



SAINT VINCENT COLLEGE

Operating Systems

CS 330

Spring 2023

- 3 credits
- Prerequisite: CS 335
- Instructor: Brother David Carlson
- Office: Dupre Science Pavilion, Tenley Hall W217
- Office hours via email, phone, or in person in my office, or Zoom.
 - Mon 9:00 am – 10:20 am, 2:00 pm – 4:00 pm
 - Tue, Thurs 9:00 am – 9:45 am, 2:30 – 4:30 pm
 - Fri 9:00 am – 10:20 am
 - and by appointment
 - Office hours are times that I will normally be in the office and can likely meet with you or answer email. I will try to answer at other times, though it might take longer to get a reply.
- The CIS lab in W214 of the Dupre science complex will be available according to a schedule that will be posted after classes start. The CIS tutors usually work in this room.
- Phone: 724-805-2416
- Email: david.carlson@stvincent.edu
- Class Times and Location
 - Mon, Wed, Fri 10:30 pm - 11:20 pm, Dupre W214
- Date of Final Exam:
 - Tue, May 7, 11:00 am - 1:00 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

See our bookstore to purchase your access code for the online text, identified as STVINCENTCS330CarlsonSpring2024. Sign in or create an account at learn.zybooks.com and then select this zyBook name online: STVINCENTCS330CarlsonSpring2024

That online text is: Operating Systems, A. Silberschatz. G. Gagne, P. Galvin, 2022, Zyante Inc. (zyBooks.com). You also need some software: ssh and ftp clients to connect to our Linux server, either from W214 or from elsewhere. This software is provided on the PCs in W214, but you may want to work from elsewhere as well.

Course Learning Objectives

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

1. Identify the important issues, modules, or variables in a computing problem.
2. Describe a solution using principles or techniques appropriate to the class.
3. Create and compare different potential solutions using analytical techniques appropriate to the class.
4. Design a solution that meets a given set of computing requirements using techniques appropriate to the class.
5. Implement a solution that meets a given set of computing requirements using techniques appropriate to the class.
6. Evaluate a solution using appropriate metrics for the problem.
7. Construct software to solve a given problem.
8. Explain the theory or software-development fundamentals underlying the solution he or she built to solve a given problem; or, show how theory was applied to solve the problem.
9. Use computer science theory or software-development fundamentals to select among different solutions.
10. 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).
11. Be able to solve basic theory of operating systems problems (such as CPU scheduling problems, mapping logical addresses to physical addresses).
12. 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.
13. Be able to describe the role and basic functions of an operating system, and how operating systems interact with hardware and software applications.
14. Be able to identify and describe basic security issues of operating systems.
15. Have an understanding of operating systems theory and implementation. Students will understand OS internals to the level that they can design and implement significant architectural changes to an existing OS.
16. 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).
17. Be able to write simple linear and looping scripts.
18. Be able to write simple and compound conditions within a programming language or similar environment (e.g., scripts, macros, SQL).
19. 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:

1. The CS, IS, or CYSEC major will have the 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 the 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 major will have the ability to apply computer science theory and software development fundamentals to produce computing-based solutions.
4. 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.
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.

Course Schedule

Due dates and other details for assignments are posted in Schoology. The schedule below merely attaches topics and assignments to the approximately correct spot in the course. Many assignments require your work to be posted on the department's Linux server. In fact, much of your work should be created on that server so that you learn your way around this type of server.

Date	Topic	Assignment/Exam
Wk 1, Jan 15	Syllabus, Ch 1: Introduction	Exercises will be assigned throughout the course. HW0: email your instructor
Wk 1, Jan 17	Review of simple computer architecture: CPU.doc and FetchDecodeExecuteCycle.doc	
Wk 1, Jan 19	Ch 2: Operating-System Structures, differences between C and C++	Ch 1 homework
Wk 2, Jan 22	Ch 2: Operating-System Structures	Ch 2 homework
Wk 2, Jan 24	How to install Linux, Intro to the C language	
Wk 2, Jan 26	Intro to the C language, in-class Linux kernel modules example	
Wk 3, Jan 29	Ch 3: Processes	ForkExecProblem1
Wk 3, Jan 31	SystemCalls.docx	
Wk 3: Feb 2	Ch 3: Processes, Unix shell project explained	ForkExecProblem2
Wk 4, Feb 5	Ch 4: Threads & Concurrency	
Wk 4, Feb 7	Ch 4: Threads & Concurrency pthreadExamples.docx To compile pthreadEx2.c in Linux: gcc pthreadEx2.c -lpthread -o pthreadEx2	

Wk 4, Feb 9	Ch 5: CPU Scheduling	Unix shell project from Ch 3
Wk 4, Feb 12	Ch 5: CPU Scheduling	
Wk 4, Feb 14	CPU Scheduling EthicalSocialProfessionalGuidelines.docx	Thread programming problem
Wk 4, Feb 16	Ch 6: Synchronization Tools	
Wk 5: Feb 19	Ch 6: Synchronization Tools	Scheduling algorithm project
Wk 5, Feb 21	Ch 7: Synchronization Examples	
Wk 5: Feb 23	Ch 7: Synchronization Examples	RoundRobinProb.docx homework
Wk 6: Feb 26	Ch 8: Deadlocks, Review	
Wk 6: Feb 28	Ch 8: Deadlocks, Review	Programming problem on multithreading and race conditions
Wk 6: Mar 1	Midterm exam	Ch 1 - 8 and associated material
Wk 7: Mar 4	Spring Break Week	
Wk 7: Mar 6	Spring Break Week	
Wk 7: Mar 8	Spring Break Week	
Wk 8: Mar 11	Ch 9: Main Memory	
Wk 8: Mar 13	Ch 9: Main Memory, Ch 10: Virtual Memory	
Wk 8: Mar 15	Ch 10: Virtual Memory, LinuxUtilities.doc	Contiguous memory allocation project
Wk 9: Mar 18	BashPipesAliasesScripts.docx	
Wk 9: Mar 20	BashPipesAliasesScripts.docx	
Wk 9: Mar 22	Ch 11: Mass-Storage Structure, more bash scripts	BashScript1
Wk 10: Mar 25	Ch 12: I/O Systems, BashPipesAliasesScripts.docx	
Wk 10: Mar 27	TheArtistryOfTop.docx, webmonitor script: webmonitor.txt, Ch 13: File-System Interface	Exercise on disk scheduling
Wk 10: Mar 29	Easter Break: no class	
Wk 11: Apr 1	Easter Break: no class	
Wk 11: Apr 3	ShellReference.docx, more bash scripts	BashScript2.docx
Wk 11: Apr 5	Ch 14: File-System Implementation	
Wk 12: Apr 8	more bash scripts, account generation scripts, regularExpressionsAndGrep.docx	
Wk 12: Apr 10	Ch 15: File-System Internals	

Wk 12: Apr 12	Ch 15: File-System Internals	
Wk 13: Apr 15	Real-Time Operating System Security.pdf, InputChecking script	FileSystemExercises.docx
Wk 13: Apr 17		BashScript3.docx
Wk 13: Apr 19	Ch 16: Security, CybersecurityFirstPrinciples.docx, InputChecking2 script, Ch 17: Protection, check_input_type bash script	
Wk 14: Apr 22	BufferOverflow.cpp, SecurityDemoPage4.jpg,	Ch 17 Exercises
Wk 14: Apr 24	stack_smashing.pdf, more bash scripts	
Wk 14: Apr 26	Ch 19: Networks and Distributed Systems	
Wk 15: Apr 29	Ch 20: The Linux System	
Wk 15: May 1	Netlogon Exploit, Security Issues in Distributed Computing.pdf	
Wk 15: May 3	SeriousFlaws3.docx, Review	
Final Exam Tue, May 7, 11 am – 1 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

- 10% Exercises (in your ZyBook)
- 24% Programs and Projects
- 33% Midterm Exam
- 33% Final Exam

Grading a Student Program

- 55% Correctness (meets its specifications)
- 10% Good program design
- 10% Clarity, style, and readability
- 15% Good documentation, including answering any questions that the assignment asks for (such as a running time analysis, a comparison with a different version of the project, etc.).
- 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 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 likely to fail. That holds true whether you are working on a huge real-world project or a small project in this course.

Work on your programming projects over the week or two 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 or one of the tutors for assistance. Note that a

programming project nearly always takes longer than you expect! Last minute attempts are very likely to fail. That holds true whether you are working on a huge million-dollar software project or a 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, ask to see that person's code, get ChatGPT or similar to produce a solution, or get a solution in some way other than doing it yourself, as that is plagiarism!** Of course, you are allowed to look up small items such as how a particular C function works. You may consult only the tutors or the instructor for any of the homework.

Projects must be done separately by each individual unless the instructor tells you otherwise. Some projects or homework might be done in small teams (probably of 2 students). Except for such team assignments where 2 people can work together, **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 on individual assignments.

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, tests, 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. Going on vacation is not a valid excuse for missing an exam. Being sick is a valid excuse.

CIS Department Policies

Although we intend to keep a traditional in-person class schedule this semester, policies may change during the semester if significant danger develops because of covid or some other disease. Here are our current policies:

- For all assignments and exams, illegible answers will not be graded, and no points will be awarded.
- At any time, you may be asked to explain the code you turned in for an assignment or as the answer to an exam question. If you cannot explain the code or answer, you will not receive any points for that assignment or exam question. See the Academic Honesty Policy below.
- If you cannot attend a class: Assignments may be turned in via Schoology. Then email me to let me know about this.
- If you miss a class, it is your responsibility to get any notes, handouts, or assignments. If a reasonable excuse is provided, you will be given the opportunity to make up any missed in-class assignment. In cases of illness that requires quarantine or similar, remote attendance may be possible via Zoom. Please contact me as soon as possible when such a situation arises.
- In general, recording the class is prohibited. However, see the general college policy on recordings below.
- 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 in to the course. Students are expected to be prepared, attentive, and respectful of others.
- If a class must be canceled for any reason, I will contact you by email and/or a posting in Schoology. If assignments are due when a class has been canceled, they should be turned in via Schoology (or by sliding paper solutions under my office door) by the same due date.

- Students should consult the CIS Department Policies, [DepartmentPolicies.pdf](#), for additional information regarding course and department policies.
- Please use the same seat throughout the semester to aid in taking attendance. See specific attendance policies below.

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.** Faculty decide, for example, in each class and will clearly state in their syllabus or assignment instructions how AI large language models may be used or prohibited; failure to adhere to these expectations, including citing the AI if use is allowed, constitutes academic dishonesty. In any case of academic dishonesty, the faculty member together with the Academic Integrity Officer (usually the Assistant Vice President for Academic Affairs), who may meet 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. A more complete description of the policy addressing academic honesty complaints is provided in the Student Handbook.

In this course, students are expected to do entirely their own work on the exams, the individual programming projects, and the various exercises. However, some of these may be team projects, but most will be individual projects. The team projects should be done with each team doing its own work. No team should consult a different team. Every assignment should list all sources that contributed to the solution. This would include the individual student (or the group members for a team project). It may also include the instructor, a reference book, a web site, etc. AI (such as ChatGPT) is **not** to be used unless an assignment specifically asks you to use it. Web sites or people that simply give you a solution to an assignment are **not** to be used. If you need assistance beyond simple clarification of the description of the assignment, consult the instructor or one of our tutors. **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. Note that class sessions are not likely to be recorded unless it is known to the instructor that someone has a legitimate reason to miss the class.

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.

Photographs

Students are not allowed to take photographs during class without the permission of the instructor. If you missed something in a lecture, check with me or ask a fellow student about the item that you missed.

Attendance Policy

- Follow the current college policies on dealing with covid.
- Note that any significant changes to the health situation may require modifications to this policy.
- In person attendance is normally expected in this class. Attendance will be taken. Each unexcused absence after the first 4 will result in 1 point being subtracted from the final course grade.
- If there is anyone in this course who must attend remotely, contact your instructor immediately so that arrangements can be worked out.
- Students who are required to quarantine or isolate due to covid will be given excused absences from the relevant class sessions. These students should contact their professor for how they can continue with the class remotely. A likely method is to follow along in the text (and its interactive exercises). The use of Zoom might also be a possibility.
- Students who have some other significant reason for missing a class should contact their professor to see if the absence can be excused. The reason for the absence should fit under the category of extreme verifiable circumstances. Examples of extreme circumstances are serious illnesses or the death of a family member. Examples of non-extreme circumstances are nonrefundable airline tickets, sporting events and concert tickets. Proof of the extreme circumstance is required, such as a note from a nurse, doctor or coach, or an obituary notice, or a receipt from a car-towing company, etc.
- Email me if you must miss class 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.
- 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 reducing the course grade by one entire letter (for example, a B- becomes a C-). If the missed exam is not made up before the end of the semester, the course grade becomes an F.
- 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 (e.g. due to sports) and consult with your instructor for any other situations involving missing an exam.
- 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. Contact me if unusual circumstances might be cause for an exception.

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 in to the course. Students are expected to be prepared, attentive, and respectful of others.

Accessibility Statement for Students with Disabilities

For spring 2024, students with disabilities who may be eligible for academic accommodations and support services should contact Ms. Nicole Kerr, the Accommodations Coordinator to schedule a meeting. Ms. Kerr can be reached at 724-805-2371 or by email to AcademicSupport@stvincent.edu. Her office is located in the Academic Affairs suite on the 2nd floor of Headmasters Hall (above post office). 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.

Sexual Harassment and 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 does not include information shared in class discussions or assignments, but it does include 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. 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 College website](#).

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 College website](#).