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
  - Tuesday 14:15–15:45 (5052)
  - Wednesday 10:15 - 12:45 (9U10)
  - Check web-page for dates!

- **Exercises**: once per week (Wed 14:15–15:45, 4201b, start: Oct 26)
  - marked exercises (40% of points needed)
  - assistants: Matthias Volk and Tim Quatmann

- **Exam**: to be determined

- **Credits**: 6 credits (M.Sc/B.Sc)
Principles of Model Checking

CHRISTEL BAIER
TU Dresden, Germany

JOOST-PiETER KATOEN
RWTH Aachen University, Germany
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
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
Related Courses

- Modeling and Verification of Probabilistic Systems
  - compositional modeling of probabilistic systems
  - model checking of probabilistic models

- Automata Theory Courses
  - applied automata theory, infinite computations, . . .

- Modeling and Analysis of Hybrid Systems
Advanced model checking

- hybrid automata, reachability in hybrid automata, decidability . . .

- **Satisfiability Checking**
  - SAT solving algorithms, usage of SAT solving in verification . . .
Questions?