Course Outline

Instructors
Dr. Farhana Islam, E-mail: farhanaisalama2@email.carleton.ca
Office hours: Thursday, 3:00 – 4:00 pm or by appointment (request by e-mail)
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Course Number and Calendar Description
Course Reference Number (CRN): 15279
Calendar Description: This course will introduce students to the advanced development of real-time and distributed systems by model-driven development that shifts the focus from coding to modeling. It covers different types of models and generating code by model transformations. It also includes design patterns for distributed/concurrent systems with examples from communication applications and design issues for reusable software.
Prerequisite(s): knowledge of UML and operating systems concepts, and permission of the Department.

Course Objectives
A paradigm shift is taking place in the field of software development moving the focus and development effort from code to models. The Model-Driven Development (MDD) paradigm promotes the vision that software development should be based on models throughout the entire system lifecycle: from business modeling to requirement analysis, system design, component construction, assembly, integration, code generation, deployment, management, and evolution.
Models provide abstractions of a physical system that allow engineers to reason about that system by ignoring extraneous details while focusing on relevant ones. All forms of engineering rely on models to understand complex, real-world systems. Models are used in many ways: to predict system qualities, reason about specific properties when aspects of the system are changed, etc.
The building of software systems can be organized around a set of models by imposing a series of transformations between models. In the MDD approach, the code that represents the final software product is generated by a series of model transformations implemented by tools. Models also facilitate the analysis of non-functional properties (NFPs), such as performance, scalability, reliability, security, safety, etc. To evaluate a software model for NFPs, analysis models are ideally generated automatically from the software models used for development by model transformations and become part of the model suite maintained with the product.
UML and other Object Management Group standards provide the foundation for OMG's approach to MDD, called Model-Driven Architecture (MDA). The instructor of the course has been active in OMG working groups as a contributor to two OMG standards, the “UML Profile for Schedulability Performance and Time” (SPT) and “UML Profile for Modeling and Analysis of Real-Time Embedded systems” (MARTE), whose main goal is to extend UML with concepts necessary for the modeling and analysis of real-time and distributed systems.

The goal of the course is to teach students concepts related to MDD, such as software modeling languages (e.g., UML), metamodels, extending UML with standard mechanisms, introduction to model transformations principles and model transformation languages.

**Learning Outcomes**

Students will have the knowledge of Model Driven Development, metamodels, UML. They will learn to use UML for the development of real-time systems. They will have the knowledge of extending UML through profiling. They will learn the concepts and applications of model transformation languages.

**Reading**

The following titles cover issues of interest covered in this course:

- Selected papers from literature.
- Standard documents for UML and MARTE (links provided on the course website).

**Evaluation and Grading Scheme**

- **Assignments (20%)** (up to three): UML 2 and analysis and design of real-time systems and UML profiles.
- **Term Project (35%)**: each student will take a deeper investigation of a specific topic related to model-driven development. Examples of project topics: a) model-driven design of a problem of your choice with a UML 2 tool, b) defining and using UML profiles, c) model-to model transformations (with languages such as Epsilon ETL, ATL or QVT), model to text transformation, etc.
- **Class Presentation (10%)**: each student will make a class presentation of their project. Both the oral presentation and the slides will be evaluated by the instructor and the peers, based on a common evaluation form.
- **Final Exam (35%)**.
To pass the course, a student must pass the final examination, hand in most of the assignments and the project, and do the presentation.

The final examination is for evaluation purposes only and will not be returned to students. You will be able to make arrangements with the instructor or with the department office to see your marked final examination after the final grades have been made available.

**Week-by-Week breakdown**

Week 1: Introduction to MDD and Class Diagrams  
Week 2: More on Class Diagrams, Structure Diagrams and State Machine Diagrams  
Week 3: More on State Machine Diagrams and Sequence Diagrams  
Week 4: Activity Diagrams and Use Case Diagrams  
Week 5: More on Use Case Diagrams and COMET methodology  
Week 6: Introduction to Metamodeling, Introduction to UML Profile  
Week 7: Reading week  
Week 8: Introduction 2 UML 2 Metamodel  
Week 9: MARTE Profile Tutorial  
Week 10: Model Transformation from SysML to Fault Trees  
Week 11: Model Transformation from Activity Diagrams to Petri Nets  
Week 12: Model Transformation from UML+MARTE to LQN and Students presentation  
Week 13: Students presentation  
Week 14: Students presentation

**General Regulations**

**Student Responsibility:** It is the student's responsibility to remain informed of all rules, regulations and procedures required by their program and by the Faculty of Graduate and Postdoctoral Affairs. Ignorance of regulations will not be accepted as a justification for waiving such regulations and procedures.

**Academic Integrity:** Students should be aware of their obligations with regards to academic integrity. Please review the information about academic integrity at: [https://carleton.ca/registrar/academic-integrity/](https://carleton.ca/registrar/academic-integrity/). This site also contains a link to the complete Academic Integrity Policy that was approved by the University's Senate.

**Plagiarism:** Plagiarism (copying and handing in for credit someone else's work) is a serious instructional offense that will not be tolerated.

**Deferred Term Work:** Students who claim illness, injury or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for making alternate arrangements with the instructor and in all cases this must occur no later than three (3.0) working days after the term work was due. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule. For more information, see the current *Graduate Calendar, Academic Regulations of the University, Section 9.3.*
**Academic Accommodation:** You may need special arrangements to meet your academic obligations during the term. You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at [http://www.carleton.ca/equity/](http://www.carleton.ca/equity/). For an accommodation request, the processes are as follows:

- **Pregnancy obligation:** write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see [https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf](https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)

- **Religious obligation:** write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see [https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf](https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)

- **Academic Accommodations for Students with Disabilities:** The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or [pmc@carleton.ca](mailto:pmc@carleton.ca) for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult [https://carleton.ca/pmc/students/dates-and-deadlines/](https://carleton.ca/pmc/students/dates-and-deadlines/) for the deadline to request accommodations for the formally-scheduled exam (if applicable).

- **Survivors of Sexual Violence:** As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton’s Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: [https://carleton.ca/sexual-violence-support/](https://carleton.ca/sexual-violence-support/).

- **Accommodation for Student Activities:** Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see [https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf](https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf)

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