**ESOF 422 Spring 2025**

**Advanced Software Engineering: Secure Software Practices**

**Lecture Time and Location:** M,W,F 14:10 – 15:00 in AIH 166

**Instructor:** Dr. Clem Izurieta and Mr. Reese Pearsall

**Contact:** [clemente.izurieta@montana.edu](mailto:clemente.izurieta@montana.edu)

[reese.pearsall@montana.edu](mailto:reese.pearsall@montana.edu)

**Office Hours:** Dr. Izurieta: MWF 11:00 – 12:00, or by appointment

**Office Location:** NAH 253D

**Office Hours:** Mr. Pearsall: TWF 12:00 PM – 1:00 PM, or by appointment

**Office Location:** Barnard 361

**Course and Lab Assistant:** Sarker Mahmud

**Contact email:** [sarkersafat.mahmud@student.montana.edu](mailto:sarkersafat.mahmud@student.montana.edu)

**Office Hours:** M 17:10 – 18:10

**Office Location:** Barnard 348

**Textbooks:**

1. Warmer and Kleppe, “The Object Constraint Language Second Edition,” Addison Wesley 2003. ISBN 0-321-17936-6

* *This is out of print but you can find old copies on the net and it is a good book to have. I will provide handouts in class.*

Any textbook or resource that will help you with UML. This is your choice.

**Prerequisites:**

ESOF 322 – Software Engineering

Strong grasp of UML diagrams and design patterns

**Course Description:**

This course focuses on the early phases of the software lifecycle, extending the knowledge developed in ESOF 322 around UML specifications to formulate precise requirements. We rely heavily on UML and Design Patterns. We will focus on advanced software modeling and specification techniques. We will discuss model-driven engineering through model-driven software development and its support tools, such as UML, USE, and OCL. We then turn our attention to the cybersecurity aspects of software engineering. We will discuss cloud computing, digital forensics, the security lifecycle of software, and security analysis techniques.

**Course Objectives:**

* Build expertise in modeling techniques
* Introduce software design through the use of rigorous UML
* Introduce constraint-based modeling
* Learn relevant and pragmatic topics in cybersecurity. Specifically the Security Lifecycle and analysis techniques
* Learn many relevant cybersecurity tools
* Learn advanced testing techniques also applied in cybersecurity
* Learn relevant digital forensics

**Course Outcomes**

* Articulate what formal methods are.
* Be able to read and write formal specifications written in UML and OCL.
* Write and analyze specification constraints using OCL.
* Write SOIL to extend UML diagrams.
* Form informed opinions about model-driven techniques.
* Use a constraint solving tool –USE
* Cybersecurity Knowledge Units (KUs):
  + Describe the Security lifecycle (KU: LCS)
  + Understand and perform simple software forensics and software analysis (KU: DFS)
  + Software Security Analysis (KU: SSA)
  + Penetration Testing (KU: QAT)

**Software and Additional Reference Material**

The following is a list of the software and relevant downloads that we will use throughout this course:

***Modeling***

We will use the USE framework (v6.0) to do modeling.

Download here: <https://sourceforge.net/projects/useocl/>

***Cybersecurity***

We will need access to a Linux machine, which we will use Kali Linux VM. You will also need virtualization software, such as VirtualBox or VMWare.

Download here: [https://www.kali.org/get-kali/#kali-platforms](https://www.kali.org/get-kali/%23kali-platforms)

**Grading Policy:**

HWs, exams, attendance and class participation.

3 Exams: 40%

HW: 60%

The final exam is optional. If you decide not to take it, the average of your first two exams will be used as your final exam grade.

**Instruction:**

New HW is assigned every fortnight. We will typically load the HW to D2L on Mondays, and they will be due on Friday of the subsequent week. The TA will be available during his/her office hours. There will be **no makeup Labs or HWs (strictly enforced).**

**Attendance and Participation:**

Class attendance and participation are highly encouraged, as they will be taken into consideration for final grades. Attendance can be worth (5% - 10%) of your grade. You are responsible for all the material covered in class. Prepare in advance for class by reading and studying the assigned text and ensuring you understand the previous lecture.

**Student Help:**

A student who desires accommodation for a disability needs to speak to the instructor prior to the graded event.

**Academic Integrity:**

Honesty and integrity is expected in all class work. The standards set by MSU’s academic integrity and student conduct guidelines apply to this class. Academic misconduct is unacceptable. It is the responsibility of all students to adhere to strict standards of integrity in their professional and scholarly activities. **Misconduct will be treated swiftly and harshly**. It is a breach of academic integrity to present the ideas or works of another as one's own work, or to permit another to present one's work without customary and proper acknowledgment of authorship.

Students are responsible for the honest completion and representation of their work, the appropriate citation of sources and the respect and recognition of others' academic endeavors. According to MSU's Conduct Guidelines and Grievance Procedures for Students, academic misconduct includes cheating, plagiarism, forgery, falsification, facilitation or aiding academic dishonesty; multiple submission, theft of instructional materials or tests; unauthorized access to, manipulation of or tampering with laboratory equipment, experiments, or computer programs, without proper authorization; alteration of grades or scores; misuse of research data in reporting results; use of personal relationships to gain grades or favors, or otherwise attempting to obtain grades or credit through fraudulent means.

**Syllabus (this can and will change… please monitor)**

**Advanced Software Engineering – Lectures**

**Spring 2025**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **W** | **Date** | **Topic** | **Resources** | **Events/Readings** |
| 1 | Jan 15, 17 | Introduction, UML review  Model driven development  USE: <https://sourceforge.net/projects/useocl/> | IntroToUML, MDSE Handout | Start of classes |
| 2 | Jan 20, 22, 24  **No class Jan 20** | OCL Inheritance  Liskov’s rules | OCL | OCL Book (Ch 2)  **HW1 due 1/31** |
| 3 | Jan 27  **No class** Jan 29, 30 **Clem at conference** | Aggregation, Composition | OCL | OCL Book (Ch 2, 3) |
| 4 | Feb 3, 5, 7 | Component diagrams  Security design patterns |  | **HW2 due 2/14** |
| 5 | Feb 10, 12, 14 | 2/10: Exam 1  Lifecycle Security, Software Assurance maturity model (SAMM), Software Architecture  <https://owasp.org/www-project-samm/> |  | **Feb 10: Exam 1** |
| 6 | Feb 17, 19, 21  **No class Feb 17** | Testing Introduction  Graph Coverage Criteria  Graph coverage with paths |  | **HW3 due 2/28** |
| 7 | Feb 24, 26, 28 | Predicate Logic Coverage |  |  |
| 8 | Mar 3, 5, 7  **No class Mar 3** | 3/7: Exam 2  Input space partitioning |  | **Mar 7: Exam 2** |
| 9 | Mar 10, 12, 14  **No class Mar 14** | Secure by Design |  |  |
| 10 | Mar 18, 20, 22 | **No Class** |  | **Spring Break** |
| 11 | Mar 24, 26, 28 | Vulnerability Analysis |  |  |
| 12 | Mar 31, Apr 2, 4 | Penetration Testing |  | **HW 4 due 4/2** |
| 13 | Apr 7, 9, 11 | Digital Forensics Introduction  Principles of Digital Forensics  Incident Management  Investigation Models  Capturing Digital Evidence |  |  |
| 14 | Apr 14, 16, 18  **No class Apr 18** | Memory Forensics  System Architecture Review  Operating System Fundamentals  Volatility |  | **HW 5 due 4/16** |
| 15 | Apr 21, 23, 25  **No class Apr 21** | Digital Forensics  Volatility |  |  |
| 16 | Apr 28, 30 May 2 | Digital Forensics, Course Conclusion |  | **HW6 due 5/4** |
| F | Wednesday May 7th 2:00 – 3:50 PM | Final Exam (in our normal classroom) |  | **May 7: Exam 3** |