

# CS 4375: Operating Systems

**Instructor:** Dr. Deepak K. Tosh  
**Semester:** Fall 2021  
**Email:** [dktosht@utep.edu](mailto:dktosht@utep.edu)

**Class Hr:** MW 1:30 – 2:50PM  
**Office Hr:** MW 9 – 10AM @ Zoom  
**Classroom:** LART 106

## COVID-19 PRECAUTION STATEMENT

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, and will be available at no charge on campus during the first week of classes. For more information about the current rates, testing, and vaccinations, please visit [epstrong.org](http://epstrong.org).

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](mailto:covidaction@utep.edu), so that the Dean of Students Office can provide you with support and help with communication with your professors. The Student Health Center is equipped to provide COVID-19 testing.

## A. Course Description

Process and thread management, processor scheduling and concurrency, inter-process communication, memory management, input/output management, file systems, and networking basics

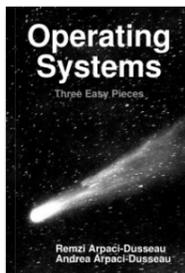
## B. Course Goals

Introduce core operating systems concepts that will be foundational for further study, whether academic or professional, in the domain of 1) Computer Security and Forensics, 2) Systems Administration and Network Administration, and 3) Systems Programming and Network Programming, including developing for embedded systems, cloud systems, and high-performance systems.

## C. Prerequisite

The prerequisite for this class is CS 3432: Computer Architecture with a C or better.

## D. Required Materials/Books



“**Operating Systems: Three Easy Pieces**” by Remzi Arpaci-Dusseau and Andrea Arpaci-Dusseau. A free electronic copy of this book is available at the following link: <https://pages.cs.wisc.edu/~remzi/OSTEP/>



“Computer Networks: A Systems Approach” by Larry Peterson and Bruce Davie. A free electronic copy of this book is available at the following link: <https://book.systemsapproach.org/>

**Required Prior Knowledge – (1)** You must know how to write programs in C and Python. These two programming languages will be heavily used in the assignments. Please visit the following link to learn more about C-Programming.

- 1) Learn C - <https://www.learn-c.org/>
- 2) Learn Python - <https://www.learnpython.org/>

### E. Course Outline (TENTATIVE)

Week	Topics	Reading
1	OS Introduction	OSTEP Ch. 1-2
2-3	Processes	OSTEP Ch. 3-7, 11
4-6	Memory	OSTEP Ch. 12-19, 24
7-8	Threads and Concurrency	OSTEP Ch. 25-32
9-11	Sockets, Network Fundamentals, and Security	Parts from PD Ch 1, 2, 8, 9
12-13	Filesystems and I/O	OSTEP Ch. 35-37, 39-40

**Note:** If time permits, we may cover advanced topics that are beyond the textbook. In that case, the instructor will upload the electronic copies of the handouts/weblinks in the Blackboard. Therefore, you will need regular access to a computer, stable/consistent Internet, Blackboard, and your UTEP email account for succeeding in this class.

### F. Course Assignments and Grading Policies

Your semester grade will be based on a weighted combination of homework assignments, quizzes, participation, and exam. The approximate percentages for each category are given in the following and the final grade will be calculated using weighted average of these items.

#### Grade Distribution

- 15% - Quizzes and Participation (QP)
- 40% - Homework Assignments (A)
- 20% - Midterm Exam (M)
- 25% - Final Exam (F)

$$\text{Total Score} = 0.2 * QP_{\text{avg}} + 0.4 * A_{\text{avg}} + 0.15 * M + 0.25 * F$$

Total Score	90-100	80-89	70-79	60-69	59 and Below
Grade	A	B	C	D	F

**\*\* Students are required to agree to the UTEP College of Engineering's [Honor Code](#).**

**Important Note:** You will have one week to appeal for your grades after the graded assignments and tests are returned. So, please keep this in mind if you think that there is a problem/issue with the grading of your work.

#### a. Homework Assignments

There will be tentatively six large homework assignments, approximately two per month. Through these assignments, students will develop concrete understanding on operating system concepts.

**Note-1:** Students/Teams may be asked to demonstrate their assignments and answer additional follow up questions, whenever the instructor needs to verify the originality of their works. It is student's responsibility to come prepared while demonstrating his/her work. If the student could not answer, the 50% of the respective question's score will be deducted.

**Note-2:** Uniqueness and plagiarism will be strictly checked in the submitted codes, documents, reports etc. If the instructor finds plagiarized submission, the student will be reported to dean's office and score for that assignment will be given as zero.

**Note-3:** Any external materials referred to solve the assignment tasks must be CITED as references in the reports.

#### b. Quizzes, and Participation

We will have **weekly quizzes** starting from 2<sup>nd</sup> week of the semester. Students should expect to spend 10-15 minutes on **iClicker** during the class hour to attempt the quizzes, which contributes 15% of total grade. Please make sure to either bring a laptop to the class or install iClicker on your smartphone to take the quizzes in class. Also note that the "iClicker REEF" is already integrated in the Blackboard for your convenience.

#### c. Midterm and Final Exam

Midterm exam is scheduled to be on **Oct 4, 2021**, and Final exam will be conducted on the day of UTEP's allotted day, which is **Dec 8, 2021, 4-6:45pm**. Each exam will be taken in-person at our classroom and the estimated duration will be 100-120 minutes. The format of the exams will be further discussed in the class and announced later.

#### **Late Submission Policy:**

- **No extension** on the **assignment or quiz** submission due dates will be given, unless there are special medical emergencies.
- Late submissions will be penalized with 10% deduction per day up to a maximum of 5 days. Submission after 5 days of due date will receive 0 points.

#### **Make-up Work Policy:**

Make-up work will be given only in the case of a documented emergency. Note that make-up work may be in a different format than the original work, may require more intensive preparation, and may be graded with penalty points. If you miss an assignment and the reason is not considered excusable, you will receive a **zero**. It is therefore important to reach out to me—in advance if at all possible—and explain with proper documentation why you missed a given course requirement.

Once a deadline has been established for make-up work, no further extensions or exceptions will be granted.

### **Incomplete Grade Policy:**

Incomplete grades may be requested only in exceptional circumstances after you have completed at least half of the course requirements. Talk to me immediately if you believe an incomplete is warranted. If granted, we will establish a contract of work to be completed with deadlines.

## **G. Course Outcomes**

### **Level 1 Outcomes: Knowledge and Comprehension**

Level 1 outcomes are those in which the student has been exposed to the terms and concepts at a basic level and can supply basic definitions. The material has been presented only at a superficial level.

Upon successful completion of this course, students will be able to:

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. Describe and motivate 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, and file names work and why.

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).

E1j. Explain the difference between lossy and lossless compression.

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 the functionality handled at the physical, link, network, and transport layers.

E1p. Explain the functionality handled at different network layers.

E1q. Explain some data structures used for storing files on disk.

E1r. Explain the memory hierarchy, locality, and redundancy.

E1s. Explain generic device APIs, including the bidirectional handling of interrupts and requests.

### **Level 2 Outcomes: Application and Analysis**

Level 2 outcomes are those in which the student can apply the material in familiar situations, e.g., can work a problem of familiar structure with minor changes in the details.

Upon successful completion of this course, students will be able to:

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 inter-process 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 (e.g., determine page number or whether an address is within a power-of-2 segment)

### **Level 3 Outcomes: Synthesis and Evaluation**

Level 3 outcomes are those in which the student can apply the material in new situations.

This is the highest level of mastery.

Upon successful completion of this course, students will be able to:

V3p. Choose among virtual machines, processes, containers and sandboxes as ways to support common programmer needs.

V3w. When a process or a computer is running too slowly, infer some probable causes.

C3j. Distinguish when blocking vs nonblocking calls are appropriate.

## **H. Technology Requirements**

Class will meet at the scheduled time at LART 106. The course content will be posted in the Blackboard learning management system. Therefore, please ensure to have stable Internet and a laptop with working microphone & webcam to connect with instructor and accessing course materials. If you encounter technical difficulties beyond your scope of troubleshooting, please contact the [Help Desk](#) as they are trained specifically in assisting with technological needs of students.

## **I. Course Communication**

We will use the following mediums to communicate throughout the course.

- **Office Hours:** We will not be able to meet on campus, but I will hold office hours on Zoom for your questions and comments about the course.
  - Office Hour Zoom Link: Enabled in Blackboard left side panel
  - Office Hours: Mondays and Wednesdays: **9-10 A.M. Mountain Standard Time**

- **Email:** UTEP e-mail is the best way to contact me, in case you were not able to meet during office hours. I will make every attempt to respond to your e-mail within 24-48 hours of receipt. When e-mailing me, be sure to email from your UTEP student account and please put the course number in the subject line. In the body of your e-mail, clearly state your question. At the end of your e-mail, be sure to put your first and last name, and your university identification number.  
***Note:** Please, do not email me in the last minute asking for help on the assignments/tests. You may not get a quick answer, rather be early on attempting such activities.*
- **Discussion Board:** If you have a question that you believe other students may also have, please post it in the Help Board of the discussion boards inside of Blackboard. Please respond to other students' questions if you have a helpful response.
- **Announcements:** Check the Blackboard announcements frequently for any updates, deadlines, or other important messages.

## J. Class Recordings

The instructor plans to record classroom discussions in the Blackboard for offline reference to the students. The use of recordings will enable you to have access to class lectures, group discussions, and so on in the event you miss a synchronous or in-person class meeting due to illness or other extenuating circumstance. Our use of such technology is governed by the Federal Educational Rights and Privacy Act (FERPA) and UTEP's acceptable-use policy. A recording of class sessions will be kept and stored by UTEP, in accordance with FERPA and UTEP policies. Your instructor will not share the recordings of your class activities outside of course participants, which include your fellow students, teaching assistants, or graduate assistants, and any guest faculty or community-based learning partners with whom we may engage during a class session. **You may not share recordings outside of this course. Doing so may result in disciplinary action.**

## K. Netiquette and Standards of Conduct

Students are expected to conduct themselves in a professional and courteous manner, as prescribed by the Standards of Conduct. Students may discuss work assignments and programming exercises in a general way with other students, but the solutions must be done independently. Similarly, groups may discuss group project assignments with other groups, but the solutions must be done by the group itself. Graded 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 -- and will -- report academic dishonesty and any other violation of the Standards of Conduct to the Dean of Students. Some **key points** to remember:

- Always consider audience. Remember that members of the class and the instructor will be reading all the postings.
- Respect and courtesy must be provided to classmates and to instructor at all times. No harassment or inappropriate postings will be tolerated.
- When reacting to someone else's message, address the ideas, not the person. Post only what anyone would comfortably state in a F2F situation.
- Blackboard is not a public Internet venue; **all postings to it should be considered private and confidential.** Whatever is posted on in these online spaces is intended for classmates and professor only. Please do not copy documents and paste them to a publicly accessible

website, blog, or other space. If students wish to do so, they have the ethical obligation to first request the permission of the writer(s).

## L. Copyright Statement for Course Materials

All materials used in this course are protected by copyright law. The course materials are only for the use of students currently enrolled in this course and only for the purpose of this course. They may not be further disseminated.

## M. Academic Dishonesty and Code of Honor

Academic dishonesty is strictly prohibited and is considered a violation of the UTEP Handbook of Operating Procedures. It includes, but is not limited to, cheating, plagiarism, and collusion. Cheating may involve copying from or providing information to another student, possessing unauthorized materials during a test, or falsifying research data on laboratory reports. Plagiarism occurs when someone intentionally or knowingly represents the words or ideas of another as one's own. Collusion involves collaborating with another person to commit any academically dishonest act. Any act of academic dishonesty attempted by a UTEP student is unacceptable and will not be tolerated. All suspected violations of academic integrity at The University of Texas at El Paso must be reported to the [Office of Student Conduct and Conflict Resolution \(OSCCR\)](#) for possible disciplinary action. To learn more [HOOP: Student Conduct and Discipline](#).

**Note:** Students are required to agree to the UTEP College of Engineering's [Honor Code](#).

## N. Accommodations Policy

UTEP is committed to providing reasonable accommodations and auxiliary services to students, staff, faculty, job applicants, applicants for admissions, and other beneficiaries of University programs, services and activities with documented disabilities in order to provide them with equal opportunities to participate in programs, services, and activities in compliance with sections 503 and 504 of the Rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act (ADA) of 1990 and the Americans with Disabilities Act Amendments Act (ADAAA) of 2008. Reasonable accommodations will be made unless it is determined that doing so would cause undue hardship on the University. Students requesting an accommodation based on a disability must register with the [UTEP Center for Accommodations and Support Services](#).

## O. Student Resources

UTEP provides a variety of student services and support:

- [UTEP Library](#): Access a wide range of resources including online, full-text access to thousands of journals and eBooks plus reference service and librarian assistance for enrolled students.
- [Help Desk](#): Students experiencing technological challenges (email, Blackboard, software, etc.) can submit a ticket to the UTEP Helpdesk for assistance. Contact the Helpdesk via phone, email, chat, website, or in person if on campus.
- [University Writing Center \(UWC\)](#): Submit papers here for assistance with writing style and formatting, ask a tutor for help and explore other writing resources.

- [Math Tutoring Center \(MaRCS\)](#): Ask a tutor for help and explore other available math resources.
- [Military Student Success Center](#): UTEP welcomes military-affiliated students to its degree programs, and the Military Student Success Center and its dedicated staff (many of whom are veterans and students themselves) are here to help personnel in any branch of service to reach their educational goals.
- [RefWorks](#): A bibliographic citation tool; check out the RefWorks tutorial and Fact Sheet and Quick-Start Guide.