Syllabus_CS0449 Introduction to Systems Software (2024-2025_Spring)

1 General Information

- Course Number: 312195030; Credit hours: 3
- Instructor: Dr. CHEN Yanru, chenyanru@scu.edu.cn
- Office: Rm417, PI New Building(North), Jiangan Campus 江安匹兹堡学院大楼(北楼)417
- Office hours: Thurs. afternoon
- Lecture: **01- Thurs., 08:15-11:00,** 江安现代工学互动教学中心(南楼)S103
  Teaching Assistant: **01-** ZENG Di, 2327900323@qq.com
- Lecture: **02- Thurs., 19:20-21:55,** 江安综合楼 B 座 B506
  Teaching Assistant: **02-** LUO Zhiwei, 3516024892@qq.com

2 Course Information

2.1 Description

Introduction to Systems Software (SS) course is designed to teach you the vital concepts underlying a computer system which is comprised of both hardware and software. It aims to enhance the understanding of how hardware, operating systems (OS) and compilers interact and influence the performance and correctness of application programs. It explores issues of programming computer systems by examining abstractions, interfaces, and design decisions that influence the way that software runs. This includes the role OS has in communication and resource management. This course focuses on high-level models of modern processors, offering comprehensive insights into SS. It lays the groundwork for advanced programming and system development, adaptable for a 17-week semester.

2.2 Prerequisite

CS0445 Data Structures; CREQ: CS0447 Computer Organization and Assembly Language

2.3 Course Objectives

This course begins with the creation of executable programs in the C programming language. We will then explore the resultant program as it is stored on disk and as it is loaded for execution. Next, we will examine the interactions between our code and the code provided via libraries or the OS to facilitate common, low-level tasks. Lastly, we will look at the abstractions and resource management undertaken by OS & its drivers to facilitate communication & hardware interaction.

2.4 Learning Outcomes

- Learning C programming. C is the most common language used for SS.
- Exploring the layout of an executable programs code and data both as stored on disk and loaded into memory.
- Interacting with the abstractions that libraries and the OS provide.
- Implementing abstractions and managing hardware resources through device drivers.

3 Textbooks & Readings

- **CSAPP3e**: Randal E. Bryant and David R. O'Hallaron, Computer Systems: A Programmer's Perspective, Third Edition (CS:APP3e), Pearson, 2016, North American Edition (ISBN-10: 0-13-409266-X).
- **Misurda**: Jonathan Misurda. Introduction to Systems Software (online). https://people.cs.pitt.edu/~jmisurda/teaching/cs449/cs449_latest.pdf

- **Practical C**: Oualline, Steve. Practical C Programming. OReilly, Sebastopol, CA, 1997. ISBN: 1-56592-306-5.
- **K&R**: Kernighan, Brian W. and Ritchie, Dennis M. C Programming Language. 2nd Ed. Prentice Hall PTR, 1988.
- **ALP**: Mark Mitchell, Jeffrey Oldham, Alex Samuel, Advanced Linux Programming (online). https://ia800700.us.archive.org/22/items/ost-computer-science-advanced-linux-programming/Advanced%20Linux%20Programming.pdf
- **LDD3**: Jonathan Corbet, Alessandro Rubini, and Greg Kroah-Hartman, Linux Device Drivers, Third Edition (online). https://lwn.net/Kernel/LDD3/
- **C Notes for Professionals**: The C Notes for Professionals book is compiled from Stack Overflow Documentation by GoalKicker.com (online). https://goalkicker.com/CBook/

4 Schedule

The weekly topics may be adjusted based on class progress. They serve as a guide for your primary, supplementary and extra readings, helping you to concentrate on specific concepts.

Week	Date	Thursday Topics	Readings	Timeline
1	02.27	**Intro to the Course**	CSAPP3e: Chap 1	
2	03.06	C Programming: Data Types and Representation; Operators & Bitwise Manipulation, Control Flow, Arrays; **Representing and Manipulating Information1**	Practical C: Chap 1-11 CSAPP3e: Chap 2.1-2.2	
3	03.13	C Programming: Strings, Functions, Scope vs. Lifetime, Pointers; I/O, Console, Files, Memory management, malloc/free; **Representing and Manipulating Information2**	Practical C: Chap 12-23 Misurda: Chap 1-2 CSAPP3e: Chap 2.3-2.5	
4	03.20	Multi-file Development, Providing an interface/API, Header files, Makefiles; **Machine-Level Representation of Programs1**	PracticalC: Chap7,10,18 CSAPP3e: Cha3.1-3.5	Projects due(03.22)
5	03.27	**Machine-Level Representation of Programs2**	CSAPP3e: Chap 3.6-3.7	Assignment1 due(03.29)
6	04.03	**Machine-Level Representation of Programs3**	CSAPP3e: Chap 3.8-3.12	Assignment2 due(04.05)
7	04.10	**Optimizing Program Performance1**	CSAPP3e: Chap 5.1-5.2	
8	04.17	**Optimizing Program Performance2**	CSAPP3e: Chap 5.3-5.4	Assignment3 due(04.19)
9	04.24	Interaction with Operating System, interrupts, calling convention/ABI,Syscalls; Threading, User vs. Kernel Threading, Scheduling/yield/sleep, Pthreads; Synchronization, Deadlock; Communication and Networking; **Operating Systems**	Misurda: Chap 8 ALP: Chap 3, 8 Misurda: Chap 9 ALP: Chap 4 Misurda: Chap 10 Misurda: Chap 11	Presentation
10	05.01	Labor's Day Recess (No classes)		
11	05.08	**The Memory Hierarchy1**	CSAPP3e: Chap6.1-6.2	Projects due(05.10)
12	05.15	**The Memory Hierarchy2**	CSAPP3e: Chap6.3-6.7	Assignment4 due(05.17)
13	05.22	Midterm Exam ING (No classes)		
14	05.29	Program Representation, Linking(Static&Dynamic),Libraries,archives,shared objects,Executable file formats; **Linking**	Misurda: Chap 3, 4 CSAPP3e: Chap 7	Assignment5 due(05.31)
15	06.05	Linux Device Drivers, Signal Handling; **Exceptional Control Flow**	LDD3: Chap1, 2 CSAPP3e: Chap 8	Assignment6 due(06.07)
16	06.12	Processes & Address Spaces, Data Representation, Globals, constants, Activation Records, Arrays&Structures; **Virtual Memory**	Misurda: Chap 5, 7 CSAPP3e: Chap9	
17	06.19	Final Exam ING (No classes)		

5 Grading Policy

5.1 Grading Structure

Total	Attendance	Assignments	Projects	Midterm Exam	Final Exam
100%	*5%*	*20%*	*20%*	*25%*	*30%*

5.1.1 Attendance: Besides 5% of attendance, attending lectures can effectively boost your grade, as bonus points are selectively awarded (it's recorded) based on factors like class interaction, individual improvement, random quizzes, & special roles like course representatives.

5.1.2 Assignments: 6 assignments (due on Saturday night; see the Schedule).

5.1.3 Projects: 3 projects in total. Specific requirements for the projects are attached or will be announced by TA during the semester. Kindly remind that it's mandatory to do all projects; otherwise, this portion of grade is gone (as it's crucial to make the effort).

5.1.4 Exam INSTRUCTIONS:

1. Exam is closed-book with one double-sided A4 sheet with handwritten or printed notes (Excluding pre-worked or pre-solved problems; No pasted/stuck-on materials; More than one sheet will be confiscated; Each individual must prepare your own sheet independently).

2. All materials (exam papers and A4 sheets) must be submitted together. Early submission is only allowed after 60 minutes.

3. During exam: Pencils & red pens are not allowed for answering; they're considered as drafts. Calculators & correction tapes are allowed, but no borrowing. Tearing papers by pages, talking to others, electronic aids such as smartwatches, phones are not allowed.

4. Full mark is 100; write clearly to avoid grading errors. If make a mess, clearly indicate your final answers. Answer directly in the provided space; no extra answer paper is needed. For your convenience, the provided space can work as drafts too, just clearly separate drafts from answers. Do not bring your own draft paper.

5.2 Grade Rebuttal

To correct honest grading mistakes & prevent unnecessary requests, one-time grade rebuttal requests are allowed. It includes regrading entire work for fairness, possibly altering grade up or down. Submit official requests via email within certain period set by instructors, not via social media (after the period, the grade is final). Requests must attach the typewritten paragraph clearly explaining perceived grading errors, with reasonably references.

5.3 Grace-day Policy

For your well-being, if you encounter an ongoing issue where grace-day policy cannot help you, such as long-term hospitalization, etc., promptly inform advisor & instructor ***before due date****, as it can affect all courses.*

You have 3 grace days at your disposal for this course to handle any emergencies like computer issues, high workloads, medical situation, personal matters, family things, school events, etc. It's automatically used for attendance, assignments & projects in chronological order.

Grace days cannot be exchanged, traded, bought, or sold. We advise conserving them later for challenging submissions or unexpected emergencies where you have to use it.

5.3.1 Grace-day Policy for Attendance:

1. If informing instructor in advance for lecture absence due to any emergencies with some grace days left, your attendance will be fine as 1 grace day is automatically used.

2. Students are responsible to obtain missed contents due to own absence & complete all submissions based on the timeline. Ideally, following the original schedule facilitate learning in a more structured way.

5.3.2 Grace-day Policy for Late Submissions (Assignments & Projects):

1. All submissions are due by 11:59pm on due date, only latest one is graded; if submitted at 00:01am (2mins past), it's 1 day late because it's the next calender day. Late submissions beyond grace days incur 20% daily penalty; submissions are not accepted more than 4 days overdue.

2. If submitted 1 day late with grace days left, no penalty incurs as 1 grace day is automatically used; if submitted 4 days late with 3 grace days left, 1-day penalty incurs as 3 grace days are automatically used; if submitted 4 days late with no grace days left, 4-day penalty incur; if submitted 5 days late, it's considered not done and grace days do not apply.

6 Academic Integrity

Students must maintain professionalism, honesty, integrity & ethical standards throughout the semester. Cheating is strictly prohibited including unauthorized materials, copying, or viewing others' solutions, etc. You may discuss & share insights (that's how you learned), but you must work independently & submit your own work.

Specifically, violations in submissions result in heavy score penalties for both parties (don't take away others' learning opportunities). Violations in exams directly lead to disciplinary actions under University's Academic Integrity Policy.

Thanks!