Software design
Course introduction

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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

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

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

Course slides

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

Textbooks

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

Required skills

Object oriented programming

- You should now about Java..but any OO language is fine!
- MS C# is the most modern/advanced for the things I'll teach you
- IDE (Eclipse? VS Code? CLion?)

The Python problem

- PY and other "dynamic" languages are less suitable for large-scale methodologies
- Better for faster prototyping

Tools for creating diagrams

- MS Visio, Miro, Draw.io, even powerpoint!!!

Passion, passion, passion!!

How to contact me?

AKA: ricevimento

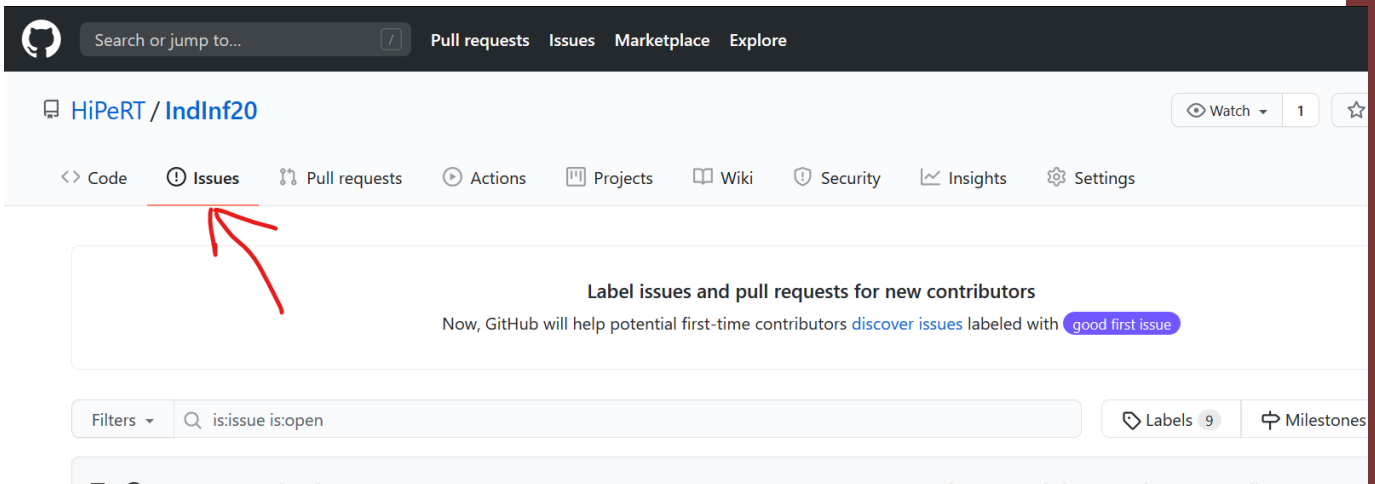
› paolo.burgio@unimore.it

But let's try something different..

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

› So, all of your colleagues will enjoy the answers

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



What is this about?

Software design methodologies

AKA: software engineering

- Not really the same thing, but it helps!
- Focus on the **process**, not on the **code**

One solution to rule 'em all?

- Multiple methodologies, tailored for different needs
- All of them boil down to few principles/families
- If you structure the process, you can create tools to automate it!
  - Ex: folder structure for your documents

Why?

- "Few weeks of debugging can save you 2 hour of design"
- "Weeks of coding can save you hours of planning"
- Code/Technical debt


TECHNICAL DEBT
I DON'T UNDERSTAND WHY IT TAKES SO LONG TO ADD A NEW WINDOW.
@VINCENTDNL

Documentation: why?

No-one programs alone!!

(…no-one programs **large scale software** alone)

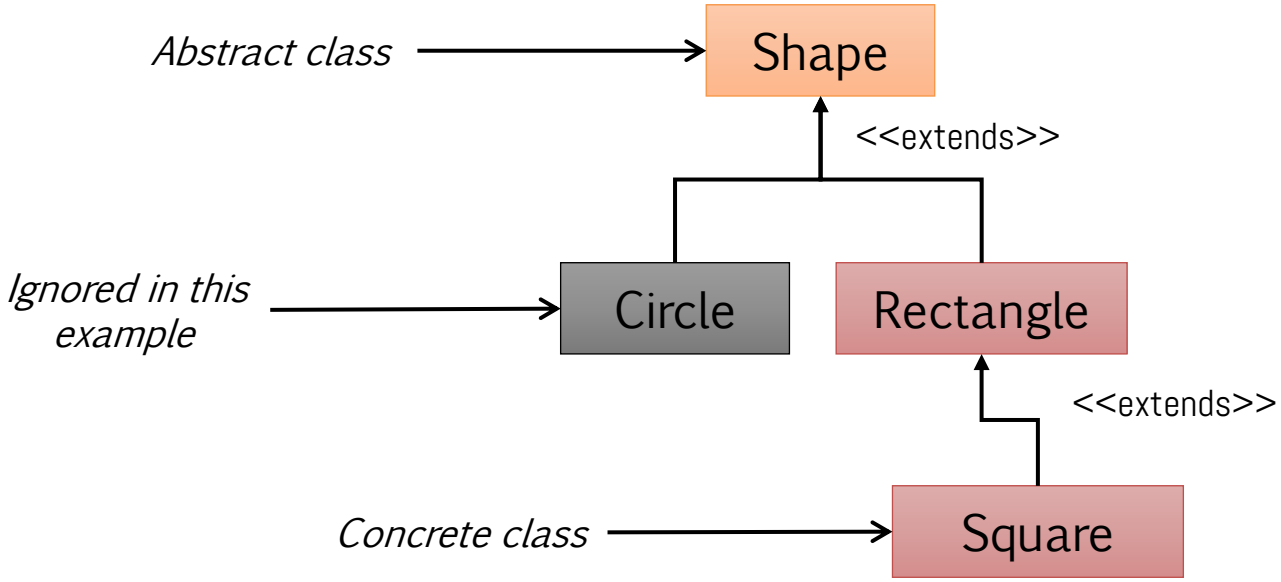
Code documentation to

- Teach how to use our SW artifacts
- Explain how to modify them
- Show how to test/deploy/use them/their code in other projects…

Licensing!!!

Communicate

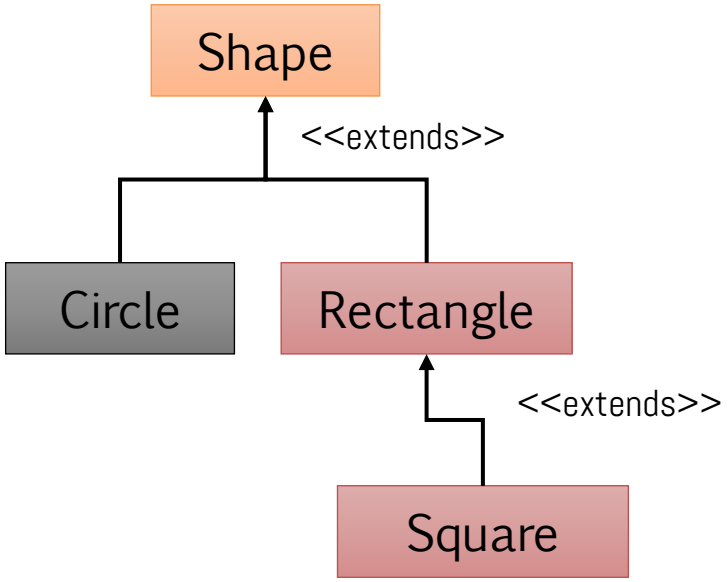
› A standardized way of expressing concepts



Of rectangles and squares

A classical example

› Do you remember that?



The story so far…

Programming is taught using very simple concepts

› Object-Oriented Programming

› Often **mixed** with procedural/functional programming

› **Dynamic typing** as powerful mean to deal, e.g., with polymorphism

Clutter is removed

› Pointers and explicit memory management are powerful yet dangerous!
  – C++ managed, RUST try to get rid of them

› Parallel programming hidden within libraries, e.g., Python modules

› Production code often is written in languages more suitable for fast prototyping (e.g., Python)

Software structured in monolithic manner

› Middlewares are often seen as a library, or a communication mechanism

› E.g., MPI, MQTT, .netCore

The present: agile and microservices

How do we develop today?

- Traditional project management and tools are still used
- New generation of agile methodologies to enable quick Time-To-Market
- *"Code today, deploy tomorrow, get worried about that next year"*

Large scale projects require flexible and resilient structures

- E.g., Google server farms
- First design the communication channels and protocols
  - MQTT, Sockets, ROS with JSON, etc
  - Aka: the **interaction** between software components
- …then, design single SMALL components, with very restricted functionalities
  - DB, Web API/Frontend, aggregation logics…

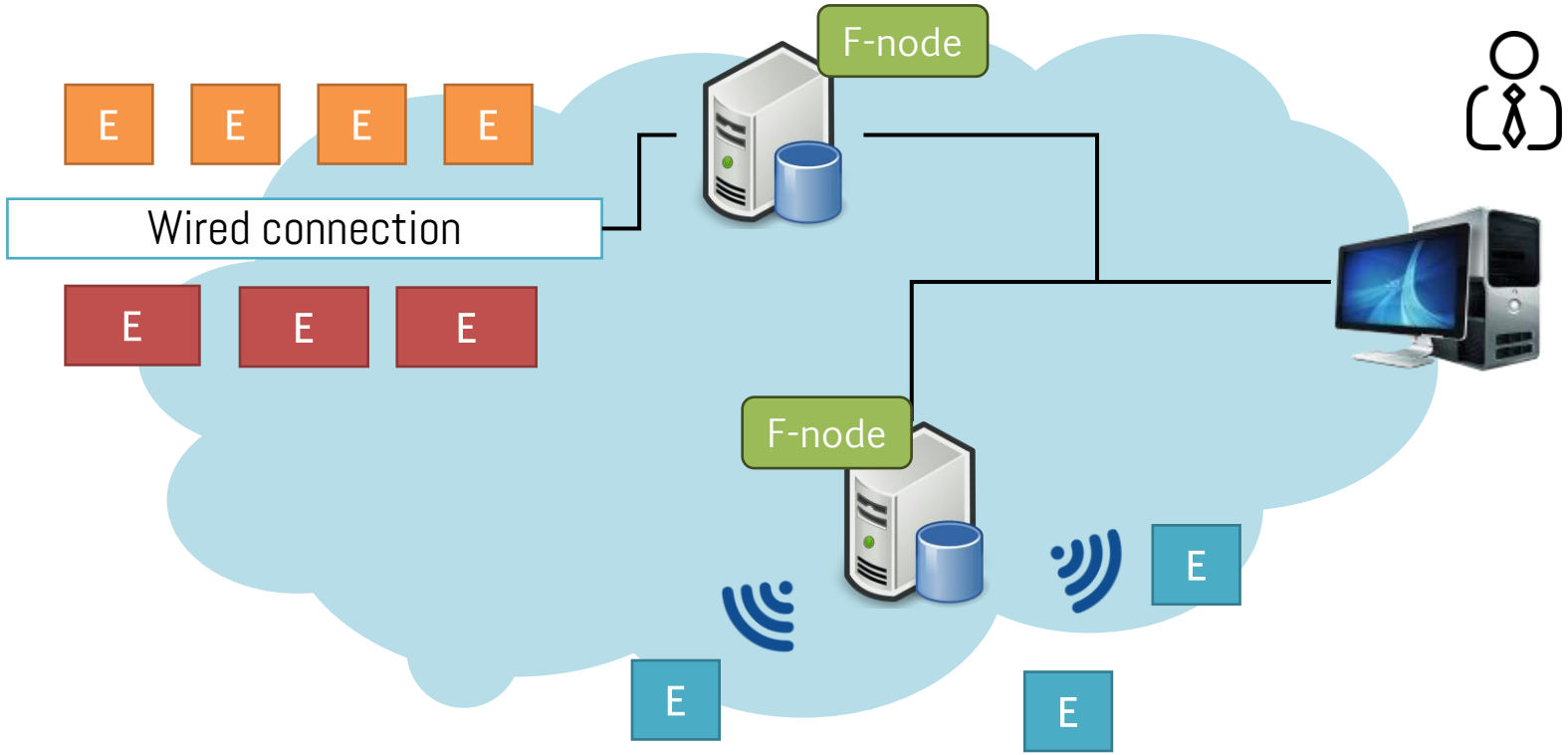
The future: CPS - Cyber Physical (Eco)Systems

Tight interaction with the environment

› Computational **edges** with highest enery efficiency (Performance => Performance/Watt)

› Highly scalable hierarchy of computers, with (multiple) Cloud/Fog nodes

› Parallel/distributed computation: GPGPUs, multi-threading, MQTT, ROS, MPI…



Our journey

Will cover these main topics

- Requirements, KPIs and test-driven design
- Collaborative tools
- Design tools: UML, E/R diagrams, …
- Design patterns
- Advanced programming: how to structure?

..and…

- Use-case: Yoox net-a-porter
- Use-case: HiPeRT's Fire: F1/10, UNIMORE MMR Driverless, IAC?

…always with an hands-on approach!

Credits to

- Prof. Cabri, for the material of the past “Progetto del SW” course

- Uncle Bob (& Friends), for the insightful details on modern structures for SW

  (And for being always harsh in code/SW reviewing)

References

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My contacts

- paolo.burgio@unimore.it
- http://hipert.mat.unimore.it/people/paolob/
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