# CSCY 3765: Secure Network and System Programming
Department of Computer Science and Engineering
College of Engineering, Design, and Computing
University of Colorado Denver
**Fall 2023**

## Instructor Information

| **Section 001 – Cross-listed as CSCI 3740** | |
|---|---|
| **Instructor**: Javier Pastorino ([website](#)) | **Class Meeting Days**: Tuesday & Thursday |
| **Email**: [javier.pastorino@ucdenver.edu](mailto:javier.pastorino@ucdenver.edu) | **Class Meeting Hours**: 2:00 – 3:15 pm |
| **Phone**: 303-315-1408 | **Classroom Location**: LSC-844 |
| **Office**: LW 320-E | **TA**: TBA |

**Office Hours**: times posted on Canvas. Appointments are required. Schedule through [Calendly](#).

## General Information

### Catalog Description
This course provides a deep understanding of operating systems and TCP/IP networking architecture and the low-level interfaces that are required to build secure system-level, multithreaded, and network applications, including file and process operations, inter-process communications, creating and implementing networking protocols and sockets-based programming. Students will learn how to design secure applications, write secure code to withstand attacks, conduct security testing and auditing, and apply those skills to real-world problems.

### Course Objectives
This course is intended to provide students with the skills needed to develop applications that are resilient to attacks. Development of single- and multi-threaded secure network applications using socket communication. Analysis and defense against low-level implementation flaws and validation of user inputs. Defensive programming the role of exception handling. Prevention of attacks to compromise storage access like SQL Injections. Network defense techniques (Firewall, VLAN, and Routing). Security testing and Web security.

### Course Format
This course will be conducted in person with two 75-minute sessions each week.

### Prerequisites and Co-requisites
**Prerequisites**: This course requires **CSCI-3761** with a **C-** or higher grade.
**Co-requisites**: None
**Note**: Each student must sign the online Prerequisites Agreement form to receive credit for the course. If this form is not completed by 5:00 pm on Friday of week 1, the student will be administratively dropped from the course. *The form is linked on Canvas.*

## Learning Outcomes

### Expected Knowledge at the Start of the Course:

Understanding computer programming, compilation, program memory management, data structures, and basic algorithms. Understanding of networks, protocols, and OSI model. We expect the student to have experience in C or C++ programming language.

### Expected Knowledge Gained at the End of the Course:

Students are expected to understand the basis of computer security and the cryptographic techniques used for securing communication and data storage. Students should be capable of designing and developing applications to withhold attack and be able to test cases for their programs.

## Textbooks

- **Designing Secure Software, a guide for developers** by L. Kohnfelder. 1st edition, No Starch Press. ISBN 978-1-7185-0192-8. *(required). Available online through Auraria Library*

- **Security in Computing** by C. Pfleeger, et al. **6th edition**. Published by Pearson. ISBN 978-0-13-789121-4. *(required). Available at Pearson (digital and print)*

- **Java How to Program** by P. and H. Deitel. **11th edition**. Published by Pearson. ISBN 978-0-13-474335-6. Reference Only. Other references can substitute it.

Other materials can be assigned for specific topics.

## Topics

- Security Fundamentals.
- Security Design Patterns.
- Cryptography.
- Secure Design and Programming.
- Low-level and Input Coding Flaws
- Defensive Programming and Reliable Code
- Secure Networking and Multi-threaded Programming. Secure Network Infrastructure.
- Securing DB Applications.
- Security Testing
- Security and the Web.

## Course Schedule

The following schedule is tentative. However, we will adhere to it as much as possible.

**Class Schedule for CSCY 3765 - Fall 2023**

| Week # | | Topic to be Covered | Assigned Readings | Assessments |
|--------|--|---------------------|-------------------|-------------|
| 1 | Aug-22 - Aug-24 | Course Presentation, Introduction to Computer Security. Threats and Mitigation. | DSS 1, 2, 3 | |
| 2 | Aug-29 - Aug-31 | Java Basis. Exceptions and Arrays. Security Design Patterns. | DSS 4. (JB) | |
| 3 | Sep-05 - Sep-07 | Cryptography. | DSS 5, SC 2 | **Lab 1 - Java Basis** |
| 4 | Sep-12 - Sep-14 | Advanced OO-Programming and Interfaces. Secure Design. | DSS 6, 7. (JB) | Hw1 posted |
| 5 | Sep-19 - Sep-21 | Secure Programming. | DSS 8, SC 3 | **Lab 2 - Secure Prog.** |
| 6 | Sep-26 - Sep-28 | Low-Level Flaws | DSS 9, SC 3 | **Hw 1 Due** |
| 7 | Oct-03 - Oct-05 | Input Validation | DSS 10 | |
| 8 | Oct-10 - Oct-12 | Defensive Programming and Reliable Code | SC 3.3, DSS 13 | Hw 2 Posted - **Midterm Exam** |
| 9 | Oct-17 - Oct-19 | Networking (Java) | SC 6.(JB) | **Lab 3 - Secure Network** |
| 10 | Oct-24 - Oct-26 | Multithreading Programming | (JB) | **Hw 2 Due** |
| 11 | Oct-31 - Nov-02 | Multithreading Programming | (JB) | **Lab 4 - Secure Multithreading** |
| 12 | Nov-07 - Nov-09 | DB, SQL, and DB-Programming. SQL Injection. | Add. Material. | **Lab 5 - SQL Injection** |
| 13 | Nov-14 - Nov-16 | Security Testing | DSS 12 | **Hw 3 Due**. Hw 4 Posted. |
| 14 | Nov-21 - Nov-23 | **Fall Break - No Class** | | |
| 15 | Nov-28 - Nov-30 | Web Security. | DSS 11. | |
| 16 | Dec-05 - Dec-07 | Virtual LAN, Routing, and Firewalls. | SC 6. (other) | **Hw 4 Due.** |
| 17 | Dec-12 - Dec-14 | **Final Weeks. Final Date TBD** | | |

DSS: Designing Secure Software. SC: Security in Computing. JB: Java How to Program (as reference only).

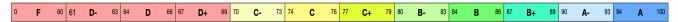Assigned readings **must** be completed before the lecture.

## Grading Policies

Grades will be recorded on Canvas. You can check on Canvas for all your assignments' current grades. After grades are posted on Canvas, you will have <u>one week to meet with the instructor/TA</u> to clarify any corrections or incorrect grades. <u>After that week, no changes will be made.</u>

Course grades are a weighted average of the grades earned on all graded material. The weights for the different categories are:

| | |
|--|--|
| Participation | 10% |
| Homework | 20% |
| Labs | 35% |
| Exams | 35% |

**Letter grades will be assigned as follows:**

| 0 | **F** | 60 | 61 | **D-** | 63 | 64 | **D** | 66 | 67 | **D+** | 69 | 70 | **C-** | 73 | 74 | **C** | 76 | 77 | **C+** | 79 | 80 | **B-** | 83 | 84 | **B** | 86 | 87 | **B+** | 89 | 90 | **A-** | 93 | 94 | **A** | 100 |

**This course will have the following assessments:**

- **Homework**: There are four homework assignments to be completed alone. Homework will provide additional practice and reflection on specific topics.

- **Labs**: There are four labs to be completed during class sessions. Each lab will develop a particular topic. Labs will be completed in teams of two students, and students must prepare in advance. Labs can include using cloud environments, application development, etc.

- **Exams**: There are two exams: a midterm and a final (comprehensive) exam. Both exams will have the same weight on the final grade.

- **Participation**: Attendance and participation are required for this course. Being on time is essential, and students arriving at most five minutes late will not be marked as present for that class period. Students who miss more than four periods (excused or not) will not receive participation credits for the semester. Being actively engaged in the class by asking and answering questions, participating in discussions, completing assigned tasks, etc., is expected in this course. We will inform students when they are in a low participation rhythm so that they can improve it. Otherwise, they will not receive participation credits, even with perfect attendance. Completing the assigned readings before class is crucial for developing good participation skills.

## Course Procedures

**Incomplete Grade**: The current university policy concerning incomplete grades will be followed in this course. A grade of Incomplete will only be considered when unexpected emergencies prevent a student from completing the course. Unfinished work must be finished by the end of the subsequent semester, or the "I" will automatically be recorded as an "F" on your transcript.

**Canvas**: We will be using Canvas in this course to assign all the coursework, communicate class-wide announcements, and record grades. So, you should check it frequently.

**Individual Communication**: Students should rely **only on the University email system** (Outlook) to communicate with the instructors. If you need to contact us, please **email us**. Do NOT use Canvas messages. Your instructor's email is listed at the beginning of this document. Include `CSCI3765` in the subject line for a quicker response (usually within 24-48 hours on weekdays). However, to discuss exercises/problems, please schedule an appointment with your instructor (see office hours on the first page); we usually cannot answer those questions over email.

**Classroom Devices**: Out of respect for everyone in the classroom, you must first receive my approval if you would like to record the lectures. I generally will approve the request, but I first would like to speak with you concerning the scope of the recording. **The use of electronic devices is otherwise NOT permitted**.

## Student Expectations

**Civility**: Our commitment is to create a climate for learning characterized by respect for each other and each person's contributions to the class. We ask for a similar commitment from our students.

**Professionalism**: Since mobile devices can be a distraction during class, I ask that all devices be put into "silent" mode and not utilized during class; this includes checking Facebook, sending a Tweet, or checking email.  If the instructor feels your mobile device distracts other students, you, or the instructor themselves, you will be asked to leave the classroom.

**Religious Observations**: We understand that an individual's religion plays a large part in their life, and we want this course to interfere with those as little as possible.  If you find that your religion's holiday(s) falls on a class day and you cannot attend due to this, **please email the instructor two weeks in advance of the holiday's date**. We will work together to try to accommodate; however, note that this accommodation may not be possible in some cases, like on exams.

## Collaboration and Cheating

We encourage you to review material and discuss ideas with other students, and work on problems you encounter. Discussions often help clarify problems and resolve difficulties — feel free to take advantage of this to improve your understanding of the material, but make sure you **create your own work**.  It's vital that you go through the program design, coding, and debugging processes yourself, or you will not be developing your programming skills and understanding.

AI-generated solutions should be documented appropriately, showing what you used from a tool and how the student correctly extended that. Failing to do so will be considered cheating (not the student's work). Please, meet with your instructor before using any of these tools to discuss how you plan to use them. AI tools, like ChatGPT and others, are generally **not allowed** in this course. However, its usage must be permitted for particular assessments, and in that case, it must be adequately disclosed, and the student's contribution must be clear. Otherwise, it may be considered dishonesty and fall under the purview of plagiarism. Students should check the restrictions for each assessment and contact the instructor if they need clarification.

Please see your instructor if you have any questions about what this means.

We reserve the right to use automated similarity metrics to detect plagiarism in this course.

<p align="center">**All students must create their work on their own!**</p>

Any instances of cheating will result in a zero for the assignment, a grade of zero (an "F") in the course, or sanctions determined by the college (including suspension and expulsion).

Sharing solutions (whole or partial) is not allowed and is considered plagiarism. Using somebody else's solution as your own is also considered plagiarism. This includes taking someone else's solution with or without their permission or asking a third party (like a tutor) for the answer.

If you need help, visit your instructor's or TA's office hours.

All students must adhere to the [College of Engineering, Design, and Computing - Student Honor Code](College of Engineering, Design, and Computing - Student Honor Code).

## University Policies

**Access**: The University of Colorado Denver is committed to providing reasonable accommodation and access to programs and services to persons with disabilities. Students with disabilities who want academic accommodations must register with Disability Resources and Services (DRS) in Student Commons Building, Suite 2116, Phone: 303-315-3510, TTY: 303-556-4766, Fax: 303-315-5315. I will happily provide approved accommodations once you provide me with a copy of DRS's letter. DRS requires students to provide current and adequate documentation of their disabilities. Once a student has registered with DRS, DRS will review the documentation and assess the student's request for academic accommodations in light of the documentation. DRS will then provide the student with a letter indicating which academic accommodations have been approved.

**Academic Honesty and Student Code of Conduct**: Students are expected to know, understand, and comply with the ethical standards of the university and the college, including rules against plagiarism, cheating, fabrication and falsification, multiple submissions, misuse of academic materials, and complicity in academic dishonesty. For more information on Academic Honesty and the Student Code of Conduct, please see:
https://www.ucdenver.edu/student/health-wellness/student-conduct

| **Mental Health Resources:** |
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| CU Denver faculty and staff understand the stress and pressure of college life. Students experiencing symptoms of anxiety, depression, substance use, loneliness or other issues affecting their mental well-being, have access to campus support services such as the [Student and Community Counseling Center](Student and Community Counseling Center), the [Wellness Center](Wellness Center), and the [Office of Case Management](Office of Case Management). Students also have access to the [You@CUDenver](You@CUDenver) on-line well-being platform available 24/7. More information about mental health education and resources can be found at [Lynx Central](Lynx Central) and CU Denver's [Health & Wellness](Health & Wellness) page. Students in imminent crisis can contact [Colorado Crisis Services for immediate assistance](Colorado Crisis Services for immediate assistance) 24/7 or walk-in to the counseling center during regular business hours. |

*Last updated on August 09, 2023.*