

# CSCI 1570 - Design and Analysis of Algorithms

## Course Information and Syllabus

### Fall 2025

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| Instructor         | Eli Upfal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Course Description | <p>This is a core undergraduate Computer Science course on the foundations of algorithmic theory and applications.</p> <p>The questions it aims to answer are:</p> <ul style="list-style-type: none"> <li>• What are the different algorithmic archetypes?</li> <li>• How can we analyze the performance of algorithms?</li> <li>• Which design guidelines should be followed towards achieving efficient algorithms?</li> <li>• What data structures can be used for specific algorithmic tasks?</li> </ul> <p>We will cover these questions and, in the process, explore the use of algorithms in important applications such as artificial intelligence, data management, network analysis, and geographic information systems.</p> <p>The course has lectures, written homework assignments, and exams.</p> |
| Topics             | <ol style="list-style-type: none"> <li>1. Methodologies for algorithms analysis</li> <li>2. Data structures</li> <li>3. Sorting and searching</li> <li>4. Greedy algorithms</li> <li>5. Dynamic programming</li> <li>6. Divide &amp; conquer</li> <li>7. Hashing and Dealing with collisions</li> <li>8. Graph algorithms</li> <li>9. Text analysis and pattern matching</li> <li>10. Computational geometry</li> <li>11. Time Complexity <ol style="list-style-type: none"> <li>a. P vs NP</li> <li>b. Reductions</li> <li>c. NP-Complete problems</li> </ol> </li> <li>12. Algorithms for external memory</li> <li>13. Online algorithms</li> <li>14. Linear programming</li> </ol>                                                                                                                           |
| Learning outcomes  | <p>At the successful completion of the course, a student should:</p> <ul style="list-style-type: none"> <li>• Demonstrate advanced knowledge of the main algorithmic design archetypes.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

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|                                    | <ul style="list-style-type: none"> <li>• Demonstrate ability to deploy the main algorithm design archetypes and analyze them.</li> <li>• Show a competent understanding of hashing and collision handling.</li> <li>• Show a competent understanding of algorithms for network flow analysis, pattern matching, and computational geometry.</li> <li>• Have understanding and competence with reductions and reduction-based proof arguments.</li> <li>• Show a competent understanding of complexity theory (time complexity ) and its main results</li> <li>• Be proficient in proving hardness results for given problems of interest.</li> </ul>                                                                                             |
| Course Website                     | For more in-depth information about the course, refer to the Course website <a href="http://cs.brown.edu/courses/csci1570/">http://cs.brown.edu/courses/csci1570/</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Prerequisites                      | CSCI 0160, CSCI 0200, or CSCI 0190, and one of CSCI 0220, CSCI 1010, CSCI 1450, MATH 0750, MATH 1010, MATH 1530.<br>Requests for override of the prerequisites must be submitted using CAB.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Sections                           | S1 - Main, In-person section only                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Lectures                           | Tuesdays and Thursdays. Time: 2:30-3:50 pm in CIT 368.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Lecture Slides                     | Lecture slides will be available on the Ed platform of the course, usually by the evening before each lecture.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Textbook                           | Recommended but to required:<br>M. T. Goodrich, R. Tamassia - Algorithms Design and Applications, Wiley, 2014, ISBN: 978-1-118-33591-8.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Enrollment Cap and Waitlist Policy | <p>The course enrollment is currently capped. While we plan to revise this cap upwards, we cannot guarantee this will happen.</p> <p>If you could not register for the course, to be added to the waitlist please send an override request through CAB. No further action is necessary.</p> <p>Whenever slots are available, codes are sent out in the evening of every workday. Codes that are unredeemed for 48 hours will be retracted. Please be mindful of your enrollment request.</p> <p>Students who drop out of the course but later wish to re-enroll will be placed at the end of the waitlist.</p> <p>CAB may display available seats but those are likely allocated to override codes that have been sent but not yet redeemed.</p> |

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|                                                     | Inquiries regarding “position on the waitlist” and/or “likelihood of joining the course” will not be addressed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Enrolling in courses with overlapping meeting times | Petitions to enroll in CSCI 1570 with overlap with other courses <b>will not be approved</b> in accordance with the university <a href="#">policy on overlapping courses</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Professor’s Office Hours                            | Thursdays 4-5pm. CIT 314.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Communications                                      | All email communications regarding the course addressed to Eli or the TA staff must have “[CSCI 1570]” as the first term of the subject.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Head TA                                             | <a href="#">John Zou</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| UTAs                                                | <a href="http://cs.brown.edu/courses/csci1570/">http://cs.brown.edu/courses/csci1570/</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| TA Office Hours                                     | <a href="http://cs.brown.edu/courses/csci1570/">http://cs.brown.edu/courses/csci1570/</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Time Requirements                                   | <p>Each week, in addition to 2 hours 40 minutes in class (for a total of 24 classes), students will spend on average as much time reading the material, 7 hours on the eleven homework assignments. Midterm and Final will each last 2.5 hours. Preparation for each midterm should take 10 hours. Per Brown University policy, 1-credit courses should require a minimum of 180 total hours of work throughout the semester.</p> <p>The above estimates satisfy this: 24 lectures will yield 40 hours of class time. As much time will be spent reading material. Ten homework assignments will require roughly 70 additional hours outside of class time. Midterm and Final exams will yield at least 30 hours.</p>    |
| Course credit and Grading                           | <p><b>Course Credit:</b></p> <p><b>10% homework + 40% midterm grade + 50% final grade.</b></p> <p><b>At least 50% of the questions in the midterm and final exam will be taken from the weekly homework assignments.</b></p> <p><b>Grading:</b> Please be aware that undergraduate TAs will be scoring your work. The final responsibility for all grades lies with the instructor.</p> <p><b>Final Grade cutoffs:</b> The cutoffs for an A/B/C grade are set to 90%/80%/70% of the available credit. These thresholds may only be adjusted down to in the instructor’s discretion. To receive an “S with distinction,” students need to complete the class with a score well within the “A” range (i.e., &gt; 92%).</p> |

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| Homework policy | <p>Ten take-home homework assignments will be released during the course. The schedule of homework releases and due dates is presented in the <a href="#">official course calendar</a>. Homework assignments will be released on the same page. Any modifications will be communicated by the instructor, and such modifications will be reflected in the calendar.</p> <p>.Students will receive feedback on each assignment within one work week after the deadline via graded assignment on Gradescope.</p> <p><b>Credit:</b> The credit tied to homework will be assigned based on the average score of all submitted homework, weighted equally.</p> <p><b>Gradescope policy:</b> Homework assignments must be submitted using Gradescope. When registering, use your @brown.edu email account. Solutions and feedback on assignments will be delivered there as well.</p> <p><b>LaTeX:</b> Homework assignments <b>must be typeset</b> (LaTeX is strongly preferred as it facilitates the formatting of math formulas and pseudocode) and submitted as PDF documents using Gradescope. Submissions must follow this rule to receive credit. Guides on how to use LaTeX and GradeScope will be provided on the course website.</p> <p><b>Collaboration policy:</b> We allow (and encourage!) discussion of the material presented in lectures, help sessions, and the textbook, as well as discussion of concepts involved in homework assignments. Written work is another matter. <b>You must write up your homework solutions by yourself.</b> This ensures that you understand the material even if you collaborated on the problem. You should not take notes away from collaboration sessions and should be by yourself when writing the solution. Rule of thumb: <b>If you cannot independently reproduce what you hand in, don't hand it in.</b> We reserve the right to request that you explain your solution to a problem, so we can ensure that the solution was your own work.</p> <p>Violations of the collaboration policy will result in a <b>zero score</b> on the involved homework assignment and a reduction to the highest achievable grade to a B. A second repeated offense will result in the inability to complete the class and a report of the violation to the <a href="#">Academic Code of Conduct</a>.</p> <p><b>Late submission policy:</b> <b>At most two homework assignments can be handed in at most one day late. Other assignments submitted late will not receive any credit.</b> Additional late-day passes may be granted by the</p> |
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|                          | <p>instructor in consideration of extenuating circumstances (e.g., illness). Those requests <b>must be accompanied by a Dean's Note</b> and sent directly to the instructor.</p> <p>While we sympathize with other possible occurrences, <b>extensions will not be given for random special events</b> (e.g., I/my roommate/pet spilled water on my laptop, I lost my laptop/power adapter). You are free to update your submission up to the deadline date (or past it if you use late days). We recommend doing so to avoid losing potential partial credit and/or keep a version of your work backed up online.</p> <p><b>Double-check your work before submitting it.</b> Submitting blank pages and/or forgetting to upload materials or uploading the wrong version of an assignment will not be granted "special" late deadlines.</p> |
| Midterm and Final Policy | <p>Midterm and Final will be in-person assignments for students in S1. Dates and locations will be announced in the first two weeks of the semester.</p> <p>The Midterm will be held during a lecture slot on TBA. The time allotted for the exam is 1 hr 40 minutes</p> <p>The Final will be held on TBA at TBA am in TBA. The time allotted for the exam is 2.5 hrs.</p> <p>No electronic devices may be used.</p> <p>No collaboration is allowed. You should not discuss the problems and your solutions with other students.</p> <p>Violations of such policy will result in the inability to complete the course and will be reported as violations of the <a href="#">Academic Code of Conduct</a>.</p> <p>Solutions for the Midterm and Final will not be released.</p>                                                               |
| Incomplete grades        | <p>In extraordinary situations, students may request to receive an incomplete grade. Such cases must be accompanied by a Dean's note and will be assessed case by case.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Ed discussion policy     | <p>Students are encouraged to interact through the Ed Discussion platform for the course under the following policy:</p> <ul style="list-style-type: none"> <li>• Public posts cannot be anonymous. The TA staff will moderate these posts to make them visible.</li> <li>• Private posts may be anonymous.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

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|                                  | <ul style="list-style-type: none"> <li>We will observe quiet hours 8 pm-9 am, and for 4 days after midterm/final.</li> </ul> <p>Ed is NOT meant to be the place to request extensions. Any such posts will be deleted.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Diversity:<br>All are Welcome    | <p>The course intends to provide a welcoming environment for all students. We especially welcome diverse ideas and perspectives during class discussions.</p> <ul style="list-style-type: none"> <li>All members of the CS community, including faculty and staff, are expected to treat one another professionally. Toward this goal, TAs have undergone training in diversity and inclusion. However, despite our best efforts, we may accidentally slip up, so please feel free to speak to any member of the course staff with any concerns you have during the semester, and do not hesitate to contact the instructor directly. We will take your concerns very seriously.</li> </ul>                                                                                                                                                                       |
| Accommodations                   | <p>If you feel you have physical, psychological, or learning disabilities that could affect your performance in the course, we urge you to contact SAS/SEAS (<a href="https://www.brown.edu/campus-life/support/accessibility-services/">https://www.brown.edu/campus-life/support/accessibility-services/</a>).</p> <p>We will do whatever we can to support accommodations recommended by SAS/SEAS.</p> <p>If you require SAS/SEAS accommodations, please let the instructor know <b>at the beginning of the semester</b>.</p> <p>Students requiring SAS/SEAS accommodations will be granted the following:</p> <ul style="list-style-type: none"> <li>A budget of four late days, with the possibility of applying up to two late days to a single assignment.</li> </ul> <p>Extra 50% of the time for in-class exams and a separate location (if needed).</p> |
| Mental Health                    | <ul style="list-style-type: none"> <li>Being a student can be very stressful. If you feel you are under too much pressure or there are psychological issues that are keeping you from performing well at Brown, we encourage you to contact Brown's <a href="#">Counseling and Psychological Services (CAPS)</a>. They provide confidential counseling.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Coping with<br>Unforeseen Events | <p>If there are events that are upsetting to you, whether political, family-related, weather-related, etc., that affect your ability to do well in class, we are happy to take them into account with respect to our late and incomplete policies. Please feel free to talk to the instructor about this.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Agreeing to class<br>rules       | <p>At the beginning of the course, all students are required to formally indicate they understand and agree to abide by the course collaboration</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

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|  | <p>policy by downloading the PDF of the syllabus, reading it thoroughly, and submitting it on Gradescope as HW 0 by 9/18/2024.</p> <p><b>Failure to do so in a timely fashion will not allow students to complete the course.</b></p> |
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