Software Verification and Validation: Course overview

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Administrative data

- Class schedule in 2018
  - Wednesday: 14:15-16:00, room I.L.405.
  - Thursday: 16:15-18:00, room I.L.405.
- Official holidays (no classes)
  - Sept. 20., Nov. 1., Nov. 14.
- Additional working day (instead of Oct. 22.)
  - Saturday, Oct. 13.: Thursday schedule (16:15-18:00. I.L.405)
- Web page of the course
  - https://inf.mit.bme.hu/en/edu/courses/swvv
  - Uploaded as the course advances:
    - Course material (slides, background materials)
    - News and announcements
    - Previous homework presentations
    - Exam topics

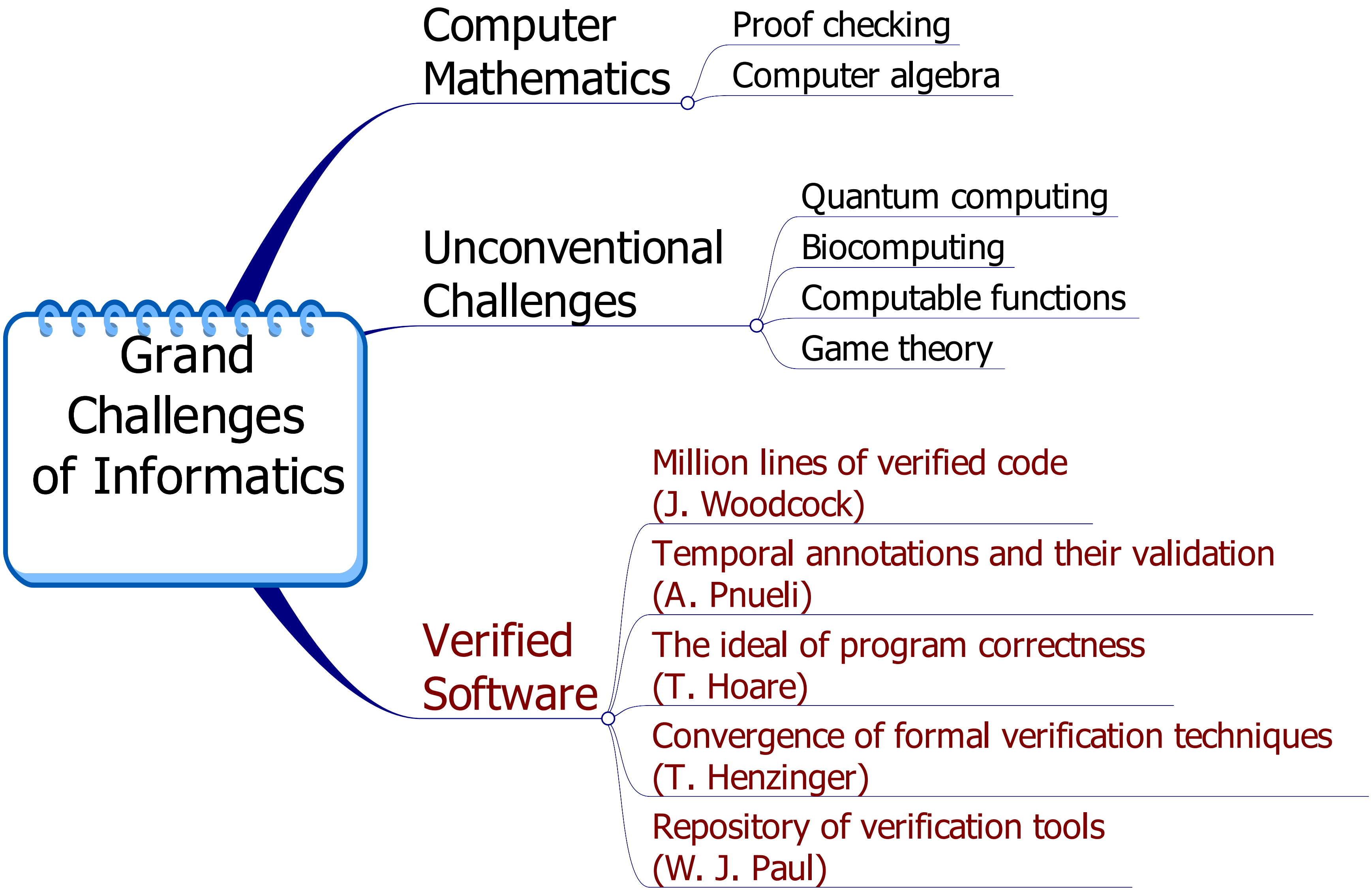
Assessment

- During the semester: Three options for homework assignment
  1. Oral presentation of a V&V case study based on your own work
  2. Oral presentation of a V&V case study based on selected literature (journal or conference paper presenting a case study)
  3. Submission of a short essay (4-5 pages) that summarizes a case study based on selected literature
- In the examination period: Oral exam based on a list of topics
  - Exam topics are given in pairs (known in advance)
  - In case of having oral presentation (option 1 or 2) during the semester, only one of the topics shall be answered
- To do:
  - Negotiate the topic of your oral presentation / abstract with the instructor (in email: <majzik@mit.bme.hu>)
  - Deadline: October 31, 2018
  - Homework presentations: in the last weeks of the semester

Motivations and goals of the course

- Increasing costs of design faults in software; this way it is important to
  - verify that the design and implementation are correct w.r.t. the specification
  - perform verification in each phase of the development (not only testing the implementation)
  - validate the product or prototype w.r.t. user requirements and expectations
- Systematic overview and assessment of verification and validation methods and techniques
  - Classic methods: review, testing, …
  - Formal methods: mathematically precise techniques based on design models, to prove design correctness

SW verification – Grand Challenges of Informatics



Grand Challenges of Informatics

Computer Mathematics

- Proof checking
- Computer algebra

Unconventional Challenges

- Quantum computing
- Biocomputing
- Computable functions
- Game theory

Verified Software

- Million lines of verified code (J. Woodcock)
- Temporal annotations and their validation (A. Pnueli)
- The ideal of program correctness (T. Hoare)
- Convergence of formal verification techniques (T. Henzinger)
- Repository of verification tools (W. J. Paul)

Knowledge to be obtained

- Participants of the course will be able to
  - Understand the role, advantages and limitations of various verification and validation (V&V) techniques
    - → Select proper techniques for each development phase
  - Plan and integrate V&V processes that support development processes
  - Understand the mathematical background of emerging techniques (e.g., formal verification, static source code analysis, model based test case generation)
  - Know typical tools that support V&V techniques
- Background included from courses:
  - Software and System Verification (testing techniques)
  - Formal Methods (temporal logic, model checking)

Synopsis

- Introduction
- Verification in the requirement specification phase
- Architecture verification and evaluation
- Verification of the detailed design
  - Classic techniques
  - Formal methods: model checking, equivalence checking
  - Advanced methods: formal verification of extra-functional properties and timed behavior, handling complex designs (large state spaces)
- Verification of the source code
  - Code review, abstract interpretation, symbolic execution
  - Classic techniques of proving program correctness
- Testing and test design
  - Test case generation at unit level
  - Integration and system testing
  - Model based testing and test case generation
- Validation and assessment
- V&V in the maintenance phases
- Integrated approaches (esp. formal frameworks)