SYSC 5807X: Security Engineering
Advanced Topics in Computer Systems
Course Syllabus
Winter 2020

Instructor
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Extension: 1873
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Office Hours: TBD and posted on cuLearn

Dates, Times, and Locations
Mondays 11:35AM–12:55PM
Wednesdays 11:35AM–12:55PM
Students should consult cuLearn for the locations of the lectures.

Calendar Description
Fundamentals of Security Engineering and its activities, including security evaluation, threat modelling, risk assessment, formal methods for security, and security assurance. Examination and discussion of approaches and challenges for engineering secure and trustworthy systems in a variety of application areas.

Assumed Knowledge: Upon entry into this course, students are expected to have knowledge of:
Fundamentals of computer security (cryptography, authentication, access control, etc.), Software development lifecycles, Fundamentals of software design.

Course Objectives
With security among the highest concerns for many organizations, the need for security-conscious engineers is higher than ever. It has been noted that many security issues can be avoided simply by understanding the problems involved.

This course is designed to bring an awareness of the many challenges in engineering secure and trustworthy systems. The course aims to cover a broad range of application areas suitable for a variety of student specialties and interests, including software and hardware, cyber-physical and embedded systems (e.g., automotive, aerospace, medical devices, etc.), Internet of Things (IoT), cloud computing, distributed systems, mobile devices, social networks, and critical infrastructures, among others.

It can be argued that a large number of the topics to be discussed in this course are deep and important in their own right, and that entire courses can be constructed to describe the details of each. However, this course does not intend to teach everything there is to know about system security. Rather, the primary objective of this course is to demonstrate the cross-cutting, multi-faceted, and multi-disciplinary nature of security issues that commonly span each of the aforementioned systems and domains. It also aims to illustrate the notion that each domain comes with its unique set of challenges and constraints that must be overcome to ensure the development and maintenance of a secure and trustworthy system. This course aims to have students explore security issues and understand common techniques and approaches for solving these problems, so that they may be better equipped as security-conscious engineers.
Learning Outcomes

Upon completion of this course, students should know and understand:

1. the cross-cutting, multi-faceted, and multi-disciplinary nature of security;
2. the role of security engineering and its main activities in the development of secure and trustworthy systems;
3. the overarching challenges faced by security engineers;
4. the unique challenges and constraints faced by different application domains for achieving security;
5. common approaches and techniques for addressing typical security challenges;
6. open research problems in the area of security engineering.

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

7. describe the common security challenges faced in the development of secure and trustworthy systems;
8. analyze and evaluate the security of a given system to identify security risks and threats;
9. propose recommendations for addressing security challenges in the development of secure and trustworthy systems.

Textbook

The following textbook is strongly recommended and is available at the Carleton bookstore.


Note: This course may not always follow the textbook closely.

Additional References & Resources

Throughout this course, the following useful references and resources may also be used:


Course Webpage

The course announcements, course syllabus, lecture slides used in class, and any material needed or used in the course project, can be found on cuLearn. It is the student’s responsibility to be aware of the information on cuLearn, and to check regularly for announcements.
Email Correspondence

In order to ensure that you receive a timely response to emails that are sent to the instructor or TAs, please include [SYSC 5807X] in the **Subject**, as emails will be filtered using this identifier.

Students are expected to show and maintain a high-level of professionalism in all email correspondence. This means that emails should include a proper salutation and sign-off/signature, and should refrain from using slang, texting abbreviations and acronyms, and emojis/emoticons.

Note that email is not the best medium for technical questions. Technical questions submitted by email will be answered at the beginning of the next lecture.

Tentative Course Outline

Note that this course outline is subject to change as circumstances dictate.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>Security Engineering and its Activities</td>
</tr>
<tr>
<td>2</td>
<td>Overarching Challenges faced by Security Engineers</td>
</tr>
<tr>
<td>3</td>
<td>Management and Development of Secure and Trustworthy Systems</td>
</tr>
<tr>
<td>4</td>
<td>Threat Modeling and Risk Assessment</td>
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<tr>
<td>5</td>
<td>Security Design Principles and Patterns</td>
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<tr>
<td>6</td>
<td>Security Evaluation</td>
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<tr>
<td>7</td>
<td>Security Metrics and Measures</td>
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<tr>
<td>8</td>
<td>Security Assurance</td>
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<tr>
<td>9</td>
<td>Formal Methods for Security</td>
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<tr>
<td>10</td>
<td>Tools for Formal Security Analysis</td>
</tr>
<tr>
<td>11</td>
<td>Applications of Security Engineering</td>
</tr>
<tr>
<td>12</td>
<td>Applications of Security Engineering</td>
</tr>
</tbody>
</table>

Evaluation and Grading Scheme

Course Project (35%)

Students will be required to complete a course project worth 35% of the final grade. The project will be conducted in teams of 2-3 (depending on course enrolment) and will involve a proposal and a project report. The project components will be evaluated according to the following scheme:

<table>
<thead>
<tr>
<th>Project Component</th>
<th>Weight</th>
</tr>
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<tbody>
<tr>
<td>Project Proposal</td>
<td>5%</td>
</tr>
<tr>
<td>Final Report</td>
<td>30%</td>
</tr>
</tbody>
</table>

See the project related material on cuLearn for further information about the course project as well as important dates and deadlines.

Paper Reviews (15%)

Students will be required to complete three (3) paper reviews. Each paper review is worth 5% of the final grade. Reading lists for each of the paper review assignments will be posted on cuLearn, and completed reviews will be due on the following dates:

<table>
<thead>
<tr>
<th>Review #</th>
<th>Category</th>
<th>Due Date</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Threat Modeling and Secure Design</td>
<td>February 1, 2020</td>
</tr>
<tr>
<td>2</td>
<td>Evaluation and Assurance</td>
<td>March 1, 2020</td>
</tr>
<tr>
<td>3</td>
<td>Formal Methods for Security</td>
<td>April 1, 2020</td>
</tr>
</tbody>
</table>

Each review must be submitted on cuLearn using the supplied form.
Midterm Exam (15%)
There will be one (1) midterm examination. It will be a closed book examination. The midterm exam is worth 15% of the final grade and will take place on Wednesday, February 12, 2020, from 11:25AM–12:55PM (during the lecture time). The location of the midterm exam will be announced on cuLearn in due time. The midterm exam will cover the material from the lectures, labs, assignments, and the required textbook.

Final Exam (35%)
The final examination will be scheduled by the Registrar’s office in the usual way. It will be two (2) hours in duration and will cover the material from the lectures, projects, and the required textbook. The final exam counts for 35% of the final grade. 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.

Instructor Expectations, Policies, and Notes

1. A regrading request of an assignment, quiz, or exam will be considered by the instructor only if it is made within the two weeks that follow the return date of the majority of the concerned assignment, quiz, or exam.

2. The instructor reserves the right to assign extra grades for extra work done by willing students. However, the work subject to extra grades will be advertised during the lectures to provide the opportunity to all students.

3. No responsibility for loss of assignments or labs can be assumed by either the instructor or the TAs. Keep copies of your own assignments and labs.

4. Students are responsible for ensuring that their assignments are submitted correctly and without corruption.

5. The lectures will not necessarily follow the order in which the topics are presented in the detailed course outline. Regular class attendance is required.

6. Significant study, reading, and group discussions outside of class are required. Looking at, or only reading the slides that are provided may not be enough to achieve the level of understanding required for the assignments and exams.

7. Students are expected to show professional behaviour. This includes being on-time for lecture, lab, and/or problem analysis sessions, meeting assignment deadlines, and maintaining a suitable level of professionalism in oral and written (email) correspondence with the instructor and TAs.

8. Students that are having difficulty with the course content are expected to seek help early. Students are encouraged to ask questions in class and/or seek help during the instructor’s office hours.

9. Suggestions on how to improve the course and the instructor’s teaching methods are always welcomed.

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.

Health & Safety: Every student should have a copy of the Health and Safety Manual. Students are reminded to consult the Health and Safety Manual should they, at any time have any questions or concerns regarding Health and Safety.
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.

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

- **Pregnancy 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, visit the Equity Services website.

- **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, visit the Equity Services website.

- **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). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC 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/.

- **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 the Senate Policy on Accommodation for Student Activities.
Copyright on Course Materials

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Students from the University of Ottawa

You can request to have access to cuLearn: please see http://gradstudents.carleton.ca/forms-policies/.