Course Syllabus

Course	16:198:512:03 Introduction to Data Structures and Algorithms
Canvas Site	**https://rutgers.instructure.com/courses/72805**
Location	Zoom**[1]**
Date and Time	Monday 6:40PM - 9:30PM **Except for the first class which is Tuesday, September 8th.**
Instructor	Steven E. Kreutzer, PhD **sk1552@stat.rutgers.edu (mailto:sk1552@stat.rutgers.edu)** Email will be returned within one business day. To protect your privacy, you must use your Rutgers email address to communicate with your instructor.
Office Hours	Via Zoom Friday 4:0PM - 5:00PM and by appointment
Text	Data Structures and Algorithms in Python by Goodrich, Tamassia, and Goldwasser, Wiley, ISBN: 978-1-118-29027-9 Algorithm Design and Applications by Goodrich and, Tamassia, Wiley, ISBN-13: 9781118335918 [Recommended]

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This course covers the fundamental ideas for efficiently analyzing large amounts of data. These fundamental ideas come from two sources: data structures and algorithms. Data structures are strategies for organizing information and algorithms are instructions for solving problems. Efficient algorithms require appropriate data structures. As a result, the study of algorithms and data structures are tightly linked. In this course we learn about the key algorithms and data structures that form the building blocks for large-scale computer systems.

Learning Outcomes

This course covers fundamental abstract data types, sorting algorithms, searching algorithms, graph processing, and algorithm design patterns. Upon successful completion of the course, students will be able to:

1. Analyze the time and space complexity of an algorithm
2. Select and apply appropriate algorithms for solving computational problems
3. Implement, explain, and compare various data structures and algorithms.

Topics

1. Fundamentals

- Analysis of Algorithms
- Complexity Notation
- Master Theorem
- Union-Find

2. Data Structures

- Bags, Queues, and Stacks
- Linked Lists, Trees, Priority Queues
- Maps and Hash Tables

3. Sorting

- Selection sort
- Insertion sort
- Shellsort
- Mergesort
- Quicksort
- Heaps
- ▶ eapsort

4. Searching

- Binary Search Trees
- Balanced Search Trees
- Hashing

5. Graphs

- Depth-first search
- Breadth-first search
- Connected components
- Reachability
- Topological sort
- Strong components (Kosaraju)

- Minimum spanning tree (Prim, Kruskal)
- Shortest paths (Dijkstra)
- Shortest paths in DAGs
- Shortest paths (Bellman-Ford)

6. Design Patterns

- Recursion
- Divide-and-conquer
- Brute force
- Dynamic programming
- Greedy method
- Prune and search

7. Intractability

- NP, NP-Hardness, and NP-Completeness
- Transformations

Technology Requirements:

- Windows or Mac Personal computer with a webcam and microphone
- Python IDE on your computer such as Spyder or PyCharm. You can download them from the following sources:
  - **https://www.anaconda.com/** ↗ **(https://www.anaconda.com/)**
  - **https://www.jetbrains.com/pycharm/** ↗ **(https://www.jetbrains.com/pycharm/)**
- Alternatively, you can use a browser-based IDE such as **https://repl.it/** ↗ **(https://repl.it/)** which is very good if you wish to collaborate with another person

▶ se visit the **Rutgers Student Tech Guide** ↗ **(https://it.rutgers.edu/technology-guide/students/)** page for resources available to all students. If you do not have the appropriate technology for financial reasons, please email Dean of Students **deanofstudents@echo.rutgers.edu (mailto:deanofstudents@echo.rutgers.edu)** for assistance. If you are facing other financial hardships, please visit the Office of Financial Aid at **https://financialaid.rutgers.edu/** ↗ **(https://financialaid.rutgers.edu/)** .

Learning remotely presents new challenges. For assistance with learning how to address these challenges, please consult the resources available here: https://rlc.rutgers.edu/remote_instruction

Course Structure and Requirements

This course will follow a weekly rhythm:

Before Class	During Class on Zoom	After Class
§ Read textbook § View video lesson § Low-stakes quiz	§ Brief lecture § Review last week's assignment § Problem solving § Quiz	§ Programming Assignment posted due Sunday before next class

- To avoid the stress of high-stakes exams, there will be a quiz most weeks of the semester. The nine highest grades will count.
- The programming assignment cannot be submitted late because it will be covered in class the next day. But the four lowest scores will be dropped.
- Assignments will be graded within one week.
- Students with disabilities requesting accommodations must follow the procedures outlined at **https://ods.rutgers.edu/students/getting-registered** ⬈ **(https://ods.rutgers.edu/students/getting-registered)** .
- Full disability policies and procedures are at **https://ods.rutgers.edu/** ⬈ **(https://ods.rutgers.edu/)**

Piazza

▶ We will be using Piazza for group discussions and questions.   Please click on the Piazza link in the left menu panel in Canvas to register.

Assessment

Student progress will be assessed through weekly assignments (mostly programming), quizzes most weeks, and a final exam.

Grading

Final grades will be based on four parts weighted as shown in the table below.

Pre-lecture, low stakes quizzes	5%
Assignments	40%
Quizzes	40%
Final Exam	15%

Final Exam Date and Time

- TBA

Policies

1. There will be no make-up exams or quizzes. If you arrive late and a student has completed the exam or quiz, you will not be able to take it.
2. Your Instructor is here to help you be successful. If you have questions, concerns or are falling behind, please seek help. It is easier to fall behind than catch up.
3. Ask questions in class if you do not understand.
4. Assignments will be submitted for grading through Canvas only. Students must not submit assignments through email.
5. Communication with students will be through Canvas announcements and students' college email address. Students must check Canvas and their email for course announcements every day or two. Please make sure that your college email address is correct in Canvas.
6. Academic Integrity: Copying answers from any source including published solutions and other students is considered academic dishonesty.
7. There will be some number of assignments that will be designated as group assignments in which students will work together and submit one solution. All assignments are to be done individually unless the assignment instructions designate that it is a group assignment.
8. This syllabus is subject to change.

Academic Integrity Policy:

Rutgers University takes academic dishonesty very seriously. By enrolling in this course, you assume responsibility for familiarizing yourself with the Academic Integrity Policy and the possible penalties

(including suspension and expulsion) for violating the policy. As per the policy, all suspected violations will be reported to the Office of Student Conduct. Academic dishonesty includes (but is not limited to):

- Cheating
- Plagiarism
- Aiding others in committing a violation or allowing others to use your work
- Failure to cite sources correctly
- Fabrication
- Using another person's ideas or words without attribution–re-using a previous assignment
- Unauthorized collaboration
- Sabotaging another student's work in doubt, please consult the instructor

Please review the **Academic Integrity Policy** ⧉ **(http://nbacademicintegrity.rutgers.edu/home-2/academic-integrity-policy/)** and **Resources for Students** ⧉ **(http://nbacademicintegrity.rutgers.edu/home-2/for-students/)**

Use of external website resources such as Chegg.com or others to obtain solutions to homework assignments, quizzes, or exams is cheating and a violation of the University Academic Integrity policy. Cheating in the course may result in grade penalties, disciplinary sanctions or educational sanctions. Posting homework assignments, or exams, to external sites without the instructor's permission may be a violation of copyright and may constitute the facilitation of dishonesty, which may result in the same penalties as plain cheating.

Protecting the intellectual property of students and instructors: Many students do not realize that they infringe on the intellectual property rights of instructors or fellow students. Below is suggested language to include to deter such practices.

Almost all original work is the intellectual property of its authors. These works may include syllabi, lecture slides, recorded lectures, homework problems, exams, and other materials, in either printed or electronic form. The authors may hold copyrights in these works, which are protected by U.S. statutes. Copying this work or posting it online without the permission of the author may violate the author's rights. More importantly, these works are the product of the author's efforts; respect for these efforts and for the author's intellectual property rights is an important value that members of the university community take seriously.

Honor pledge:

All students will need to sign the Rutgers Honor Pledge on every major exam, individual assignment, or other assessment as follows:

On my honor, I have neither received nor given any unauthorized assistance on this examination (assignment, paper, quiz, etc.).

Student-Wellness Services (All of these services are being provided remotely during Fall 2020.)

Counseling, ADAP & Psychiatric Services (CAPS)

(848) 932-7884 / 17 Senior Street, New Brunswick, NJ 08901/ http://health.rutgers.edu/medical-counseling-services/counseling/ ↗ **(http://health.rutgers.edu/medical-counseling-services/counseling/)**

CAPS is a University mental health support service that includes counseling, alcohol and other drug assistance, and psychiatric services staffed by a team of professionals within Rutgers Health services to support students' efforts to succeed at Rutgers University. CAPS offers a variety of services that include: individual therapy, group therapy and workshops, crisis intervention, referral to specialists in the community, and consultation and collaboration with campus partners.

Crisis Intervention : http://health.rutgers.edu/medical-counseling-services/counseling/crisis-intervention/ ↗ **(http://health.rutgers.edu/medical-counseling-services/counseling/crisis-intervention/)**

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Report a Concern: http://health.rutgers.edu/do-something-to-help/ ↗ **(http://health.rutgers.edu/do-something-to-help/)**

Violence Prevention & Victim Assistance (VPVA)

(848) 932-1181 / 3 Bartlett Street, New Brunswick, NJ 08901 / www.vpva.rutgers.edu/ ↗ **(http://www.vpva.rutgers.edu/)**

The Office for Violence Prevention and Victim Assistance provides confidential crisis intervention, counseling and advocacy for victims of sexual and relationship violence and stalking to students, staff

and faculty. To reach staff during office hours when the university is open or to reach an advocate after hours, call 848-932-1181.

Disability Services

(848) 445-6800 / Lucy Stone Hall, Suite A145, Livingston Campus, 54 Joyce Kilmer Avenue, Piscataway, NJ 08854 / https://ods.rutgers.edu/ ⟂ (https://ods.rutgers.edu/)

Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: **https://ods.rutgers.edu/students/documentation-guidelines** ⟂ **(https://ods.rutgers.edu/students/documentation-guidelines)** . If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodations. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. To begin this process, please complete the Registration form on the ODS web site at: **https://ods.rutgers.edu/students/registration-form.** ⟂ **(https://webapps.rutgers.edu/student-ods/forms/registration)**

[1] Please log on to Canvas for the Zoom meeting link. A few minutes before the specified meeting time, go to Canvas and click on Zoom in the left side panel or open your Canvas Calendar to find the link.

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Date	Details	
Tue Sep 8, 2020	📅 **2020FA - DS & ALG INTRO 16:198:512:03 (https://rutgers.instructure.com/calendar? event_id=122315&include_contexts=course_72805)**	6:40pm to 9:25pm
Fri Sep 11, 2020	📅 **2020FA - DS & ALG INTRO 16:198:512:03 OFFICE HOURS (https://rutgers.instructure.com/calendar? event_id=122317&include_contexts=course_72805)**	4pm to 5pm

Date	Details	
Mon Sep 14, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03 (https://rutgers.instructure.com/calendar? event_id=122333&include_contexts=course_72805)](https://rutgers.instructure.com/calendar?event_id=122333&include_contexts=course_72805)**	6:40pm to 9:10pm
Fri Sep 18, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03 OFFICE HOURS (https://rutgers.instructure.com/calendar? event_id=122318&include_contexts=course_72805)](https://rutgers.instructure.com/calendar?event_id=122318&include_contexts=course_72805)**	4pm to 5pm
Mon Sep 21, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03 (https://rutgers.instructure.com/calendar? event_id=122334&include_contexts=course_72805)](https://rutgers.instructure.com/calendar?event_id=122334&include_contexts=course_72805)**	6:40pm to 9:10pm
Fri Sep 25, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03 OFFICE HOURS (https://rutgers.instructure.com/calendar? event_id=122319&include_contexts=course_72805)](https://rutgers.instructure.com/calendar?event_id=122319&include_contexts=course_72805)**	4pm to 5pm
Mon Sep 28, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03 (https://rutgers.instructure.com/calendar? event_id=122335&include_contexts=course_72805)](https://rutgers.instructure.com/calendar?event_id=122335&include_contexts=course_72805)**	6:40pm to 9:10pm
Fri Oct 2, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03 OFFICE HOURS (https://rutgers.instructure.com/calendar? event_id=122320&include_contexts=course_72805)](https://rutgers.instructure.com/calendar?event_id=122320&include_contexts=course_72805)**	4pm to 5pm
▶ Mon Oct 5, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03 (https://rutgers.instructure.com/calendar? event_id=122336&include_contexts=course_72805)](https://rutgers.instructure.com/calendar?event_id=122336&include_contexts=course_72805)**	6:40pm to 9:10pm
Fri Oct 9, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03 OFFICE HOURS (https://rutgers.instructure.com/calendar? event_id=122321&include_contexts=course_72805)](https://rutgers.instructure.com/calendar?event_id=122321&include_contexts=course_72805)**	4pm to 5pm
Mon Oct 12, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03 (https://rutgers.instructure.com/calendar? event_id=122337&include_contexts=course_72805)](https://rutgers.instructure.com/calendar?event_id=122337&include_contexts=course_72805)**	6:40pm to 9:10pm

Date	Details	
Fri Oct 16, 2020	📅 **2020FA - DS & ALG INTRO 16:198:512:03 OFFICE HOURS (https://rutgers.instructure.com/calendar? event_id=122322&include_contexts=course_72805)**	4pm to 5pm
Mon Oct 19, 2020	📅 **2020FA - DS & ALG INTRO 16:198:512:03 (https://rutgers.instructure.com/calendar? event_id=122338&include_contexts=course_72805)**	6:40pm to 9:10pm
Fri Oct 23, 2020	📅 **2020FA - DS & ALG INTRO 16:198:512:03 OFFICE HOURS (https://rutgers.instructure.com/calendar? event_id=122323&include_contexts=course_72805)**	4pm to 5pm
Mon Oct 26, 2020	📅 **2020FA - DS & ALG INTRO 16:198:512:03 (https://rutgers.instructure.com/calendar? event_id=122339&include_contexts=course_72805)**	6:40pm to 9:10pm
Fri Oct 30, 2020	📅 **2020FA - DS & ALG INTRO 16:198:512:03 OFFICE HOURS (https://rutgers.instructure.com/calendar? event_id=122324&include_contexts=course_72805)**	4pm to 5pm
Mon Nov 2, 2020	📅 **2020FA - DS & ALG INTRO 16:198:512:03 (https://rutgers.instructure.com/calendar? event_id=122340&include_contexts=course_72805)**	6:40pm to 9:10pm
▶ Fri Nov 6, 2020	📅 **2020FA - DS & ALG INTRO 16:198:512:03 OFFICE HOURS (https://rutgers.instructure.com/calendar? event_id=122325&include_contexts=course_72805)**	4pm to 5pm
Mon Nov 9, 2020	📅 **2020FA - DS & ALG INTRO 16:198:512:03 (https://rutgers.instructure.com/calendar? event_id=122341&include_contexts=course_72805)**	6:40pm to 9:10pm
Fri Nov 13, 2020	📅 **2020FA - DS & ALG INTRO 16:198:512:03 OFFICE HOURS (https://rutgers.instructure.com/calendar? event_id=122326&include_contexts=course_72805)**	4pm to 5pm

Date	Details	
Mon Nov 16, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03](https://rutgers.instructure.com/calendar?event_id=122342&include_contexts=course_72805)**	6:40pm to 9:10pm
Fri Nov 20, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03 OFFICE HOURS](https://rutgers.instructure.com/calendar?event_id=122327&include_contexts=course_72805)**	4pm to 5pm
Mon Nov 23, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03](https://rutgers.instructure.com/calendar?event_id=122343&include_contexts=course_72805)**	6:40pm to 9:10pm
Fri Nov 27, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03 OFFICE HOURS](https://rutgers.instructure.com/calendar?event_id=122328&include_contexts=course_72805)**	4pm to 5pm
Mon Nov 30, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03](https://rutgers.instructure.com/calendar?event_id=122344&include_contexts=course_72805)**	6:40pm to 9:10pm
Fri Dec 4, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03 OFFICE HOURS](https://rutgers.instructure.com/calendar?event_id=122329&include_contexts=course_72805)**	4pm to 5pm
▶ Mon Dec 7, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03](https://rutgers.instructure.com/calendar?event_id=122345&include_contexts=course_72805)**	6:40pm to 9:10pm
Fri Dec 11, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03 OFFICE HOURS](https://rutgers.instructure.com/calendar?event_id=122330&include_contexts=course_72805)**	4pm to 5pm
Mon Dec 14, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03](https://rutgers.instructure.com/calendar?event_id=122346&include_contexts=course_72805)**	6:40pm to 9:10pm

Date	Details	
Fri Dec 18, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03 OFFICE HOURS (https://rutgers.instructure.com/calendar?event_id=122331&include_contexts=course_72805)](https://rutgers.instructure.com/calendar?event_id=122331&include_contexts=course_72805)**	4pm to 5pm
Mon Dec 21, 2020	📅 **[2020FA - DS & ALG INTRO 16:198:512:03 (https://rutgers.instructure.com/calendar?event_id=122347&include_contexts=course_72805)](https://rutgers.instructure.com/calendar?event_id=122347&include_contexts=course_72805)**	6:40pm to 9:10pm

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