



SAINT VINCENT COLLEGE

Introduction to Algorithms

CS 312
Fall 2020

- 3 credits
- Prerequisite:
 - CS 171 and CS 221
- Instructor: Brother David Carlson
- Office: Dupre Science Pavilion, Tenley Hall W217, but all office hours will be online or by other electronic means, not in-person. Tentative plans are for at least one Zoom conference per week as well as communicating via Schoology messages or similar.
 - Mon, Wed, Fri 2:00 pm - 2:50 pm
 - Tue 12:30 pm - 2:30 pm
 - Thurs 8:30 am - 11:20 am
 - and by appointment
 - Office hours indicate times that I will be in the office and can likely answer messages you send me. I will also try to answer at other times, though it might take longer to get a reply.
 - We will also try a weekly Zoom conference for asking and answering questions. The day and time will be decided during the first week or two of the course.
- Phone: 724-805-2416
- Email: david.carlson@stvincent.edu
- Class Times and Location
 - Mon, Fri 12:30 pm - 1:45 pm, Dupre W214
 - Date of Final Exam: Sun, Nov 22, 2:00 - 3:45 pm

Course Description

This course covers the design, operation, and running time analysis of a wide array of algorithms. This includes the study of algorithms that follow these paradigms: divide-and-conquer, dynamic programming, randomized algorithms, and greedy algorithms. Algorithms examined include many for searching and sorting; insertions, lookups, and deletions in various data structures, and common graph algorithms. Prerequisite: CS 221 and CS 171.

Required Text

Text: Introduction to Algorithms, 3rd ed.; Cormen, Leiserson, Rivest, Stein; MIT (2009), hard cover version, ISBN 978-0-262-03384-8.

- Do not get an e-book as only a printed text is allowed for in-class exams. If we should be forced to move to an online-only course, then an e-book would be acceptable.
- Additional materials will be posted under our course in Schoology, <https://saintvincent.schoology.com> .

Course Learning Objectives

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

1. Identify the important issues, modules, or variables in the 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 to select among different solutions.

Relevant CIS Department Student Learning Outcomes

By the time of graduation the CS major will have an ability to:

1. Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.
2. 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. Apply computer science theory and software development fundamentals to produce computing-based solutions.

Course Schedule

Date	Topic
Wk 1: Aug 17	syllabus, very briefly: Ch1 Role of Algorithms; Ch 2: Getting Started
Wk 1: Aug 21	Ch 2: Getting Started; Ch 3 Growth of Functions
Wk 2: Aug 24	Ch 3: Growth of Functions
Wk 2: Aug 28	Ch 4: Divide-and-Conquer
Wk 3: Aug 31	Ch 4: Divide-and-Conquer; Ch 6 briefly: Heapsort
Wk 3: Sept 4	Ch 7 briefly: Quicksort; Ch 8: Sorting in Linear Time

Wk 4: Sept 7	Ch 8: Sorting in Linear Time; Ch 10 very briefly: Elementary Data Structures; Ch 11 briefly: Hash Tables
Wk 4: Sept 11	Ch 12 briefly: Binary Search Trees; Very briefly: project analysis & design; Ch 13: Red-Black Trees
Wk 5: Sept 14	Ch 13: Red-Black Trees
Wk 5: Sept 18	Ch 13: Red-Black Trees; Ch 15: Dynamic Programming
Wk 6: Sept 21	Ch 15: Dynamic Programming
Wk 6: Sept 25	Ch 15: Dynamic Programming; Very briefly: Algorithms of Oppression
Wk 7: Sept 28	Ch 15: Dynamic Programming; Ch 16: Greedy Algorithms
Wk 7: Oct 2	Ch 16: Greedy Algorithms
Wk 8: Oct 5	Midterm covers all that we did in chapters 1 - 16
Wk 8: Oct 9	Ch 18 briefly: B-Trees; Ch 19: Fibonacci Heaps
Wk 9: Oct 12	Ch 19: Fibonacci Heaps
Wk 9: Oct 16	Ch 19: Fibonacci Heaps
Wk 10: Oct 19	Ch 22: Elementary Graph Algorithms
Wk 10: Oct 23	Ch 22: Elementary Graph Algorithms
Wk 11: Oct 26	Ch 23: Minimum Spanning Trees
Wk 11: Oct 30	Ch 23: Minimum Spanning Trees
Wk 12: Nov 2	Ch 24: Single-Source Shortest Paths
Wk 12: Nov 6	Ch 24: Single-Source Shortest Paths
Wk 13: Nov 9	Ch 25: All-Paris Shortest Paths
Wk 13: Nov 13	Ch 25: All-Paris Shortest Paths
Wk 14: Nov 16	Ch 26: Maximum Flow
Wk 14: Nov 20	Ch 26: Maximum Flow
Wk 15: Nov 22 - 24	Final Exam: Sun, Nov 22, 2:00 - 3:45 pm. Final mostly covers the 2nd half of the course, but includes a few review questions from earlier.

Course Requirements and Grading

- 25% Midterm Exam
- 25% Final Exam
- 25% Homework
- 25% Projects (probably two)

Letter grades will be assigned according to the scheme found in the current College Bulletin. Exams will be announced in advance. Calculators may be used (and are expected to be used) on exams. Calculators, Wolfram Alpha, and other calculation software are of use in certain other parts of this course, including homework.

Note that assignments may be of different types. Some may come from the textbook, while others may be supplied by the instructor. Some problems may ask you to do a running time analysis of an algorithm, others may ask you for a proof of correctness for an algorithm, still others may ask you to implement an algorithm. One of the projects will ask you to design, implement in C++, and evaluate software that uses appropriate algorithms to solve a particular problem. The other project may ask you to produce competing designs to solve a particular problem and to evaluate and compare those designs. For both homework and projects, the clarity of any proofs and running time analysis, as well as the formatting and documenting of the work are all important. Due dates are posted in Schoology.

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.
- 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 and homework problems. Every written homework should list all sources that contributed to the solution. This would include the individual student. It may also include the instructor, a reference book, a web site, another student, etc. If you need assistance beyond simple clarification of the description of the assignment, consult the instructor. You may not look at the answers of another student in this course or show yours (even a part of it) to another student in the course. You may not work out a project or homework with one or more persons other than the instructor. If you break one of the conditions spelled out here, 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 alert the professor so that a live Zoom conference of the class can be made and the student can attend that conference. If a student cannot attend in-person or by means of a live Zoom conference, a recording of a Zoom conference may be made available to that student, but recordings are not normally made available to the class.

- 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.
- Late work is not normally accepted, but partial credit is given for incomplete homework 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 are 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 Campus Reopening Health and Safety Plan at <https://www.stvincent.edu/student-life/campus-reopening> .

Class Cancellation Policy

If the instructor needs to cancel class, every effort will be made to send an online message to students and/or post a notice in the course in Schoology.

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

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](#).

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](#).