

**Operating Systems**

CS 330

Spring 2021

* 3 credits
* Prerequisite: CS 335 or permission (e.g. for IT concentration students)
* Instructor: [Brother David Carlson](https://cis.stvincent.edu/cis/FacultyInfo/BrDavid.php)
* Office: Dupre Science Pavilion, Tenley Hall W217
* Office hours via Zoom, email, phone, or socially distanced in the atrium. Email me if you want to request a Zoom meeting.
  + Mon 2:00 pm - 4:30 pm
  + Tue 8:45 am - 11:20 am
  + Tue, Thurs 2:30 pm - 4:30 pm
  + and by appointment
* Phone: 724-805-2416
* Email: [david.carlson@stvincent.edu](mailto:david.carlson@stvincent.edu)
* Class Times and Location
  + Mon, Fri 12:30 pm - 1:45 pm, Dupre W214
* Date of Final Exam: Tue, May 18, 4:00 pm - 6:00 pm

**Course Description**

This course covers basic computer hardware, processes, CPU scheduling, virtual memory and main memory management, caching, interrupts, processes and threads, system calls, synchronization, I/O, deadlock, disk scheduling, real time scheduling, operating systems security, file systems, interprocess communications, multiprocessor systems, storage management, virtualization, the user interface, and performance. In addition, it uses Linux as a case study, emphasizing system administration tasks, Linux utilities, pipes, and bash scripts. Prerequisite: CS 335. Offered spring semester. Three credits.

**Required Text and Other Materials**

Text: Operating Systems Concepts, Enhanced eText, 10th ed., Silberschatz, Galvin, Gagne, Wiley (2018), ISBN 978-1-119-32091-3 and other related ISBNs. Either a print book or e-text is fine.The e-text may be helpful in that you can do a search for particular things.

You will also need some software: ssh and ftp clients to connect to our Linux server, either from W214 or from elsewhere. This software is provided in W214. Contact Br. David if you want to get some of this software for your PC. One early exercise has you build a virtual machine on our Windows server. As far as I know, that has to be done in W214 itself.

**Course Learning Objectives**

By the end of the course, students will be able to:

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| 1. Be able to perform certain typical Linux server administration tasks (such as adjusting file and directory permissions, using a script to automate a task, and setting a script to run automatically at a set time). 2. Be able to solve basic theory of operating systems problems (such as CPU scheduling problems, mapping logical addresses to physical addresses). 3. Be able, in the area of operating systems, to recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles. 4. Be able to describe the role and basic functions of an operating system, and how operating systems interact with hardware and software applications. 5. Be able to identify and describe basic security issues of operating systems. 6. Have an understanding of operating systems theory and implementation. They will understand OS internals to the level that they can design and implement significant architectural changes to an existing OS. 7. Be able to demonstrate their proficiency in the use of scripting languages (such as bash) to write simple scripts (e.g., to automate system administration tasks). 8. Be able to write simple linear and looping scripts. 9. Be able to write simple and compound conditions within a programming language or similar environment (e.g., scripts, macros, SQL). 10. Be able to demonstrate proficiency in the use of a programming language (such as bash, C, C++) to solve complex problems in a secure and robust manner. |

**Relevant CIS Department Student Learning Outcomes**

By the time of graduation

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| 1. The CS, IS, or CYSEC major will have an ability to analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions. 2. The CS, IS, or CYSEC major will have an ability to design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program’s discipline. 3. The CS, IS, or CYSEC major will have an ability to recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles. 4. The CS major will have an ability to apply computer science theory and software development fundamentals to produce computing-based solutions. 5. The CYSEC major will have an ability to apply security principles to maintain operations in the presence of risks and threats. 6. The IS major will have an ability to support the delivery, use, and management of information systems within an information systems environment. |
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**Course Schedule**

Due dates and other details for assignments are posted in Schoology. The schedule below merely attaches assignments to the approximately correct spot in the course. Most assignments require your work to be posted on the department's Linux server. In fact, most of your work should be created on that server.

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| Date | Topic | Assignment/Exam |
| Wk 1, Feb 8 | Syllabus, Ch 1: Introduction, Review of simple computer architecture: CPU.doc and FetchDecodeExecuteCycle.doc | Exercises will be assigned throughout the course |
| Wk 1, Feb 12 | Review of computer architecture: mic1.exe and mic015.txt, Ch 2: Operating-System Structures | email your instructor,  Ch 1 homework |
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| Wk 2, Feb 15 | Ch 2: Operating-System Structures | Ch 2 homework |
| Wk 2, Feb 19 | In-class lab on Linux kernel modules project | Intro to Linux kernel modules project in Ch 2 |
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| Wk 3, Feb 22 | Ch 3: Processes |  |
| Wk 3, Feb 26 | Ch 3: Processes, SystemCalls.docx | Unix shell project from Ch 3 |
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| Wk 4, Mar 1 | Ch 4: Threads & Concurrency, pthreadExamples.docx  To compile pthreadEx2.c in Linux:  gcc pthreadEx2.c -lpthread -o pthreadEx2 | ForkExecProblem1.docx |
| Wk 4, Mar 5 | Ch 5: CPU Scheduling | Programming problem 4.24 on thread programming |
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| Wk 5: Mar 8 | Ch 5: CPU Scheduling,  EthicalSocialProfessionalGuidelines.docx | ForkExecProblem2.docx |
| Wk 5: Mar 12 | Ch 6: Synchronization Tools | Scheduling algorithm project from Ch 5 |
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| Wk 6: Mar 15 | Ch 7: Synchronization Examples, Review | RoundRobinProb.docx |
| Wk 6: Mar 19 | Chapters 1 - 7 and associated material | Midterm exam |
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| Wk 7: Mar 22 | Ch 8: Deadlocks | Programming problem 7.17 on multithreading and race conditions |
| Wk 7: Mar 26 | Ch 9: Main Memory | Contiguous memory allocation project |
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| Wk 8: Mar 29 | Ch 10: Virtual Memory |  |
| Wk 8: Apr 2 | Good Friday: No class |  |
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| Wk 9: Apr 5 | Ch 10: Virtual Memory |  |
| Wk 9: Apr 9 | BashPipesAliasesScripts.docx, LinuxUtilities.doc |  |
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| Wk 10: Apr 12 | Ch 11: Mass-Storage Structure, more bash scripts | BashScript1.docx |
| Wk 10: Apr 16 | Ch 12: I/O Systems, webmonitor script: webmonitor.txt, TheArtistryOfTop.docx | Exercise 11.13 on disk scheduling |
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| Wk 11: Apr 19 | Ch 13: File-System Interface, ShellReference.docx more bash scripts |  |
| Wk 11: Apr 23 | Ch 14: File-System Implementation, more bash scripts, RegularExpressionsAndGrep.docx | BashScript2.docx |
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| Wk 12: Apr 26 | Ch 15: File-System Internals, InputChecking script,  account generation scripts | FileSystemExercises.docx |
| Wk 12: Apr 30 | Ch 16: Security, InputChecking2 script,  Real-Time Operating System Security.pdf |  |
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| Wk 13: May 3 | Ch 16: Security, CybersecurityFirstPrinciples.docx, check\_input\_type bash script | BashScript3.docx |
| Wk 13: May 7 | Ch 17: Protection, more bash scripts, BufferOverflow.cpp, SecurityDemoPage4.jpg, stack\_smashing.pdf | Exercises 17.21 and 17.22 |
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| Wk 14: May 10 | Ch 19: Networks and Distributed Systems, Security Issues in Distributed Computing.pdf, Netlogon Exploit |  |
| Wk 14: May 14 | Ch 20: The Linux System, SeriousFlaws.docx, Review |  |
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| Finals Week: Tue, May 18, 4:00 - 6:00 pm | Covers mostly topics from after the midterm exam, but a few questions from the first half of the course may be included. | Final exam |

**Course Requirements and Grading**

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| * 10% Exercises that are collected * 30% Projects, scripts, and programming problems * 30% Midterm exam * 30% Final exam |
| Letter grades will be assigned according to the scheme found in the current College Bulletin. Exams will be announced in advance and (assuming that we have not had to switch to online classes) will be closed-book, pencil and paper exams in nature, except that you may use one two-sided 8.5 in. x 11 in. page of notes of any kind. Thus, on exams, only the test paper, calculators, the one page of notes, pens, pencils, and erasers may be used. Cell phones, tablets, laptops, PCs, and similar devices should be turned off and put away. Calculators may be used on exams but are not to be shared among students.  Software assignments will be graded using the following rubric:   |  | | --- | | * 60% Correctness (meets its specifications) * 10% Good program design * 10% Clarity, style, and readability * 10% Good documentation * 10% Efficiency | |

The homework and projects in this class generally involve writing or modifying software, often in a Linux environment. It requires careful work and usually cannot be completed in one sitting. **Work on your these tasks over a few days or so before each is due -- not at the last minute.** Plan to have each project done early so that there will be time to test it and to fix the problems that testing usually reveals. That also gives you time to ask the instructor for assistance. Note that a software project nearly always takes longer than you expect! Last minute attempts are bound to fail. That holds true whether you are working on a huge real-world project or a small project in this course. **Projects must be done separately by each individual** unless the instructor tells you otherwise. **Do not ask a fellow student in the class how to solve the problem or ask to see that person's code, as that is plagiarism!** You may consult only the tutors or the instructor for homework and project help.

Tests will ask critical thinking questions that require careful analysis, explanation, and sensible conclusions. Test questions may be like the exercises from the text, the scripts, parts of the projects, or parts of the programming problems. Watch Schoology for details of assignments, their due dates, etc.

Make-up exams are discouraged. If possible, take the regularly scheduled exam. However, see your instructor ahead of time if you know you must miss an exam and consult with your instructor for any other situations involving missing an exam.

**CIS Department Policies**

As much as possible, the CIS Department faculty intend to keep a traditional lecture schedule this semester. Bear in mind, policies may change during the semester as the covid situation changes. Please refer to the Department’s website for the latest information. Here are our policies:

* We will provide normally scheduled lectures. Depending on the class, we may offer synchronous on-line lectures, recorded lectures, or some other format. Faculty will provide specific instructions for their classes in their syllabi.
* Given lecture-room capacity limitations due to the College’s covid response, you may be asked to attend in-class lecture only once or twice per week. For all other lectures, you must attend the synchronous, on-line lecture for your class.
* If you cannot attend synchronous, on-line lectures, the faculty will accommodate you. The form of accommodation will vary among classes. The faculty will **not** normally publish lecture recordings.
* Usually, assignments will be distributed and collected through Schoology. Some classes, however, may use different websites for homework and projects. (In CS 330 most of your assignments will simply be left for me to read under your Linux home folder.)
* The College has allowed office hours and group meetings (e.g., research, senior-project teams) to be held via Zoom. Check the syllabus for your class to determine how and when office hours will be held. Faculty will make available in their syllabi both the methods and times when they will be available for office hours. Please use those hours!
* Tutoring and CLP sessions will be delivered via Zoom. Schedules will be posted on the department’s website <https://cis.stvincent.edu> .
* Please use the same seat throughout the term to minimize contamination and to aid faculty in taking attendance. Faculty must take attendance in each class for contact tracing if there is a covid case on campus. Attendance policies are given in the course syllabus. Please read it.
* When working in teams, remember to follow the College’s policies for distancing and masks.

Course Policies

Academic Honesty Policy

Saint Vincent College assumes that all students come for a serious purpose and expects them to be responsible individuals who demand of themselves high standards of honesty and personal conduct. Therefore, it is college policy to have as few rules and regulations as are consistent with efficient administration and general welfare. **Fundamental to the principle of independent learning and professional growth is the requirement of honesty and integrity in the performance of academic assignments, both in the classroom and outside, and in the conduct of personal life. Accordingly, Saint Vincent College holds its students to the highest standards of intellectual integrity and thus the attempt of any student to present as his or her own any work which he or she has not performed or to pass any examinations by improper means is regarded by the faculty as a most serious offense**. In any case of academic dishonesty, the faculty member together with the Assistant Vice President for Student Success and Retention, who confers with the student, decide on the appropriate sanction. Depending on the seriousness of the offense, possible sanctions are failure for the assignment, failure for the course, suspension or expulsion. If a student receives the sanction of a failure for the course during the withdrawal period and drops the course, a WF will be recorded on the transcript.

**In this course, students are expected to do entirely their own work on the exams, programming problems, scripts, and projects. You may work together on the exercises from the text** (but not the programming problems and projects from the text). A possible exception is that students may sometimes be asked to work in small groups on some of the programming projects or other projects. Every assignment should list all sources that contributed to the solution. This would include the individual student (or the group members if we do some small group work). It may also include the instructor, a reference book, a web site, etc. Web sites or people that simply give you a solution to an assignment are **not** to be used. One student or group should not consult another student or group in the class. If you need assistance beyond simple clarification of the description of the assignment, consult the instructor. **You may not look at the work of another student (or group) in this course or show yours (even a part of it) to another student (or group) in the course. You may not work out an assignment with one or more other students from the course (who are not in your group, for a group project). If you break one of those conditions, then this is a case of academic dishonesty**. See above for how this gets handled and the possible consequences.

*Appropriate Academic Use of Recordings*

Please be advised that elements of this course may be recorded for the sake of students in need of certain accommodations. This recording may include any contributions you make during the class sessions by answering/asking questions or making presentations. If you have concerns about being recorded, please contact your professor before class to discuss those concerns and the possibility of other ways that you might contribute.

All students are expected to use recorded course material only for their own personal academic use. Recorded content may not be shared with others outside of the course, unless the instructor has given explicit permission for the student to do so.

Violations of this policy will be reported to and addressed by the Office of Student Conduct. Behavior that constitutes a violation of academic integrity will also be reported to Academic Affairs as such and may incur additional sanctions.

Attendance Policy

Saint Vincent College recognizes that the current pandemic situation complicates face-to-face attendance for many students. The tradition of face-to-face classes is at the heart of a liberal arts education and we value the way that being physically present in the same space promotes dynamic interactions and community building. As such, we are making these opportunities available as much as possible. At the same time, in order to minimize risk of disease transmission, SVC has modified classroom arrangements and instructors are modifying their modes of instruction to make the best and safest use of space, while also utilizing technology-based modes of instruction that have been shown to meet our learning objectives. The Saint Vincent policy for Fall 2020 and Spring 2021 is that no student can be penalized for not being physically present in a classroom.  Each instructor will establish a course-specific attendance contingency plan that incorporates alternative modes of instruction and attendance for students who are required to quarantine, or who have secured accommodations through Ms. Marisa Carlson, the Director of COVID-19 Accommodations.

In this course, students who cannot attend in-person classes for any reason should ask the instructo to do a live Zoom conference. (In other words, if no one has asked to not attend in person, no Zoom conferences will be made. You must ask so that the instructor can set up a Zoom conference for the applicable class or classes.) If, for a good reason, a student cannot attend in-person or by means of a live Zoom conference, a recording of the conference may be made available to that student, but recordings are not normally made available to the class.

* Each unexcused class absence after the first 3 results in 1.5 percentage points being deducted from the final course grade.
* Arriving late for class or leaving early (without a proper excuse) is counted as 1/2 of an absence.
* An unexcused absence from an exam results in the failure of the course.
* Unexcused absence from more than one-third of the semester's classes results in the failure of the course.
* Attendance is used to decide borderline grades at the end of the semester.
* Late work is not normally accepted, but partial credit is given for incomplete work that is submitted on time.
* Email me if you must miss class (in-person or online) for any reason, whether it is due to an illness or some other issue. It is always best to let me know instead of leaving me to wonder why you were not in class.
* Because of the possibility of the covid-19 virus, the flu, or other communicable diseases affecting us on campus, please practice good hand washing, wearing of masks, staying at least 6 feet apart, etc. If you get ill, please notify me and follow good medical advice and college policy. Check with me about what you miss. You are still responsible for all course material, but an incomplete grade can be given if you cannot finish the course in the given time frame. See the Saint Vincent College Covid-19 Updates at <https://www.stvincent.edu/resources/covid-19-updates/index.html> .

*Class Cancellation Policy*

If the instructor needs to cancel class, every effort will be made to send an email message to students' Saint Vincent email accounts and/or to place a note on the course Schoology page.

Classroom Etiquette

An essential characteristic of Saint Vincent College is the dignity and civility with which students and instructors conduct themselves both inside and outside the classroom. All students share in the responsibility of making the classroom, whether physical or virtual, a positive place to learn. Attendance is more than just being in the classroom or logged into the course. Students are expected to be prepared, attentive, and respectful of others.

*Accessibility Statement for Students with Disabilities*

Students with disabilities who may be eligible for academic accommodations and support services should contact Ms. Marisa Carlson, Assistant Dean of Studies, by email (marisa.carlson@stvincent.edu) to schedule a meeting. Reasonable accommodations do not alter the essential elements of any course, program, or activity. The Notification of Approved Academic Accommodations form indicates the effective date of all approved academic accommodations and is not retroactive.

Title IX Statement

Saint Vincent faculty are committed to helping create a safe learning environment for all students and for the college as a whole. If you have experienced any form of gender or sex-based discrimination or harassment, including sexual assault, sexual harassment, intimate partner (dating or domestic) violence, sexual exploitation, or stalking, know that help and support are available. Saint Vincent College has staff members trained to support students in navigating campus life, accessing health and counseling services, providing academic and housing accommodations, and more. The College strongly encourages all students to report any such incidents.

Please be aware that all Saint Vincent employees (other than those designated as confidential employees such as counselors, clergy and healthcare providers) are required to report information about such discrimination and harassment. This means that I have a mandatory duty to report to the Title IX Coordinator any information I receive about possible sexual misconduct.  This includes information shared in class discussions or assignments, as well as information shared in conversations outside class.  The Title IX Coordinator will contact you to inform you of your rights and options and connect you with support resources, including possibilities for holding accountable the person who harmed you. Know that you will not be forced to share information and your level of involvement will be your choice. The purpose of reporting is to allow Saint Vincent to take steps to ensure that you are provided with any necessary resources needed and to provide a safe learning environment for all.

The College’s Title IX Coordinator is:

Eileen K. Flinn, Esq.

Saint Vincent College

Second Floor, Alfred Hall

724-805-2897

The College also has confidential resources available, who can provide assistance to those who have experienced sexual misconduct without triggering a mandatory reporting duty.  More information about confidential resources is available on the [Saint Vincent Student Life page](https://www.stvincent.edu/student-life/title-ix).

If you wish to speak to a confidential employee who does not have this reporting responsibility, you can contact Campus Ministry at 724-805-2350 or the Wellness Center in the Carey Student Center at 724-805-2115. For more information regarding your rights and options, please see the Sexual Misconduct and Harassment policy which can be found on the MySV portal under Quick Links or on the [Saint Vincent Student Life page](https://www.stvincent.edu/student-life/title-ix).