



POLITECNICO
DI TORINO



e-Lite

Course Introduction

Ambient intelligence: technology and design

Fulvio Corno

Politecnico di Torino, 2014/2015



<http://bit.ly/polito-ami>



Basic information

- Title: Ambient Intelligence: Technology and Design
- Code: 01PRDxx
- Year: 3, Semester: 2
- Credits: 6
- Language: English (almost...)

<http://bit.ly/polito-ami>

Tattoo this!

Summary

- Goals and contents
- Organization
- Resources
- Exam
- 2014's projects and Showcase
- 2015's Project Theme



Course Introduction

GOALS AND CONTENTS

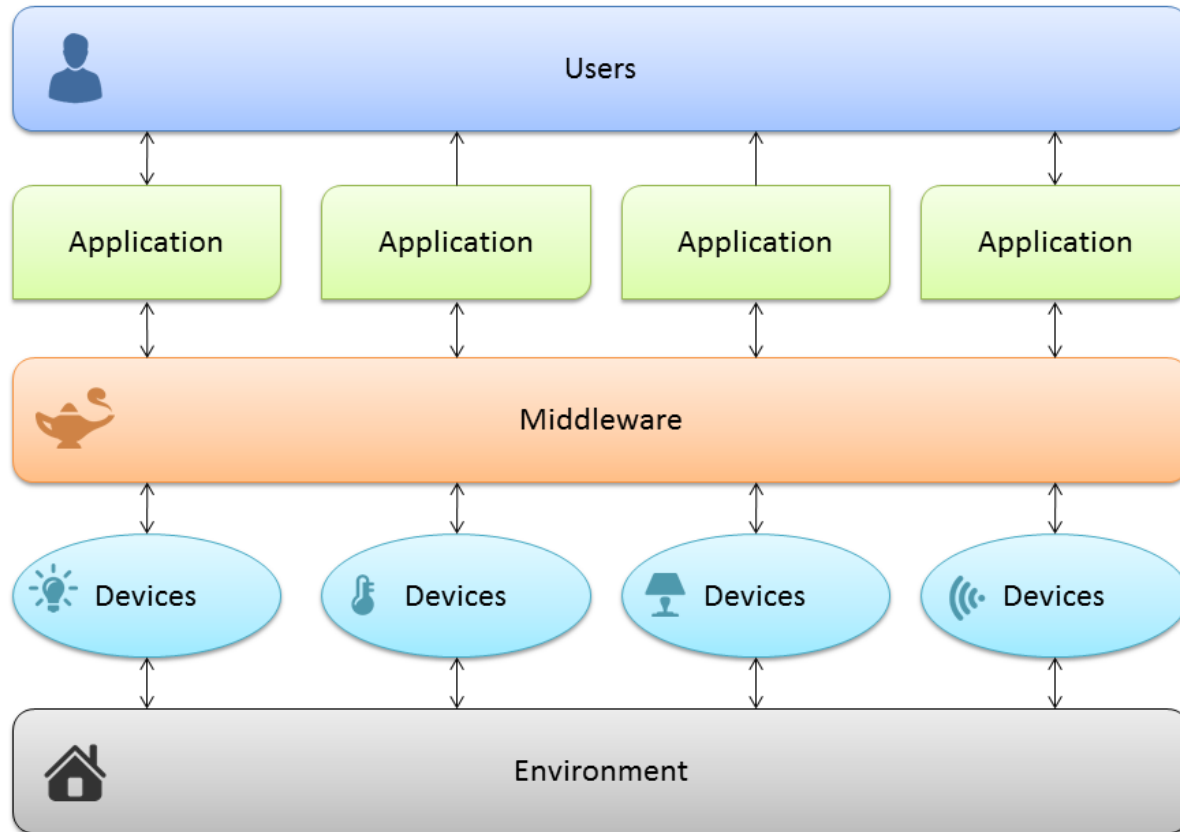
Goals

- 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.**”

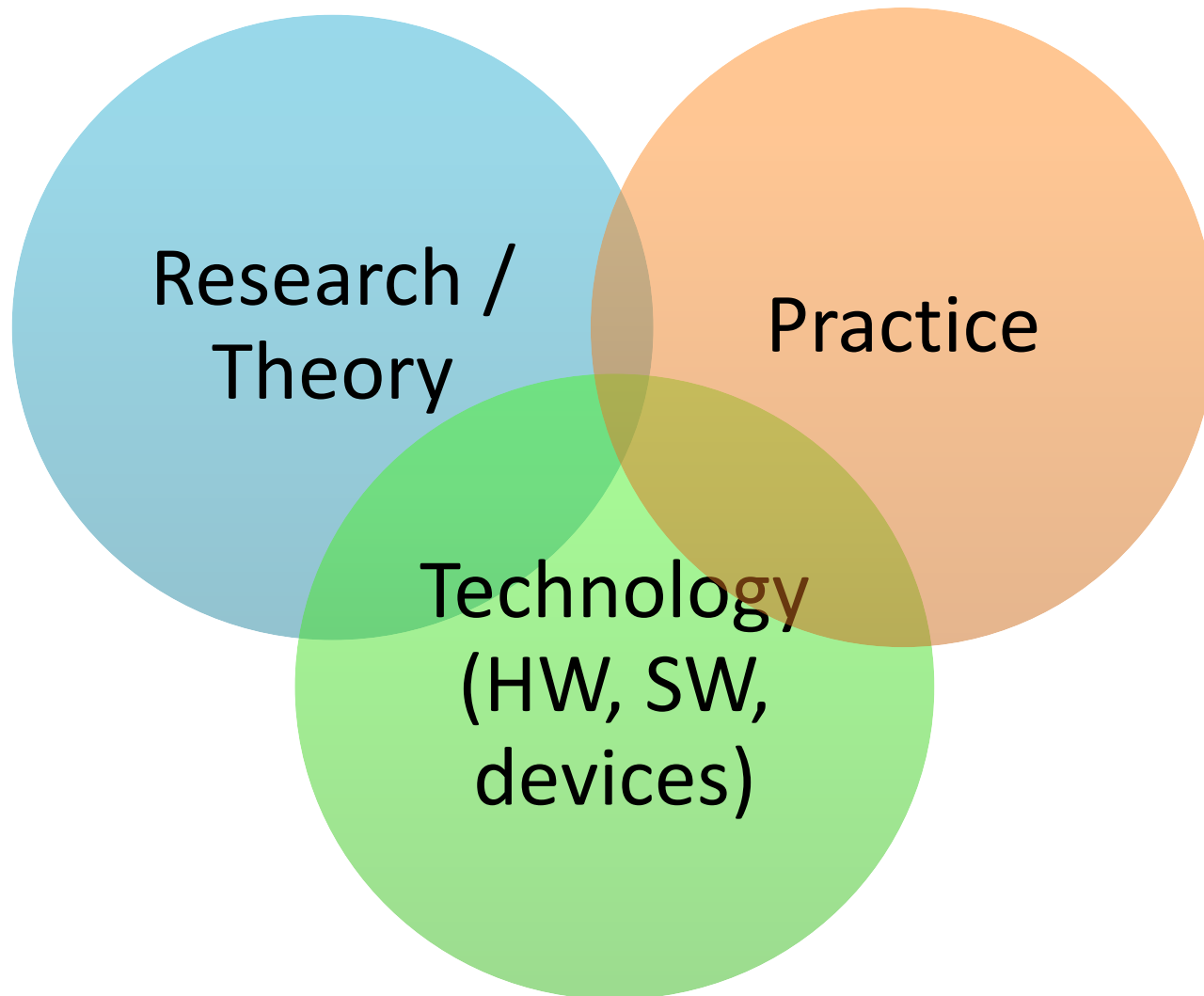
Reference architecture



Main contents

- Aml definitions, applications, systems: taxonomy and market overview
- Feature-driven design methodology
- Enabling technologies: Linux, hardware boards, python, Web, Dog3.0
- 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>
 - Politecnico di Torino, Dipartimento di Automatica e Informatica
- Dario Bonino <bonino@ismb.it>
 - Istituto Superiore Mario Boella
- ~20 hours each, mixed Lecture / Exercise / Lab

Schedule

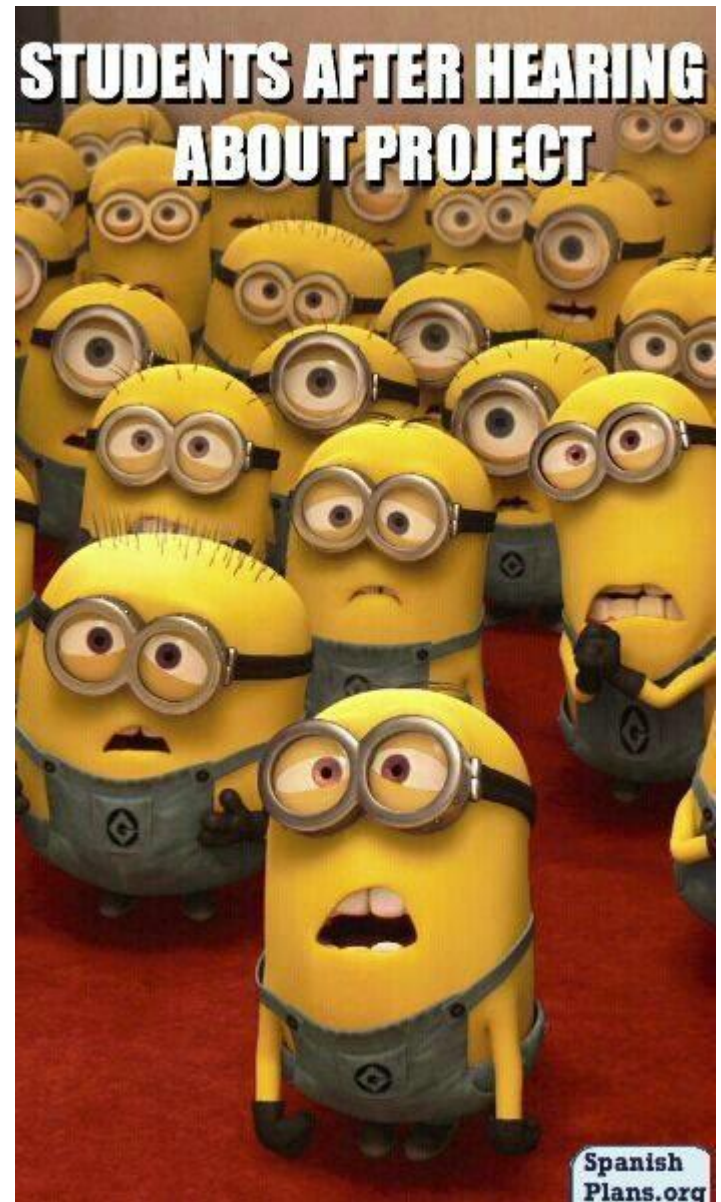
- Monday
 - 16:00-17:30
 - Room 4D (sometimes)
 - LADISPE (most of the times)
 - 17:30-19:00 (sometimes)
 - Room 4D / LADISPE
 - Free LADISPE access
- Thursday
 - 16:00-17:30
 - Room 3I
 - 17:30-19:00 (sometimes)
 - Room 3I

Updated week-by-week schedule on the course website (“Log” 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



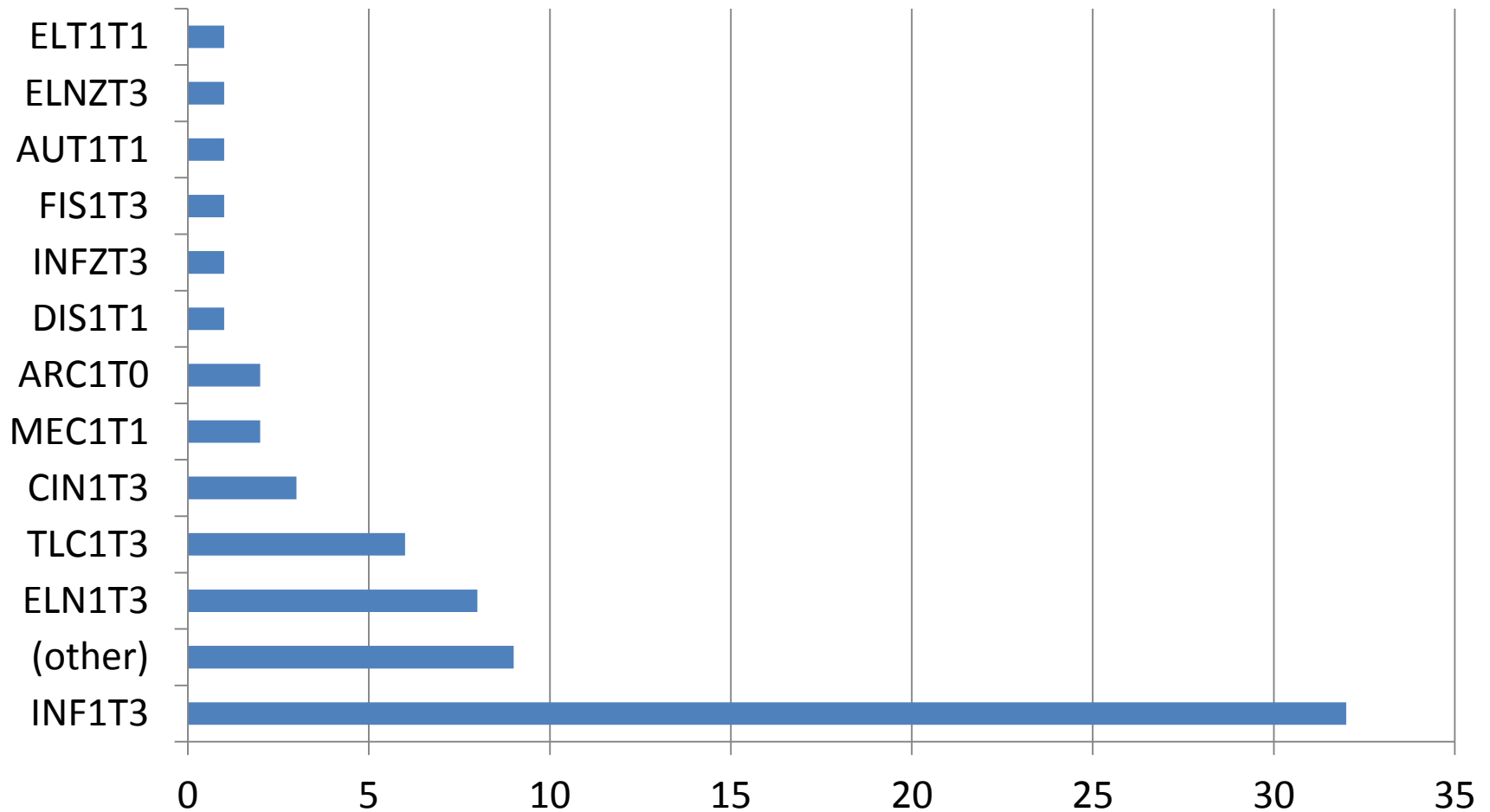
The Skewed Schedule

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

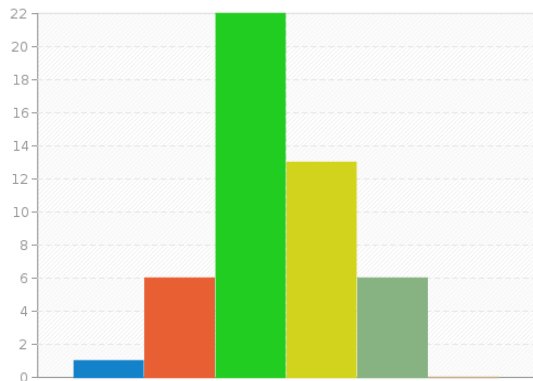
BETA

- Non-uniform distribution of hours
- Decreasing impact of classes
- Increasing time for supervised GW
- Increasing free time for developing the project

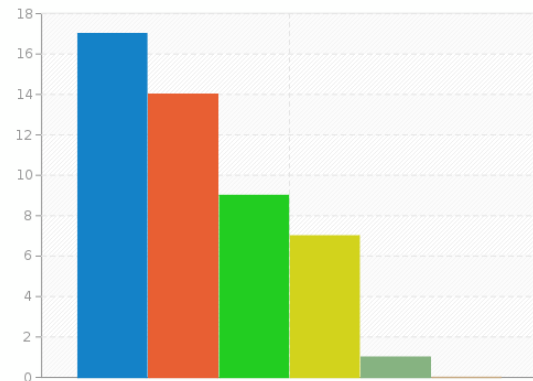
Students (about you...)



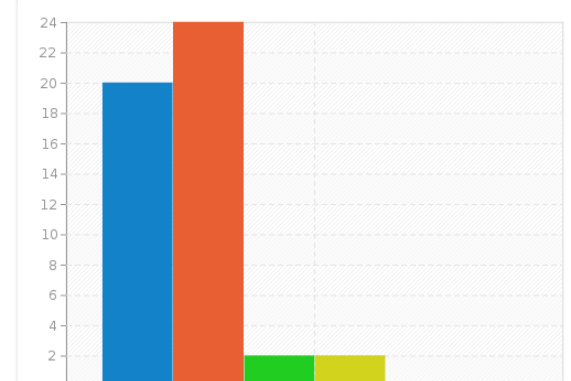
Skills



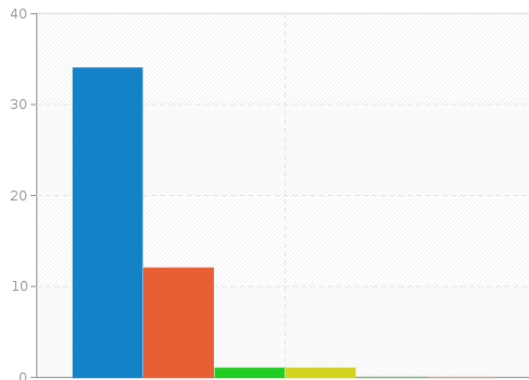
Programming (in general)



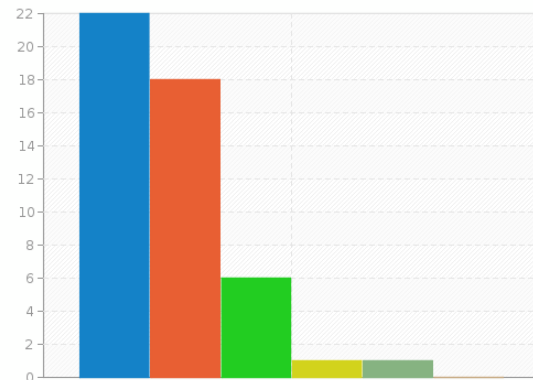
Web architectures



Mobile development

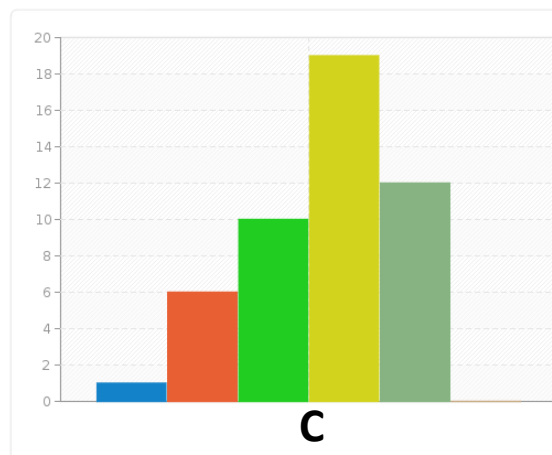
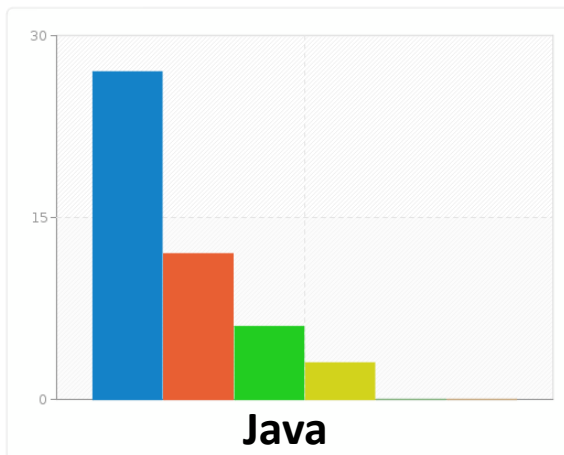
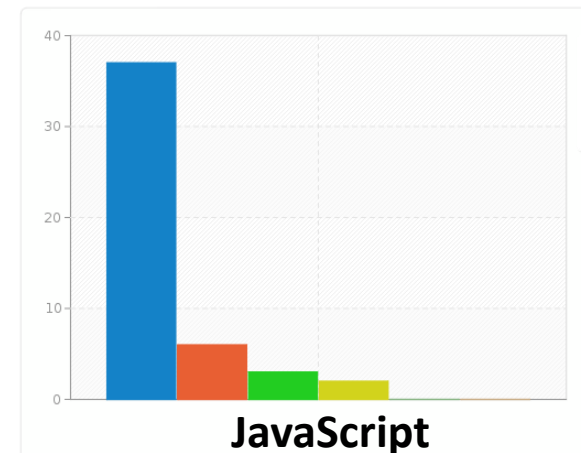
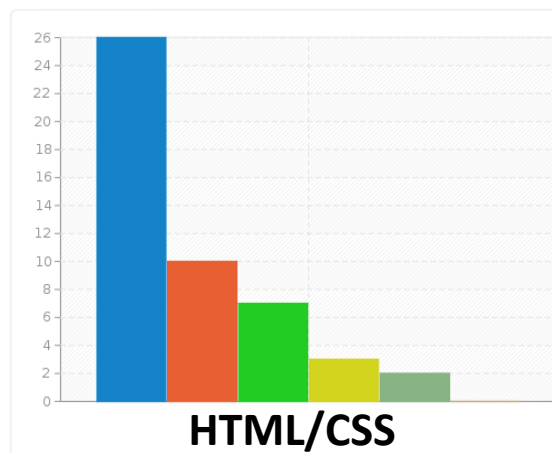
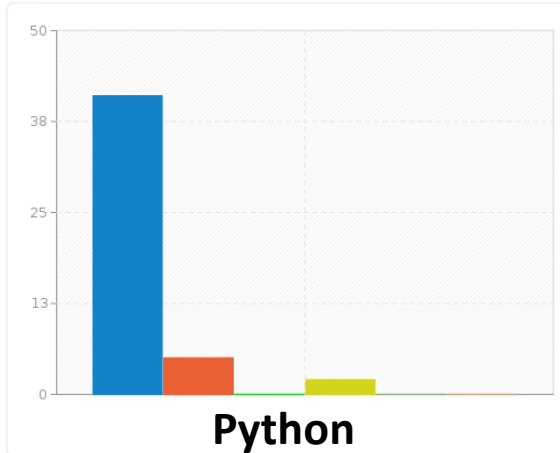


Source control



Software requirements

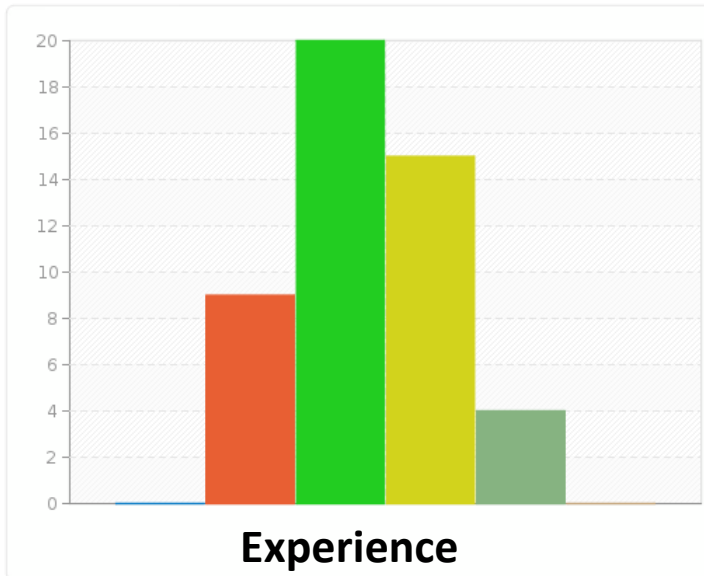
Programming languages



Others...

C++, Assembler,
gawk, C#, PHP, Pascal,
Matlab

Team working



| | |
|-----------------------|--------------|
| Standard deviation | 0.64 |
| Average | 3.58 |
| Minimum | 2.0000000000 |
| 1st quartile (Q1) | 3 |
| 2nd quartile (Median) | 4 |
| 3rd quartile (Q3) | 4 |
| Maximum | 5.0000000000 |

Best group size



Course Introduction

RESOURCES

Course website

- <http://bit.ly/polito-ami>
 - Long version: <http://elite.polito.it/index.php/teaching/current-courses/196-01prd-ami>
- All lecture slides
- All exercise material (texts, solutions, examples, ...)
- Reference papers, links, ...
- Exams
- News and notices (official)
- Detailed (tentative) schedule
- Lecture video recordings
 - On your page on the Portale della Didattica

Additional on-line resources

- Facebook group, for open discussion and information exchange:

<https://www.facebook.com/groups/polito.ami/>



- Slides will also be posted on slideshare (delayed w.r.t. the course website)



- Lectures will also be uploaded on youtube (at the end of the course)



Study material

- No suitable textbook for the whole course
- Teachers' slides
- Lecture videos
- Suggested books for some of the topics
- Suggested papers
- On-line technical documents



Course Introduction

EXAM

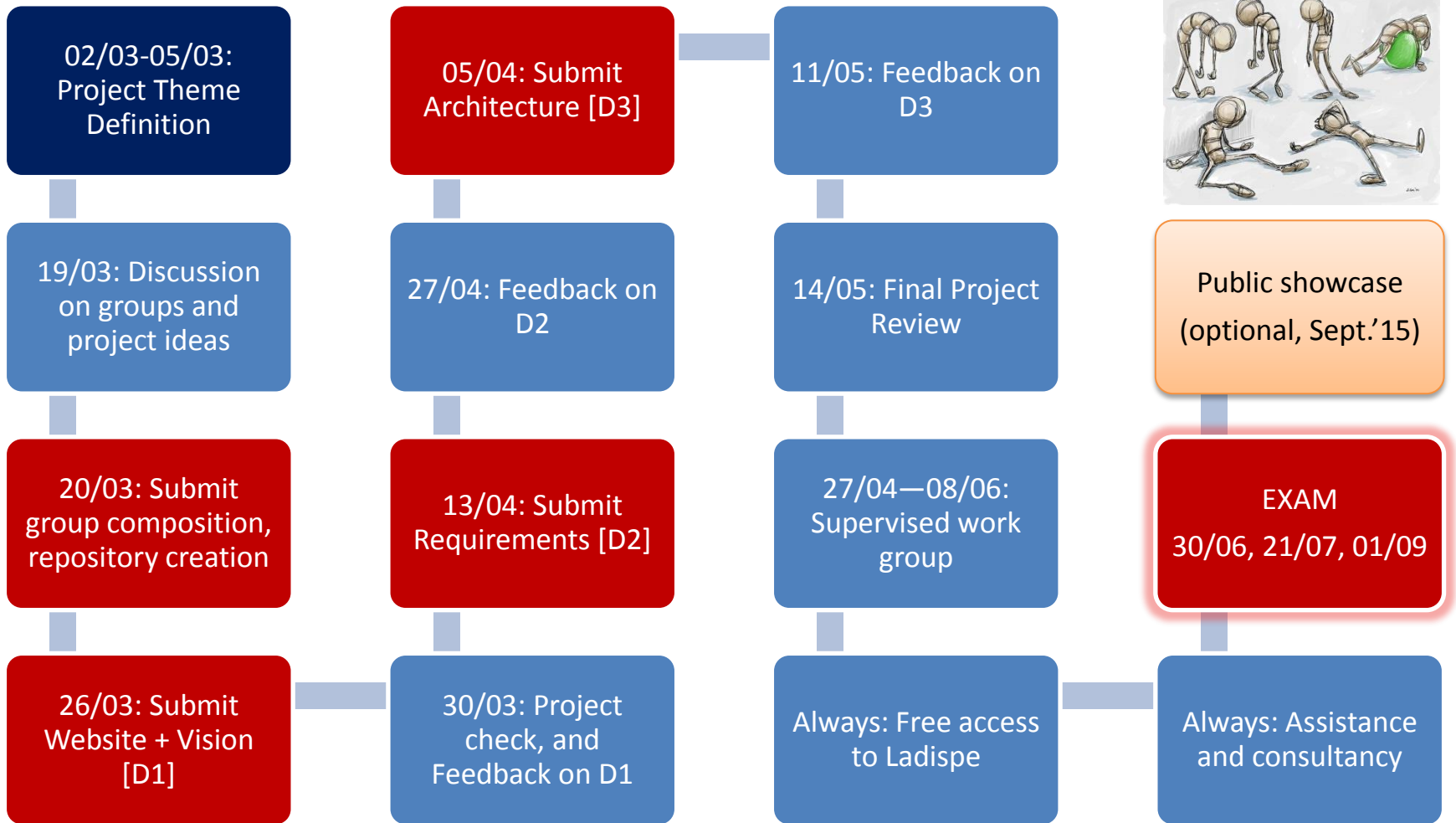
Goal and rationale

- 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 (requirements)
 - Deliverable D3 (architecture)
 - Presentation video
 - Project sources on github
- Oral exam
 - Presentation (15 minutes)
 - Demo (5 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

2014'S PROJECTS AND SHOWCASE

Successful projects

DoorOnPhone (PacMan)

Most people spend the most of their time far from home. Imagine if you can be advised everytime someone is on your door and actively interact with him/her as you are actually at home. DoorOnPhone transforms the concept of Intercom in a powerful **web service** that can be controlled from your smartphone.

With DoorOnPhone:

Read more...



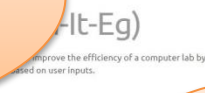
10 projects



Smart Pet Feeder (GGHF)

Are you having a lovely pet in your home? or do you intend to have a pet in the future? do you secretly love your pet and wish him a hassle-free and sometimes get bored of the daily feeding routine? then you

End-user involvement



improve the efficiency of a computer lab by controlling the power based on user inputs.

Different application domains



Smart Pet Feeder (GGHF)
We want to provide to the...
What happens:
The system recognizes the hand-re...
How it happens:
• Sensing: A webcam, placed on every workstation, captures the raising hand gesture. When a student's hand is raised, the system's perception will be notified to him.
• Reservation: The request is sent to a priority queue manager running on the Raspberry Pi.
• Communication: The manager notifies the tutors of the next student to whom provide help, through a smartwatch or a smartphone.
• Smart Management: The queue is managed in a intelligent way to optimize resources.*
Read more...



Smart Butler (SmartUp)

The Smart Butler project aims to create a system able to substitute a human butler in a domestic environment.

Read more...



Creativity, enthusiasm, technology



Treasure Hunting (iMe)

Improvements in technology have in the last few years lead to a new vision of gaming which introduces the player in incredible scenarios, where computer graphics and artificial intelligence take the user in another dimension, from time to time more realistic and enjoyable.

Our purpose anyway is different, our idea is to bring software and technology in the scenario of the real world and not in a virtual one, and to exploit the greatest GPU available in the market for the user's benefit. Mainly the game consists in a treasure hunt controlled by a central computer which works as creator of the paths and clues to solve in order to find the treasure and win the match, but don't worry, you're always under control!
Read more...

Multi disciplinary approach



Smart Routine Optimizer (PiSquared)

What if you could come home to a comfortable and warm environment?
What if you could forget about controlling your home's heating?
What if you could down your energy bill without doing anything?
What if you never run into a cold shower again?
What if it could make up to a hot cup of coffee?
What if you could buy a product that did all this and more for you?
At PiSquared we have worked hard to ensure our customers find more than what they expect. PiSquared is a smart routine optimizer that controls your home's heating, lighting, and energy consumption. PiSquared controls desired appliances when you need them without you having to move a finger. It's simple. You can sit back, relax and enjoy life while PiSquared does the tedious things you would rather not do. PiSquared is designed to save energy, saving on the shower's heating system in the morning when you're gone... are all things of the past.
Read more...

From the idea to a working prototype

Smart Notifications (TAP)

Smart notifications are reminders for the users of the system to help them keep track of several activities to do, places to go to and events to attend. It can sometimes be difficult to remember all of these duties due to the fact that many of these notifications reside on different platforms that are not integrated with each other. Our Smart Notifications system aims at providing an efficient way to solve this issue!

Read more...



Smart Notifications (TAP)

Smart Notifications (TAP) consists in preventing the user from leaving the room forgetting important things, keys and similar objects. Everyone can benefit of the system because it is simple and doesn't require any direct interaction. When the user is leaving the room, the system can detect if he's not carrying some important object and warn him. It can also check presence of the objects when the user gets back in the room. The system can warn the user on mobile devices or on smart devices such as smartphones or smart
Read more...

Successful projects

DoorOnPhone (PacMan)

Most people spend the most of their time far from home. Imagine if you can be advised everytime someone is on your door and actively interact with him/her as your are actually at home. DoorOnPhone transforms the concept of Intercom in a powerful home-station that can be controlled from your smartphone.

With DoorOnPhone you can't

[Read more...](#)



Set App (Ten-It-Eg)

The purpose of this project is to help improve the efficiency of a computer lab by controlling the power of the workstations and the lights based on user inputs.

[Read more...](#)

Smart Butler (Sm)

The Smart Butler project aims to create a system able environment.

[Read more...](#)

<http://ami-2014.github.io/>



Smart Gardener (NULL)

Smart Gardener is a project that would allow you to enjoy plants while lifting you from the task of watering them. It would also optimize resources by avoiding watering if rainfall is forecast in the near future or if the day will not be particularly hot. Feedback from the plants allows to tailor irrigation cycles to their specific needs without manual input.

[Read more...](#)

Smart Notifications (TAP)

Smart notifications are reminders for the users of the system to help them keep track of several activities to do, places to go to and events to attend. It can sometimes be difficult to remember all of these duties due to the fact that many of these notifications reside on different platforms that are not integrated with each other. Our Smart Notifications system aims at providing an efficient way to solve this issue!

[Read more...](#)



Smart Pet Feeder (GGHF)

Are you having a lovely pet in your home? or do you intend to have a pet in the future? do you secretly love your pet and wish him a happy life? and sometimes get bored of the daily feeding routine? then you will find some use in our project—the new era of pet care.

[Read more...](#)

Smart Raise Your Hand (SmartAttack)

We want to provide to the LADISPE a smart system able to manage the help requests of the students.

What happens:

The system recognizes the hand raised and assures the reservation for getting help from the tutor.

How it happens:

- Sensing: A webcam, placed on every workstation, sends continuously images to a program able to generate the raising hand gesture. When a student needs help he rises his hand, until the gesture perception will be notified to him.
- Reservation: The request is sent to a priority queue manager running on a Raspberry Pi.
- Communication: the manager notifies the tutors of the next student to whom provide help, through a smartwatch or a smartphone.
- Smart Management: The queue is managed in a intelligent way to optimize resources.

[Read more...](#)



Smart Routine Optimizer (PiSquared)

What if you could come home to a comfortable and warm environment?

What if you could forget about controlling your home's heating system?

What if you could save your energy bill without doing anything?

What if you never run into a cold shower again?

What if you could make up to a hot cup of coffee?

What if you could buy a product that did all this and more for you?

At PiSquared we have worked hard to ensure our customers find more than what they are looking for. PiSquared is what and when PiSquared desired appliances when you need them without you having to move a finger. Yes, it's that simple. You can sit back, relax and enjoy life while PiSquared does the tedious things you would rather not do. Lowering the temperature at night to save energy, turning on the shower's heating system in the morning, the coffee machine, the TV, the alarm when you're gone... are all things of the past.

[Read more...](#)



Never be locked outside your apartment again! (YAAG)

The idea of the project consists in preventing the user from leaving the room forgetting important objects such as wallet, phone, keys and similar objects. Everyone can benefit of the system because it exploits low cost hardware and doesn't require any direct interaction.

When the user is leaving the room, the system can detect if he's not carrying some important object and warns him in multiple ways. It can also check presence of the objects when the user gets back in the room. The system can warn the user on ad-hoc devices or on smart devices such as smartphones or smart watches.

[Read more...](#)



Student's showcase @ I3P

| | | | |
|---|---|--|---|
| <h3>STUDENT SHOWCASE</h3> <h2>SMART PET FEEDER</h2> <p>Description: Three efficient feeding modes, flexibility advanced feeding routine data administration, notify the animal condition, self study the habit of the pet -- the new way of pet care, let your pets have a healthy life.</p> <p>Keywords: Intelligence, Health, Connected, Advanced</p> <p>http://www-2014.github.io/I3P/</p> | <h3>STUDENT SHOWCASE</h3> <h2>DOOR ON PHONE</h2> <p>Description: DoorOnPhone transforms the concept of intercom in a powerful home station that can be controlled from your smartphone.</p> <p>Keywords: Smart Intercom, notification, video streaming, a keys, authorized access, immediate response, face recognition, external services (DropShare), social</p> <p>http://www-2014.github.io/DoorOnPhone/</p> | <h3>STUDENT SHOWCASE</h3> <h2>SMART APP</h2> <p>Description: The purpose of this project is to help improve the efficiency of a computer task by controlling the power of the workstations and the lights based on user input.</p> <p>Keywords: Smart Notifications, Social Networks, Device Life Integration, Home Condition Monitoring, Aggregated notification, Friendfeed calendar, Busy time alarm</p> <p>http://www-2014.github.io/SmartApp/</p> | <h3>STUDENT SHOWCASE</h3> <h2>SMART BUTLER</h2> <p>Description: The Smart Butler project aims to create a system able to substitute a human butler in a domestic environment. It is an ALWAYS ON voice computing platform. With few words you will get a big help to manage your daily routine relieving you from boring or tricky tasks and letting you enjoy your life with more energy!</p> <p>Keywords: Always-on, Voice Controlled - Accessible from everywhere in your home - Completely customizable - Make your life easy. You can. With our Smart Butler!</p> <p>http://www-1-in-4.com/smartbutler/</p> |
| <h3>STUDENT SHOWCASE</h3> <h2>SMART GARDENER</h2> <p>Description: Smart Gardener is an easy and advanced system that takes care of your plants for you. It uses a self-learning algorithm that, combined with the analysis of the environment, provides the perfect amount of water for all the plants in your garden.</p> <p>Keywords: Smart, Adaptive, Easy To Install, Plug-and-play, Data-Driven, Customizable, Extensible</p> <p>http://www-2014.github.io/SG/</p> | <h3>STUDENT SHOWCASE</h3> <h2>SMART RAISE YOUR HAND</h2> <p>Description: Hand-raising. Hand-raising help! They can and save your hand. Your intention will work after you. Hand-raising will be immediately recognized by your workstation. No will be put in a queue. At your hand, the video attached to the next speech will come.</p> <p>Keywords: Gesture, Audio technology, natural user interface, multi-touch, ubiquitous technology, communication channels, sensor-based interaction</p> <p>http://www-2014.github.io/SmartHand/</p> | <h3>STUDENT SHOWCASE</h3> <h2>SMART NOTIFICATIONS</h2> <p>Description: The system is a system able to filter, filter, push for notifications from other web and mobile and presenting them in a unified and easy-to-use way. Through simple and easy-to-use keywords and through real-time light indicators, all the right messages at the right time.</p> <p>Keywords: Social Networks, Device Life Integration, Home Condition Monitoring, Aggregated notification, Friendfeed calendar, Busy time alarm</p> <p>www-smart-notifications.com</p> | <h3>STUDENT SHOWCASE</h3> <h2>TREASURE HUNTING!</h2> <p>Description: Treasure Hunting is a game that consists in competing against an evil AI while finding checkpoints in your city thanks to the clues the app gives you. It's a fully customizable, competitive, multiplayer game.</p> <p>Keywords: Cooperative, Customizable, Game Libraries, Treasure Hunt, Clues, Riddles, Checkpoints, Artificial Intelligence, Android, app, GPS, Smart City</p> <p>http://www-2014.github.io/TH/</p> |

Student's showcase @ I3P

The image shows a student showcase event at I3P. The central photograph captures a large audience of students and faculty members seated in a well-lit hall, facing a stage. A large projection screen on the stage displays a presentation with green and yellow graphics. The event is organized into sections, with labels at the top of the frame: 'SMART PET FEEDER', 'DOOR ON PHONE', and 'BUTLER'. Each section includes a brief description and a list of 'Adopted technologies'.

SMART PET FEEDER
 Description: Smart Garden is always on plants for you. It uses a self-analysis of the environment, the plants in your garden.
 Adopted technologies: Smart, Adaptive, Easy

DOOR ON PHONE
 Description: To submit their a home...
 Adopted technologies: Raspberry Pi, Internet, REST, Dog Gateway, Vocal Recognition

BUTLER
 Description: To submit their a home...
 Adopted technologies: Raspberry Pi, Internet, Z-Wave, Vocal Recognition

SMART NOTIFICATIONS
 Description: Social Networks, Delta V3 integrations, News condition monitoring, Aggregated notifications, Priority calendar, Busy time alarm.
 Adopted technologies: Social Networks, Delta V3 integrations, News condition monitoring, Aggregated notifications, Priority calendar, Busy time alarm

SMART GAMES
 Description: Cooperative, Customizable, Game Lobbies, Treasure Hunt, Clues, Riddles, Distances, Artificial Intelligence, Android, app, GPS, Smart City.
 Adopted technologies: PHP/MySQL, Robot, XQuery, Python/Orange, Wi-Fi

The bottom of the frame features logos for the University of Verona, I3P, and Treacbit, along with social media links and project URLs.

Ambient Intelligence?

| | Sensitive | Responsive | Adaptive | Transparent | Ubiquitous | Intelligent |
|-----------------------|-----------|------------|----------|-------------|------------|-------------|
| Smart Pet Feeder | ★ | ★ | | | | ★ |
| Door On Phone | ★★★ | ★★★ | ★ | ★★★ | ★★★ | ★★★ |
| SétApp | ★★★ | ★★★ | | ★ | ★★★ | ★ |
| Smart Butler | ★ | ★★★ | | ★★★ | ★★★ | ★★★ |
| Smart Gardener | ★★★★ | ★★★ | ★★★ | ★★★ | ★ | ★★★ |
| Smart Raise Your Hand | ★★★ | ★ | ★ | ★★★ | ★★★ | ★★★ |
| Smart Notifications | ★★★ | ★★★★ | ★★★★ | ★★★★ | ★★★ | ★★★ |
| Treasure Hunting | ★ | ★★★ | ★ | ★ | ★★★ | ★ |



Course Introduction

2015'S PROJECTS THEME

Project Theme for 2015



Project Theme for 2015



Smart
"Cittadella
Politecnica"

Smart “Cittadella Politecnica”

- How can the campus be “smarter”?
- For end-users
 - Students (enrolled & visiting)
 - Teachers & staff
- What services, which information, how to interact, ...
- Must be feasible within the exam constraints

- Some ideas in the student survey, keep brainstorming!
- More hints in Thursday’s class
- Deadline: 19/03 (group + project title)

Questions?

01PRD AMBIENT INTELLIGENCE: TECHNOLOGY AND DESIGN

Fulvio Corno

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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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