WILFRID LAURIER UNIVERSITY

LAURIER

Inspiring Lives.

Course Syllabus

CP400S Computer Security

Department of Physics and Computer Science, Faculty of Science, Waterloo
2021 Winter Semester

I acknowledge that in Kitchener, Waterloo, Cambridge and Brantford we are on the traditional territory of the Neutral, Anishnawbe, and Haudenosaunee peoples.

Instructor Information

Name: Lunshan(Shaun) Gao, PhD., P.Eng.
Email: lgao@wlu.ca
Office Location: N2091A
Weekly Office Hours: Tuesdays 5:30 pm – 7:30 pm, By Appointment

Course Information

Pre-réquisits: CP363, CP372, CP386
Course location: (Lecture: BA112, Lab: BA113) - Online
Meeting times: 4:00 pm – 5:20 pm, Tuesdays and Thursdays
Lab times: 8:30 pm – 9:20 pm, Tuesdays

Course Overview and Approach

Computer security is to protect valuable information in computer systems. The aim of this course is to provide a broad understanding of computer security and cover basic concepts, fundamental principles and practical examples of computer and network security. It also includes special software tools and practical skills for protecting computer and network systems. The topics include computer security concepts, common attack techniques such as denial of service attacks, web attacks, and malware attacks, countermeasure techniques such as firewalls, intrusion detection systems, and anti-malware scanners, symmetric key and asymmetric key cryptography algorithms, software security, operating system security, cloud and Internet of Things security. While this course mainly focuses on concepts, technical knowledge and skills, it also addresses the nontechnical aspects of computer security such as security policies and ethical issues.

The teaching approach will be class lectures and hands-on laboratory sessions. The lectures will discuss main topics in computer security, while laboratory sessions will provide hands-on experiences, practical skills and tools relevant to the main topics that are discussed in the lectures.

Course Goals and Learning Outcomes

On the successful completion of this course, students will be able to:

1. Explain basic concepts in computer security, such as threat, vulnerability, malware, firewall, IDS, denial of service (DoS) attacks, SQL injection, Cross site scripting, countermeasure.
2. Understand the basic principles and practices in computer security.
3. Compare and contrast various kinds of malware and different kinds of security threats.

4. Explain basic concepts that are used in modern cryptography including symmetric cryptography, asymmetric cryptography, digital signature algorithm, digital certificate.
5. Understand common vulnerabilities in application software and operating systems and understand the importance of the software security.
6. Understand the reasons why attackers can succeed in attacking computer systems and learn how to mitigate and prevent cyber-attacks.
7. Explain major computer network attacks that include denial of service (DoS) attack, session hijacking, DNS poisoning.
8. Explain countermeasures for network attacks, including authentication, firewall, intrusion detection system and cryptography.
9. Understand wireless network security including mechanism and weakness.
10. Explain the requirements and techniques for security management including security policies, security assessments.

Course Tools and Learning Materials

1. Reference textbook:

    1) Computer Security: Principles and Practice (Global, 4th Edition), Authors: William Stallings, Lawrie Brown. Publisher: Pearson, ISBN: 9781292220611

    2) Computer & Internet Security, A Hands-on Approach, (2nd Edition), Author: Wenliang Du, ISBN: 9781733003933

2. Lecture PowerPoint slides will be posted in MyLearningSpace

Student Evaluation

In order to complete this course, students are required to participate in regular classes, complete three quizzes, write two lab reports, and complete midterm and final exams. Please refer to the table below for details.

Evaluation scheme	Weighting	Due Date
Quizzes 3x10%	30%	Please refer to the weekly schedule
Lab reports 2x10%	20%	Please refer to the weekly schedule
Midterm	20%	Please refer to the weekly schedule
Final Exam	30%	Please refer to the weekly schedule
Total	**100%**	

Learning Activities, Assignments, Tests, Quizzes and Examinations

- All quizzes will be close book test and performed online with MyLearningSpace. Since this course introduces many important concepts in computer security, the purpose of the quizzes is to foster students' critical thinking skills and the ability to understand the important concepts in computer security.
- Six labs will be practiced in this course and two lab reports will be required. The purpose of the two lab reports is to train students communication skills and creative thinking skills. The lab reports will be delivered into MyLearningSpace, and be evaluated with the rubrics (please refer

to Appendix A). The originality of students writing will be checked by TurnItIn in MylearningSpace. A lab report template will be given in MyLearningSpace (please refer to Appendix B).

Weekly Tentative Schedule(s) (lecture and lab)

Week	Topics and chapters	Lesson Outcomes	Labs and Quizzes
Week 1: Jan. 12	Course introduction and preparation (basic protocols, OSI model, IP address)	TCP/UDP and IP protocols, OSI model, IPv4 address classes.	Lab environment setup
Jan. 14	Chapter 1, Introduction of computer security	The concept of computer security, CIA	
Week 2: Jan. 19	Chapter 2, Cryptographic tools	the concepts of symmetric key and asymmetric key cryptography	Lab 1: network utility and Wireshark
Jan. 21	Chapter 3, User authentication	authentication, multi-factor authentication, message authentication code.	
Week 3: Jan. 26	Chapter 4, Access control	Access control models	Quiz 1 (chapter 1,2,3)
Jan. 28	Chapter 5, Data base and data center security	web application security, SQL injection, cross-site scripting	
Week 4: Feb. 2	Chapter 6, Malicious software,	concepts, types of malware, and countermeasures, anti-malware scanner and its mechanism	Lab 2: Nmap
Feb. 4	Chapter 7, Denial-of-Service attacks	types, mitigations and defenses	
Week 5: Feb. 9	Chapter 8, Intrusion detection	concept, mechanism and types	Quiz 2 (chapter 4,5,6)
Feb. 11	Chapter 9, Firewall and intrusion prevention systems	concepts, types of firewalls, configurations.	
Week 6: Feb. 16	Chapter 10, Buffer overflow	concepts, and buffer overflow attacks, attacking process	Lab 3: Cross-site scripting
Feb. 18	Chapter 11, Software security	concepts, methodologies, and limitations	
Week: Feb.22-26	Students reading week		Lab (1,2,3) reports submission due date Feb. 26 11:00 PM
Week 7: Mar. 2	Chapter 12, Operating system security,	Concepts, Linux/UNIX, and Windows security,	Midterm exam (chapter 1-11(focus on 7-11)).

Mar. 4	Chapter 13, Cloud and IoT security	Concepts of cloud computing, IoT, cloud security, IoT security	
Week 8: Mar. 9	Chapter 20-1, Symmetric key encryption and message confidentiality	The algorithms of data encryption standard and advanced encryption standard	Lab 4: secret-key encryption
Mar. 11	Chapter 20-2, Symmetric encryption and message confidentiality	stream cipher and RC4, cipher block modes and key distributions.	
Week 9: Mar. 16	Chapter 21-1, Public key cryptography and message authentication	hash function and it applications, HMAC	Quiz 3 (chapter 12-13 and 20)
Mar. 18	Chapter 21-2, Public key cryptography and message authentication	Asymmetric key cryptography, RSA, Diffie-Hellman algorithm	
Week 10: Mar.23	Chapter 22, Internet security protocols and standards	Secure email, HTTPS, SSL and TLS	Lab 5: one-way Hash function
Mar. 25	Chapter 23, Internet authentication applications	Kerberos, X.509, digital certificate	
Week 11: Mar. 30	Chapter 24-1, Wireless network security	Concepts, weaknesses and problems and countermeasures	Lab 6: asymmetric key encryption and digital signature
Apr. 1	Chapter 24-2, Wireless network security	Wireless security, wireless communication overview, IEEE 802.1X authentication	
Week 12: Apr. 6	Chapter 14, IT security management and risk management, Chapter 19, legal and ethical aspects	Security risk analysis, Security policy, Cybercrime, and ethical issues, code of conduct	Final exam (chapter 1-13 and 20-24)
Apr. 8	Course review and QA		Lab report (lab 4, 5 6) submission due date April 9.

Intellectual Property

The educational materials designed and developed for this course that are posted to MyLearningSpace are the intellectual property of the course instructor. These materials are for students use only and they are not intended for wider dissemination outside of a given course. Recording lectures in any way is prohibited in this course unless permission has been granted by the instructor. Posting or providing unauthorized audio or video material of lecture content to third-party websites violates the instructor's intellectual property rights and the Canadian Copyright Act.

University and Course Policies (proposed and required text)

Laurier has several senate approved policy statements it requires instructors to include in their syllabus. Those with specific wording approved by senate are indicated specifically below.

1. **Academic Calendars:** Students are encouraged to review the Academic Calendar for information regarding all important dates, deadlines, and services available on campus.

2. **Special Needs:** Students with disabilities or special needs are advised to contact Laurier's Accessible Learning Centre for information regarding its services and resources.

3. **Plagiarism:** The University has approved the following wording for inclusion on all course syllabi about the use of the institutionally supported plagiarism software tool. "Wilfrid Laurier University uses software that can check for plagiarism. If requested to do so by the instructor, students are required to submit their written work in electronic form and have it checked for plagiarism." (Approved by Senate May 14, 2002) .

   Lab reports have to be delivered into MyLeaningSpace for academic plagiarism checks.

4. **Academic Integrity:** Laurier is committed to a culture of integrity within and beyond the classroom. This culture values trustworthiness (i.e., honesty, integrity, reliability), fairness, caring, respect, responsibility and citizenship. Together, we have a shared responsibility to uphold this culture in our academic and nonacademic behavior. The University has a defined policy with respect to academic misconduct. As a Laurier student you are responsible for familiarizing yourself with this policy and the accompanying penalty guidelines, some of which may appear on your transcript if there is a finding of misconduct. The relevant policy can be found at Laurier's academic integrity website along with resources to educate and support you in upholding a culture of integrity. Ignorance is not a defense.

5. **Classroom Use of Electronic Devices:** State your classroom practice and any consequences for student failure to comply – see Policy 9.3 (Approved by Senate March 8, 2012).

6. **Late Assignment Policy:** Without reasonable explanations, the grades for late submissions of lab reports will be reduced by 20% per day.

7. **Final Examinations:** Students are strongly urged not to make any commitments (i.e., vacation) during the examination period. Students are required to be available for examinations during the examination periods of all terms in which they register. Refer to the Handbook on Undergraduate Course Management for more information.

8. **Foot Patrol, the Wellness Centre, and the Student Food Bank:** The University approved the inclusion of information about select wellness and safety services and supports on campus in the course information provided to students. (Approved by Senate November 28, 2011.) Specific language (by campus) is provided below.

   Multi-campus Resource:

   - Good2Talk is a postsecondary school helpline that provides free, professional and confidential counselling support for students in Ontario. Call 1-866-925-5454 or through 2-1-1. Available 24-7.

   Kitchener/Waterloo Resources:

- Waterloo Student Food Bank: All students are eligible to use this service to ensure they're eating healthy when overwhelmed, stressed or financially strained. Anonymously request a package online 24-7. All dietary restrictions accommodated.

- Waterloo Foot Patrol: 519.886.FOOT (3668). A volunteer operated safe-walk program, available Fall and Winter daily from 6:30 pm to 3 am. Teams of two are assigned to escort students to and from campus by foot or by van.

- Waterloo Student Wellness Centre: 519-884-0710, x3146. The Centre supports the physical, emotional, and mental health needs of students. Located on the 2nd floor of the Student Services Building, booked and same-day appointments are available Mondays and Wednesdays from 8:30 am to 7:30 pm, and Tuesdays, Thursdays and Fridays from 8:30 am to 4:15 pm. Contact the Centre at x3146, wellness@wlu.ca or @LaurierWellness. After hours crisis support available 24/7. Call 1-844-437-3247 (HERE247).

Brantford Resources:

- Brantford Student Food Bank: All students are eligible to use this service to ensure they're eating healthy when overwhelmed, stressed or financially strained. Anonymously request a package online 24-7. All dietary restrictions accommodated.

- Brantford Foot Patrol: 519-751-PTRL (7875). A volunteer operated safe-walk program, available Fall and Winter, Monday through Thursday from 6:30 pm to 1 am; Friday through Sunday 6:30 pm to 11 pm. Teams of two are assigned to escort students to and from campus by foot or by van.

- Brantford Wellness Centre: 519-756-8228, x5803. Students have access to support for all their physical, emotional, and mental health needs at the Wellness Centre. Location: Student Centre, 2nd floor. Hours: 8:30 am to 4:15 pm Monday through Friday. After hours crisis support available 24/7. Call 1-884-437-3247 (HERE247).

Appendix A

CP400S Lab Report Rubric

The lab report will be evaluated with the following rubric. Please refer to the lab report template in MyLearningSpace, and write down each lab you have learned in one single document.

Grade / Items	A (5)	B (4)	C (3)	D (2)	F (1)
Format	An excellent format such that preparation, observation, and reflection appear in each lab	The format follows the template style.	The format is partially followed by the template style.	Somewhat format follows the template style a little bit.	The format does not follow the template style.
Content	Exceptionally well-presented and argued; ideas are detailed, well-developed, and specific details.	Well-presented and argued; ideas are detailed, developed, and most specific.	Content is sound and solid; ideas are present but not particularly developed.	Content is fair, but not well developed. The number of words is less than required	Content is not sound. The number of words is less than required
Understanding	Exceptionally well-understand the purpose of the labs	Well-Understand the purpose of the labs	Understand the purpose of the labs	Somewhat understand the purpose of the labs	Not really understand the purpose of the labs
References	Sources are exceptionally well-integrated and they support claims argued in the report very effectively. Quotations and works cited conform to APA style.	Sources are integrated and support the claims. There may be occasional errors, but the sources and works cited conform to APA style.	Sources support some claims made in the report, but might not be integrated well within the report's argument. There may be a few errors in APA style.	Sources are not integrated well. They are not cited correctly according to APA style.	The report does not use adequate references. They are not cited correctly according to APA style.

Note: APA stands for American Psychological Association. Please refer to https://library.wlu.ca/help/activity/citing-sources/styles for details.

Appendix B

Lab Report Template

Name:
Student number:

Lab Name

Write a brief description of what this part of the lab is supposed to achieve.

Preparation

What you need to do in order to perform this lab?

Observations

What have you observed from this lab? You may include a few strategic screenshots if you wish. But the evaluation is based on your descriptions rather than screenshots.

Reflections

What kinds of problems you can solve after this Lab? Or what have you learned from this lab?

The number of words in this section is expected to be more than 200. You may use your writing skills to create some scenarios to apply or explain what you have learned.

Reference

In APA format. Please refer to https://library.wlu.ca/help/activity/citing-sources/styles in details.

Note: The lab report is individual work, and must be written with your own sentences and ideas. If you would like to cite other's work, please use citation in APA style properly. The originality of your lab report will be checked in MyLearningSpace. Academic plagiarism is not tolerated.
If you have any questions, please ask me at lgao@wlu.ca