Systems and Network Security

Course Overview

Instructor: Khaled Diab

What’s wrong with this picture?

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Course Staff

- Instructor: Khaled Diab
  - PhD, SFU, 2019
  - Research: Networking and systems
  - Affiliation: Network systems lab
  - Web: http://www.sfu.ca/~kdiab

- TA: Carmen Zhuang
  - Research: Security

WWW

- Course website:
  - https://netsys-security.github.io/sp20/
  - Syllabus, policy, schedule, slides, assignments, project
- Piazza:
  - https://piazza.com/sfu.ca/spring2020/cmpt479980
  - Discussion board, announcements
- Coursys:
  - https://coursys.sfu.ca/2020sp-cmpt-980-x1/
  - Submissions, grades

Communication

- kdiab@sfu.ca
  - Use my email for topics that are sensitive, confidential, etc…
- Piazza
  - Use this if your question/discussion would be beneficial for other students
- **Please** be professional and plan ahead

Office Hours

- Khaled:
  - Fridays (12pm – 1pm) at TASC1, room 9010

- Carmen:
  - TBA

Course Goals

- Learn how an attacker gains control of a system
- Learn how to defend a system
- Gain hands-on experience in various security topics

Two Key Themes of this Course

- How to think like an attacker
  - To develop the “security mindset”

- Technical aspects of security
  - Reproducing attacks
  - Building defensive solutions

Topics

- System security:
  - Control-flow hijacking and defenses
  - Return-oriented programming
  - OS security
  - (Tentative) Sandboxing and Fuzzing
- Network security:
  - TCP/IP attacks
  - DoS and DDoS attacks
  - Internet naming security
  - Internet routing security
  - IDS and Firewalls
- (Tentative) Hardware security:
  - Intel SGX
  - Spectre and Meltdown attacks

This course is not about…

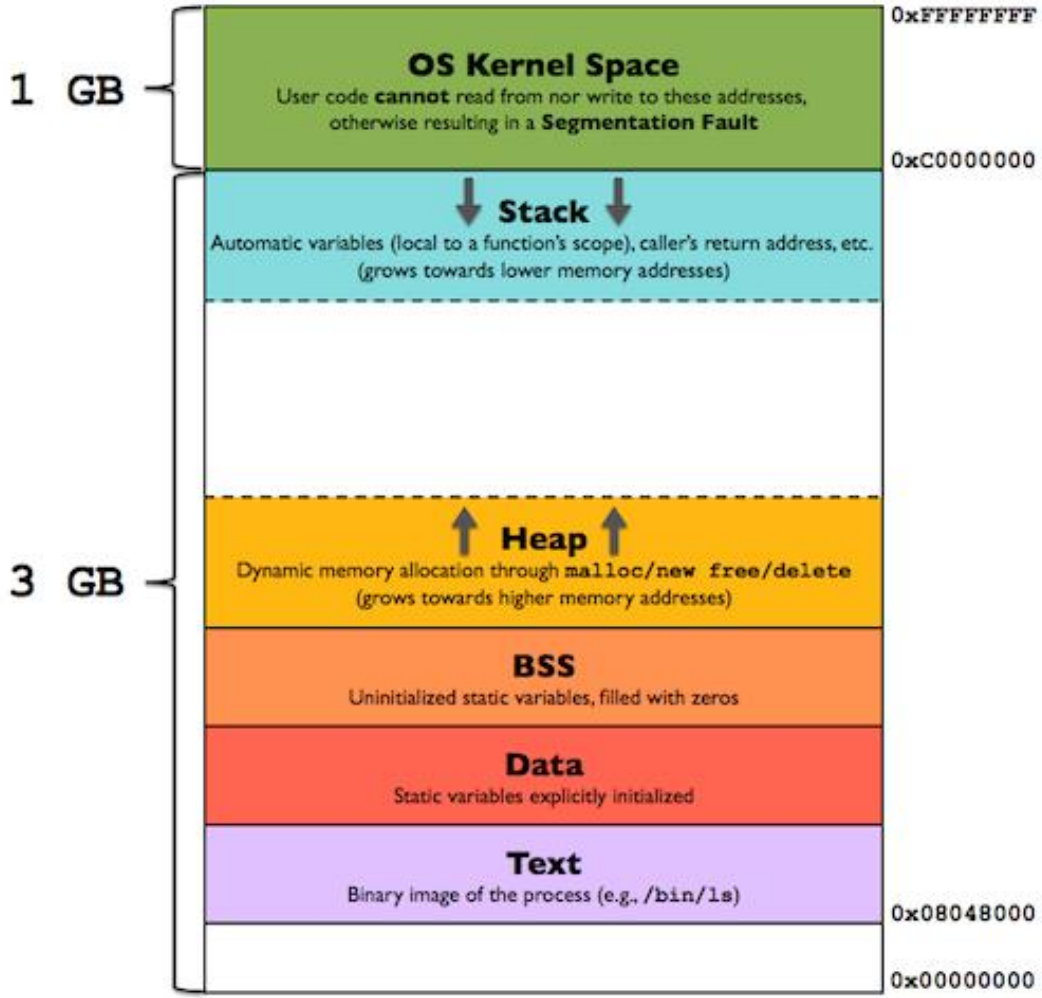
- **Not** about cryptography
  - An important topic. Yet, we assume that security flaws are from coding mistakes or protocol weakness ☹
- **Not** about all the topics in security
  - Security is broad!
  - E.g., web security, database security, social engineering
- **Not** about the latest attacks
- **Not** about blockchains

Prerequisites

- Required: CMPT 300
- Assumed:
  - operating systems (e.g., memory layout, execution semantics)
  - computer networks (e.g., IP networks, Internet naming and routing)
  - strong programming skills in C/C++ and Python
  - ability to write working Assembly code
  - knowledge of software dev. tools in linux (gcc, gdb, objdump, ld, git, etc.)
  - ability to learn new languages, tools and frameworks

- I expect you to do quite a bit of work.

Assess your knowledge base




```
int (*func)();
func = (int (*)()) code;
(int)(*func)();
```

```
mov ebx, 42
mov eax, 0x1
int 0x80
```

Assess your knowledge base

- Networking
  - Wireshark labs: https://www-net.cs.umass.edu/wireshark-labs/
  - E.g.,: TCP lab: https://www-net.cs.umass.edu/wireshark-labs/Wireshark_TCP_v7.0.pdf

Credits: Computer Networking: A Top-Down Approach, 7th ed., J.F. Kurose and K.W. Ross

Course Materials

- *There is no good book that covers all the topics*
- Materials are research papers, book chapters, related articles etc.
- Use the slides to guide your study

Grading

- No midterm or final exam!

- Final Project (Group of 2–3): 35%
- Assignments (Individual): 30% (3 x 10%)
- Research Reading (Individual): 12%
- Quizzes: 18% (3 x 6%)
- Participation: 5%

Final Project (BYOP)

- This is your opportunity to explore or dig deeper in a specific security-related topic.
  - Related to **systems** and **networking** topics
  - Can be a research-related project
  - Reproducing known and recent attacks, or security-related systems
  - Searching for a vulnerability: Analysis of a program, misconfiguration in the network
  - Other topics: Smart home security, ML-based Firewalls IDS

Final Project (BYOP)

- Has to have an implementation component
- Highly recommended to discuss with the instructor and/or in the discussion board
- Four major milestones/checkpoints
  - The first one is on Jan 31st
- Details on website soon

Assignments

- Three assignments
    1. Shellcode and buffer overflow
    2. Packet sniffing and spoofing
    3. TCP/IP attacks

Reading

- A major activity in this course
- You will read and summarize a subset of the papers
- More details are posted to the website page.

Quizzes

- Three quizzes.
- One every 3—4 weeks
- Format:
  - Written quiz
  - Programming contest (e.g., CTF)

Participation

- In-class: I expect students to take active and regular roles in discussion, asking/answering questions, etc.

- Discussion board:
  - discuss the assignments and projects and other class materials
  - you can also use it to exercise the “security mindset”
    - Discussing recent security incidents
    - Posting and discussing resources and news
    - …

Late Submission Policy

- Late submissions will not be graded.
- Unless
  (1) there is an excused absence (e.g., illness with sick note, emergency) **and**
  (2) student made arrangements with the instructor prior to the deadline.

Academic Honesty and Conduct Policies

- No tolerance to violations of academic integrity
- Students of any academic dishonesty incident will:
  - Get an ‘F’ grade and
  - Be referred to the appropriate University/School bodies for further action.

Ethics

As Uncle Ben said…

Don't try this at home

- Attacks discussed in class are illegal to execute
- Goal of this course is not to teach you how to attack systems!
  - But, to teach you how to defend systems by knowing how the attackers think
- Never use any of the attacks on a network connected to the Internet!
  - Even if it seems simple (e.g., TCP RST)
- Project/assignments?
  - code should run in an isolated env (e.g., VM)
- If in doubt, please contact me!

Ethics Forms

To receive a non-zero grade in this course, you must sign the CMPT 479/980 ethics form by 11:59pm on January 22, 2020.

- URL: https://forms.gle/XzRogNnLaZLf6GEm7
- Late forms will not be accepted.

Todo 0

- Read the “how to read a paper”

- Read the “project startup document”

Todo 1

- Read and understand the syllabus
- Sign the Ethics form

Todo 2

- Get to know your classmates, and form project groups
- Start thinking about project ideas

Todo 3

- Prepare an answer for “What do you think security is?”

Next Lecture

- What is “security” anyway?
- What are the main principles of security?