CS-478 Model-based system design				Model-based system design
Lecturers : Sifakis Joseph				Language : English
Study plan	Semester	Mand.	Option	Filières Credits : 4
Informatique 2014-15	MA2		x	B
Systèmes de communication 2014-15	MA2		x	Number of hours :
Systèmes de communication 2014-15	MA4		x	A week :4h
				Distribution : Lecture : 2h hebdo Exercises : 2h hebdo

SUMMARY

We will discuss foundational and practical aspects of model-based system design. We consider design as a formal process leading from formal requirements to mixed HW/SW systems that are trustworthy and optimal.

CONTENT

- Transition Systems – Operational Semantics
- Predicate Transformers, Invariants
- Petri Nets
- Process Algebras
- Timed & Hybrid Systems
- Requirements Specification - Temporal Logics
- Algorithmic Verification
- Model-Based Design in BIP

Keywords

Model-based system design, correctness, requirements specification, temporal logic, modeling, domain-specific languages, process algebra, timed automata, hybrid systems, verification, model-checking, synthesis, correctness-by-construction, components, source-to-source transformation, code generation.

LEARNING PREQUISITES

Required courses

- CS-251 English Madry Theory of computation
- CS-205 English Odersky Programming principles

Recommended courses

- CS-453 English Guerraoui Concurrent algorithms
- CS-305 English Candea Software engineering
- CS-206 French Schiper Concurrency
- MATH-310 French Bayer Fluckiger Algebra
- MATH-381 French Duparc Mathematical logic

Important concepts to start the course

- Automata theory and formal languages
- Logics (axiomatization, proof methods, semantics)

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Identify key issues and methodological aspects in system design.
- Discuss strengths and limitations of formal methods and their applications in system design.
- Select appropriately the modelling formalism suitable for a particular system.
- Analyze the system requirements and structure.
- Structure a system as a family of functionally meaningful, self contained components

- Design faithful models.
- Contrast parallel composition operators in component frameworks
- Apply existing modelling, simulations and analysis tools to system models.

Transversal skills

- Use a work methodology appropriate to the task.
- Access and evaluate appropriate sources of information.
- Summarize an article or a technical report.

TEACHING METHODS

- Ex-cathedra
- Exercises

EXPECTED STUDENT ACTIVITIES

- Attending lectures and exercise sessions
- Discussing with fellow students
- Criticql reading and reporting on scientific papers

ASSESSMENT METHODS

- Continuous control during the semester
- Paper reports

SUPERVISION

Office hours	No
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

Hermann Kopetz Real-Time Systems: Design Principles for Distributed Embedded Applications 1441982361 978-1441982360
Peter Marwedel Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems 9400702566 978-9400702561
Alan Burns Real Time Systems & Programming Language 0321417453 978-0321417459
Zohar Manna, Amir Pnueli Temporal Verification of Reactive Systems: Safety 0387944591 978-0387944593
Zohar Manna, Amir Pnueli The Temporal Logic of Reactive and Concurrent Systems: Specification 0387976647 978-0387976648
Edmund M. Clarke Jr., Orna Grumberg, Doron A. Peled Model Checking 0262032708 978-0262032704
Wan Fokkink Introduction to Process Algebra 354066579X 978-3540665793
Glynn Winskel Formal Semantics of Programming Languages 0262731037 978-0262731034

Ressources en bibliothèque

- Design Principles for Distributed Embedded Applications / Kopetz
- Embedded System Design / Marwedel
- Real Time Systems And Programming Language / Burns
- Temporal Verification of Reactive Systems / Manna
- The Temporal Logic of Reactive and Concurrent Systems / Manna
- Peled Model Checking / Grumberg
- Introduction to Process Algebra / Fokkink
- Formal Semantics of Programming Languages / Winskel

Références suggérées par la bibliothèque

Moodle Link
http://moodle.epfl.ch/course/view.php?id=13958

Videos
http://artist-summer-school.epfl.ch/speakers

CREDITS AND WORKLOAD

Credits	4
Total workload	120h
Exam session	Summer
Type of assessment	During the semester