Algebraic and Coalgebraic Methods in Software Development

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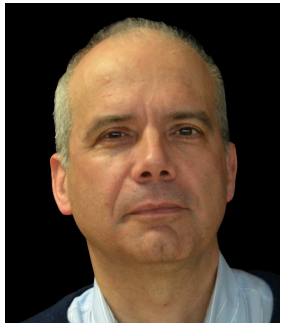
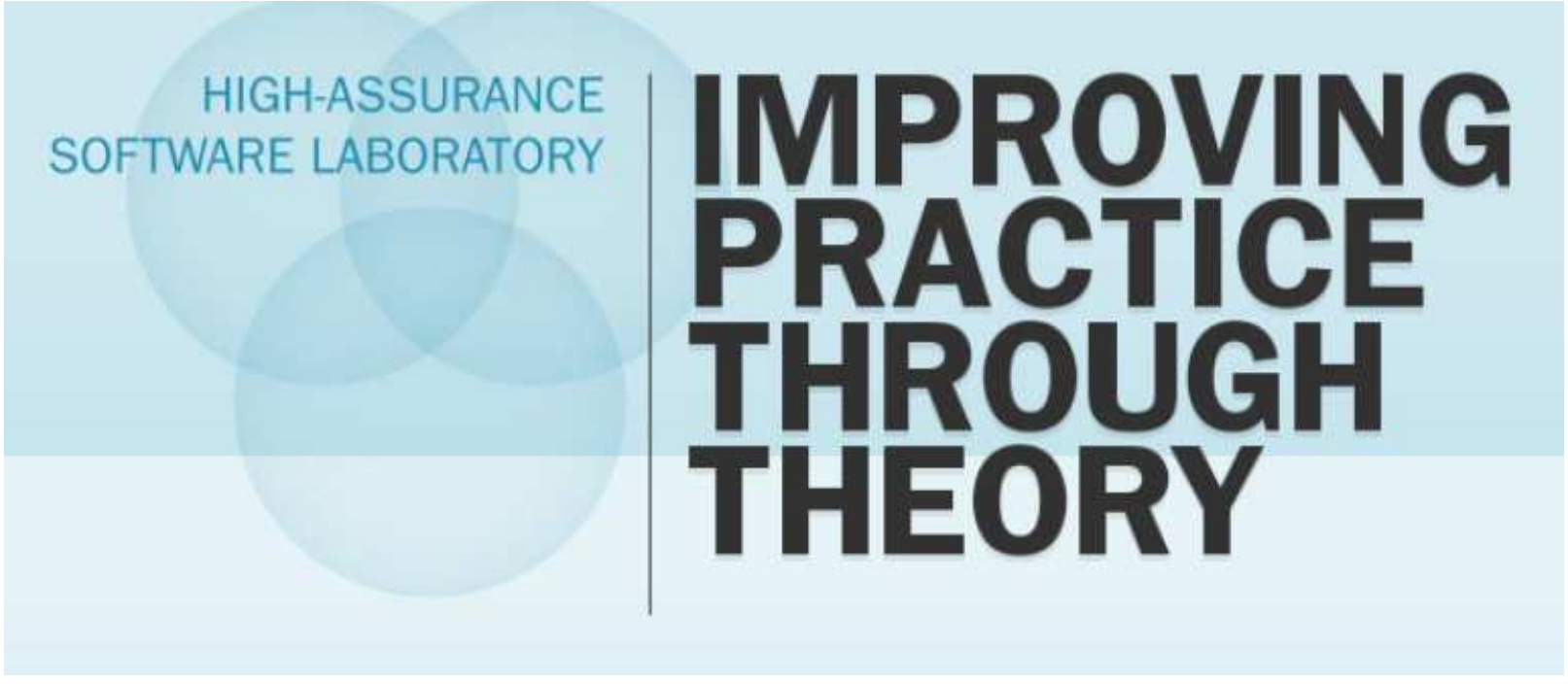
Our group (UA/UM)

ACMSD
17/18



Our motto


HIGH-ASSURANCE
SOFTWARE LABORATORY
IMPROVING
PRACTICE
THROUGH
THEORY

Our times

Industry 4.0 to rely on highly **sophisticated** software on an **unprecedented scale**.

Billions, not thousands, of lines of code required to

> **for** *all* **do** { *human* := *robot* }

This big? Yes — complex, therefore risky software.

Software **correctness** and **robustness** thus essential.

Our past

Industrial revolutions made possible by advances in Physics.

Industry 4.0 will rely on **software** on an unprecedented scale (CPS, data-mining, robotics...)

However

- Physics is a **truly scientific** discipline
- Software is a **pre-scientific** discipline

Uupps!

> *As happened in physics, the software sciences need to find a* **unified theory**.

Our aim

This course is about such **unifying theory**.

This will provide you with **better** knowledge of what **software** is all about.

Abstraction essential to better knowledge,

"The purpose of **abstraction** *is not to be* **vague**, *but to create a new semantic level in which one can be* **absolutely precise**." *(E. Dijkstra)*

E.W. Dijkstra (1920-2002)

Our course

Intimidated by

> *Algebraic and Coalgebraic Methods in Software Development ?*

Don't worry — you've seen this before without noticing:

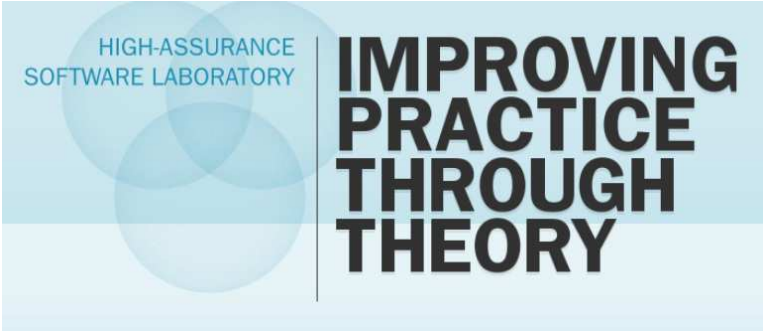
Programs = Algebras + Coalgebras

Examples:

- a **programming language** forms an **algebra**
- an **automaton** forms a **coalgebra**

Want to know why? — come to the course :-)

Our motto, again



Which **practice**?

- data mining
- cyber-physical systems
- software architecture
- risk analysis
- probabilistic programming
- ....

Note, however, that the course is a theoretical — i.e. **foundational** — one.

After all, *"There is nothing more practical than a good theory"* — as Kurt Lewin (1890-1947) once write it!

Course structure

Course plan:

1. **Category theory for computer science** (JNO)
2. **Advanced Category theory** (DH)
3. **Coalgebras and coalgebraic modelling** (LSB)
4. **Algebras and algebraic specification** (MAM)
5. **Modal logics – a logics on-demand approach** (AM)

where

- AM — Alexandre Madeira, UMinho
- DH — Dirk Hoffman, UAveiro
- MAM — Manuel Antonio Martins, UAveiro
- LSB — Luís Soares Barbosa, UMinho
- JNO — José Nuno Oliveira, UMinho

Course structure

Operating mode

- Organized in 5 modules (one per lecturer)
- One lecture per afternoon (with breaks!)

Bibliography

- Papers / books suggested by lecturers

Grading

- Paper recitation + paper resumé (individual assessment).

Last year's website: http://wiki.di.uminho.pt/twiki/bin/view/Education/ACMSD/WebHome