Carleton University  
Department of Systems and Computer Engineering  
SYSC 4120 - Software Architecture and Design - Fall 2019  
Course Outline

Instructor Information and Office hours:

Prof. Samuel A. Ajila - Office: MC 7038, Office Hours: Tuesday 11:00 am to 12:00 noon

TA Information and Office hours:

TBD & TBA (in class)

Calendar description
Introduction and importance of software architectures and software system design in software engineering. Current techniques, modeling notations, method processes and tools used in software architecture and system design. Software architectures, architectural patterns, design patterns, software qualities, software reuse. [http://calendar.carleton.ca/undergrad/courses/SYSC/](http://calendar.carleton.ca/undergrad/courses/SYSC/)

Includes: Experiential Learning Activity
Precludes additional credit for SYSC 3020, SYSC 4800 and COMP 3004.

Prerequisite(s): SYSC 3120.

Lectures three hours a week, laboratory three hours alternate weeks.

Students should:
- Understand the basic principles of requirement engineering – requirement elicitation, analysis, and simple design;
- Ability to use effectively Unified Modeling Language (UML) – use case modeling, object interactions, class diagrams, and state machine;
- Understanding of static modeling vs dynamic modeling; and
- Have an elementary understanding of the application of formal methods to systems design.
- Able to program in Java and/or C++ or any other high level OO program language.

Students who have not satisfied the prerequisites for this course must either withdraw from the course or obtain a prerequisite waiver by visiting the Engineering Undergraduate Academic Support Office.

Course Objectives

This course focuses on software systems design, software architecture, and object design. The objectives are:

- Study software system design activities using architectural and design patterns, and the role of object design in software development.
• Master model-based software system design by using the UML and formal methods (e.g. OCL, LTL, 1st Order Logic);

Learning Outcomes

1. Be able to use domain knowledge to identify, formulate, analyze complex software systems requirement
2. Ability to clarify systems requirement definition and to deal with missing and/or badly-defined requirements
3. Be able to make reasonable assumption about systems requirements and design a solution that best match the requirements
4. Conduct complex systems design using appropriate engineering techniques and tools (e.g. UML, LTL, OCL, 1st Order Logic, etc.). Specifically, UML and OCL will be used in this course because LTL and 1st Order Logic were introduced in SYSC 3120.
5. Be able to measure, verify, and validate the end product (i.e. the software system).

Graduate Attributes (GA’s)

The Canadian Engineering Accreditation Board requires graduates of engineering programs to possess 12 attributes at the time of graduation. Activities related to the learning outcomes listed above are measured throughout the course and are part of the department’s continual improvement process. Graduate attribute measurements will not be taken into consideration in determining a student’s grade in the course. For more information, please visit: https://engineerscanada.ca/.

<table>
<thead>
<tr>
<th>Graduate Attribute</th>
<th>Learning Outcome(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8.S Knowledge Base: Discipline-Specific Concept SCE-5: Software Engineering</td>
<td>1</td>
</tr>
<tr>
<td>4.1 Clear design goals</td>
<td>3</td>
</tr>
<tr>
<td>4.2 Detailed design specifications and requirements</td>
<td>2</td>
</tr>
<tr>
<td>4.4 Design solution(s)</td>
<td>4</td>
</tr>
<tr>
<td>4.5 Design implementation / Task(s) definition</td>
<td>3 &amp; 4</td>
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<tr>
<td>4.6 Alternate solution(s) definition</td>
<td>5</td>
</tr>
<tr>
<td>4.7 Evaluation based on engineering principles</td>
<td>1</td>
</tr>
</tbody>
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Textbooks (or other resources)


Other useful readings (referenced) include:

Evaluation and Grading Scheme

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Weights</th>
<th>Dates</th>
<th>Remarks</th>
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</thead>
<tbody>
<tr>
<td>Proj-like Assignments</td>
<td>10%</td>
<td></td>
<td>All students are expected to attend and do labs. A no show will be graded 0 (zero).</td>
</tr>
<tr>
<td>Assign#1</td>
<td>5%</td>
<td>Sept 23</td>
<td>Oct 7</td>
</tr>
<tr>
<td>Assign#2</td>
<td>5%</td>
<td>Nov 11</td>
<td>Nov 25</td>
</tr>
<tr>
<td>Labs</td>
<td>10%</td>
<td></td>
<td>Each lab is worth 2.5% and the best 4 (FOUR) labs will be chosen. <strong>So, there is NO DIFERRED LAB</strong></td>
</tr>
<tr>
<td>Mid-term Exam</td>
<td>20%</td>
<td>Oct. 17, 2019 in class (2:30 pm to 4:00 pm)</td>
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<tr>
<td>Final Exam</td>
<td>60%</td>
<td>The final exam will be scheduled by the University</td>
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- **L1O laboratory dates:** 10/09; 24/09; 08/10; 29/10; 12/11; and 26/11 → 2019
- **L1E laboratory dates:** 17/09; 01/10; 15/10; 05/11; 19/11; and 03/12 → 2019
- All exams (midterm and final) are closed book exams.
- A student is expected to pass (i.e. obtain at least 50% in) the final exam in order to pass the course.
- Each lab is worth 2.5% and each project assignment is worth 5%. As part of engineering design training and CEAB accreditation requirements, the labs and project like assignments will be done as group work of two (2) students per group.
- The mid-term exam will be held during the regular class hours, **on Thursday, October 17, 2019**.
- In general, there is no differed mid-term exam. However, another midterm exam may be granted to a student that due to sickness could not write the midterm exam. For such student who missed the midterm due to illness, a mandatory, original, signed, and stamped Doctor sick note is required. I will NOT accept scanned or photo copies of medical certificate!
- **Note that midterm deferred exam if approved will cover everything taught in class, lab, and project assignment up to the date of the deferred exam.**
- Assignments are due at midnight of on the due date and must be submitted on the course cuLearn. Late assignments will be graded according to the following policy: a 20% penalty per day with a maximum of two late days after which the grade of 0 (zero) is assigned. The penalty starts at 12:05 am i.e. 5 minutes after mid-night due date.
- Laboratory work is due at the end of the laboratory session and must be submitted on the course cuLearn. Late laboratory work will receive a grade of 0. A lab is considered late if submitted 10 minutes after the end of lab session. **There is no deferred lab and a no show**
or absent from lab will receive a grade of 0. Although all labs are compulsory, maximum of four (4) labs will be used for the final assessment.

**Assignments:** Students are encouraged to discuss issues when working on assignments; however, you are expected to submit your own work for grading. There is a fine line between cooperating with your colleagues (discussing problems and ideas) and copying solutions (plagiarism). Not only is plagiarism an instructional offence (see the Undergraduate Calendar), but doing the assigned work by yourself is by far the best way to prepare for the exams (mid-term and final).

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**

1. Introduction to Software System Design – Week 1
2. System Design using UML and System Architecture
   a. Definition and objectives, object-oriented design with UML, architectural design, detailed design, concurrent software, safety analysis and fault tolerance. - Weeks 2 – 4
3. Object Design - Weeks 5 – 6
   a. Optimizing software architecture, optimizing class diagram.
4. Software Design Patterns - Weeks 7 – 8
5. Revisiting Design Patterns and Applications - Weeks 9 – 10
6. Other Software Engineering Issues - Weeks 11 – 12
   a. Fault tolerance, real-time systems, verification and validation, re-engineering
7. Review – Week 13

**General Regulations**

**Attendance:** Students are expected to attend all lectures and lab periods. The University requires students to have a conflict-free timetable. For more information, see the current Undergraduate Calendar, Academic Regulations of the University, Section 2.1.3, Course Selection and Registration and Section 2.1.7, Deregistration.

**Health and Safety:** Every student should have a copy of our Health and Safety Manual. A PDF copy of this manual is available online: [http://sce.carleton.ca/courses/health-and-safety.pdf](http://sce.carleton.ca/courses/health-and-safety.pdf)

**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 Undergraduate Calendar, Academic Regulations of the University, Section 4.4, Deferred Term Work.
Appeal of Grades: The processes for dealing with questions or concerns regarding grades assigned during the term and final grades is described in the Undergraduate Calendar, Academic Regulations of the University, Section 3.3.4, Informal Appeal of Grade and Section 3.3.5 Formal Appeal of Grade.

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/. 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.

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/. For an accommodation request, the processes are as follows:

- **Pregnancy or Religious obligation:** 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/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 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). Requests made within two weeks will be reviewed on a case-by-case basis. After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website (www.carleton.ca/pmc) 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/.

- **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

**Copyright on Course Materials:** The materials created for this course (including the course outline and any slides, posted notes, labs, project, assignments, quizzes, exams and solutions) are intended for personal use and may not be reproduced or redistributed or posted on any web site without prior written permission from the author(s).

**More on Attendance**
Being (consistently) late to lectures and/or labs does not show professional behavior. Moreover, those students who miss lectures and/or labs may encounter difficulties as far as their final grade is concerned since (i) a lot of the material introduced during lectures is not necessarily in the slides provided on the course web site, and (ii) questions during the final exam will target the understanding of the concepts presented in class, assignments as well as lab material.

**Expectations**
I expect the students to invest a substantial amount of time and energy in reading the textbook and doing the assignments/lab works. Looking at or just reading the slides I will provide may not be enough to achieve the level of understanding that will be required for the mid-term and final exams.

**Note: All Exams (Mid Term, Final, and Deferred)**
I (i.e. the Professor for the course) reserved the right to set the exams to cover all the materials (i.e. lecture notes, books, handouts, teaching, and reference materials) examined and covered in class, during the labs, and assignments.