DALHOUSIE UNIVERSITY
Faculty of Computer Science

CSCI 4174 Network Security
CSCI 6708 Advanced Topics in Security

Winter 2024

Course Professor:
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Course Description

Welcome to CSCI 4174 Network Security/CSCI 6708 Advanced Topics in Network Security. The fourth-year undergraduate course CSCI 4174 is co-listed (and co-taught) with the graduate level course CSCI 6708. Network Security stands out as a critical issue in the design, deployment, and management of networks. The primary objective of this course is to provide a comprehensive coverage of the theory, concepts, design principles and technologies for network security. Industry-driven issues and problems in cyber security and emerging trends in security will also be discussed.

Grading Scheme

Assignments:	20%
Short pop quizzes during lecture sessions:	10%
Case Study (4174)/ Research Paper (6708):	10%
Midterm exam:	25%
Final exam:	35%

Prerequisites

CSCI 4174: Intended for fourth year CS students; Prerequisite is CSCI 3171 or equivalent.

CSCI 6708: Intended for graduate students. All students must have completed an undergraduate course in networking with strong emphasis on TCP/IP.

Students who have already taken 4174 cannot take 6708.

Course Format

The course will be offered in-person only. Exams and pop quizzes will be in-person only. All students must be available during the lecture times since attendance to lectures is important for completing the course successfully.

Lecture Sessions

Lectures for this course will be on **MWF 1.30 to 2.30 PM in Kenneth Rowe Management Building Room 1028 (Potter Auditorium).**

Lecture Notes

Skeletal lecture notes will be available on Brightspace before the start of each module. Annotated notes will be posted on Brightspace after the completion of the module.

Panopto Recordings

Lectures will not be recorded. Instead, short videos on important concepts will be made available on Panopto. **Link through Panopto on Brightspace**. Note: Recordings are not a replacement for live lecture sessions.

Attendance to Lectures

Students are **strongly encouraged** to attend all lecture sessions in person since they will provide a better vehicle for understanding concepts and interactive discussions, and for success in the course. Furthermore, pop quizzes will be held during lecture sessions.

Bonus for Attendance: You can get up to 2.5% bonus marks for attendance. The bonus will range from 0.5% for 60% attendance to 2.5% for 100% attendance.

Hardware/Software

Programming languages for assignments: Java, C, C++, Python.
Students will also get an exposure to security and testing tools.

Assignment Details

Assignments are worth **20% of your grade**.
Assignments will be posted on Brightspace, and submission is on Brightspace. No collaboration is permitted – you must work on your assignment independently.

There will be **six assignments, one of which is optional** – it means that the best five out of six assignments will be taken for grading. You can choose to do all six assignments, or simply aim to do the any five out of six.

Each assignment will be worth 4% and will be of approximately equal level of difficulty.

Late Submissions

Assignments are due at 11.59 PM on the day of the submission due date. It is understandable that there may be last minute Internet issues. Hence **late submissions of up to 5 hours will be accepted without late penalty**. However, please make every attempt to submit it before 11.59 PM. Past the five hours grace period, the assignment or the lab will be marked as late. Late assignments will be subject to a penalty of 10% per day up to 5 days. Late assignments which are more than 5 days late will not be accepted.

Short Pop Quizzes

There will be eight short pop quizzes held during the lecture sessions. These are worth **10% of your grade**. They are mainly meant to be reflective, and to encourage you to attend the lecture sessions. **Two quizzes will be dropped.** These quizzes will be on Brightspace. Pop Quizzes are open book.

Student Declaration of Absence (SDA) – not required.

You have the option of dropping one assignment.
You have the option of dropping two pop quizzes.
In view of the above flexibility already in the course, there is no need to submit SDAs.

Case Study Debate/Research Paper

This component is worth **10% of your grade**. There will be research paper (individual submission) for CSCI 6708 students and a case study debate (group work) for CSCI 4174 students.

Case Study Debate: In the course, you will be exposed to many issues in cyber security that border on ethical and legal issues. Many of these issues can be debated from both angles. The objective of the group case study and debate is to make a presentation, as a group, arguing both in favour of and against a topic. The deliverable will be the group presentation and a copy of the presentation slides.

Research Paper: 6708 students will work on the literature survey paper on an emerging research area in network security. The deliverable will be a written report which is due at the end of the term.

Exams

Midterm and final exams will be held in person. They are closed book, proctored, and will be on Brightspace with Respondus Lockdown Browser.

Midterm exam (worth 25% of your grade):
Wednesday, February 28, 6 PM – 8 PM
Final exam (worth 35% of your grade):
In April. Date will be scheduled by the Registrar's office.

Important Dates

Jan. 8:	First lecture
Jan. 22:	Last date to register
Feb. 2:	Munro Day – University closed
Feb. 6:	Last day to drop course without a "W"
Feb. 19-23:	Winter Study Break
Feb. 28:	MIDTERM EXAM
March 6:	Last day to drop course with a "W"
March 29:	Good Friday – University closed
April 9 :	Last Lecture
April 11-23:	Final Exam period

Course Calendar

Assignments

A1: Given: Tuesday, Jan. 16, Due: Monday, Jan. 29
A2: Given: Tuesday, Jan. 30, Due: Monday, Feb.12
A3: Given: Tuesday, Feb.13, Due: Monday, Feb. 26
A4: Given: Tuesday, Feb. 27, Due: Monday, Mar.11
A5: Given: Tuesday, Mar.12, Due: Monday, Mar.25
A6: Given: Tuesday, Mar. 26, Due: Friday, Apr.5

Exams

Midterm: Wednesday, February 28, 6 to 8 PM
Final: April 11-23 (Scheduled by Registrar)

Case Study/ Research Paper

Case Study presentations for 4174 students:
To be scheduled in April
Research Reports for 6708 students:
Due in April

Responsible Use of ChatGPT and Generative AI Tools

You may use ChatGPT and other generative artificial intelligence (AI) tools in a responsible manner, mainly to enhance your understanding, and as a supplement to your learning outcomes. I will not be using any ChatGPT checkers. However, you must acknowledge its use if you used its assistance in your assignments.

You must use these tools only to enhance your understanding and get references, just like you would use Google. You must not copy and paste from a generative AI tool generated content, but rather, paraphrase in your own words and also acknowledge and cite your sources.

Tests and the Final Exam are closed book and in person, and will have no access to such tools.

Course Communication

All course information, including announcements, lecture material, assignments, etc. will be posted on Brightspace. Some announcements will be sent to the course mailing list. Please **check Brightspace and your Dal e-mail** daily.

CSCI 4174/6708 NETWORK SECURITY
OVERVIEW OF TOPICS

Module 0: Review of Networking Concepts

- Basic network topologies
- Generic topology
- Internet structure
- TCP/IP Protocol Suite
- Data encapsulation, addresses, demultiplexing

Module 1: Introduction to Network Security

- Basic terminology
- Intrusion classification
- Intrusion levels/phases
- Techniques and tools used by the hackers
- Security goals

Module 2: Denial of Service and Social Engineering

- Motivation
- Types, Techniques and Mitigation
- Social Engineering: Tricks and Techniques

Module 3: Securing the network – Firewalls

- Firewall concept and types
- Packet filtering router and Access Control Lists
- Gateway Firewalls
- Concept, design aspects of bastion hosts
- Screened Host, Dual homed gateway, Screened subnet
- Network Address Translation
- Stateful inspection
- Firewall Rule Anomalies
- Practical notes on firewalls (examples, host firewalls, Next Generation Firewalls)

Module 4: Securing the transaction – Basic Cryptography

- Concept and terminology
- Private Key Cryptosystems
    - Simple techniques (Substitution ciphers, transposition ciphers, limitations)
    - BLOCK CIPHERS
    - DES: Permutations, key generation, single DES round
    - How secure is DES?
    - Encrypting large messages: ECB and CBC techniques
    - 3-DES
    - STREAM CIPHERS
- Public Key Encryption
    - RSA Technique

Module 5: Securing the transaction: Digital Signatures, Key Exchange and Hashing

- Digital Signature Generation
- Secure Hash and Message Digests
- Certification
- Private Key vs. Public Key Techniques
- Algorithms for key exchange
- Diffie-Hellman Algorithm
- Hashing and hash algorithms

Module 6: Virtual Private Networks (VPNs)

- VPN components and Design Issues
- Tunneling mechanisms
- IPSec Protocol
- Tunneling and Transport Modes
- Authentication Header
- Encapsulated Security Payload
- Internet Key Exchange

Module 7: Wireless Network Security

- Overview of wireless technologies
- Security in 802.11 Networks
- Security in Cellular Networks

Module 8: Higher Layer Security Protocols

- Email and file security: PGP
- Electronic Commerce Security: SET

Module 9: Emerging Areas

- Biometric Security
- IoT Security
- Ransomware
- Cloud Security
- SCADA Security
- Quantum Cryptography

Module 10: Establishing a security plan

- Standards and Regulations
- The five phases of a security plan
- Risk analysis and mitigation

Note: The above is a broad listing of the breakdown of topics intended to be covered in the course. Detailed breakdown of topics will be provided as the course progresses.

Textbook: The course modules have been prepared by referring to several textbooks and resources in the area of security. As such, there is no prescribed textbook for the course. **Lecture notes will be important.** Additional references and resources will be posted on Brightspace as appropriate.

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THERE WILL BE NO CONVERTING OF FINAL GRADES TO PASS/ILL THIS SEMESTER.
ALL LETTER GRADES WILL BE FINAL!

University and Faculty of Computer Science Policies

Responsible Computing Policy

Usage of all computing resources in the Faculty of Computer Science must be within the Dalhousie Acceptable Use Policies (https://www.dal.ca/dept/university_secretariat/policies/information-management-and-technology/acceptable-use-policy-.html) and the Faculty of Computer Science Responsible Computing Policy. For more information please see https://www.dal.ca/content/dam/dalhousie/pdf/faculty/computerscience/policies-procedures/fcs_policy_local.pdf

Academic Standards

Failure to properly attribute sources in your work will be treated as an academic standards issue and points may be deducted for not following citation requirements. For example, forgetting to quote text taken from other sources, failure to include in-text citations, or a failure to include required information in the citations or references. Please see the resources on proper citation provided by the Dalhousie Writing Center (https://dal.ca.libguides.com/c.php?g=257176&p=5001261).

Please note that if it appears that the error was made with intent to claim other people's work as your own such as a lack of both citations and references, an allegation of plagiarism will be submitted to the Faculty Academic Integrity Officer, which could result in consequences such as a course failure.

Student Health and Wellness

Taking care of your health is important. As a Dalhousie student, you have access to a wide range of resources to support your health and wellbeing. Students looking to access physical or mental health & wellness services at Dalhousie can go to the Student Health & Wellness Centre in the LeMarchant Building. The team includes egistered nurses, doctors, counsellors and a social worker. Visit **dal.ca/studenthealth** to learn more and book an appointment today.

Students also have access to a variety of online mental health resources, including telephone/texting counselling and workshops/training programs. Learn more and access these resources at d**al.ca/mentalhealth**.

Culture of Respect[1]

Every person has a right to respect and safety. We believe inclusiveness is fundamental to education and learning. Misogyny and other disrespectful behaviour in our classrooms, on our campus, on social media, and in our community is unacceptable. As a community, we must stand for equality and hold ourselves to a higher standard.

[1] Source: Speak Up! © 2005 Southern Poverty Law Center. First Printing. This publication was produced by Teaching Tolerance, a project of the Southern Poverty Law Center. Full "Speak Up" document found at: http://www.dal.ca/dept/dalrespect.html. Revised by Susan Holmes from a document provided April 2015 by Lyndsay Anderson, Manager, Student Dispute Resolution, Dalhousie University, 902.494.4140, lyndsay.anderson@dal.ca www.dal.ca/think.

What we all need to do:

1. **Be Ready to Act:** This starts with promising yourself to speak up to help prevent it from happening again. Whatever it takes, summon your courage to address the issue. Try to approach the issue with open-ended questions like "Why did you say that?" or "How did you develop that belief?"
2. **Identify the Behaviour:** Use reflective listening and avoid labeling, name-calling, or assigning blame to the person. Focus the conversation on the behaviour, not on the person. For example, "The comment you just made sounded racist, is that what you intended?" is a better approach than "You're a racist if you make comments like that."
3. A**ppeal to Principles:** This can work well if the person is known to you, like a friend, sibling, or co-worker. For example, "I have always thought of you as a fair-minded person, so it shocks me when I hear you say something like that."
4. **Set Limits:** You cannot control another person's actions, but you can control what happens in your space. Do not be afraid to ask someone "Please do not tell racist jokes in my presence anymore" or state "This classroom is not a place where I allow homophobia to occur." After you have set that expectation, make sure you consistently maintain it.
5. **Find or be an Ally:** Seek out like-minded people that support your views, and help support others in their challenges. Leading by example can be a powerful way to inspire others to do the same.
6. **Be Vigilant:** Change can happen slowly, but do not let this deter you. Stay prepared, keep speaking up, and do not let yourself be silenced.

University Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and the Senate. https://academiccalendar.dal.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog&catalogid=117&loaduseredits=False

Territorial Acknowledgement

Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people.

Dalhousie acknowledges the histories, contributions, and legacies of the African Nova Scotia people and communities who have been here for over 400 years.

Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." https://www.dal.ca/about-dal/internationalization.html

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect. As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. (read more: http://www.dal.ca/dept/university_secretariat/academic-integrity.html)

Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion please contact: https://www.dal.ca/campus_life/academic-support/accessibility.html for all courses offered by Dalhousie with the exception of Truro.

Conduct in the Classroom — Culture of Respect

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

Diversity and Inclusion — Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). (read more: http://www.dal.ca/cultureofrespect.html)

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. (read more: https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/university_secretariat/policy-repository/Code%20of%20Student%20Conduct%20rev%20Sept%202021.pdf)

Fair Dealing Policy

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. (read more: https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html)

Originality Checking Software

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work, and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. (read more: https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/university_secretariat/policy-repository/OriginalitySoftwarePolicy.pdf)

Student Use of Course Materials

These course materials are designed for use as part of the CSCI courses at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading material to a commercial third party website) may lead to a violation of Copyright law.

Learning and Support Resources

Please see https://www.dal.ca/campus_life/academic-support.html