COURSE DESCRIPTION

This course covers

- performance analysis of algorithms: asymptotic bounds for worst case, best case, average case, NP-completeness;
- algorithms and data structures for classical problems such as sorting, searching, graph problems, etc., and
- algorithm design techniques, for example recurrence, divide and conquer, dynamic programming, greedy choice, and approximation.

PREREQUISITES

The class has the following prerequisites:

- calculus and lower level math,
- discrete mathematics, for example CSC 224/226, or a comparable course,
- data structures, for example CSC 314/316, or a comparable course, and
- basic programming skills in python or java.

LEARNING OUTCOMES

You will learn how to solve computational problems using concepts of algorithms and discrete mathematics, e.g.

- prove the correctness of sorting, selection, graph and other algorithms,
- reduce an instance of a problem to a smaller instance of the same problem,
- give big-oh, big-omega, big-theta, little-oh and little-omega bounds for functions,
- analyze the worst and average case running time of algorithms described in pseudocode,
- prove a lower bound on comparison-based sorting algorithms and distinguish between lower bounds for algorithms and lower bounds for problems,
- solve recurrence relations related to divide and conquer algorithms,
- identify properties of problems that lead to efficient algorithms or make them intractable,
• solve problems using common algorithm design techniques: greedy, divide and conquer, dynamic programming, graph searching, and the use of efficient data structures,
• describe algorithms and their characteristics such as worst case running time, space requirements, etc. in textual form,
• identify problem domains in which theoretical results in algorithm design and analysis have practical applications and derive appropriate models for the practical problems,
• define NP-completeness and outline a proof of NP-completeness of a given decision problem.

**TEXTBOOK (REQUIRED)**


The textbook is required.

**INSTRUCTOR**

Steffen Heber  
Email: sheber@ncsu.edu  
Phone: 919-513-1118  
Office Location: 2260 EB2  
Online Office Hours: Wednesday 4:30PM-5:30PM, or by appointment
COURSE STRUCTURE AND POLICIES

The coursework consists of lectures, readings, homework assignments, and exams.

- Lectures (videos) might depart from our textbook. Some of the material presented might not be available through the lecture notes, or textbook. You are responsible for all material presented or discussed in class (videos).
- Readings will generally be taken from our textbook with possible supplements from the literature.
- We will have four homework assignments, two midterms, and a final exam.
- All homework assignments are intended to be individual work.
- All exams are closed book exams. However, calculators (not programmable!) are permitted. Sorry, no cell phones are allowed.
- Exams might include material from lectures, assignments, and readings. All exams are closed book exams.

ELECTRONICALLY-HOSTED COURSE COMPONENTS

Students may be required to disclose personally identifiable information to other students in the course, via electronic tools like email or web-postings, where relevant to the course. Examples include online discussions of class topics and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course.

**Electronically-hosted Components:** Moodle Web site, contains information about syllabus, and tentative timeline. We will be using Piazza for class discussion. Find our class page at: piazza.com/ncsu/fall2019/csc505/home. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself. If you have any problems or feedback for the developers, email team@piazza.com. Disclaimer: Do not post solutions to assignments or exams before they have been returned - this will be considered as cheating. For questions about personal grades or requests for meetings please contact the instructor, or the TAs via private post.
GRADING

Grades will be computed with a weighted average using the weights shown below.

<table>
<thead>
<tr>
<th></th>
<th>Section 601</th>
</tr>
</thead>
<tbody>
<tr>
<td>final exam</td>
<td>40%</td>
</tr>
<tr>
<td>two midterm exams (equal weights)</td>
<td>40%</td>
</tr>
<tr>
<td>four homework assignments (equal</td>
<td>20%</td>
</tr>
<tr>
<td>weights)</td>
<td></td>
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</tbody>
</table>

This Course uses Standard NCSU Letter Grading.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Score Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>97 ≤ A+ ≤ 100</td>
</tr>
<tr>
<td>A</td>
<td>93 ≤ A &lt; 97</td>
</tr>
<tr>
<td>A-</td>
<td>90 ≤ A- &lt; 93</td>
</tr>
<tr>
<td>B+</td>
<td>87 ≤ B+ &lt; 90</td>
</tr>
<tr>
<td>B</td>
<td>83 ≤ B &lt; 87</td>
</tr>
<tr>
<td>B-</td>
<td>80 ≤ B- &lt; 83</td>
</tr>
<tr>
<td>C+</td>
<td>77 ≤ C+ &lt; 80</td>
</tr>
<tr>
<td>C</td>
<td>73 ≤ C &lt; 77</td>
</tr>
<tr>
<td>C-</td>
<td>70 ≤ C- &lt; 73</td>
</tr>
<tr>
<td>D+</td>
<td>67 ≤ D+ &lt; 70</td>
</tr>
<tr>
<td>D</td>
<td>63 ≤ D &lt; 67</td>
</tr>
<tr>
<td>D-</td>
<td>60 ≤ D- &lt; 63</td>
</tr>
<tr>
<td>F</td>
<td>0 ≤ F &lt; 60</td>
</tr>
</tbody>
</table>

- Bad Midterm Forgiveness Policy: one midterm score that is lower than your score in the final exam will be replaced by the final exam score.
- Course grades may be curved up, but they will never be curved down.
- There is a one-week time limit for submission of disputes for exams and assignments. The entire exam or homework may be re-graded, and not just the disputed question.
- There are no makeup exams. If you are forced to miss an exam, you need to contact the instructor before the exam, and a university accepted excuse must be presented. If the excuse is accepted, the score of your final exam will be used to replace the grade of the missed exam.
- Extra credit: there might be extra points in homework assignments and exams. The bonus points earned in a specific assignment or exam cannot be transferred to other assignments or exams.
- At the end of the class, every student will obtain an increase of x percentage points (x will be announced by the instructor) in the final grade point average. The purpose of these bonus points is to protect students that cannot double-check their final exam from grading mistakes. The bonus will be removed if a regrade request is submitted.
HOMEWORK POLICIES

- All homework assignments are intended to be individual work. Turning in an exam, or assignment which is not the student’s own work is cheating. Copying of text, code, or other content from the Internet (or other sources) is plagiarism. Write all homework solutions from scratch using your own words; paraphrases of solutions from other sources are unacceptable even if you cite those sources.
- If an academic integrity violation occurs, the offending student(s) will be assessed a penalty that is at least as severe as getting a 0 for the whole homework for which the violation occurred. The case will always be reported to the Office of Student Conduct.
- Any tool/resource must be approved in advance by the instructor and identified and acknowledged clearly in any work turned in, anything else is plagiarism. For more information, please consult the university’s Code of Student Conduct.
- Homework assignments must be submitted in printed form via Moodle before the announced deadline. To avoid reduced marks, please submit word/latex-formatted PDF file, NOT scanned writing in pdf format. Scanned writing is hard to read, takes longer to grade, and produces gigantic files. Use "UnityID_HW#" as a name of pdf file, where # should be replaced by current homework number; write your name and unity ID at the top of your homework on page one. Please try this out well before the due date to make sure that it works for you.
- Late Policy: All assignments are due on 9 PM of the due date. Late homework will be accepted only in circumstances that are grounds for excused absence under university policy (policies.ncsu.edu/regulation/reg-02-20-03, item 3). The university provides mechanisms for documenting such reasons (severe illness, death in the family, etc.); these are described on the web site. Arrangements for turning in late homework must be made by the day preceding the due date if possible. Unexcused late submissions will result in a 10%/40% point reduction on the first/second day after the due date. No credit will be given for submissions that are three or more days late.

POLICIES ON INCOMPLETE GRADES

If an extended deadline is not authorized by the Graduate School, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions), or (b) by the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as an attempted course on transcripts. The burden of fulfilling an incomplete grade is the responsibility of the student. The university policy on incomplete grades is located at http://policies.ncsu.edu/regulation/reg-02-50-03. Additional information relative to incomplete grades for graduate students can be found in the Graduate Administrative Handbook in Section 3.18.F at http://www.fis.ncsu.edu/grad_publicns/handbook/.

REQUIREMENTS FOR AUDITORS

This class cannot be audited.
ACADEMIC INTEGRITY

Students are required to comply with the university policy on academic integrity found in the Code of Student Conduct found at http://policies.ncsu.edu/policy/pol-11-35-01.

ACADEMIC HONESTY

See http://policies.ncsu.edu/policy/pol-11-35-01 for a detailed explanation of academic honesty.

HONOR PLEDGE

Your signature on any test or assignment indicates "I have neither given nor received unauthorized aid on this test or assignment." Students are responsible for reviewing the PRRs which pertain to their course rights and responsibilities. These include: http://policies.ncsu.edu/policy/pol-04-25-05 (Equal Opportunity and Non-Discrimination Policy Statement), http://oied.ncsu.edu/oied/policies.php (Office for Institutional Equity and Diversity), http://policies.ncsu.edu/policy/pol-11-35-01 (Code of Student Conduct), and http://policies.ncsu.edu/regulation/reg-02-50-03 (Grades and Grade Point Average).

ACCOMMODATIONS FOR DISABILITIES

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, student must register with the Disability Services Office (http://www.ncsu.edu/dso), 919-515-7653 and contact the instructor. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation at http://policies.ncsu.edu/regulation/reg-02-20-01.

NON-DISCRIMINATION POLICY

NC State University provides equality of opportunity in education and employment for all students and employees. Accordingly, NC State affirms its commitment to maintain a work environment for all employees and an academic environment for all students that is free from all forms of discrimination. Discrimination based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation is a violation of state and federal law and/or NC State University policy and will not be tolerated. Harassment of any person (either in the form of quid pro quo or creation of a hostile environment) based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation also is a violation of state and federal law and/or NC State University policy and will not be tolerated. Retaliation against any person who complains about discrimination is also prohibited. NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at http://policies.ncsu.edu/policy/pol-04-25-05 or
http://www.ncsu.edu/equal_op/. Any person who feels that he or she has been the subject of prohibited discrimination, harassment, or retaliation should contact the Office for Equal Opportunity (OEO) at 919-515-3148.

This syllabus is subject to change.