CS 4375 Operating Systems Concepts
Fall 2022 Syllabus
Lecture: CRN 17800; TR 3:00-4:20pm; GEOL 123
Instructor: Shirley Moore
Course webpage: http://svmoore.pbworks.com/

CS 4375 is a course about the systems-level software called the operating system that provides an interface between application software and the computer hardware. The operation system is responsible for sharing resources, providing common services, and protecting programs from interference from other programs. Topics covered in the course include process and thread management, processor scheduling and concurrency, interprocess communication, memory management, input/output management, file systems, and networking basics.

- **Teaching Team**
  - Instructor: Shirley Moore, svmoore@utep.edu
    - Office: CCSB 3.0608
    - Office phone: 915-747-5054
    - Office hours: Regular office hours TBD by polling the class, also by appointment
    - Webpage: http://www.cs.utep.edu/svmoore
  - Teaching Assistant: TBD
- **Prerequisite**
  - CS 3432 with a grade of C or better
- **Texts and Resources** (required textbooks are freely available in electronic form)
  - Required: **Operating Systems: Three Easy Pieces,** by Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau. https://pages.cs.wisc.edu/~remzi/OSTEP/
  - Required: **xv6: a simple, Unix-like teaching operating system**, by Russ Cox, Frans Kaashoek, and Robert Morris. https://pdos.csail.mit.edu/6.828/2021/xv6.html
  - Required: **An Introduction to Computer Networks**, by Peter L. Dordal. http://intronetworks.cs.luc.edu/current/ComputerNetworks/
  - Supplementary (not required): **The Linux Programming Interface**, by Michael Kerrisk. https://nostarch.com/tlpi
  - Supplementary (not required): The xv6 Kernel YouTube videos. https://www.youtube.com/playlist?list=PLbtzT1TYeoMhTPzyTZboW_j7TPAnjv9XB
  - Other readings and resources will be posted on the course webpage.
- **Learning Outcomes**
  - Learning outcomes are in the appendix at the end of this document.
- **Computers**
  - You will need access to a computer capable of running Linux (either natively or using virtualization software) to participate in class activities. If you are running Linux natively, you need to have root privileges. If you do not have access to an appropriate machine, the department has a limited number of portable computers that can be loaned to students.
- **Attendance**

- Attendance is strongly encouraged at all lecture sessions. Lecture sessions will be recorded if possible, but viewing the recorded session will not be the same as attending class in person. Breakout groups and hands-on exercises will be part of lecture sessions and it will not be possible to record those portions. The instructor will only answer questions from and interact with students who are physically present in class, unless prior arrangements are made in the case of extenuating circumstances. The instructor will make use of the whiteboard in addition to presentation slides, and whiteboard contents will not be part of the recording.
- The above paragraph assumes that UTEP will be conducting classes in person. In the unlikely event that classes are moved online by UTEP administration during the semester, then all content presentation and interaction will be moved online.

- **Grading Breakdown**

  1000-900 = A 899-800 = B 799-700 = C 699-600 = D 599 and Below = F
  - Lab assignments: 30% (300 points)
  - Homework: 20% (200 points)
  - Project: 15% (150 points)
  - Class participation: 5% (50 points)
  - Quizzes: 10% (100 points)
  - Exam 1: 10% (100 points)
  - Exam 2: 10% (100 points)

- **Class Participation, Homework, Quizzes, and Lab Assignments**
  - Homework and lab assignments will be posted on teams, along with related materials.
  - To obtain full credit for the class participation grade, you will need to post questions about at least 25 different reading assignments (25 points) and attend and actively participate in person in at least 25 class sessions (25 points). Questions about reading assignments must be posted before the class for which they are assigned and cannot be made up later.
  - Please use Teams for questions and discussion about course topics and assignments.
  - Blackboard will be used for quizzes and to keep track of grades.

- **Project**
  - The course project is intended to be a semester-long, open-ended investigation of a topic that is relevant and of interest to you. The project may be done individually or as part of a team. You may choose a topic from the list below or propose your own project idea. The topics below are explained in more detail on the course webpage. The instructor will provide guidelines and suggestions for how to proceed with the project, but you will decide on your specific goals and objectives and plan the tasks to be carried out.
  - You will need to submit a weekly progress report on your project, starting the second week of classes. Your first report may be about an investigation of possible project topics if you have not yet chosen a topic. Requirements for the weekly reports will be given in the Teams assignments for the reports. Each weekly report will be worth 5 points, for a total of 75 points. The remaining 75 points will be for your project final report, code (if applicable), and project presentation during the final exam period.

- Possible project topics
    1. Linux From Scratch - https://www.linuxfromscratch.org/lfs/view/stable/index.html
    2. Fuchsia - https://fuchsia.dev/fuchsia-src/development
    3. SeL4 - https://sel4.systems/
    4. LibertyOS - https://github.com/LibertyOS-Development/kernel
    5. Interplanetary File System (IPFS) - https://docs.ipfs.io/
    6. WasmEdge - https://wasmedge.org/book/en/index.html
    7. EVE-OS - https://www.lfedge.org/projects/eve/
    8. HomeAssistant - https://www.home-assistant.io/

- **Course Schedule**
    - The course schedule of topics and assignments will be posted on the course website.

Disabilities and Accommodations

- If you have a disability and need accommodations, please contact The Center for Accommodations and Support Services (CASS) at 747-5148, or by email to **cass@utep.edu**. For additional information, please visit the CASS website at **www.sa.utep.edu/cass**.

Academic Honesty

- Students are expected to conduct themselves in a professional and courteous manner, as prescribed by the Standards of Conduct: https://www.utep.edu/hoop/section-2/student-conduct-and-discipline.html
- Submitted work should be unmistakably your own. You may not transcribe or copy a solution taken from another person, book, or other source (e.g., a web page). Professors are required to report academic dishonesty and any other violation of the Standards of Conduct to the Dean of Students.
- Permitted collaboration: Students may discuss requirements, background information, test sets, solution strategies, and the output of their programs. However, implementations and documentation must be their own creative work. Students are required to document advice received from others and all resources utilized in the preparation of their assignments.
- If academic dishonesty is suspected: The Dean of Students office will be contacted for adjudication. A temporary "incomplete" grade will be issued if their investigation extends beyond the grading period.

COVID-19 Precaution Statement

- Please stay home if you have been diagnosed with COVID-19 or are experiencing COVID-19 symptoms. If you are feeling unwell, please let me know as soon as possible, so that we can work on appropriate accommodations. If you have tested positive for COVID-19, you are encouraged to report your results to covidaction@utep.edu, so that the Dean of Students Office can provide you with support and help with communication with your professors.
- The Center for Disease Control and Prevention recommends that people in areas of substantial or high COVID-19 transmission wear face masks when indoors in groups of people. The best way that Miners can take care of Miners is to get the vaccine. If you still need the vaccine, it is widely available in the El Paso area. For more information about the current infection rates, testing, and vaccinations, please visit epstrong.org.

Appendix. CS 4375 Learning Outcomes

Level 1

V1i. Choose a scheduling approach suitable for given simple problem.
V1j. Explain segmentation and its security implications.
V1l. Explain some ways in which virtualization creates vulnerabilities.
V1m. Explain the components of process and virtual machine context.
V1n. Explain the need for paging and the basics of demand loading.
V1o. Describe the motivation for and gross characteristics of a trusted computing base.
V1x. Explain how domain names, IP addresses, file names, and memory segments are handled.
C1c. Given an application, identify the factors relevant to choosing a synchronous or asynchronous solution.
E1f. Choose when to use datagram versus virtual-circuit communication.
E1h. Differentiate transmission and propagation latencies and some factors affecting them.
E1i. Explain how data is serialized (byte order, representation, buffering).
E1l. Interpret the output of a packet capture tool.
E1n. Explain the role of cryptographic hashes and symmetric and asymmetric keys in security.
E1o. Explain domains names, IP and MAC addressing and how they support administration and data locality.
E1p. Explain the functionality handled at different network layers.
E1q. Explain some concepts in storing files on disk.
E1r. Explain the memory hierarchy and the basic concepts of distributed storage.
E1s. Explain generic device APIs, including the bidirectional handling of interrupts and requests.

Level 2

V2q. Use the concepts of process state and state transition to characterize system and process behavior.
V2r. Relate the distinction between supervisor and user permissions to the design and implementation of system calls.
V2t. Write programs that use interprocess communication, specifically pipes and/or sockets.
V2u. Use simple system calls for common needs.
C2g. Implement producer-consumer coordination.
C2h. Build a server-side program that uses multi-threading to handle multiple simultaneous clients.
C2i. Identify situations where deadlock may occur and suggest ways to prevent it.
A2g. Perform simple arithmetic computations related to major families (for example, determine page number or whether an address is within a power-of-2 segment)

Level 3

V3w. When a process or a computer is running too slowly, infer some probable causes.
V3p. Choose among virtual machines, processes, containers and sandboxes as ways to support common programmer needs.
C3j. Distinguish when blocking versus nonblocking calls are appropriate.