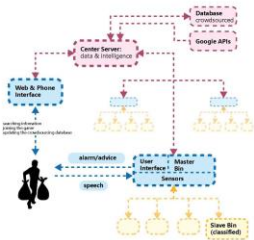


NICE Bins

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/>



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2017 showcase

The Battery Drive-in

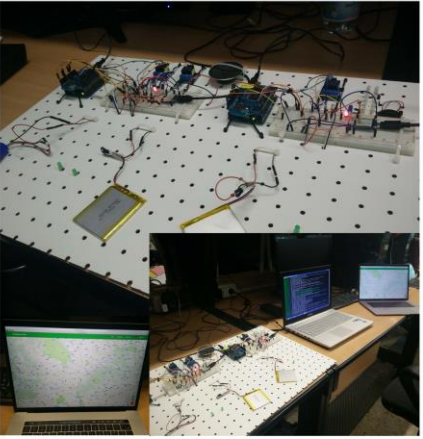
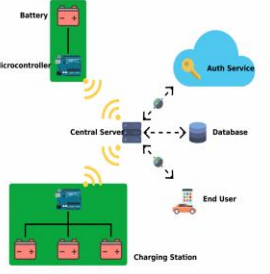
Price limitations? Limited life? Long charging process?

Why not switching Electric Vehicles batteries up?

Paolo Notaro
Matteo Manfredi
Simone Longobardi


Adopted technologies

- Arduino
- Raspberry Pi
- Li-ion battery
- Python


Electric Vehicles - Sustainability - Ambient Intelligence - Batteries

<https://ami-2017.github.io/battery-in/>



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Treatabit
powered by I3P

Trash-IT

Trash-IT is an intelligent waste collection system that reduces human workload and increases efficiency within an eating environment. Through sensors, it locates tables that need to be cleaned, offering the option of sending a bin directly to them.

Sirio Longo
Marybeth Iannuzzi
Pietro Rastelli
Victoria Florence

Adopted technologies

- OpenCV
- ROS
- Android
- Arduino
- Raspberry Pi





Keywords: Sustainability, Recycling, Waste Disposal, Computer Vision, ROS

<https://ami-2017.github.io/Trash-IT/>



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Treatabit
powered by I3P

2016 showcase winners

Safety Mama

SafetyMama helps women to attain a peaceful pregnancy. It collects and monitors data pertaining to their physical 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.

Adopted technologies
 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/>

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 Ambient Intelligence Student Showcase 2016
<http://bit.ly/polito-ami>
 Treatabit powered by ISP

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

Adopted technologies
 Raspberry Pi, LVT, freibit, Elask, hup, smart house, main server, room station, mobile App, monitoring bracelet

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

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

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 Ambient Intelligence Student Showcase 2016
<http://bit.ly/polito-ami>
 Treatabit powered by ISP

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.

Adopted technologies
 Arduino
 Accelerometers
 Light Sensor

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

<http://ami-2016.github.io/StS/>

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 Ambient Intelligence Student Showcase 2016
<http://bit.ly/polito-ami>
 Treatabit powered by ISP

2015 showcase winners

Student Showcase
MARCO POLI

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!

Adopted technologies
HTML5, jQuery, JavaScript, 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>

Student Showcase
Well Cleaned

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.

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>

Student Showcase
MyBikePlace

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.

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>

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>

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