Introduction to Secure Coding for Software Engineering (ENPM 680) Sections 0101, 0201, and SW01

Course Dates: From August 28th – December 19th

Professor: Gananand Kini
Pronouns: He, Him
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Office Hours: TBD

Course Times:

Teaching Assistant: Lakshmi Manasa Nittala
Pronouns: She, Her
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Term: Fall 2023
Credits: 3

Sections 0101 and SW01: Wednesdays from 7:00 - 9:40 PM and Online
Section 0201: Wednesdays from 4:00 -6:40 PM

Classroom:
Section 0101: JMP 2222
Section 0201: JMP 2216

CANVAS/ELMS Link: https://umd.instructure.com/courses/1348125
Section 0101: TBD
Section 0201: TBD

Course Description

Software pervades our everyday lives and is a critical part of many of the technologies in use by people globally. It is both complex and diverse in its applications including but not limited to a significant number of domains where technology is used including communications, finance, manufacturing etc. Software tends to fail [1] due to several factors and these causes for software failures are referred to as bugs. However, a significant class of these bugs tend to have serious security implications that affect the confidentiality, integrity, availability and non-repudiation principles that underpin the security of managing and operating such software systems.

This course will cover core concepts and techniques to analyze and characterize such security bugs, and potential ways to mitigate them. Concepts will be introduced and discussed within the context of an adversary intent on altering or subverting the behavior of the software with security impacts. The course does not expect students to have any prior security experience. At the conclusion of this course the student will be familiar with:

1. Auditing a software application to find security weaknesses.

2. Describing weaknesses using CWE.

3. Methodology and techniques used in peer code review.

4. Using analysis tools to find security weaknesses.

[1] https://spectrum.ieee.org/computing/software/why-software-fails

Prerequisites

Relevant but Optional (Any, Or): CMSC335, CMSC388J, CMSC389T, CMSC398I, ENEE150, ENEE351

Learning Outcomes
After successfully completing this course, you will be able to:

- Define and apply the Secure Development Lifecycle (SDLC).
- Understand how to define, communicate and mitigate software security weaknesses as part of the SDLC.
- Apply penetration testing techniques to test software security.
- Apply security analysis techniques and tools to assess software security.
- Be able to explain weaknesses in software systems.
- Be able to organize, and perform a Secure Code Review.
- Apply defenses to remediate software exploits.

Course Materials

Required Technology
- A Laptop Computer with an x86 (Intel or AMD) 64-bit Processor and at least 12 GB of RAM and 128 GB of disk space.
- VMWare Workstation Player or VMWare Fusion Installed on Laptop (Available on terpware.umd.edu). ● Google Chrome or Firefox browser installed.
- A code.umd.edu account (Sign in using UMD CAS).

The laptop computer with an x86 (Intel or AMD) 64-bit processor (not a Chromebook, notebook or a tablet!) should be capable of running an x86_64 (64-bit Intel/AMD processor based) Windows virtual machine, have one free USB port, 128GB free on hard disk or an external USB 3.1 superspeed drive.

Supplemental Resources
This class utilizes classroom lectures, demonstrations, labs and classroom discussion to facilitate learning. Students are encouraged to seek outside resources to come up to speed on some of the topics taught in this class (LinkedIn Learning for example) and other free resources provided on the internet.

Course Structure
This course includes both on-campus and online sections.

For asynchronous online students, all lectures will be recorded and made available on ELMS-Canvas under "Panopto Recordings/Video Lectures" within 24 hours of the class time. Be sure to review the recorded lecture in a timely manner. If online students wish to attend synchronously online, you can do so by logging into ELMS-Canvas at the time of the Section 0101/0201 class (Wed 7:00PM/Wed 4:00 PM) and selecting "Video Conference" from the left side menu. This will open a Zoom link to the live classroom.

On-campus students are expected to attend in-person class sessions and be prepared to engage with the lecture and materials. If you have a conflict on a particular day, please reach out to me in advance to discuss. Online students, be sure to log into Canvas regularly and participate in discussions and activities. Regardless of the section you are enrolled in, participation is expected.

Please note that F1 students enrolled in the on-campus section are required to attend in person.

Communication Guidelines

Communicating with the Instructor
My goal is to be readily available to you throughout the semester. I can be reached by email at gkini@umd.edu. Please DO NOT email me with questions that are easily found in the syllabus or on ELMS-Canvas (e.g., When is this assignment due? How much is it worth? etc.), but please DO reach out about personal, academic, and intellectual concerns/questions.

While I will do my best to respond to emails within 48 hours, you will more likely receive email responses from me on Mondays, Wednesdays and Fridays from 8:00am-10:00am EST.

When constructing an email to me please put "ENPM 680 Fall 2023 (Section [0101/0201]): [Your Topic]" in the subject line. This will draw my attention to your email and enable me to respond to you more quickly.

Additionally, please review [These tips for 'How to email a Professor'](). By following these guidelines, you will be ensured to receive a timely and courteous response.

Finally, if you need to discuss issues not appropriate for the classroom and/or an email, we can arrange to talk by phone, over Zoom, or in person. Send me an email asking for a meeting and we can set something up.

Announcements
I will send IMPORTANT messages, announcements, and updates through ELMS-Canvas. To ensure you receive this information in a timely fashion, make sure your email and announcement notifications (including changes in assignments and/or due dates) are enabled in ELMS-Canvas ([How to change notification settings in CANVAS]()).

Log into our ELMs-Canvas course site at least once every 24-hour period to check your inbox and the Announcements page.

Cell Phones
Please refrain from using your cellphone in class. If you have critical communication to attend to, please excuse yourself and return when you are ready.

Names/Pronouns and Self-Identifications
The University of Maryland recognizes the importance of a diverse student body, and we are committed to fostering inclusive and equitable classroom environments. I invite you, if you wish, to tell us how you want to be referred to in this class, both in terms of your name and your pronouns (he/him, she/her, they/them, etc.). Keep in

mind that the pronouns someone uses are not necessarily indicative of their gender identity. Visit trans.umd.edu to learn more.

Additionally, it is your choice whether to disclose how you identify in terms of your gender, race, class, sexuality, religion, and dis/ability, among all aspects of your identity (e.g., should it come up in classroom conversation about our experiences and perspectives) and should be self-identified, not presumed or imposed. I will do my best to address and refer to all students accordingly, and I ask you to do the same for all of your fellow Terps.

Communicating with your Peers

With a diversity of perspectives and experience, we may find ourselves in disagreement and/or debate with one another. As such, it is important that we agree to conduct ourselves in a professional manner and that we work together to foster and preserve a virtual classroom environment in which we can respectfully discuss and deliberate controversial questions. I encourage you to confidently exercise your right to free speech—bearing in mind, of course, that you will be expected to craft and defend arguments that support your position. Keep in mind, that free speech has its limit and this course is NOT the space for hate speech, harassment, and derogatory language. I will make every reasonable attempt to create an atmosphere in which each student feels comfortable voicing their argument without fear of being personally attacked, mocked, demeaned, or devalued.

Any behavior (including harassment, sexual harassment, and racially and/or culturally derogatory language) that threatens this atmosphere will not be tolerated. Please alert me immediately if you feel threatened, dismissed, or silenced at any point during our semester together and/or if your engagement in discussion has been in some way hindered by the learning environment.

Netiquette Policy

Netiquette is the social code of online classes. Students share a responsibility for the course's learning environment. Creating a cohesive online learning community requires learners to support and assist each other. To craft an open and interactive online learning environment, communication has to be conducted in a professional and courteous manner at all times, guided by common sense, collegiality and basic rules of etiquette.

Grading

To perform satisfactorily in this class, students are expected to:
- Perform assigned reading.
- Complete and submit assigned homework and laboratories according to schedule.
- Complete a software development project including requirements, specifications and development from a security perspective.
- Attend all lectures, ask plenty of questions and be ready to discuss topics of relevance to the
- course.
- Complete the knowledge check quizzes and a final exam.

Grade Breakdown

Assignment	Percentage %
Lab Reports	25%

Homework	15%

Quizzes	10%
Final Exam	20%
Project	30%
Total	100%

Course Assignments

Lab Reports
- There are 12 laboratory reports that will be due over the course of the semester.
- The labs are designed to reinforce all the material covered in the course using a practical hands-on approach.
- The labs assess whether you are able to apply the theoretical concepts covered in the course using a practical hands-on approach.
- The lab reports and/or a text file containing your code commit-id will all be submitted via Gradescope.

Homework Assignments
- There are 6 homework assignments that will be due over the course of the semester. ● The homework assignments are designed to get students accustomed to reading journal articles and research papers relevant to the course material.
- The homework assignments assess whether the student has been able to grasp the concepts laid out in the journal article/research paper and how well they have connected it with the course material covered in the course.
- The homework assignments typically entail reading a paper or journal article and then answering about 10 questions.
- They will be submitted via Gradescope.

Quizzes
- There are 12 self-paced quizzes that will be due by the end of the semester (Dec 6th 2023).
- They are designed to reinforce the theoretical concepts covered in the course material. ● The quizzes can be taken several times and the highest score is used.
- The quizzes can be taken from anywhere and are open book and open notes.

Individual Project
- The individual project is a chance for students to express their creativity and work on a real-world software project while learning to apply the concepts from the Secure Development Lifecycle.

Final Exam
- The final exam will integrate all the concepts covered in the course where the student will perform a hands on laboratory style exercise.
- The final exam will require the submission of a spreadsheet and students will have about a week to complete it.
- The final exam will be a take home and must be completed individually

Grading Assignments

All assignments will be graded according to a predetermined set of criteria (i.e., rubric) which will be communicated to students before the assignment is submitted.

To progress satisfactorily in this class, students need to receive timely feedback. To that end, it is my intention to grade all assignments within **2 weeks** of their due date. If an assignment is taking longer than expected to grade, students will be informed of when they can expect to see their grade.

Grade Computation

All assessment scores will be posted on ELMS/Canvas page. If you would like to review any of your grades (including the exams), or have questions about how something was scored, please email the TA and schedule a time to meet and discuss.

It is expected that you will submit work by the deadline listed in the syllabus and/or on ELMS-Canvas. Late work will be penalized according to the late work policy described in the **Course Policies and Procedures** section below.

Grade Disputes: The teaching assistants/grader will be responsible for grading. Any questions regarding received grades please direct to the teaching assistants or grader. If a mistake in a grade calculation has been made, it will be corrected immediately. Any formal grade disputes must be submitted in writing and within one week of receiving the grade.

All homework, lab reports, exam, quizzes and project will be graded on a point scale, 0- 100. Averages will be calculated of each group, multiplied by the above percentages, then added to determine final grade.

For example: Assume the following average grades for
● Lab Reports is 80
● Homework is 90
● Quizzes is 79
● Final is 86
● Project is 78

The semester grade will be calculated as follows:
$(80*.25) + (90*.15) + (79*.10) + (86*.20) + (78*.30) = 82$ which corresponds to a letter grade of B.

The plus/minus grading system will not be used in this class. Numerical course grades will be translated into letter grades as follows:

Final Grade Cutoff	Letter Grade
90 – 100%	A
78 – 89%	B
60 – 77%	C
50 – 59%	D

0 – 49%	F

Course Schedule

Week	Date	Instructor	Weekly Description	Weekly Assignments
1	08-30-23	Mr. Kini	Module: Course Intro / Syllabus / Grading Module: Introduction to the Secure Development Lifecycle TA Lecture: Intro to Git	Project Assigned. Quiz 0 – Student Survey Assigned.
2	09-06-23		Module: Secure Software Design Principles	Homework 1 Assigned. Quiz 1 Assigned. Quiz 2 Assigned. Lab 0: Setup Lab environment Assigned. **Project Phase 1 Due.**
3	09-13-23	Mr. Kini	Module: Input/Data Validation – Attacks	Homework 2 Assigned. Quiz 3 Assigned. Attack Lab 1: Input Injection attacks Assigned. **Homework 1 due. Project Phase 2 Due Sat 09/16.**
4	09-20-23	Mr. Kini	Module: Input/Data Validation - Defenses	Fix Lab 2: Perform Input validation Assigned. Quiz 4 Assigned. **Attack Lab 1 Due. Homework 2 Due.**
5	09-27-23	Mr. Kini	Module: Cryptography - Attacks	Homework 3 Assigned. Quiz 5 Assigned. Attack Lab 3: Breaking encryption Assigned. **Fix Lab 2 Due.**

6	10-04-23	Mr. Kini	Module: Cryptography - Defenses	Fix Lab 4: Implementing Cryptography Securely Assigned. Quiz 6 Assigned. **Attack Lab 3 Due.** **Homework 3 Due.**
7	10-11-23	Mr. Kini	Module: Authentication & Authorization -	Homework 4 Assigned.

			Attacks	Quiz 7 Assigned. Attack Lab 5: Attack authentication and authorization Assigned. **Fix Lab 4 Due.** **Project Phase 3 Due Sat 10/14.**
8	10-18-23	Mr. Kini	Module: Authentication & Authorization - Defenses	Fix Lab 6: Implement secure authentication and authorization Assigned. Quiz 8 Assigned. **Attack Lab 5 Due.** **Homework 4 Due.** **Project Phase 4 Due Sat 10/21.**
9	10-25-23	Mr. Kini	Module: Session Management - Attacks	Homework 5 Assigned. Quiz 9 Assigned. Attack Lab 7: Session Hijacking Assigned. **Fix Lab 6 Due.**
10	11-01-23	Mr. Kini	Module: Session Management - Defenses	Fix Lab 8: Preventing Session Hijacking Assigned. Quiz 10 Assigned. **Attack Lab 7 Due.** **Homework 5 Due.**

11	11-08-23	Mr. Kini	Module: Error Handling and Logging - Attacks Module: Peer Code Review and Tools	Homework 6 Assigned. Quiz 11 Assigned. Attack Lab 9: Leaking information in errors and logs Assigned. Final Project Peer Reviews Assigned. **Fix Lab 8 Due. Project Phase 5 Due Sat 11/11.**
12	11-15-23	Mr. Kini	Module: Error Handling and Logging - Defenses	Quiz 12 Assigned. Fix Lab 10: Secure Error Handling and Logging Assigned. Lab 6: Code Analysis Tools Assigned. **Attack Lab 9 Due. Homework 6 Due.**
13	11-22-23	Mr. Kini	Module: Debug Code Secure Code Warrior Competition	Homework 7 Assigned. Quiz 13 Assigned.

				Attack Lab 11: Leaking information via debug code Assigned. **Fix Lab 10 Due. Project Phase 6 Due.**
14	11-29-23	Mr. Kini	Module: Code Analysis	Quiz 14 Assigned. Fix Lab 12: Fixing information leaks and release proofing Assigned. **Homework 7 Due. Attack Lab 11 Due.**

15	12-06-23	Mr. Kini	Final Project Presentations	**Project Presentations Fix Lab 12 Due.** **All Quizzes Due.** **Final Exam Released.**
16	12-12-23	Mr. Kini	READING DAY	
17	12-13-23		Final Exam Due	

Note: This is a tentative schedule, and subject to change as necessary – monitor ELMS-Canvas for current deadlines. In the unlikely event of a prolonged university closing, or an extended absence from the university, adjustments to the course schedule, deadlines, and assignments will be made based on the duration of the closing and the specific dates missed.

Course Policies and Procedures

The University of Maryland's conduct policy indicates that course syllabi should refer to a webpage of course related policies and procedures. For a complete list of graduate course related policies, visit the [Graduate School website](#). Below are course-specific policies and procedures which explain how these Graduate School policies will be implemented in this class.

Satisfactory Performance
The Graduate School expects students to take full responsibility for their academic work and academic progress. The student, to progress satisfactorily, must meet all the academic requirements of this course. Additionally, each student is expected to complete all readings and any preparatory work before each class session, come to class prepared to make substantive contributions to the learning experience, and to proactively communicate with the instructor when challenges or issues arise.

Questions about Assignments
Please ask all questions you may have about an assignment by 6:00 PM the day before the assignment is due. Any questions asked after that time may not be answered in time for you to make changes to your work.

Late Work Policy
Assignments should be completed by the due date and time listed with the assignment, on the syllabus, and/or in the course calendar. If you are unable to complete an assignment by the stated due date, it is your responsibility to contact your instructor to discuss an extension, at least 24 hours BEFORE the assignment is due. Extensions are not guaranteed, but may be granted at the instructor's discretion.

The course modules are designed to follow each other closely and hence it is important that you complete all labs

and assignments on time. It is expected that all assignments, projects, quizzes and exams be completed by their assigned deadlines. For late assignments or late projects submissions beyond the assigned deadline, the student will incur a late penalty of 10% grade deduction per day. The assignment will not be accepted beyond 3 days late and will automatically incur a grade of 0.

Religious Observance
It is the student's responsibility to inform the instructor of any intended absences for religious observances in advance. Notice should be provided as soon as possible but no later than the end of the schedule adjustment period.

Academic Integrity
For this course, some of your assignments will be collected via Turnitin on ELMS/Canvas. I have chosen to use this tool because it can help you improve your scholarly writing and help me verify the integrity of student work. For information about Turnitin, how it works, and the feedback reports you may have access to, visit [Turnitin Originality Checker for Students](#)

The University's Code of Academic Integrity is designed to ensure that the principles of academic honesty and integrity are upheld. In accordance with this code, the University of Maryland does not tolerate academic dishonesty. Please ensure that you fully understand this code and its implications because all acts of academic dishonesty will be dealt with in accordance with the provisions of this code. All students are expected to adhere to this Code. It is your responsibility to read it and know what it says, so you can start your professional life on the right path. **As future professionals, your commitment to high ethical standards and honesty begins with your time at the University of Maryland.**

It is important to note that course assistance websites, such as CourseHero, or AI generated content are not permitted sources, unless the instructor explicitly gives permission. Material taken or copied from these sites can be deemed unauthorized material and a violation of academic integrity. These sites offer information that might be inaccurate or biased and most importantly, relying on restricted sources will hamper your learning process, particularly the critical thinking steps necessary for college-level assignments.

Additionally, students may naturally choose to use online forums for course-wide discussions (e.g., Group lists or chats) to discuss concepts in the course. However**, collaboration on graded assignments is strictly prohibited unless otherwise stated**. Examples of prohibited collaboration include: asking classmates for answers on quizzes or

exams, asking for access codes to clicker polls, etc. Please visit the **Office of Graduate Studies' full list of campus wide policies** and reach out if you have questions.

Finally, on each exam or assignment you must write out and sign the following pledge: ***"I pledge on my honor that I have not given or received any unauthorized assistance on this exam/assignment."***

If you ever feel pressured to comply with someone else's academic integrity violation, please reach out to me straight away. Also, ***if you are ever unclear*** about acceptable levels of collaboration, ***please ask***!

To help you avoid unintentional violations, ***the following table*** lists levels of collaboration that are acceptable for each graded exercise. Each assignment will contain more specific information regarding acceptable levels of collaboration.

	OPEN NOTES	USE BOOK	LEARN ONLINE	GATHER CONTENT With AI	ASK FRIENDS	WORK IN GROUPS
Homework Assignments	✔	✔	✔	---	---	---
Lab Reports	✔	✔	✔	---	✔	---
Quizzes	✔	✔	✔	---	---	---
Project	✔	✔	✔	✔	✔	---
Final Exam	✔	✔	✔	---	---	---

Course Evaluation

Please submit a course evaluation through Student Feedback on Course Experiences in order to help faculty and administrators improve teaching and learning at Maryland. All information submitted to Course Experiences is confidential. Campus will notify you when Student Feedback on Course Experiences is open for you to complete your evaluations at the end of the semester. Please go directly to the **Student Feedback on Course Experiences** to complete your evaluations. By completing all of your evaluations each semester, you will have the privilege of accessing through Testudo the evaluation reports for the thousands of courses for which 70% or more students submitted their evaluations.

Copyright Notice

Course materials are copyrighted and may not be reproduced for anything other than personal use without written permission.

Tips for Succeeding in this Course

1. **Participate.** I invite you to engage deeply, ask questions, and talk about the course content with your classmates. You can learn a great deal from discussing ideas and perspectives with your peers and professor. Participation can also help you articulate your thoughts and develop critical thinking skills.

2. **Manage your time.** Students are often very busy, and I understand that you have obligations outside of this class. However, students do best when they plan adequate time that is devoted to course work. Block your schedule and set aside plenty of time to complete assignments including extra time to handle any technology related problems.

3. **Login regularly.** I recommend that you log in to ELMS-Canvas several times a week to view announcements, discussion posts and replies to your posts. You may need to log in multiple times a day when group submissions are due.

4. **Do not fall behind.** This class moves at a quick pace and each week builds on the previous content. If you feel you are starting to fall behind, check in with the instructor as soon as possible so we can troubleshoot together. It will be hard to keep up with the course content if you fall behind in the pre-work or post-work.

5. **Use ELMS-Canvas notification settings.** Pro tip! Canvas ELMS-Canvas can ensure you receive timely notifications in your email or via text. Be sure to enable announcements to be sent instantly or daily. 6. **Ask for help if needed.** If you need help with ELMS-Canvas or other technology, IT Support. If you are

struggling with a course concept, reach out to me and your classmates for support.

Student Resources and Services

Taking personal responsibility for your learning means acknowledging when your performance does not match your goals and doing something about it. I hope you will come talk to me so that I can help you find the right approach to success in this course, and I encourage you to visit the [Counseling Center's Academic Resources](#) to learn more about the wide range of resources available to you. Below are some additional resources and services commonly used by graduate students. For a more comprehensive list, please visit the Graduate School's [Campus Resources Page](#).

Accessibility and Disability Services
The University of Maryland is committed to creating and maintaining a welcoming and inclusive educational, working, and living environment for people of all abilities. The University of Maryland is also committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs, or activities of the University, or be subjected to discrimination. The [Accessibility & Disability Service (ADS)](#) provides reasonable accommodations to qualified individuals to provide equal access to services, programs and activities. ADS cannot assist retroactively, so it is generally best to request accommodations several weeks before the semester begins or as soon as a disability becomes known. Any student who needs accommodations should contact me as soon as possible so that I have sufficient time to make arrangements.

For assistance in obtaining an accommodation, contact Accessibility and Disability Service at 301-314-7682, or email them at adsfrontdesk@umd.edu. Information about [sharing your accommodations with instructors, note taking assistance](#) and more is available from the [Counseling Center](#).

Writing Center
Everyone can use some help sharpening their communication skills (and improving their grade) by visiting [The Graduate School's Writing Center](#) and schedule an appointment with them. Additionally, international graduate students may want to take advantage of the Graduate School's free [English Editing for International Graduate Students (EEIGS) program](#).

Health Services
The University offers a variety of physical and mental health services to students. If you are feeling ill or need non emergency medical attention, please visit the [University Health Center](#).

If you feel it would be helpful to have someone to talk to, visit [UMD's Counseling Center](#) or [one of the many other mental health resources on campus](#).

Notice of Mandatory Reporting
Notice of mandatory reporting of sexual assault, sexual harassment, interpersonal violence, and stalking: As a faculty member, I am designated as a "Responsible University Employee," and I must report all disclosures of sexual assault, sexual harassment, interpersonal violence, and stalking to UMD's Title IX Coordinator per University Policy on Sexual Harassment and Other Sexual Misconduct.

If you wish to speak with someone confidentially, please contact one of UMD's confidential resources, such as [CARE](#)

to Stop Violence (located on the Ground Floor of the Health Center) at 301-741-3442 or the Counseling Center (located at the Shoemaker Building) at 301-314-7651.

You may also seek assistance or supportive measures from UMD's Title IX Coordinator, Angela Nastase, by calling 301-405-1142, or emailing titleIXcoordinator@umd.edu.

To view further information on the above, please visit the Office of Civil Rights and Sexual Misconduct's website at ocrsm.umd.edu.

Basic Needs Security

If you have difficulty affording groceries or accessing sufficient food to eat every day, or lack a safe and stable place to live, please visit UMD's Division of Student Affairs website for information about resources the campus offers you and let me know if I can help in any way.

Veteran Resources

UMD provides some additional supports to our student veterans. You can access those resources at the office of Veteran Student life and the Counseling Center. Veterans and active duty military personnel with special circumstances (e.g., upcoming deployments, drill requirements, disabilities) are welcome and encouraged to communicate these, in advance if possible, to the instructor.