Industrial informatics

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UNIMORE
UNIVERSITÀ DEGLI STUDI DI
MODENA E REGGIO EMILIA

High Performance
Real Time Lab


SE NON LO SAI
SPIEGARE
IN MODO SEMPLICE,
NON L'HAI CAPITO
ABBASTANZA BENE
- Einstein

THE EXAM

Mandatory written test

- A mix of multiple (closed) responses, and open questions
- Up to 30/30
- 3 dates, 1 of which in December (tentative). See Q&A on website

Optionally, to improve your mark you can choose between

- Oral (3-4 questions)
- Project (recommended for internship and theses)
- (typically +4/-∞)

Course material

Course website

https://hipert.unimore.it/people/paolob/pub/Industrial_Informatics/index.html

Course slides

- Available on Moodle, early preview on github
  - https://github.com/HiPeRT/IndInf23.git
- Typically, enough to pass the exam, also if not attending class
- Hands-on exercises

Textbooks

- See course website
- Add reference at the end of each slides block

Required skills

Unix Programming

- Also win is fine..
- C/C++ preferred

A bit of electronics might help…but it's not mandatory

Passion, passion, passion!!

Required material on your side

A laptop with GNU/Linux

- For fast prototyping
- Also win is fine…you can use Cygwin or Windows Subsystem for Linux (WSL)

Embedded boards for hardcore hands-on

- Raspberry Pi
  - You should already have it for the IoT course
- Arduino (do you want this?)
- NodeMCU
  - ESP8266/ESP32 processor
- …plus some basic stuff (breadboard, electric cables, leds…)

CAD tools

- CODESYS by 3S-Smart Softfare Solutions GmbH
  - I will use V3.5 SP10 Patch 3+, better having the same
  - I can provide it, as well as textbook

How to contact me?

AKA: ricevimento

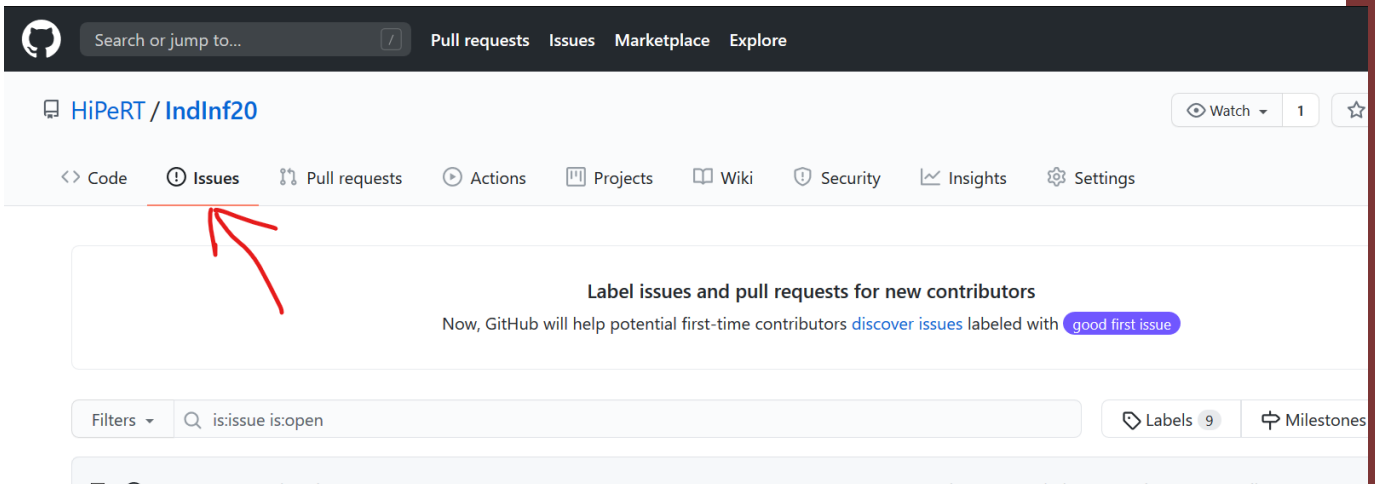
› paolo.burgio@unimore.it

But let's try something different..

› For every question, open a ticket ("issue") on GitHub
  – https://github.com/HiPeRT/IndInf23.git

› So, all of your colleagues will enjoy the answers

› Netiquette: before asking, **search in "issues"**



What is this about?

Why *"Industrial"* informatics?

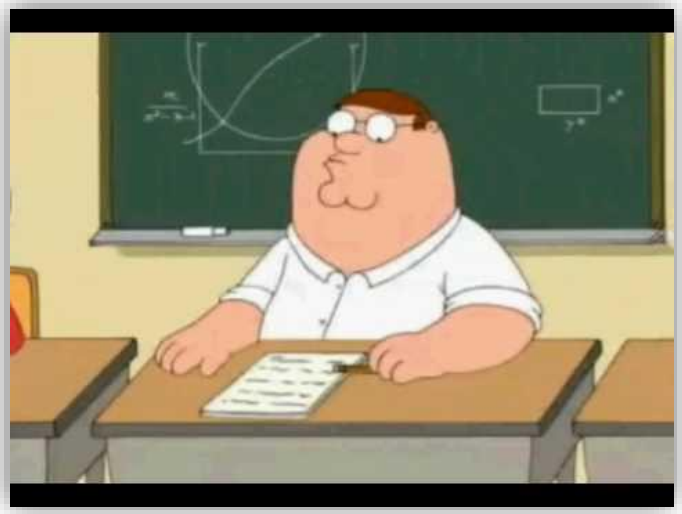
What makes them different by "standard" informatics?

- Applications
- Computers
- Requirements
- Frameworks
- Processes (industrial, not "OS processes" ☺)
- Technologies

“domain driven”…?

Es: industrial plants are different than biotech, or nuclear plants

- Tens of application domains..
- Is automotive also industrial…today? (rhetorical)
  - And aerospatial? Planes, ships, surveillance drones?
  - Safety critical systems
- Rise of many-core computers
  - Size, Weight and Power constraints - SWaP
- Internet 4.0 – Internet of Things
  - How can we use Machine Learning?



Past, present and future

- Not easy to teach, not easy to structure

What's common?

- Tight interaction with the environment
  - A plant, a machine
  - Trough sensors and actuators
  - A lot of computers
  - Huge cost
  - Centralized controller & data analytics w/human

- Eco-System architecture
- Cyber-physical systems
- Embedded systems

- We want guarantees
  - Worst-case timing behavior
  - Often, safety
  - Reliability, fail-tolerancy, also in monitoring
  - Security (we won't see this)

- Real-Time systems
- Dependable
- Observable

(WON'T SEE THIS)

- Compliancy with previous technology
  - Lombardia, ER are highly-industrial areas (consider also farms)
  - Can't always use "startup-like" models
  - Not easy to replace legacy HW/SW

- Old technologies
- Legacy software
- Old processes

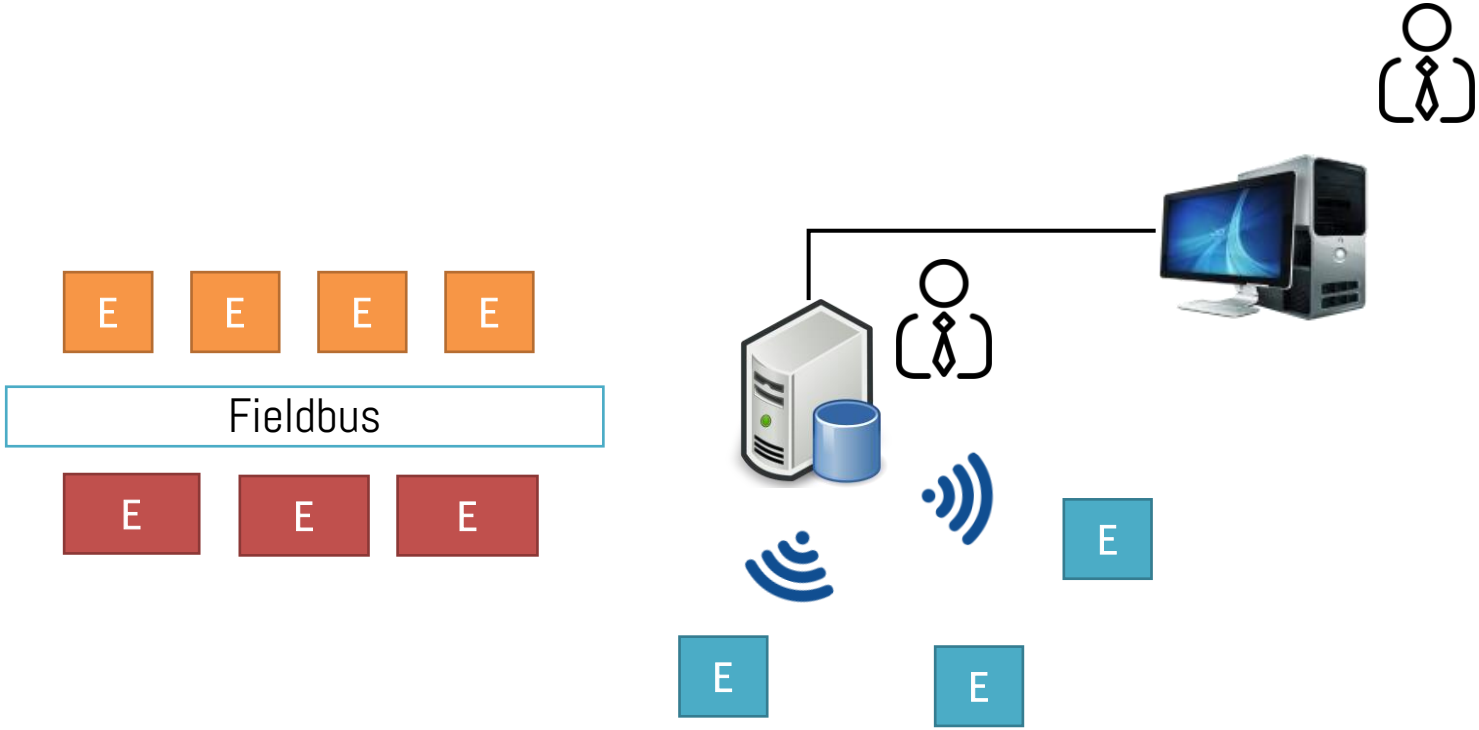
- The ~~future~~ present

- Machine Learning
- Big data
- IoT
- ...?

CPS - Cyber Physical (Eco)Systems

Tight interaction with the environment

- Typically, multiple embedded computing units close to the plant
- And one (or more) centralized controller
- Today, these computational **edges** have more and more computing power



Our journey

Will cover these main topics

- Collaborative tool (quickly)
- Languages & grammars, Automations & machines
- Computing architectures: PLCs, GPGPUs, reconfigurable archiectures, …
- Programming industrial systems: PLC, embedded GPGPUs & CUDA

..and…

- A glance on embedded machine learning
- Automotive systems
- 2-3 seminars, chosen together

…always with an hands-on approach!

References

Course website

- http://hipert.unimore.it/people/paolob/pub/Industrial_Informatics/index.html

My contacts

- paolo.burgio@unimore.it
- http://hipert.mat.unimore.it/people/paolob/
- https://github.com/pburgio