

Course Overview

2023-24 COMP3230A

Principles of Operation Systems

Chenshu Wu

Acknowledgement: The materials used in this course reuse significantly those from Dr. Anthony Tam from CS@HKU.

Course Info.

- ◉ Subclass A of COMP3230
 - ◉ For CS students
- ◉ Time & Location:
 - ◉ Tue 10:30-12:20: **CYCP1** (Chong Yuet Ming Chemistry Building)
 - ◉ Thu 10:30-12:20: **CYCP1**

Instructor & Tutors

◉ Instructor

- ◉ Dr. Chenshu Wu
- ◉ Email: chenshu@cs.hku.hk
- ◉ Office: Rm 315B, CYC Building
- ◉ Office hours
 - ◉ Tue: 9:00 am-10:30 am
 - ◉ Thu: 9:00 am-10:30 am
 - ◉ Best by appointment
 - ◉ <https://calendly.com/cswu-1/comp3230a-office-hours>

◉ Tutors

- ◉ Mr. Weiying HOU
 - ◉ Email: wyhou@cs.hku.hk
 - ◉ Office: HW101M
- ◉ Mr. Songlin HUANG
 - ◉ Email: huangs0@connect.hku.hk
 - ◉ Office: HW101M
- ◉ Office hours:
 - ◉ Tue 13:00 pm - 14:30 pm
 - ◉ Thu 13:00 pm - 14:30 pm

◉ Student TA

- ◉ Mr. Kong Chun Yung
- ◉ u3578889@connect.hku.hk



Moodle Course Site

- ◉ Homepage
 - ◉ Moodle course ID: COMP3230_1A_2023
 - ◉ <https://moodle.hku.hk/course/view.php?id=106508>
 - ◉ Course Information
 - ◉ Teaching plan
 - ◉ Lecture Notes
 - ◉ Lecture/tutorial Videos
 - ◉ Assignments information and **submission of assignments**
 - ◉ Announcements and Updates
 - ◉ Discussion Forum
 - ◉ Peer to peer discussions & asking questions
 - ◉ **Ask questions on Moodle** ([Questions by email will be redirected to Moodle](#))
- ◉ **New! FAQ Initiative**
 - ◉ Compile FAQs and our answers from previous offerings

Course Format

- ◉ Lectures and tutorials will be delivered *f2f* in teaching venues.
 - ◉ No real-time online streaming
- ◉ Video-recording of lectures/tutorials
 - ◉ At **best-effort** (i.e., no QoS/availability guarantee)

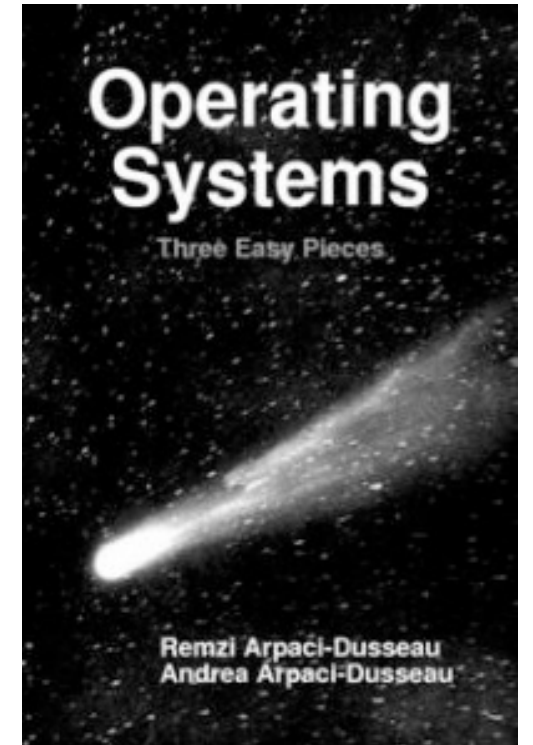
References

◉ Required online textbook

- ◉ Operating Systems: Three Easy Pieces
- ◉ by Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau
- ◉ <http://pages.cs.wisc.edu/~remzi/OSTEP/>

◉ Other references

- ◉ T. Anderson and M. Dahlin, Operating Systems: Principles and Practice, 2nd edition
- ◉ Deitelet. al, Operating Systems, 3rd Edition, Prentice Hall
- ◉ Silberschatzet. al, Operating System Concepts, 10th Edition, John Wiley
- ◉ William Stallings, Operating Systems: Internals and Design Principles, 9th Edition, Prentice Hall
- ◉ Bovet et. al, Understanding the Linux Kernel, 3rd Edition, O'Reilly
- ◉ Russinovich et. al, Windows Internals, 6th Edition, Microsoft Press
- ◉ Other online references, eg, [ChatGPT](#), "[Chat2TA](#)"



Assessment

- ◉ Continuous Assessment - 50%
 - ◉ 4+1 mini-exercises – 4% (*New! OS drills to help you ramp up.*)
 - ◉ 3 problem-set assignments – 14%
 - ◉ 2 Programming projects – 22% (Individual project)
 - ◉ Part 1 – processes: Linux shell
 - ◉ Part 2 – multithreading: A multi-threaded neural network model
 - ◉ **Midterm** (10%)
 - ◉ **Only in-person exam**
 - ◉ Tentatively scheduled on **Tuesday, Oct 31st, 2023**
- ◉ 3 hours final examination – 50%
 - ◉ Details to be announced (by the University)
 - ◉ Open book examination



Two Programming Assignments

- ◉ Ass 1 - Build a **shell** program
 - ◉ To have hand-on practice in designing and developing a system utility program
 - ◉ Involves execution of multiple processes and collection of processes' execution statistics
 - ◉ Build your own shell!!
- ◉ Ass 2 - Design multithread program
 - ◉ To have hand-on practice in designing and developing multithread programs using Pthread library
 - ◉ Involves synchronization and coordination between threads
 - ◉ How does a multi-threaded LLM sound?!

Slip Days (Late Submission) Policies

- Each assignment has a due date and a due time, which will be posted on the course web page. For assignments, we will use a system of "slip days" to give you some flexibility with the assignment deadlines. **Each person starts the term with five slip days**, which can be used to push back assignment deadlines. Slip days work as follows:
 - Pushing an assignment deadline back by one day (24 hours) costs one slip day.
 - An assignment deadline can be pushed back **at most three days**.
 - Partial slip days are not allowed, e.g., it is not possible to use part of a slip day to push a deadline back by six hours.
 - Slip days are not transferable from one student to another.
 - By default, the slip days will be applied automatically* as is needed according to the exact timestamp of submission.
 - A **FREE late window of 30 minutes** is allowed to accommodate potential technical issues upon submission. In other words, submissions made within 30 minutes after the deadline need no slip days to cover them.
 - All the thresholds will be observed strictly.** For example, a submission that is late for 1801 seconds (i.e., 30 minutes plus 1 second) will use one slip day.
 - Slip days do not apply to the mini-exercises.**
- Assignments that are submitted late (with no slip days to cover them) will not be accepted and will receive a mark of 0%.**

* Let D be the deadline, and T your submission timestamp. The number of slip days that will be used for a submission, noted as SD , is calculated as follows:

```
if (T - D) <= 30 minutes, SD = 0;  
else if (T - D) <= 24 hours, SD = 1;  
else if (T - D) <= 48 hours, SD = 2;  
else if (T - D) <= 72 hours, SD = 3;  
else SD = 0 & mark = 0.
```

- Review of Assignment Grading will **ONLY** be accepted within **TWO** weeks after the grading is released.
- Requests to review after two weeks will be ignored automatically without a reply.

Acknowledgment: This policy is borrowed from CS350@UWaterloo.

Course Platform

- ◉ Department's Linux Servers
 - ◉ The Department has allocated a virtual Linux server (workbench2) for the OS course (shared by the two subclasses). In addition, we can use the two Linux servers (academy11 & academy21) which are shared by all UG students.
- ◉ Apache Guacamole
 - ◉ Guacamole is a web application that supports remote access to servers using either RDC, VNC, and SSH. Users connect to a Guacamole server with their web browsers. The Guacamole client, once loaded, connects back to the server over HTTP using the Guacamole protocol. The web application interprets the contents of the Guacamole protocol and connects to the target remote server on behalf of the user.
- ◉ Install Windows Subsystem for Linux (version 2) on Windows 10
- ◉ [Install \(Ubuntu\) Docker \(on Windows/Mac\)](#)
- ◉ Go to Moodle for more info and see how to use



AIGC/ChatGPT Policy

- ◉ You are **allowed, and encouraged**, to use any AIGC tools including ChatGPT.
- ◉ You **must acknowledge** every single place where you use AIGC tools, including the mini-exercises, problem sets, programming assignments.
- ◉ (Apparently, “IGC”-only in exams)

Plagiarism

- ⦿ Plagiarism is a disciplinary offence. Any student who commits the offence is liable to disciplinary action
 - ⦿ <https://tl.hku.hk/plagiarism/>
- ⦿ We will make use of software tools to check against your submitted assignments
 - ⦿ If we identify any suspicious cases, we will invite you to explain to us
 - ⦿ Both the student who copies other's work and the student who offers his/her work for copying shall be penalized.
- ⦿ We will follow the departmental guidelines on handling any cases relating to the practice of plagiarism by students

Teaching Plan & Schedule

Week	Mon	Tue (CYCP1)	Wed	Thu (CYCP1)	Fri	Notes/Activities of the Week
01					09/01	
02	09/04	Course Overview, Intro ¹		Intro ¹ , Process abstraction ^{4, 5}		Release mini-exercises
03	09/11	Process abstraction ^{4, 5} Tutorialab 1 - Warm up!		CPU Virtualization ⁶		
04	09/18	Process Scheduling ^{7, 8, (9, 10)}		Process Scheduling ^{7, 8, (9, 10)}		Release PS1
05	09/25	Tutorialab 2 - Process PA1 Briefing		Threads ^{26, 27}		Release PA1
06	10/02	Concurrency ^{26, 27}		Locks, Condition Variables ^{28, 30}		PS1 Due
07	10/09	Semaphores ³¹ , Deadlock ³²		Tutorialab 3 - pthreads		Release PS2
08	10/16	Reading Week	Enjoy	Or	Work?	PA1 Due
09	10/23	Address Space ^{13, 14}		Tutorialab 4 - Semaphores PA2 Briefing		PS2 Due Release PA2
10	10/30	Midterm (Oct 31)		Address Translation ^{13, 14} , Segmentation ^{16, 17}		
11	11/06	Paging, TLB ^{18, 19}		Paging Smaller Tables ²⁰		
12	11/13	Beyond Physical Memory ^{21, 22}		Files and Directories ^{39 (36, 37, 44)}		PA2 Due Release PS3
13	11/24	Files and Directories ^{39 (36, 37, 44)}		File System Implementation ^{40 (42)}		
14	11/27	Extra Topics		Course Summary		PS3 Due

Course Objectives

- ◉ To present the fundamentals of operating systems, to study the **details of the operations and principles** behind the design of various components of an operating system
 - ◉ Understand the **major components (three easy pieces - Virtualization, Concurrency, Persistence)** that constitute the modern operating systems
 - ◉ Learn the **underlying mechanisms and policies** of the operating systems and the implications of resulting **design choices**

Intended Learning Outcomes

- ◉ On successful completion of the course, students should be able to:
 - ◉ **[ILO1 –Fundamentals]** discuss the characteristics of **different structures** of the Operating Systems (such as microkernel, layered, virtualization, etc.) and identify the **core functions** of the Operating Systems.
 - ◉ **[ILO2 –Principles]** explain the **principles behind** the core functions and **compare the algorithms** on which the core functions of the Operating Systems are built on.
 - ◉ **ILO 2a** –managing **processes/threads** and sharing of **CPU resource**
 - ◉ **ILO 2b** –managing and allocating **memory resource** effectively
 - ◉ **ILO 2c** –how to support **concurrency and synchronization control** between processes/threads
 - ◉ **ILO 2d** –managing and allocating **persistent data storage**
 - ◉ **[ILO3 –Performance]** **analyze and evaluate** the algorithms of the core functions of the Operating Systems and **explain the major performance issues** with regard to the core functions.
 - ◉ **[ILO4 –Practicability]** **demonstrate knowledge** in applying **system software and tools** available in modern operating system (such as threads, system calls, semaphores, etc.) **for software development**.

How to Achieve the Learning Outcomes

- ◉ Most topics involve discussion of **mechanisms and policies**. The materials are **quite technical** and include low-level details, which requires dedication of time to comprehend
- ◉ You are provided with **a reading list**.
- ◉ To get the best learning experience and result, it is better to **quickly** go through those chapters **before attending** the class
- ◉ Designate 6 to 7 hours every week for reading the given lecture notes and readings
- ◉ Learn by exploring more about the OS systems

How to Achieve the Learning Outcomes

- ◉ **Actively participating** during lectures
 - ◉ Raise questions if you think that helps you to understand better
 - ◉ Or ask me/TA after the lecture if appropriate
- ◉ Assignments and examination
 - ◉ Questions **won't always map directly** to the examples you have seen before as one of the goals of learning is to be able to **use the concepts and principles in new/unseen situations**
- ◉ Always work on the assignments **ASAP**
 - ◉ Give yourself enough time to plan for the work
 - ◉ Don't waste your time "spinning your wheels" needlessly; raise your questions if needed
 - ◉ Effectively utilize the discussion forum as a means of information sharing

Survey – ~~Where~~ Who are you?

- ◉ Know a little bit more about you and your background...
- ◉ ...such that we can better deliver the materials, for you.

