

## CS 692: Linux Kernel Internals (Spring 2025)

Department of Computer Science

George Mason University

Instructor: Dr. Xiaokuan Zhang ([xiaokuan@gmu.edu](mailto:xiaokuan@gmu.edu))

**This syllabus is tentative and subject to change**

- **Basic Information**

Time: Wed 4:30pm – 7:10pm  
Location: Krug Hall 5  
Credits: 3  
Office Hour: TBD

- **Recommended Textbook**

- Linux Kernel Development (2nd or 3rd Edition), Robert Love
- Understanding the Linux Kernel (3rd Edition), Daniel P. Bovet & Marco Cesati

- **Course Description**

This graduate-level class delves deep into the intricate and essential components of the Linux kernel, one of the most widely used operating systems in the world. This class is designed for computer science graduate students seeking an in-depth understanding of operating system internals. This course explores the foundational concepts, design principles, and advanced topics related to the Linux kernel, including, but not limited to: system calls, CPU scheduling, context switching, process management, memory management, file systems.

- **Course Format**

This course will consist of a combination of lectures, hands-on labs and group discussions. Students will have the opportunity to modify real-world linux kernels and gain practical experience.

- **Course Objectives**

- Master compilation and configuration of building an OS;
- Master internals of OS system call implementation;
- Be competent with CPU scheduling and process management;
- Be competent with memory management systems;
- Be competent with internals of file systems.

- **Prerequisites**

- Have a good understanding of data structures and algorithms;
- Comfortable writing programs from scratch in C and Java;
- Comfortable in a command-line Unix development environment (gdb, gcc, etc);
- Have basic knowledge of assembly languages such as x86.

**Prerequisite requirement: CS571/471. If you did not take CS571/471 before, you will be DROPPED. OS class taken from other universities do NOT count.**

**Device requirement:** CEC IT will provide virtual machines for students to use, which is similar to the Zeus server in CS 571/471. Students may also choose to run virtual machine applications such as VMware or VirtualBox locally.

- **Grading Policy**

Project: 95% (6 projects)

Participation: 5%

The final grade is computed based on the following rules:

A+ ( $\geq 95.0\%$ ) A ( $\geq 90.0\%$ ) A- ( $\geq 85.0\%$ )

B+ ( $\geq 80.0\%$ ) B ( $\geq 75.0\%$ ) B- ( $\geq 70.0\%$ )

C+ ( $\geq 66.0\%$ ) C ( $\geq 63.0\%$ ) C- ( $\geq 60.0\%$ )

F ( $< 60.0\%$ )

- **Project**

The projects are key components of this course. Each team by default will have two students. If you prefer to work alone, please ask the instructor for permission. For each team project, each team members must work on a shared github/gitlab repo, and submit the same version to Canvas. The due dates and project requirements will be announced on Canvas. In total, there will be six projects/labs.

**NOTE: Lab0 and Lab1 are individual projects; missing lab0 or lab1 will FAIL this class.**

In general, the submission should include:

1. A project report, which explains the tasks of each team member, and the revisions you have made on the kernel. It is highly recommended to include screenshots of your steps.
2. A kernel source code diff file.
3. Github/Gitlab commit history.

For details about submission requirement, please check Canvas.

- **Late Policy**

- 2% penalty for each hour after the assignment is due: (Score' = Score x (1-penalty))
  - e.g., 1.5 hours late: 4% penalty, 11.5 hours: 24% penalty; 47.5 hours: 96% penalty
  - No submission will be accepted 48 hrs after due
- You have one chance to be late for **SIX (6)** hours without any penalty!

- **Email Policy**

The instructor can be reached at [xiaokuan@gmu.edu](mailto:xiaokuan@gmu.edu). Please include **[CS 692]** in the subject line of emails for prompt response. Students must use their GMU email account to receive important University information, including communications related to this course. The instructor cannot respond to messages sent from or send messages to a non-Mason email address. To protect your privacy, the instructor cannot list your GMU email address on any public forum or provide it to any other students. You may, of course, give your email address to any other students.

- **Honor Code**

Please see the Office for Academic Integrity (<https://oai.gmu.edu/>) for a full description of the code and the honor committee process, and the Honor Code Policies of the Department of Computer Science (<https://cs.gmu.edu/resources/honor-code/>) regarding the course project. GMU is an Honor Code university. The principle of academic integrity is taken seriously and violations are treated gravely. If you rely on someone else's work in an aspect of the course project, you should give full credit in the proper, accepted form. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged in this course, with the firm expectation that all aspects of the class will be conducted with civility and respect for differing ideas, perspectives, and traditions. When in doubt (of any kind) please ask for guidance and clarification.

- **Inclusion**

Every student in this course is exactly where they belong and it is our honor to welcome each of you to join us in learning throughout this semester. Every student in this course, regardless of background, sex, gender, race, ethnicity, class, political affiliation, physical or mental ability, veteran status, nationality, or any other identity category, is an equal member of our course. You have the right to be called by whatever name you wish, to be

referred to by whatever pronoun you identify, and to adjust these at any point. If you feel uncomfortable in any aspect of our instruction that results in any barrier to your inclusion in this course, please contact the instructor directly.

- **Disabilities**

Students with a disability or other condition (documented with GMU's Office of Disability Services, ODS) that may impact academic performance should speak with the instructor as soon as possible to discuss appropriate accommodations. If you are in a situation that even temporarily affects your ability to learn or work, such as with a broken limb or other such injury, contact the Office of Disability Services to get accommodations. The instructor is happy to assist as is appropriate, but it must be documented ahead of time by ODS. Even if you do not know if you plan on utilizing the accommodations, it is in your best interest to prepare them in advance.

- **Sexual Harassment and Interpersonal Violence**

As a faculty member and designated "Responsible Employee," the instructor is required to report all disclosures of sexual assault, interpersonal violence, and stalking to Mason's Title IX Coordinator per university policy 1412. If you wish to speak with someone confidentially, please contact the Student Support and Advocacy Center (703-380-1434), Counseling and Psychological Services (703-993-2380), Student Health Services, or Mason's Title IX Coordinator (703-993-8730, [cde@gmu.edu](mailto:cde@gmu.edu)).

- **Privacy**

Video recordings of class meetings that are shared only with the instructors and students officially enrolled in a class do not violate FERPA or any other privacy expectation. All course materials posted to Canvas or other course site are private; by federal law, any materials that identify specific students (via their name, voice, or image) must not be shared with anyone not enrolled in this class.

- **Use of Generative AI (Gen-AI)**

ChatGPT or other Generative-AI models may be used (but not encouraged) in this course as an assistant when working on programming assignments or projects; students may use chatGPT as an alternative to searching for debugging assistance, similar to websites such as StackOverflow.

**Any use** of Gen-AI models must follow the fundamental principles of the Honor Code and include the following statement with project submission:

**The ideas in this submission are original and were generated by (*my name*). ChatGPT (*or name other Generative-AI model*) was used as an editorial/coding assistant, however, I take full responsibility for the originality and accuracy of the content.**

However, for any writing assignments such as paper reviews or project reports, the use of Gen-AI models is strictly forbidden, mainly because 1) Gen-AI cannot really understand papers; 2) using Gen-AI to generate reviews without reading the paper can constitute "cheating".

Risk accompanies the use of any powerful tool. Students are cautioned that sharing their original ideas with Generative-AI models can lead to a loss of control and ownership of those ideas and coding. Furthermore, in terms of learning in this class, students who replace their own learning and project work with materials prepared by Gen-AI models:

- Surrender control over the material's truthfulness and accuracy and violate the university's Honor Code.
- Sacrifice the opportunity to acquire the knowledge, skills, and critical thinking taught in the course.
- Risk being unable to perform to expectations when Gen-AI models are unavailable, such as in exams or interviews.
- Ultimately endanger their employability if they are unable to produce work other than that produced by Gen-AI models.