Introduction

Lecture #1 of Advanced Model Checking

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Lehrstuhl 2: Software Modeling & Verification

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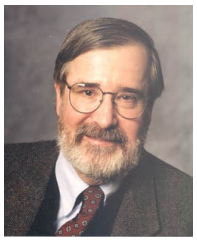
Model checking

- Automated model-based verification and debugging technique
  - model of system = Kripke structure ≈ labeled transition system
  - properties expressed in temporal logic like LTL or CTL
  - provides counterexamples in case of property refutation
- Various striking examples
  - Needham-Schroeder security protocol, storm surge barrier, C code
- 2008: Pioneers awarded prestigious ACM Turing Award



Course topics

- Abstraction
  - bisimulation, simulation, minimization algorithms
  - stutter-bisimulation, stutter trace-equivalence, divergence
  - preservation of temporal logical formulae
- Partial-order reduction
  - independence, ample set method, branching-time POR

Course topics

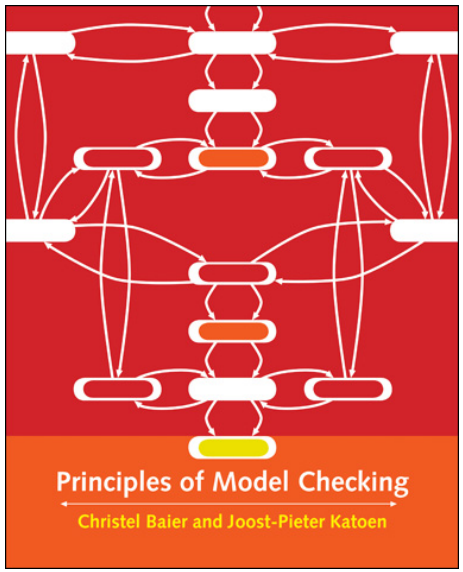
- Reduced binary decision diagrams
  - Boolean functions, operations, CTL model checking with ROBDDs
- Timed automata
  - semantics, region equivalence, timed reachability, zone automata, DBMs

Course organization

- Lectures: twice per week
  - Monday 13:30–15:00 (AH1)
  - Tuesday 8:15 - 9:45 (AH2)
  - Check web-page for dates!
- Exercises: once per week (Wed 13:30, AH3, start: April 18)
  - marked exercises (50% of points needed + one example on board)
  - assistent: Souymodip Chakraborthy, Falak Sher and Haidi Yue
- Exam: week xx and (repetition in) week yy
- Credits: 6 credits (M.Sc/B.Sc), 8 credits (Diplom)*

* extra reading material provided for oral examination

Principles of Model Checking



CHRISTEL BAIER

TU Dresden, Germany

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"This book offers one of the most comprehensive introductions to logic model checking techniques available today. The authors have found a way to explain both basic concepts and foundational theory thoroughly and in crystal clear prose. Highly recommended for anyone who wants to learn about this important new field, or brush up on their knowledge of the current state of the art."

(**Gerard J. Holzmann, NASA JPL, Pasadena**)

Course material

- Course material:
  - book “Principles of Model Checking” (Baier & Katoen)
  - several copies are available in CS library
- Detailed overview:
  - Section 6.7: Symbolic model checking
  - Chapter 7: Abstraction
  - Chapter 8: Partial-order reduction
  - Chapter 9: Timed automata
  - Chapter 10: Probabilistic models*

* extra reading material for 8 credit course

Course Prerequisites

- Mandatory courses:
  - formal languages and automata theory, and
  - complexity theory and decidability, and
  - algorithms and data structures
- Preferred courses:
  - introduction to model checking, or
  - automata and reactive systems

Follow-up Courses

- Model Checking Lab
  - solve practical model-checking problems
  - using state-of-the-art model checkers
- Modeling and Analysis of Probabilistic Systems
  - compositional modeling of probabilistic systems
  - model checking of probabilistic models
- Automata Theory Courses
  - applied automata theory, infinite computations, . . .

Questions?