

CSC-301: Analysis of Algorithms; Spring 2021

Instructor Information

- Nicole Eikmeier, Assistant Professor of Computer Science
- She/Her Pronouns
- Preferred name: Professor Eikmeier
- Email: eikmeier@grinnell.edu
- Office Hours: Book online at calendly.com/eikmeier

Course Information

- Number: CSC-301-01
- Title: Analysis of Algorithms
- Pre-Requisites: CSC-207 and [CSC-208 or MAT-218]
- Class Meetings: 1:00pm – 2:30pm Central Time, M,T,W,TH. More information can be found under Course Policies

Course Overview and Goals

In this course, we will develop your skills in the design, implementation, analysis, and verification of algorithms. We will also explore advanced abstract data types and data structures. Along the way, we will consider a variety of classic algorithms, ADTs, and data structures – the “literature” of CS, as it were. Why do we read the literature? Because knowing how problems have been solved in the past helps us solve future problems.

Learning Outcomes (LO)

Upon Completion of this Course, students will be able to:

1. write/develop a loop invariant alongside an algorithm, and can prove the correctness of their algorithm via loop-invariant technique.
2. recite the formal definition of Big-Oh, little-oh, Big-Omega and Big-Theta, and formally prove properties of these classes.
3. explain why comparison-based sorts take order $n \log n$ in the worst case.
4. reproduce Radix, Bucket, and Topological Sorts, and explain the context in which these sorting algorithms are useful.
5. develop a recurrence relation, given an algorithm which uses Divide-and-Conquer.
6. solve a given recurrence relation using the Master Theorem.
7. consider different algorithmic design strategies when solving problems.
8. solve problems using each of divide and conquer, greedy, and dynamic techniques.
9. explain the tradeoffs between different data structures when they are used for similar problems.
10. implement an advanced data structure or algorithm, demonstrating good software design practices including documentation and testing.
11. can implement a balanced tree.
12. read a primary source from the literature of algorithms
13. explain how bias and structural inequity plays a role in algorithms.
14. have a stronger sense of *growth mindset*.

Class Requirements

Exams – 40% of final grade (Assessment of LO 1-9)

There will be two exams in this class: one during the middle of the term, and one during finals week. The midterm exam will take place on **February 23-24**. The final exam will take place on **March 23-24**. Exams are open-book, open-notes, but closed internet. The Exams will have two components:

- 1) A time-sensitive written component through GradeScope
- 2) A 10-minute oral discussion with Professor Eikmeier on one of the written problems. You will not know which of the problems I will ask you about before arrival.

Problem Sets – 30% of final grade (Assessment of LO 1-12, 14)

There will be problem sets every week in which you will put into practice what we are learning, through analyzing algorithms and implementation of data structures. Acknowledge anyone you worked with in your submission. Submitted solutions will be graded for logical correctness, and clarity of the solution and arguments.

Essay – 10% of final grade (Assessment of LO 13)

As computer scientists, and as Grinnell scholars, it is critical to examine the role of racism, and bias more broadly, in your chosen field. In this written assignment you will be asked to think deeply about the role of algorithm design more broadly in society, and the potential for harm. This assignment should be completed individually. This assignment will be graded primarily on the depth of your thoughts, and secondly on the grammar and clarity.

Journaling– 20% of final grade (Assessment of LO 1-14)

Throughout the course of the semester I will ask you take notes in a Journal (I will provide an electronic template). Your journal should be completed individually, and will be graded for completion.

Letter Grades

Letter grades for the entire course will be assigned as follows in the table below. I reserve the right to adjust the percentages in order to be more lenient.

Letter Grade	Percent		
A	93.0% and higher	C+	77.0% - 79.99%
A-	90.0% - 92.99%	C	70.0% - 76.99%
B+	87.0% - 89.99%	D	60.0% - 69.99%
B	83.0% - 86.99%	F	59.99% and lower
B-	80.0% - 82.99%		

Course Schedule

	Date	Topic	Reading	Assignment(s) Due
1	2/1	Introduction to the course & Fundamentals of Analysis	<i>Guidelines for Mathematical Writing</i> – Francis Su <i>The Secret to Raising Smart Kids</i> – Carol S. Dweck CLRS: 2.1 – 2.3 CLRS: 3.1 – 3.2	Intro Survey Journal 0 Journal 1 Problem Set 1
2	2/8	Algorithm Design Strategies: Divide & Conquer	CLRS: 4.3 – 4.5	Journal 2 Problem Set 2
3	2/15	Advanced Sorting Ideas; Equity issues	CLRS: 8.1 – 8.4 <i>Race after Technology</i> , Ruha Benjamin	Journal 3 Problem Set 3 Essay
4	2/22	Advanced Data Structures: Balanced Trees & Tries	CLRS: 13.1 – 13.4	Journal 4 Problem Set 4 Mid-term Exam
5	3/1	Algorithm Design Strategies: Dynamic Programming & Greedy Algorithms	CLRS: 15.1, 15.3 – 15.5 CLRS: 16.1 – 16.3	Journal 5 Problem Set 5
6	3/8	Advanced Data Structures: Disjoint Sets & Skip Lists	CLRS: 21.1 – 21.3 <i>Skip Lists</i> , William Pugh	Journal 6 Problem Set 6
7	3/15	Algorithm Design Strategies: Network Flow	CLRS: 26.1 – 26.3	Journal 7 Problem Set 7
8	3/29	Finals Week		Final Exam

Course Materials

Required Textbooks & Materials (Note: CLRS is the only book you need to purchase)

- *Introduction to Algorithms*, Cormen, Leiserson, Rivest, and Stein (CLRS)
- *Race After Technology: Abolitionist Tools for the New Jim Code*, Ruha Noble
- *Skip Lists: A probabilistic alternative to balanced trees*, William Pugh

Technology (Note: Please contact me as soon as possible if you do not have these items already.)

- A computer. This course has a computational component which means you will be coding. Ideally you would have a computer (or laptop) which you can access up to 24 hours each week (3-5 hours each day).
- Reliable access to Internet. All course materials will be posted online.
- Webcam & Microphone – the ones built into your computer will work just fine.
- Headphones - optional. Useful during video chats to prevent audio feedback and to not disturb those in your vicinity.

Resources

- Access our course materials: [PWeb \(https://pioneerweb.grinnell.edu\)](https://pioneerweb.grinnell.edu)
- Submit your assignments on [gradescope \(https://gradescope.com\)](https://gradescope.com) Entry code: D5PV2V
- Databases, journal articles, and more: [Grinnell Library \(https://www.grinnell.edu/academics/libraries\)](https://www.grinnell.edu/academics/libraries)
- Receive Assistance with strengthening your writing: [Grinnell Writing Lab \(https://www.grinnell.edu/academics/centers-programs-and-resources/writing-lab\)](https://www.grinnell.edu/academics/centers-programs-and-resources/writing-lab)
- Health and Wellness: [SHAW \(https://www.grinnell.edu/about/offices-services/student-health\)](https://www.grinnell.edu/about/offices-services/student-health)

Course & College Policies

Attendance

This term, our class will have the following structure:

- Mondays and Wednesdays will be "**optional**" class
- Tuesdays and Thursdays will be "**required**" class

The optional classes will be structured as a lecture, and I will record and upload the class session for you to watch on your own time if you prefer.

The required classes will have much more interaction and so I request your attendance.

I highly encourage you to attend all required sessions. While attendance at these sessions will not affect your grade in this course, this portion of the class will be our main opportunity to build community with each other and solidify ideas. Please let me know if you are in a time zone which prevents you from attending our synchronous sessions.

Late Policy

All assignments are to be turned in electronically by 11:59PM Central Time on the day they are due (in most cases, the Saturday of the week they were assigned). Due to the exceptional nature of this semester I will attempt to be as flexible as possible in accepting late work. I am aware that there are a number of things outside of your control that may affect your ability to complete work on time. If possible, please let me know if you plan to turn in work late. Assignments turned in more than two days late, without prior approval of the instructor will result in a grade no higher than a B. Please refer to the Student Workload statement below, to emphasize that you should attempt to follow the posted deadlines.

Incomplete Grade Policy

All work for the course is due by 5:00 pm on the last day of finals (03/24/2020). In exceptional circumstances, incomplete grades can be granted. Talk with me if you think you might need an incomplete to complete all the requirements of the course.

Student Workload

You can expect to spend 22 hours per week on this course, including all in-class and out of class time. This number is based off of the Grinnell Guidelines for credit-hours, accounting for our "double speed" this semester. *This is a significant amount of time!!* I would not expect you to be able to complete things last minute, so we will work together on planning and organization.

Academic Honesty Statement

[Grinnell College's Academic Honesty policy](#) is located in the online Student Handbook. It is the College's expectation that students be aware of and meet the expectations expressed in this policy. In addition, in this course, it is my expectation that students may collaborate on the Problem Sets, however your collaboration must be attributed. It is my expectation that Journals, Exams, and the Essay will be completed independently.

In this course, you are not allowed to use solutions you find on the internet, and further, you are **not allowed to search for problem solutions on the internet**. I know that there is great temptation to look for solutions online when things get difficult. I will provide you with numerous resources to get help which include office hours, group class work, and mentor sessions. Additionally, we will work to build our *growth mindset* in this course, which makes it less uncomfortable to sit with a challenging problem.

If you have questions about how a particular assignment relates to the College's policy, or how to attribute your collaboration, I will gladly consult with you in advance of the assignment's due date.

Religious Observance

I encourage students who plan to observe holy days that coincide with class meetings or assignment due dates to consult with me in the first two weeks of classes so that we may reach a mutual understanding of how you can meet the terms of your religious observance and also the requirements for this course.

Students with Disabilities

I encourage students with documented disabilities, including invisible disabilities such as chronic illness, learning disabilities, and psychiatric disabilities, to discuss appropriate accommodations with me. You will also need to have a conversation about and provide documentation of your disability to the Coordinator for Disability Resources, John Hirschman, 641-269-3089.

Technology Usage Policy

Materials you have obtained from this course including lecture videos and problem sets should not be distributed outside of the members of our class. Live synchronous sessions should not be recorded by students. I will record and distribute our synchronous sessions. During synchronous sessions, I encourage you to turn on your video in order to help us build a sense of community. Recordings of courses will be deleted and no longer available once the course finishes. Finally, an online course requires all of us to be generous and supportive. Be extra thoughtful in our online spaces with the words that you choose.

Inclusion Statement

It is my intention that students from all backgrounds and perspectives will be well served by this course, and that the diversity that students bring to this class will be viewed as an asset. I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, socioeconomic background, family education level, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class. Your suggestions are encouraged and appreciated.

Take care of yourself

Do your best to maintain a healthy lifestyle this term by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.

All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available through campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is often helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, I strongly encourage you to seek support. Student Health and Wellness (SHAW) is here to help: call [641-269-3230](tel:641-269-3230) and visit their website at <https://www.grinnell.edu/about/offices-services/student-health>. Consider reaching out to a friend, faculty, or family member you trust for help getting connected to the support that can help.

If you or someone you know is feeling suicidal or in danger of self-harm, call someone immediately, day or night:

- Need to Talk Line: 641-269-4404 (available 24/7 for counseling needs)
- 24/7 Suicidal Hotline: 1-800-273-8255
- **If the situation is life threatening, call 911**

Acknowledgements

The inclusion statement has been taken verbatim from <https://lgbtq.asee.org/resources/ally-resources/>

The Take Care of Yourself Section has been taken verbatim from <https://www.cmu.edu/teaching/designteach/design/syllabus/syllabussupport.html>