

CAS 703 Software Design

Term 2, 2020-21

Instructor: Prof. Richard Paige

Office: ITB 159A

Office Hours: by appointment (typically available on days with lectures)

Email: paigeri@mcmaster.ca

Course website: on Avenue to Learn

Lectures: (starting week of 4 January) Wednesday and Friday 1030-1200 in ITB 222

Notes: midterm recess 15-19 February (no classes)

Course Outline: introduction to software design principles and processes; design by contract and constraint languages; introduction to modeling, metamodeling and Model-Driven Engineering; model validation; model transformation; model-to-text transformation; model querying; domain-specific languages; concrete vs abstract syntax; EMF; GMF; Epsilon.

Textbooks:

I will not teach directly from a textbook. You may find reading parts of the following books helpful.

- Jordi Cabot, Manuel Wimmer and Marco Brambilla, *Model-Driven Software Engineering in Practice*, second edition, Morgan and Claypool, 2017.
- John Ousterhout, *A Philosophy of Software Design*, Yakanyam Press, 2018.

Lecture notes: made available on the course website hopefully just before each lecture.

Tools: we will be using Eclipse, the Eclipse Modeling Framework (EMF), and Epsilon (<http://www.eclipse.org/epsilon>). You should download these tools – they're open-source and free – as early as possible in the term.

Prerequisite knowledge and experience:

Basic knowledge of discrete math (particularly basic propositional logic), data structures and algorithms. Familiar with key ideas in software engineering and object-oriented programming. Comfortable with Java programming or in a similar language.

Learning objectives:

You will know and understand:

- Key principles of software design, including decomposition and encapsulation.
- Design patterns and antipatterns, and their role in software design.
- Constraints and constraint languages.
- Design-by-contract.
- Fundamentals of modeling and Model-Driven Engineering.
- The different operations in model management and how they can be implemented.
- The differences between a model and metamodel.
- The definition of a domain-specific language, and the primitives used to build them.

Upon completion of this course, participants should be able to:

- Apply software design principles and patterns in constructing software systems.
- Use constraints and constraint languages to more precisely specify software systems.
- Apply design-by-contract as part of the software design process.
- Specify a domain-specific language.
- Implement operations on models, including queries, transformations and constraints.
- Differentiate abstract and concrete syntax, as well as models versus metamodels.
- Build an editor for a domain-specific language using Eclipse-based modeling tools.

Evaluation:

- Attendance and participation: 15%
- Paper presentation: 25%
- Term project: 60%

Every student will be assigned a classic paper in software design to read, analyze, and present to the rest of the class. Presentations will be marked on comprehensiveness, clarity of analysis, presentation style, and use of visual aids, and will typically be 15 minutes plus 5 minutes for questions.

The project will involve building a domain-specific language and editor for that language, using the MDE tools taught in class. Projects will be presented in the last few weeks of term to the class (schedule to be announced). Your project mark will be based on your submitted deliverables (an editor for your DSL plus a very short report – together worth 75% of your project grade) and your presentation (worth 25% of your project grade).

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.**

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the *Academic Integrity Policy*, located at <https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/>

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

AUTHENTICITY / PLAGIARISM DETECTION (boilerplate text from University policy follows)

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity

For 703: I will not be using Turnitin.com or other automatic detection software. I expect you to respect your own learning and the University's policies on academic integrity.

COURSES WITH AN ON-LINE ELEMENT

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to

this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

ONLINE PROCTORING

(This is what the University policy says.)

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

For 703: we don't have exams and won't use proctoring software in any event, because it's terrible and intrusive.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the *Code of Student Rights & Responsibilities* (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's *Academic Accommodation of Students with Disabilities* policy.

REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM WORK

McMaster Student Absence Form (MSAF): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

For 703: Please contact the instructor as soon as you know you will be MSAFing a piece of work, and before you submit the form – it may be that we can work out something sensible without having to go through a formal process.

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office ***normally within 10 working days*** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors.

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.