CS4104: Data and Algorithm Analysis
Spring 2024

Class:	CRN 13401, TuTh @ 8:00-9:15, Lavery Hall 340
Instructor:	Alex Hicks Email: alexhicks@vt.edu Office Hours: McBryde 122A Tuesday: 9:30AM-11:00AM Thursday: 9:30AM-11:00AM
GTA:	Akash Mittal, akashm@vt.edu Office Hours: McBryde 106 Monday: 5:00PM-7:00PM Zoom: Zoom Link Wednesday: 5:00PM-7:00PM Zoom: Zoom Link Friday: 9:00AM-11:00AM
UTA:	Evan Lee, evan0110@vt.edu Office Hours: McBryde 106 Tuesday: 3:30PM-5:30PM Wednesday: 1:30PM-4:30PM Thursday: 3:30PM-5:30PM Friday: 12:30PM-3:30PM
Course Prerequisites:	CS 3114 and either MATH 3124 or MATH 3134
Textbooks:	OpenDSA: Senior Algorithms Optional: *Compared to What* by Rawlins (ISBN 071678243X)

Course Overview:

The goal of this course is to build a toolkit to better solve a variety of problems and evaluate the quality of such solutions. The course will broadly be organized into six overarching ideas, **Graphs**, **Divide and Conquer Algorithms**, **Greedy Algorithms**, **Dynamic Programming**, **Network Flow**, **Reductions** with a quiz and a problem set for each of them. Within these broad sections, we will focus on topics such as:

- Formal metrics for evaluating algorithm complexity
- Problem solving approaches
- Algorithm design strategies
- Proving algorithm correctness

- Proving worst-case lower bounds using reductions
- Algorithms on graphs

Learning Outcomes: At the conclusion of this course, a successful student will be able to:

- Analyze a pre-written algorithm to determine its resource complexity
- Employ the strategies of divide and conquer, greedy, and dynamic programming (perhaps in concert) to develop novel algorithms
- Prove the correctness of algorithms built using these strategies
- Identify trade-offs in algorithm design (such as time vs. space, average-case vs. worst case, dynamic vs. static)
- Prove lower bounds on algorithm complexity

Grading Policy:

There will be two options for grading policies in this course. You will be required to commit to one of the two policies by the end of the first week via a Canvas quiz. Note: Educational studies consistently show a strong correlation between class attendance and class grade. The two options are:

- Option 1: Required Attendance
  - Attendance to every class is mandatory, and will be recorded at every class meeting. Students will lose 10 points for every class missed. You can miss two classes during the course without penalty, contact the course instructor if you need an excused absence for any other reason.
  - The course will be graded on the basis of 1000 total assigned points. Attendance will be out of 100 points. There will be five quizzes worth 60 points each. Two will be on a date in late February, two will be on a date in early April, and one will be during the final exam slot. The remaining 600 points will be based on 5 problem sets and one introductory problem set. These problem sets will be graded by course staff and one of the following scores will be assigned (along with feedback): Excellent (100), Reasonably Successful (93), Partially Successful (83), Flawed Attempt (30), No Credit (0). See table 1 for the points available breakdown for this option. There will be 1 bonus homework assignment that will be announced later.
- Option 2: No Required Attendance

Table 1: Option 1: Required Attendance Point Distribution

Assignment	Points
Problem Set 0	100
Problem Set 1	100
Problem Set 2	100
Quiz 1	60
Quiz 2	60
Problem Set 3	100
Problem Set 4	100
Quiz 3	60
Quiz 4	60
Problem Set 5	100
Quiz 5	60
Attendance	100

- There will be five quizzes worth 80 points each. Two will be on a date in late February, two will be on a date in early April, and one will be during the final exam slot. The remaining 600 points will be based on 5 problem sets and one introductory problem set. These problem sets will be graded by course staff and one of the following scores will be assigned (along with feedback): Excellent (100), Reasonably Successful (93), Partially Successful (83), Flawed Attempt (30), No Credit (0). See table 2 for the points available breakdown for this option. There will be 1 bonus homework assignment that will be announced later.

I want you to understand how you are evaluated in this class. If you have any questions about your grade or feedback on course work, please email me to schedule a time to meet. I kindly ask that you wait at least 24 hours after work has been returned before requesting an appointment. This is to give you time to more thoroughly consider questions you have about your work.

Problem Set Policy:

Solutions to problem sets will be submitted via Canvas. Student will be required to use LaTeX to typeset their problem set solutions. The course staff recommends using Overleaf, an online LaTeX editor that you will be able to use through your Virginia Tech email, but any version of Tex will do. Presentation (readability and clarity) of solutions will count for grading and you will need to typeset a lot of mathematical equations, plain ASCII text will typically not be satisfactory. Students must submit both a zip archive containing the tex source (and any necessary images/supplemental files) as well as a PDF output of their solutions.

All problem set submissions **MUST** contain the following Pledge Statement:

"**I have neither given nor received unauthorized assistance on this assignment.**"

Table 2: Option 2: No Required Attendance Point Distribution

Assignment	Points
Problem Set 0	100
Problem Set 1	100
Problem Set 2	100
Quiz 1	80
Quiz 2	80
Problem Set 3	100
Problem Set 4	100
Quiz 3	80
Quiz 4	80
Problem Set 5	100
Quiz 5	80

Table 3: Grading Scale

Grade	Points
A	930-1000
A-	900-929
B+	870-899
B	830-869
B-	800-829
C+	770-799
C	730-769
C-	700-729
D+	670-699
D	630-669
D-	600-629
F	0-599

Problem sets will normally be due on Canvas at 11:00pm on a Friday. Problem sets received late will receive an automatic late penalty of 10 points per day (taken off from the list of possible scores), up to two days late (-20). After two days, problem sets will not be accepted without an individual extension.

Collaboration Policy:

For the problem sets, students are permitted (and encouraged) to collaborate with up to 3 other students in the course, but all work submitted must be your own independently written solution. While you may discuss techniques and possible solutions with your group, you may not share any files or look at each others' write-up. For instance, sharing files on Google Docs or Overleaf is now allowed. You must list the names and PIDs of all of your collaborators in your submitted files.

While you are allowed (and encouraged) to collaborate with your peers, it is important that all students involved completely understand their own answers (that you must write up individually). The instructor reserves the right to require any student to present their answers to their problem set solutions verbally to course staff to insure that the student does understand the solution they submitted.

Office Hours Information:

We will be using MyDigitalHand for all office hours this semester

Electronic Information:

Information such as copies of the syllabus and assignments, assignment solutions, and class grades, will be made available through the class Canvas site. Notice of homework deadlines, test dates, etc., will be posted at Canvas. The course instructor accepts no responsibility or obligation for making such announcements in class. The course Canvas site is the official source for all course notifications.

Honor Code:

The Undergraduate Honor Code pledge that each member of the university community agrees to abide by states:

"As a Hokie, I will conduct myself with honor and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do."

Students enrolled in this course are responsible for abiding by the Honor Code. A student who has doubts about how the Honor Code applies to any assignment is responsible for obtaining specific guidance from the course instructor before submitting the assignment for evaluation. Students are strongly discouraged from misusing sites such as Chegg and CourseHero, as well as misusing ChatGPT and other Generative Artificial Intelligence. Students are strongly encouraged to consult their faculty members regarding the use of such outside materials as the misuse of these sources may constitute a violation of the Honor Code. Ignorance of the rules does not exclude any member of the University community from the requirements and expectations of the Honor Code.

See additional information about the Honor Code

Student Well-Being

Supporting the mental health and well-being of students in my class is of high priority to me and Virginia Tech. If you are feeling overwhelmed academically, having trouble functioning, or are worried about a friend, please reach out to any of the following offices:

- Cook Counseling
  - Schedule an appointment and/or 24/7 crisis support: 540-231-6557
  - ucc.vt.edu for more information
- Dean of Students Office
  - General advice: 540 231-3787
  - After-hours crisis: 540-231-6411
  - dos.vt.edu for more information
- Hokie Wellness
  - hokiewellness.vt.edu for more information about health and wellness workshops and consultations
  - Virginia Tech Recovery Community
- Services for Students with Disabilities (SSD)
  - Accommodations and other disability-related supports: 540-231-3788
  - ssd.vt.edu for more information

See a full listing of campus resources on well-being.vt.edu

Please also feel free to speak with me. I will make an effort to work with you; I care about your well-being and success.

Academic Accommodations:

Virginia Tech welcomes students with disabilities into the University's educational programs. The University promotes efforts to provide equal access and a culture of inclusion without altering the essential elements of coursework. If you anticipate or experience academic barriers that may be due to disability, including but not limited to ADHD, chronic or temporary medical conditions, deaf or hard of hearing, learning disability, mental health, or vision impairment, please contact the Services for Students with Disabilities (SSD) office (540-231-3788, ssd@vt.edu, or visit ssd.vt.edu). If you have an SSD accommodation letter, please meet with me privately during office hours as early in the semester as possible to deliver your letter and discuss your accommodations. You must give me reasonable notice to implement your accommodations, which is generally 5 business days and 10 business days for final exams.

Virginia Tech Community Wellness Commitment: Virginia Tech is committed to protecting the health and safety of all members of its community. By participating in this class, all students agree to abide by the Virginia Tech Wellness principles (https://ready.vt.edu/public-health-guidelines.html#wellness). Be respectful of the well-being of others, as well as individual choices about masking. Students who prefer to wear masks in class are always welcome to do so.

Basic Needs Accommodations:

For any student who has difficulty affording groceries, accessing sufficient food to eat every day, or who lacks a safe and stable place to live, and if you believe this may affect your performance in this course, you are urged to contact the Dean of Students office for support at 540-231-3787 or complete an interest form to participate in The Market at Virginia Tech. There is also a Student Emergency Fund program. If you are comfortable in doing so, please notify your professor or departmental advisor of your situation. This will enable them to provide any resources they have access to.

Land and Labor Acknowledgement

Virginia Tech acknowledges that we live and work on the Tutelo / Monacan People's homeland and we recognize their continued relationships with their lands and waterways. We further acknowledge that legislation and practices like the Morrill Act (1862) enabled the commonwealth of Virginia to finance and found Virginia Tech through the forced removal of Native Nations from their lands, both locally and in western territories.

We understand that honoring Native Peoples without explicit material commitments falls short of our institutional responsibilities. Through sustained, transparent, and meaningful engagement with the Tutelo / Monacan Peoples, and other Native Nations, we commit to changing the trajectory of Virginia Tech's history by increasing Indigenous student, staff, and faculty recruitment and retention, diversifying course offerings, and meeting the growing needs of all Virginia tribes and supporting their sovereignty.

We must also recognize that enslaved Black people generated revenue and resources used to establish Virginia Tech and were prohibited from attending until 1953. Through InclusiveVT, the institutional and individual commitment to Ut Prosim (that I may serve) in the spirit of community, diversity, and excellence, we commit to advancing a more diverse, equitable, and inclusive community.