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Week 0:

Mon, 5 August 2019 - Sat, 10 August 2019

Week 1: Introduction

Mon, 12 August 2019 - Fri, 16 August 2019




We will draw a connection between programs and models in this week.

- **File: Seshia2018_Chapter_ModelingForVerification.pdf**
Reading on modeling the behavior of programs via state transition systems. The reading is useful to understand how state transition systems can be a unified modeling formalism.
- **Web Lecture: Lecture 1 from 2018**
Web-cast of 2018 week 1 lecture
- **File: 4211-L1-ModelExtraction.ppt**
Lecture notes

Week 2: Temporal Logics - I

Mon, 19 August 2019 - Fri, 23 August 2019





Temporal logics will be introduced as property specification language. This gives a formal flavor of software requirements

- **Web Lecture: CS4211 Week 2 Lecture 2019 Webcast**
Transition system models (first hour) + Temporal Logics
- **File: TLMC.PDF**
Reading on Temporal Logics and Model Checking, excerpted from the book "Model Checking" by Clarke, Grumberg and Peled, published 1999.
- **File: 4211-L2-TemporalLogics.pptx**
Lecture notes

Week 3: Temporal Logics - II

Mon, 26 August 2019 - Fri, 30 August 2019

This lecture will cover branching time logics, and fixed point characterizations

- **Web Lecture: CS4211 Week 3 Lecture 2019 Webcast**
Temporal Logics
- **File: Clarke2018_Chapter_IntroductionToModelChecking.pdf**
General introduction to Model checking. The first author of the article is credited to be one of the inventors of model checking and received the Turing Award.
- **File: TLMC.PDF**
Reading on Temporal Logics and Model Checking, excerpted from the book "Model Checking" by Clarke, Grumberg and Peled, published 1999.
- **File: 4211-L2-TemporalLogics.pptx**
Lecture notes

Week 4: Model Checking Algorithms

Mon, 2 September 2019 - Fri, 6 September 2019

An algorithmic treatment for checking temporal logic properties of finite state machines.

**File: RecursiveCharacterization.pdf**

The reading for the mathematical part on "Fixed Point Characterizations" discussed in week 4. The material for this appears in the slide deck "4211-L2-TemporalLogics" slide 70-85

**Web Lecture: CS4211 Week 4 Lecture 2019 Webcast**

Model Checking Algorithms

**File: TLMC.PDF**

Reading on Temporal Logics and Model Checking, excerpted from the book "Model Checking" by Clarke, Grumberg and Peled, published 1999.

**File: 4211-L4-Checking.ppt**

Lecture notes

Week 5: Model Checking tools

Mon, 9 September 2019 - Fri, 13 September 2019

An introduction to the SPIN model checker and its underlying algorithm.

Demo of SPIN will be done in class.

Please see:

Files under the folder **SPIN-files** in Luminus

The tool: <http://spinroot.com/spin/whatispin.html>

**File: SPINieee97.pdf**

A basic reading about SPIN model checker

**Web Lecture: CS4211 Week 5 Lecture 2019 Webcast****File: 4211-L5-SPINChecker.pptx**

Lecture notes

**File: Spin Tutorial.pdf**

Material on SPIN model checker

**File: Holzmann2018_Chapter_Explicit-StateModelChecking.pdf**

Model checking algorithm implemented inside the SPIN model checker. We will use the SPIN checker for the assignment in CS4211.

Week 6: Visual Requirements

Mon, 16 September 2019 - Fri, 20 September 2019

Finish the discussion on Model Checking tools.

Discussion on Visual temporal logics or Live Sequence Charts.

Any demo of SPIN not done in week 5 will be done in this week.

5 marks Quiz is conducted in this week.

Assignment using SPIN model checker is posted.

**File: AirttrafficcontrolSampleReq.pdf**

Sample Requirements Document for weather control subsystem

**Web Lecture: CS4211 Week 6 lecture 2019 webcast**

Visual Requirements

**File: Introduction to Assignment.pdf**

Slides explaining the assignment

**File: assignment.pdf**

Description of assignment using SPIN model checker

**File: LSCs.pdf**

"Live Sequence Charts: Breathing Life into Message Sequence Charts", by Damm and Harel published 2001. Live Sequence Charts provide a visual formalism for capturing requirements.

**File: 4211-L6-Req.pptx**

Lecture notes

Recess Week

Sat, 21 September 2019 - Sun, 29 September 2019

No lectures will be held in this week.

**Week 7: Semantics of Modeling Notations**

Mon, 30 September 2019 - Fri, 4 October 2019

Semantics of formal design models will be covered this week.

Reading: Excerpt from my book "Embedded systems and software validation", Elsevier, Morgan Kaufmann, 2009.

**Web Lecture: CS4211 Week 7 Lecture 2019 Webcast**

Semantics of UML diagrams used in software design

**File: 2018-midterm-answers.pdf**

Midterm examination from last year with answers

**File: Modeling.pdf**

Excerpts from the book "Embedded Systems and Software Validation" by Abhik Roychoudhury, Elsevier, Morgan Kaufmann Systems-on-Silicon Series, 2009

**File: 4211-L7-Models.ppt**

Lecture notes

Week 8: Midterm Examination

Mon, 7 October 2019 - Fri, 11 October 2019

The midterm examination is in week 8. All materials up to and including Model checking tools will be covered. If any aspect of these materials are not covered by week 6 but are covered in week 7, they are still included in the syllabus of the midterm exam since the midterm is only in week 8. The topic allocated in week 7 (Semantics of modeling notations) is not included in the syllabus of the midterm examination.

**File: Mid-Answers.docx**

Sample answers to the midterm questions

Week 9: Theorem Proving and Hoare Logic - I

Mon, 14 October 2019 - Fri, 18 October 2019

Hoare style theorem proving to prove program properties will be covered.

**Web Lecture: CS4211 Week 9 Lecture 2019 Webcast**

Revision of UML semantics (first hour) + Discussion on Hoare Logic

**File: Reviseweek7.pptx**

Exercises discussed in the revision hour of week 9. The material was covered in the week 7 lecture.

File: program_verification.pdf



Reading on Hoare Logic and program verification, excerpted from the book "Logic in Computer Science" by Huth and Ryan, published 1999.



File: 4211-L9-Hoare.pptx
Lecture notes

Week 10: Theorem Proving and Hoare Logic - II, Software Model Checking

Mon, 21 October 2019 - Fri, 25 October 2019

We will continue and finish discussion on Hoare Logic, for proving properties of programs using a proof system containing proof rules for various kinds of statements in a programming language.

The discussion on software model checking was initiated in this lecture, and will be completed in the next lecture.



File: Reviseweek9.pptx
Revision exercises discussed in week 10 based on week 9 material on Hoare Logic and Theorem Proving.



File: 4211-L10-SWMC.pptx
Lecture notes



Web Lecture: CS4211 Software Model Checking on 10/21/2019 (Mon)
Week 10 Lecture webcast 2019



File: program_verification.pdf
Reading on Hoare Logic and program verification, excerpted from the book "Logic in Computer Science" by Huth and Ryan, published 1999.



File: 4211-L9-Hoare.pptx
Lecture notes

Week 11: Software Model Checking

Mon, 28 October 2019 - Fri, 1 November 2019

Model checking is adapted to programs instead of state machines.

Monday Oct 28 is public holiday. Hence a make-up lecture will be held the week before on Saturday 26 October at 10 am in Meeting Room 1 COM1 03-19.

The assignment using SPIN will be due in this week Friday 1st Nov.



Web Lecture: CS4211 Make-up Lecture Software Model Checking
Make-up Lecture on 26 October due to holiday on Monday 28 October



File: 4211-L10-SWMC.pptx
Lecture notes



File: SWMC2.pdf
Basic reading on software model checking based on an article published in 2001 by researchers from Microsoft Research.



File: SWMC1.pdf
Overview article on Software Model Checking appearing in the Communications of the ACM magazine.

Week 12: Symbolic Execution

Mon, 4 November 2019 - Fri, 8 November 2019

We discuss symbolic execution as a more formal or systematic way of conducting software testing.



Web Lecture: CS4211 Lecture on 11/4/2019 (Mon)
Webcast of week 12 lecture on symbolic execution in 2019

**File: Reviseweek11.pptx**

Revision Exercises on Symbolic Execution

**File: 4211-L11-Symbolic.pptx**

Lecture notes

**File: SymbolicExecution.pdf**

Reading on symbolic execution from the book "Testing and Analysis" by Pezze and Young.

**File: DART.pdf**

Directed Automated Random Testing, by Godefroid, Klarlund and Sen, PLDI 2005

Week 13: Revision

Mon, 11 November 2019 - Fri, 15 November 2019

Revision of materials will be conducted via questions and answers.

**File: assessment17.pdf****File: assessment18.pdf****Reading Week**

Sat, 16 November 2019 - Fri, 22 November 2019

**Examination Week**

Sat, 23 November 2019 - Sat, 7 December 2019

