

COMP-8677
Networking and Data Security
Lecture (2 identical sections): M&W 1:00pm-3:50pm on **Blackboard**

Summer 2021

Instructor: Dr. Shaoquan Jiang
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Office hours: Friday 10:00am-12:00pm on **Microsoft Teams**

Last updated: **May 12, 2021**
(TA office hours added)



**University
of Windsor**

Masters of Applied Computing
School of Computer Science

Course description

This course will teach students basic concepts of computer network, followed by detailed networking security techniques. We will emphasize hands-on experience. Our lecture will start with the basic principles and then show students how the theory will be realized through network programming. We will learn socket programming interfaces. This is our basic tool for networking. We will also learn scapy for the networking attacks. The topics we will cover are TCP/IP, DNS, HTTP, socket programming, and scapy for packet sniffing and spoofing, OpenSSL for cryptographic functions (hash, signature, public-key encryption, authentication), DoS attack, TCP hijacking, firewall, VPN, PKI, TLS and finally web security. The experiment will be conducted on a virtual machine that will be installed on every student's personal computer. The students are expected to have basics of Python languages.

Course workload expectations

Each week a student is expected to spend: 1.5hrs Independent Study; 1hr Reading for the course; 2hrs Work for assessment (essays, papers, projects, laboratory work); 2hrs Meeting with others for group work/project assignments; and 3hrs Studying for tests/examinations. The actual mixture of work and study items will vary throughout the course.

Learning Outcomes

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

- Be clear about how TCP/IP works.
- Master the hands-on attack techniques including sniffing, TCP attack, DNS attack.
- Master security tools such as scapy, iptables
- Learn programming techniques using Python on IP, TCP, UDP, DNS packets and crypto.
- Learn security analytic techniques that students can use them to solve real security problems.
- Learn web security

Participation. To encourage students to attend the class, every lecture will have a participation test. The coverage is on the previous lecture. You need to submit your answer through **discussion board**. Each test will count 1 point (total 10 points) into the final grade.

GAs and their office hours. We have the following GAs for this course. They will mark your participation questions and assignments. They also have office hours on **MS Teams**. Their contact details are as follow.

- Shaon Bhatta Shuvo **Email:** shuvos@uwindsor.ca office hour: Tuesday 12-1pm
- Rahul Raveendran **Email:** ravee111@uwindsor.ca office hour: Monday 10-11

Reference books There is no required textbook.

- Wenliang Du. *Internet Security: A Hands-on Approach*, 2nd Edition (ISBN: 978-1733003919). We mainly follow this book. But the course materials given by instructor should suffice for this course. Course reserve on this book has been placed in ledgy library, available for 7 day loan.
- J. F. Kurose and K. W. Ross. *Computer Networking: A Top-Down Approach*, 7th Edition. Pearson Education, Hoboken, New Jersey, 2017. [We will spend about 2 weeks to give a brief introduction on networking. I will take some material from this book. Certainly, you do not need to buy this book.]
- W. Richard Stevens, Bill Fenner, Andrew M. Rudoff, *UNIX Network Programming*, Volume 1, Third Edition, Addison Wesley, 2003. [This is a good reference to clarify some network programming issues.]

Prerequisites Basic understanding on Python language

Evaluation lab assignments 32% (8 sets), participation 10%, final project 20%, mid-term 18%, final exam 20%

Lab assignments Labs are embedded into the lectures. There is no separate lab class. Generally, the purpose of the lab is to let you get familiar with the lecture content. There are 8 sets of lab assignments, each worth 4 points. Assignments are also done *individually*.

Final project The final project needs to be finished in team of 2-4 members (unless you have no choice). I will provide a list of project materials. You can choose one. Your work is to provide understand the material and show your understanding in your report. To do this, you either provide some details according to your understanding or provide experiment to support the materials. Please do not directly copy anything from anywhere else; otherwise, you are subject to cheating and you will receive zero for this course. But of course, you can use other resource. But you need to understand the material in such resources and present it in your project report in your **OWN** language.

Resources

- Course Website: Blackboard
- The experiment platform SEEDLAB is the virtual machine with Ubuntu operating systems built in VirtualBox. You can set up the environment on your computer. You can also setup SEEDLAB on a cloud such as AWS or google cloud. Please follow the instruction at https://seedsecuritylabs.org/lab_env.html for this.
- Besides, the SEEDLAB environment is also available on department servers if your computer does not have sufficient memory. But preferably, you use SEEDLAB on your computer for convenience.

SET

Student Evaluation of Teaching forms will be administered in the last two weeks of classes, in accordance with Senate policy.

Grades

Numeric final grade out of 100 will be assigned to each student based on the above-stated evaluation scheme. Your final grade is the sum of marks for parts in the evaluation scheme with maximum 100.

Tentative Class Schedule (it might change up to the lecture progress)

Note: the due day of an assignment in a particular week is 11:59pm of your class day.

- **May 10/12: TCP/IP** Network overview, application layer, HTTP, DNS, socket programming basics, Instruction to set up the virtual machine minilab environment on the personal computer
- **May 17/19: TCP/IP(cont)** TCP/UDP: multiplexing/demultiplexing, segment structure, 3-way handshake for TCP; IP: routing, destination-based forwarding, IP format and datagram fragmentation [assign-1 due]
- **May 26/31: TCP/IP(cont)** Private network, subnet, DHCP, NAT, ICMP, Ethernet, MAC, ARP, Ethernet frame structure [assign-2 due]
- **June 2/7: packet sniffing and spoofing.** packet sniffing and spoofing using Scapy [assign-3 due]
- **June 9/14: TCP attack.** SYN attack, TCP reset attack on telnet, TCP session hijacking attack. [assign-4 due]
- **June 16/28: Transport Layer VPN.** TUN/TAP interface, VPN [assign-5 due]
- reading week(June 19-26)
- **June 30/July 5: Firewall.** netfilter, linux built firewall (iptables), bypassing firewall using SSH [this week has 30min mid-term on computer network]
- **July 7/12: DNS attack** DNS review, Python DNS queries/response, DNS attack [assign-6 due]
- **July 14/19: symmetric/public key encryption, hash function.** hash function, AES-CBC, OpenSSL experiment on encryption, RSA, Diffie-Hellman, Digital Signature. Python crypto APIs. [assign-7 due]
- **July 21/26: TLS** TLS protocol and implementation of a TLS client using OpenSSL. [assign-8 due]
- **July 28/Aug 9: Web security.** SQL introduction, SQL injection attack.
- **Aug 4/11: Final Review.** [Aug 11: final project due]
- **Note:** Monday class is not scheduled above on May 24 (victorial day) and Aug 2 (civic day).

General Helps

- If you need the course related assistant, please ask Mrs. Melissa Robinet via Email Melissa.Robinet@uwindsor.ca or Microsoft Teams
- For user guide of computing resource at school of computer science, check <https://legacyhelp.cs.uwindsor.ca/>
- For IT services, check <http://www.uwindsor.ca/itservices>

Course Regulations

1. No student is allowed to take a course more than two times without permission from the Associate Dean.

2. In the **exceptional** case that a student misses a quiz or lab for a **valid reason**, i.e. supported by **appropriate documentation**, the mark for that test will be carried over to the final grade. Student should provide a supporting evidence in the exceptional case but whether the evidence is acceptable or not is up to the instructor's decision. We do NOT require a doctor's note in the current term (2020 Fall) although it is a sound evidence if you have.
3. If the mid-term or final exam is missed (for a valid reason), a makeup exam will be arranged.
4. If a student is about to miss an event (class or exam), s/he **must inform** the instructor in advance. If you can not do this due to a special reason, you should inform the instructor within 7 days.
5. If a student has a medical condition, which may create problems during the term, s/he must inform the instructor in writing with supporting documents before the last day of classes. No consideration will be made afterwards, except for the final exam.
6. No extensions to the assignments, project and labs will be allowed. Late submission within 24 hours will be given **one-point** deduction and will be given zero after that.
7. If a student is caught adopting unfair means (e.g. plagiarism), that student will face **serious consequences** including official disciplinary procedures (see below) and will be given **zero** for this course.

Policy on Misconduct

The instructor will put a great deal of effort into helping students to understand and learn the material in the course. However, the instructor will not tolerate any form of cheating. The instructor will report any suspicion of cheating to the Director of the School of Computer Science. If sufficient evidence is available, the Director will begin a formal process according to the University Senate Bylaws. The instructor will not negotiate with students who are accused of cheating but will pass all information to the Director of the School of Computer Science.

The following behaviour will be regarded as cheating (this list is not exhaustive – more examples in Appendix A, Senate Bylaws 31:

- Copying assignments or labs or presenting someone else's work as your own
- Allowing another student to copy an assignment/project from you and present it as their own work
- Copying from another student during a test or exam
- Referring to notes, textbooks, etc., during a test or exam (unless otherwise stated)
- Talking during a test or exam
- Not sitting at the pre-assigned seat during a test or exam
- Communicating with another student in any way during a test or exam
- Having access to the exam/test paper prior to the exam/test
- Explicitly asking a proctor for the answer to a question during an exam/test
- Modifying answers after they have been marked
- Any other behaviour which attempts unfairly to give you some advantage over other students during the grade-assessment process
- Refusing to obey the instructions of the officer in charge of an examination

Several University of Windsor students have been caught cheating during the last few years. In most cases the evidence was sufficient to invoke a disciplinary process which resulted in various forms of punishment including letters of censure, loss of marks, failing grades, and expulsions. As an example, a student who copied a project from another student and presented it as his own was expelled from the university. Another student who was caught copying in a midterm was suspended for one year. Do not cheat, if you are caught and found guilty, you could be expelled from the university and will have to explain why when you search for a job.

For more information please visit the Academic Integrity Office page at:

<https://www.uwindsor.ca/academic-integrity/358/avoiding-plagiarism>

Exam Content Confidentiality

Examinations, quizzes, assignments and projects given in this course are protected by copyright. Reproduction or dissemination of examinations or the contents or format of examinations/quizzes in any manner whatsoever (e.g., sharing content with other students), without the express permission of the instructor, is strictly prohibited. Students who violate this rule or engage in any other form of academic dishonesty will be subject to disciplinary action under Senate Bylaw 31: Student Affairs and Integrity.

Student Recording of Lectures

Course materials prepared by the instructor (Live/Streamed lectures, Lecture notes, PowerPoint slides or other digital presentations, Labs, Class assignments, Exams, Quizzes, Projects and, supplemental materials or other digital course materials) are considered by the University to be an instructor's intellectual property covered by the Copyright Act, RSC 1985, c C-42. These materials are made available to you for your own study purposes, and cannot be shared outside of the class or "published" in any way. Students who do not have the necessary accommodations are not permitted to record lectures in any format (audio, video, photograph, etc.). Posting course materials or any recordings you may make to other websites without the expressed permissions of the instructor will constitute copyright infringement and subject to legal action.