

Course and Instructor Information

Course Title: Algorithms and Complexity

Credits: 3

Prerequisites: CSE 2050 or 2100; and 2500

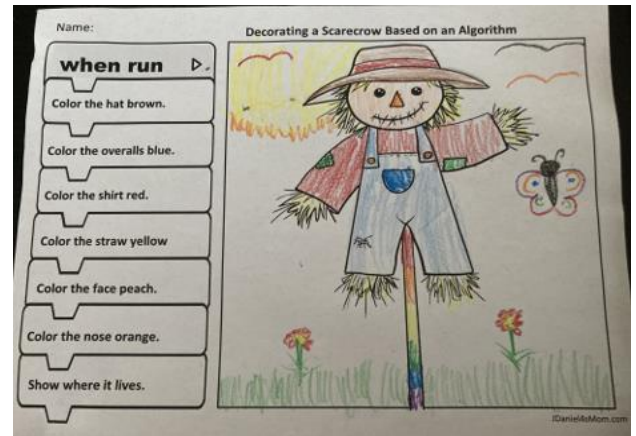
Professor: Lina Kloub

Email: lina.kloub@uconn.edu

Office location: ITE 302

Class times: Tuesday and Thursday.

12:30pm-1:45pm **BUSN 127.**



TAs, Office Hours and Availability: TBD by second week of class. The information will be posted in HuskyCT. We will do our best to respond to the emails within 48 hours Monday – Friday.

The course website is hosted on [HuskyCT](#) which is used for course material distribution, announcements, and out-of-class discussions. Changes to the course syllabus, schedule, or home-works will be announced immediately in HuskyCT and in class.

As a member of the first cohort of Neuroinclusive STEM Teaching, I am dedicated to fostering an inclusive learning environment where all students can thrive. This course is designed to celebrate and leverage the unique thinking and learning styles of neurodiverse students, focusing on their individual strengths. By incorporating student-centered approaches that prioritize inclusivity, accessibility, wellness, and belonging, we aim to create an empowering educational atmosphere. This approach is grounded in the principles of Universal Design for Learning and Inclusive Pedagogy.

Throughout the course, we will implement collaborative peer learning, engaging project-based activities, and interactive review games. These strategies are designed to deepen your understanding, encourage active participation, and provide opportunities to tackle complex problems effectively, all while emphasizing critical thinking, teamwork, and communication. By embracing diverse thoughts and learning styles, we aim to ensure that every student can succeed and flourish, promoting equity and inclusion for all.

Courses and degrees in science, technology, engineering, and mathematics (STEM) equip you with many transferable skills for successful career paths. The National Association of Colleges and Employers (NACE) has categorized these skills into eight [Career Competencies](#) that are essential to post-graduation success. You will also see the competencies mentioned and highlighted through the syllabus as a way to bring awareness to their integration into this course, as noted above.

Moreover, this course will prepare you to identify and articulate these competencies and skills through content delivery and assignments. These skills are vital to your success as a student and post-graduation, in charting a meaningful career path by [Becoming Career Ready](#). I encourage you to think about your competency development as you advance through your experiences at UConn. You can also visit the Center for Career Development by scheduling an appointment to speak with a Career Coach about ways to gain these competencies through experiences offered at UConn and strategies for articulating competencies with the application process for jobs, internships, co-ops, graduate school, and more.

Course Description

Algorithms and Complexity is a course focused on the design and analysis of efficient computer algorithms. The course covers various algorithm design techniques, including divide-and-conquer, dynamic programming, and greedy approaches. Additionally, it delves into graph algorithms, advanced data structures, and topics such as Asymptotic analysis and notation, reductions, and NP-completeness.

Course Objectives

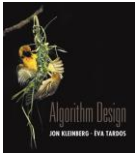
The course aims to provide a comprehensive understanding of algorithm design and analysis. You will be able to apply various algorithmic techniques, analyze algorithm efficiency, and confidently tackle a wide range of computational problems while strengthening your Critical Thinking competency. By the end of the course, I hope you will be able to:

1. Demonstrate the basic concepts of algorithms.
2. Analyze and evaluate algorithm efficiency using asymptotic notations and understanding common running time complexities. This will enable you to assess and compare the efficiency of different algorithms.
3. Gain a comprehensive understanding of heaps, heap operations, and priority queues, allowing you to effectively utilize these structures in algorithm design and analysis.
4. Explore graph algorithms: We will learn key graph concepts and applications. This knowledge will empower you to solve graph-related problems efficiently.
5. Apply greedy algorithms: We will develop proficiency in applying greedy algorithms to solve problems. This will enable you to find optimal solution for various problems.
6. Utilize advanced algorithmic techniques like divide-and-conquer strategies and study the principles and applications of randomized algorithms. This will broaden your problem-solving skills and enhance your algorithmic toolkit.
7. Utilize dynamic programming techniques: We will learn and practice dynamic programming approaches. This will enable you to effectively solve complex optimization problems.
8. Demonstrate complexity theory: We will explore the concepts of computational complexity, including classes P and NP, reduction techniques, and the concept of NP-Hard and NP-completeness. This knowledge will provide insights into the limits of different algorithmic solutions.

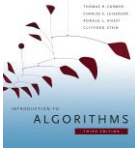
Schedule

Week	Date	Module	Book	HWs	Objective(s)
1	8/26	Basic concepts of algorithms Algorithm analysis: Asymptotic notations.	Ch. 1 2	HW 1 Due:9/6	1
2	9/2	Algorithm analysis: Asymptotic notations, Common running time. Data structures: Understand and analyze heaps, heapsort and priority queues.	Ch. 2	HW 2 Due:9/13	2, 3
3-4	9/9 9/16	Graphs: Basic definitions and applications. DFS and BFS applications, Bipartite graphs, strongly connected components, and Topological Sort.	Ch. 3	HW 3 Due:9/23	4
5	9/23	Exam 1 (Thursday 9/26)			
6-7	9/30 10/7	Greedy algorithm: Interval scheduling. Coin Change, Shortest path (Dijkstra), Minimum spanning tree(Kruskal, Prim), Huffman Code.	Ch. 4	HW 4, Due:10/11 HW 5 Due:10/18	5
8-9	10/14 10/21	Divide-and-conquer: Mergesort, Master theorem, Binary search, integer multiplication (Karatsuba). Randomized algorithms: Quick sort and Quick select.	Ch. 5	HW 6, Due:10/25 HW 7 Due:10/28	6
10	10/28	Exam 2 (Thursday 10/31)			
11-12	11/4 11/11	Dynamic programming: Fibonacci sequence, Longest common subsequence, Maximum sum subarray (Kadane), and Bellman Ford.	Ch. 6	HW 8 Due:11/15	7
13	11/18	Complexity theory: P, NP, Reduction, NP-Hard, and NP-complete.	Ch. 8	HW 9 Due:12/2	8
14	11/25	❁ Thanksgiving Break ❁			
15	12/2	Group Project presentations 🗨️			
16	12/9	Cumulative final exam during the final Exams week			

Suggested Course Materials



Algorithm Design by Kleinberg and Tardos, 2006. This book is our primary resource for the course. However, it is not mandatory to purchase the book, since the material will be covered in class through slides, which will be accessible on HuskyCT. Additionally, you can access the official slides from the authors through this [link](#).



Introduction to Algorithms by CLRS, 2009. This book is recommended for additional reading and further exploration of the subject matter.

Course Requirements and Grading

The grading breakdown for the course is as follows:

Course Components	Weight
Participation and Activities	10%
3 Exams	35%
Homework assignments	25%
Group project	20%
Individual project	10%

Classroom Participation and Activities (10%):

We want you to actively participate in lectures for 2 main reasons:

1. Effective communication and the ability to work with others are part of the Computer Science program objectives (full list here). **These are great opportunities to build your communication and teamwork competency.**
2. The single greatest predictor of student performance is class attendance. From a meta-analysis of 52 published articles and 16 unpublished dissertations:

These relationships make class attendance a better predictor of college grades than any other known predictor of academic performance, including scores on standardized admissions tests such as the SAT, high school GPA, study habits, and study skills.

Active participation is an essential component of this course. We will utilize various interactive learning strategies to enhance our understanding of the course material. One such strategy is the Think-Write-Pair-Share method. Think-Write-Pair-Share (TWPS) is an interactive learning strategy that we will utilize during our classroom sessions. **TWPS promotes active participation, critical thinking, and collaborative learning which are all NACE career competencies that are shown to improve student success**

post-graduation. During designated class activities, you will be given in-class worksheets containing questions related to the topic being discussed. (1) think individually about a topic or answer to a question;(2) write down your thoughts, ideas, or answers in the provided space on the worksheet. (3) pair with a partner and discuss the topic or question; and (4) share ideas with the rest of the class.

By incorporating the TWPS strategy, we aim to create an interactive and engaging classroom atmosphere where everyone's ideas are valued. It provides an opportunity for you to actively participate, collaborate with your peers, and deepen your understanding of the course material.

Additionally, regular quizzes will be conducted at the end of each lecture, serving the purpose of capturing the participation and assessing your grasp of the covered material.

This participation policy aims to encourage you to build these skills while accommodating absences due to illness or other circumstances.

- You can earn 1 participation point per lecture, totaling 22 possible points throughout the semester.
- You are required to attend the last two lectures on 12/3 and 12/5, during which we will have group presentations. Your participation will include helping to grade the presentations.
- Full credit for participation is awarded at:
 - 8%: 18 points out of 22. (Excluding the review lectures and exam lectures, and allowing for 4 no-questions-asked absences)
 - 2%: 2 points in the last week.

Note that there is no extra credit for going above and beyond 20 points.

Lectures will not be live-streamed, but I will do our best to post recordings.

Exams (35%):

There will be two in-class exams, each worth 10% of the final grade. Additionally, there will be a cumulative final exam worth 15%.

For each exam, you are allowed to bring **one** sheet of **handwritten** notes (8x11 size), and you can write on both sides.

Exam 1 and 2 will be scheduled on Thursday during the exam week. **This assignment will enhance the following Career Competencies: Critical Thinking, and Career & Self-Development.**

To help you prepare effectively, we have planned an interactive review session on Tuesday. During this session, we will incorporate engaging games and activities to assist you in revisiting and reinforcing the course materials. It will be a fun and interactive way to enhance your understanding and boost your confidence for the exams. **This review session will enhance the following Career Competencies: Teamwork, Communication, Critical Thinking, and Equity & Inclusion.**

If you are unable to attend an exam due to illness, religious holidays, family matters, or any other reason, please inform the instructor as soon as possible. Early communication is essential to allow us to make appropriate arrangements for a makeup exam. Your well-being and ability to perform your best are important, and we are committed to supporting you in managing any unforeseen circumstances that may arise.

Homework (25%):

There will be a total of nine homework assignments consisting of problem sets and/or programming tasks designed to assess your mastery of each subject. Additionally, at the end of each homework, there will be interview-style questions to help you prepare for interviews.

We encourage high-level discussion of ideas and problems with peers, but each student must complete and submit their homework individually. **This assignment will enhance the following Career Competencies: Career & Self-Development, Critical Thinking, and Technology.**

Homework should be handed into HuskyCT. We strongly encourage LATEX for typesetting work. www.overleaf.com is a great online LATEX editor that can be used for problem sets or programming assignment collaboration. See the [online introduction](#) to LATEX to get started. **The use of these online platforms will help you to develop the Career Competency of Technology.**

Everyone can have bad days, so, the lowest homework assignment score will be dropped.

Homework assignments are typically due by 11:59 PM EST. The specific due dates will be posted on the HuskyCT calendar.

Individual Project (10%):

The project is implemented to foster creativity and presentation skills while providing opportunities to showcase your understanding of course concepts. The individual project involves selecting an algorithm not covered in class and recording a 4–6 minute video presentation that explains the selected algorithm (Critical Thinking and Technology). Through this project, you will enhance your understanding of algorithms, develop research skills to explore topics beyond the course content, and practice effective communication by delivering a concise and informative video presentation:

- In the video, you will explain the selected algorithm and analyze its running time.
- You can use slides, a whiteboard, illustrations, or any creative approach to effectively present the algorithm.
- At the beginning of the video, state your name and netID.

Extra points will be awarded for top presentations chosen by students in two categories:

- **Most Informative category:** recognizing presentations that effectively present the algorithm and explain it professionally and comprehensibly.
- **Most Creative category:** acknowledging presentations that demonstrate exceptional creativity, innovative thinking, and unique problem-solving approaches.

Three presentations will be selected for each category, and students will vote. The most voted video in each category will receive 2 additional points toward their course grade. **This assignment will enhance the following Career Competencies: Critical Thinking and Technology competencies.**

The project is due Friday 11/15/2024 at 11:59 PM EST.

Group Project (20%):

The group project is designed to apply theoretical concepts while fostering important teamwork and communication skills. A team of 4 members offers you a valuable chance to improve problem-solving abilities, experience diverse perspectives, and cultivate essential interpersonal skills that are crucial for success in your future professional endeavors. To enhance these benefits, groups will be randomly assigned. This approach ensures inclusivity, encourages collaboration with a diverse set of peers, and mirrors real-world scenarios where teamwork often involves working with individuals you may not have chosen yourself. Randomly assigned teams provide a unique opportunity to build adaptability and enhance your ability to work effectively in diverse environments. The project involves:

- The team selects an algorithm, different from the ones picked by the team members for the Individual Project and not covered in class.
- Conducting thorough research to gain a comprehensive understanding of it.
- Develop a working implementation of the algorithm using a programming language of your choice.
- Writing a report spanning 5-10 pages. The report should include sections such as introduction, comparison with other algorithms, justification of its superiority, detailed explanation of the algorithm, implementation details, results, analysis of time complexity, and a list of references.
- Teams are required to deliver a presentation during the final week of classes, with a time limit of 4-5 minutes.

Additionally, each team member will have the chance to evaluate their fellow team members' contributions.

The grading will consider the overall delivery of the report, the presentation, and a peer evaluation. All students will participate in grading the presentation. During each team presentation, a form will be available, and each student will have the opportunity to evaluate others' presentations. This assignment will enhance the following Career Competencies: Teamwork, Leadership, Communication, Critical Thinking, and Equity & Inclusion.

Here are the deliverables and the due dates for the group project:

- Proposal submission (Due: Friday 9/20)
- One-Month progress update and team evaluation. (Due: Friday 10/25)
- Final Submission and team evaluation. (Due: Friday 11/22)

Late Work Policy

This course is too large for us to handle late work requests on a case-by-case basis with the appropriate compassion and nuance. Additionally, request-based late policies are subject to implicit bias of the instructor (see e.g. Chin et. al 2020) and may be underutilized by those who feel they will be judged for making such requests (see e.g. Whillans et. al 2021).

Instead, we use the following no-questions asked late policy for the homework assignments. You will have 5 late day tokens to spend on homework as you see fit.

1. You can use 1 late day token to submit up to 24 hours late, or 2 to submit up to 48 hours late. **A maximum of 2 tokens can be used per homework assignment.**

2. To use a late token, **just submit your assignment after the deadline**. We will manually deduct any late tokens used after the 48-hour late window closes for an assignment.
3. You can see how many late day tokens you have left in HuskyCT.
4. If you use all your late day tokens, meet with your professor to discuss more effective study habits and the possibility of adding more tokens. Communication is key, and we understand that unexpected challenges may arise.
5. We do not accept any late work after the 48-hour window and will not grade homework assignments submitted late without sufficient late tokens.

Late tokens are exclusively applicable to homework assignments; they cannot be used for the individual project or group project.

If you find that you've used all your tokens and still need more time, please reach out to the instructor to discuss your situation. We're here to support you, and open communication will help us find the best way to manage any additional challenges you may be facing.

In the event of a major life event that warrants additional extensions (it happens), contact [the dean of students](#). They will provide you with additional resources, including contacting your instructors for additional extensions.

Thresholds

I will determine exact floors and half letter grades at the end of the semester according to the standards of performance below. Instructors reserve the right to modify the floors up or down to match the appropriate level of mastery.

Grade	Letter Grade	GPA
93-100	A	4.0
90-92	A-	3.7
87-89	B+	3.3
83-86	B	3.0
80-82	B-	2.7
77-79	C+	2.3
73-76	C	2.0
70-72	C-	1.7
67-69	D+	1.3
63-66	D	1.0
60-62	D-	0.7
<60	F	0.0

Academic Misconduct

Academic misconduct is dishonest or unethical academic behavior that includes, but is not limited to, misrepresenting mastery in an academic area (e.g., cheating), failing to properly credit information, research, or ideas to their rightful originators or representing such information, research, or ideas as your own (e.g., plagiarism), or submit homework you did not write, or discussing exams before all grades are posted, or Posting questions on forums like Reddit, Stack- Overflow, or Chegg.

The penalty for academic misconduct is an F in the course.

Please check the [Academic, Scholarly, and Professional Integrity and Misconduct \(ASPIM\), Policy](#) on for more information.

Permitting use of AI ChatGPT

You are welcome to use AI tools such as ChatGPT for generating ideas, to help clarify homework questions if they are unclear, review topics, clear up any confusing concepts, help selecting an algorithm in group or individual project, and help writing the group project report. However, whenever you use them, you must include an acknowledgment statement that briefly explains how you used the tool. For example, *'I used ChatGPT to review the definition of Big O notation in question 1'* or *'I used GPT-3 to find a good algorithm for my individual project'* or *'While I was writing the group project report, after writing my second paragraph, I used ChatGPT to revise it.'*

Please also note that all large language models can still generate incorrect facts and fake citations. You will be responsible for any inaccurate, biased, offensive, or otherwise unethical content you submit, regardless of whether it originally comes from you or an AI tool.

Success and Well-Being

Success in this course program depends heavily on your personal health and well-being. Recognize that stress is an expected part of the college experience, and it often can be compounded by unexpected setbacks or life changes outside the classroom. Your teaching assistants and I strongly encourage you to reframe challenges as an unavoidable pathway to success. Reflect on your role in taking care of yourself throughout the semester, before the demands of exams and projects reach their peak. Please feel free to reach out to me about any difficulty you may be having that may impact your performance in your courses or campus life as soon as it occurs and before it becomes too overwhelming. In addition to your academic advisor, I strongly encourage you to reach out to the support services at UConn that are eager to help you with your physical, mental, and academic well-being.

Resource links: [Dean of Students Office](#) and [Student Health and Wellness – Mental Health](#).

Resources for Students Experiencing Distress

The University of Connecticut is committed to supporting students in their mental health, their psychological and social well-being, and their connection to their academic experience and overall wellness. The university believes that academic, personal, and professional development can flourish only when each member of our community is assured equitable access to mental health services. The university aims to make access to mental health attainable while fostering a community reflecting equity and diversity and understands that good mental health may lead to personal and professional growth, greater self-awareness, increased social engagement, enhanced academic success, and campus and community involvement. Students who feel they may benefit from speaking with a mental health professional can find support and resources through [the Student Health and Wellness-Mental Health \(SHaW-MH\) office](#). Through SHaW-MH, students can make an appointment with a mental health professional and engage in confidential conversations or seek recommendations or referrals for any mental health or psychological concern. Mental health services are included as part of the university's student health insurance plan and also partially funded through university fees. If you do not have UConn's student health insurance plan, most major insurance plans are also accepted. Students can visit the Student Health and Wellness-Mental Health located in Storrs on the main campus in the Arjona Building, 4th Floor, or contact the office at (860) 486-4705, or <https://studenthealth.uconn.edu/> for services or questions.

Students with Disabilities

The University of Connecticut is committed to protecting the rights of individuals with disabilities and assuring that the learning environment is accessible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, please let me know immediately so that we can discuss options. Students who require accommodations should contact the Center for Students with Disabilities, Wilbur Cross Building Room 204, (860) 486-2020 or <http://csd.uconn.edu/>.

Student Responsibilities and Resources

As a member of the University of Connecticut student community, you are held to certain standards and academic policies. In addition, there are numerous resources available to help you succeed in your academic work. Review these important [standards, policies and resources](#), which include:

- The Student Code
 - Academic Integrity
 - Resources on Avoiding Cheating and Plagiarism
- Copyrighted Materials
- Credit Hours and Workload
- Netiquette and Communication
- Adding or Dropping a Course
- Academic Calendar
- Policy Against Discrimination, Harassment and Inappropriate Romantic Relationships

- Sexual Assault Reporting Policy

Students' responsibilities with respect to academic and scholarly integrity are described in the following documents: [Responsibility of Community Life: The Student Code](#).

Help

[Technical and Academic Help](#) provides a guide to technical and academic assistance. This course is completely facilitated online using the learning management platform, [HuskyCT](#). If you have difficulty accessing HuskyCT, you have access to the in person/live person support options available during regular business hours through the [Help Center](#). You also have [24x7 Course Support](#) including access to live chat, phone, and support documents.

Evaluation of the Course

Students will be provided an opportunity to evaluate instruction in this course using the University's standard procedures, which are administered by [Office of Institutional Research and Effectiveness \(OIRE\)](#). Additional informal formative surveys may also be administered within the course as an optional evaluation tool.

Excluding materials for purchase, syllabus information may be subject to change. The most up-to-date syllabus is located within the course in HuskyCT.

CSE3500 Algorithms and Complexity

ABOUT THIS COURSE

Welcome to CSE3500 Algorithms and Complexity! This course focused on the design and analysis of efficient computer algorithms. The course covers various algorithm design techniques, including divide-and-conquer, dynamic programming, and greedy approaches. Additionally, it delves into graph algorithms, advanced data structures, and topics such as Asymptotic analysis and notation, reductions, and NP-completeness.



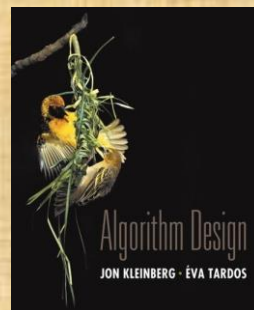
As a member of the first cohort of Neuroinclusive STEM Teaching, I am dedicated to fostering an inclusive learning environment where all students can thrive. This course is designed to celebrate and leverage the unique thinking and learning styles of neurodiverse students, focusing on their individual strengths. By incorporating student-centered approaches that prioritize inclusivity, accessibility, wellness, and belonging, we aim to create an empowering educational atmosphere. This approach is grounded in the principles of Universal Design for Learning and Inclusive Pedagogy. Throughout the course, we will implement collaborative peer learning, engaging project-based activities, and interactive review games. These strategies are designed to deepen your understanding, encourage active participation, and provide opportunities to tackle complex problems effectively, all while emphasizing critical thinking, teamwork, and communication. By embracing diverse thoughts and learning styles, we aim to ensure that every student can succeed and flourish, promoting equity and inclusion for all.

Courses and degrees in science, technology, engineering, and mathematics (STEM) equip you with many transferable skills for successful career paths. The National Association of Colleges and Employers (NACE) has categorized these skills into eight [Career Competencies](#) (**Career & Self-Development, Communication, Critical Thinking, Equity & Inclusion, Leadership, Professionalism, Teamwork, and Technology**) that are essential to post-graduation success. You will also see the competencies highlighted through the syllabus as a way to bring awareness to their integration into this course.

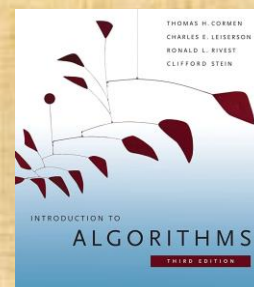


Moreover, this course will prepare you to identify and articulate these competencies and skills through content delivery and assignments. These skills are vital to your success as a student and post-graduation, in charting a meaningful career path by Becoming Career Ready.

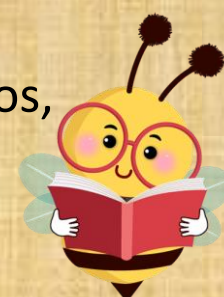
SUGGESTED COURSE MATERIALS



Algorithm Design
Kleinberg and Tardos,
2006. [Slides](#).



Introduction to Algorithms
CLRS, 2009.



COURSE GOALS AND OUTCOMES

The course aims to provide a comprehensive understanding of algorithm design and analysis. By the end of this course, you will be able to apply various algorithmic techniques, analyze algorithm efficiency, and confidently tackle a wide range of computational problems.



LATE POLICY

5 late day tokens for the homework assignments. You can use 1 late day token to submit up to 24 hours late. A maximum of 2 tokens can be used per homework assignment.

COURSE REQUIREMENTS AND GRADING



10% Participation and Activities (**communication, Professionalism, and teamwork competencies**)

In-class worksheets and the Think-Write-Pair-Share (TWPS) strategy will be integral parts of our classroom sessions. Additionally, quizzes will be conducted at the end of each lecture.



10% Individual project (**Critical Thinking and Technology competencies**)

The individual project involves selecting an algorithm not covered in class and recording a 4–6 minutes video presentation that explains the selected algorithm.



20% Group project (**Teamwork, Leadership, Communication, Critical Thinking, and Equity & Inclusion competencies**)

A team of 4 students, selects an algorithm, conducting thorough research to gain a comprehensive understanding of it. Develop a working implementation of the algorithm using a programming language of your choice. Writing a report spanning 5–10 pages. Deliver a presentation during the final week of classes.



25% Homework assignments (**Career & Self-Development, Critical Thinking, and Technology competencies**)

Homework assignments will consist of problem sets and/or programming tasks designed to assess your mastery of each subject. Additionally, each homework will include a set of interview questions related to the covered topics to help you prepare for career interviews.



35% Exams (**Critical Thinking competency**)

There will be two in-class exams, each worth 10% of the final grade. Additionally, there will be a cumulative final exam worth 15%.

Credits: 3 Prerequisites: CSE 2050 or 2100; and 2500

Professor: Lina Kloub

Email: lina.kloub@uconn.edu

Office location: ITE 302

Class times: Tuesday and Thursday.

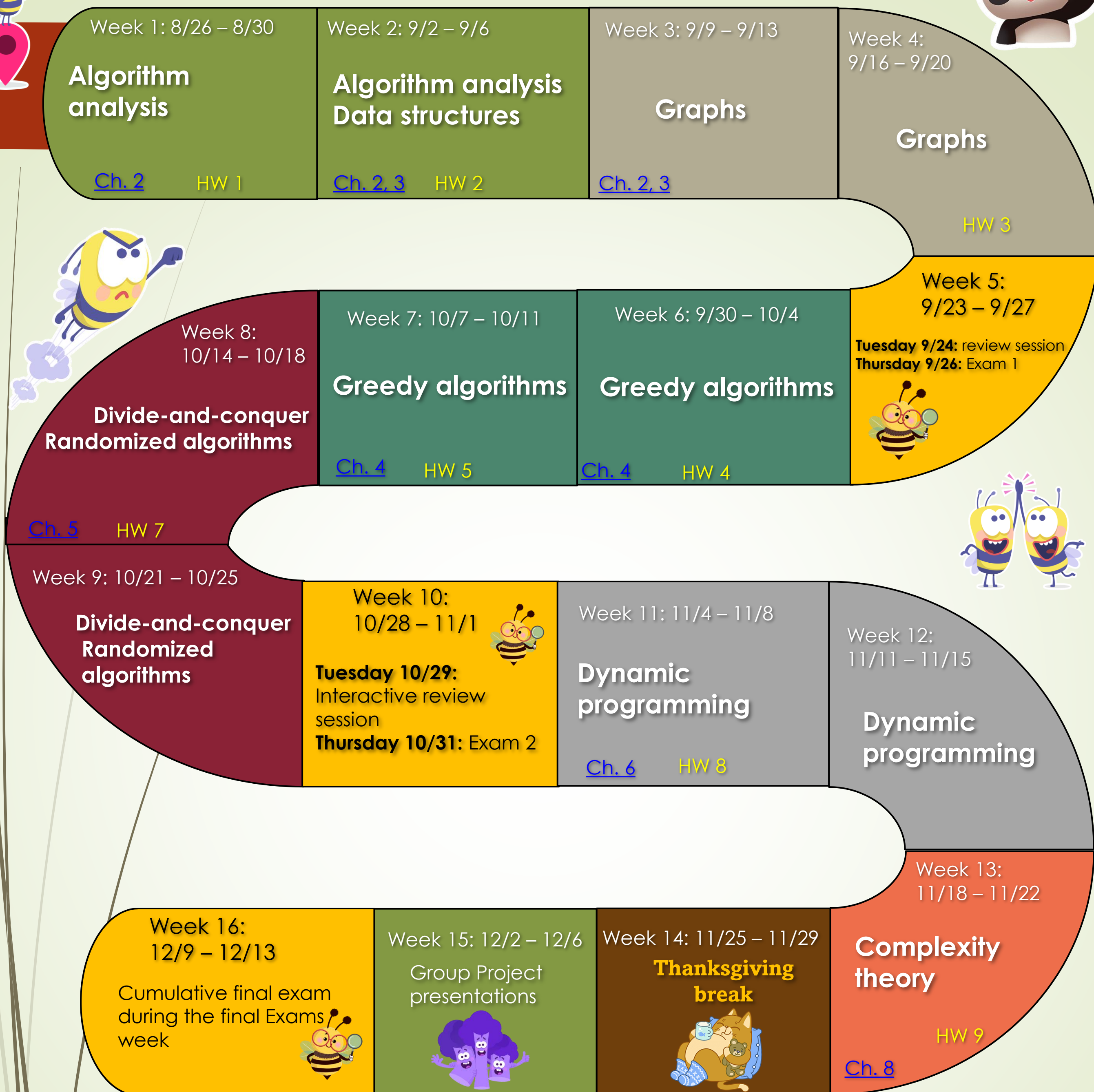
Section:



TAs, Office Hours and Availability: TBD by second week of class. The information will be posted in HuskyCT.

We will do our best to respond to the emails within 48 hours Monday – Friday

COURSE SCHEDULE



Algorithm analysis: Asymptotic notations, Common running time.

Data structures: Understand and analyze heaps, heapsort and priority queues.

Graphs: Basic definitions and applications. Depth First Search (DFS) and Breadth First Search (BFS) applications, Bipartite graphs, strongly connected components, and Topological Sort.

Greedy algorithm: Interval scheduling, Coin change, Shortest path (Dijkstra), Minimum spanning tree (Kruskal and Prim), and Huffman Code.

Divide-and-conquer: Mergesort, Master theorem, Binary search, and integer multiplication (Karatsuba).

Divide-and-conquer (Randomized algorithms): Quick sort and Quick select.

Dynamic programming: Fibonacci sequence, Longest common subsequence, Maximum sum subarray (Kadane), and Bellman Ford.

Complexity theory: P, NP, Reduction, NP-Hard, and NP-complete.