Syllabus: CS 4124
Theory of Computation
Fall, 2024

1 General Course Information

CRN	91428
Meeting Time	8:00 AM–9:15 AM; Tuesdays and Thursdays
Classroom	2003 Pamplin Hall
Final Exam	December 14, 10:05–12:05

Instructor: Lenwood S. Heath

- **Office Hours:** 9:30–11:00, Tuesdays and Thursdays

- **Location:** 2160J Torgersen

- **Email:** heath@vt.edu

Web Site: http://courses.cs.vt.edu/cs4124/fall2024/index.php
Canvas: https://canvas.vt.edu/
Prerequisites:

- MATH 3134, Applied Combinatorics and Graph Theory, or MATH 3034, Introduction to Proofs

Required Textbook: Understanding Computation: Pillars, Paradigms, Principles. Arnold L. Rosenberg and Lenwood S. Heath. Springer, 2022. ISBN: 978-3-031-10054-3.

2 Course Description

This course takes an innovative approach to the theory of computation based on the exploration of key conceptual Pillars. The approach employing the Pillars concept enables a BIG IDEAS focus that differentiates this course from other theory of computation courses. To be concrete, this course offering will explore the State, Encoding, and Nondeterminism Pillars. Topics include Myhill-Nerode Theorem, Computability Theory, and Complexity Theory.

3   Grading Policy

Grading for the course is on a 1000-point scale, with the points distributed as follows:

Homework assignments: 10 at 60 points each	600
Final exam: December 14, 10:05–12:05	400

Homework Assignments.   A typical homework assignment consists of 1 or 2 problems, posted on the course web site approximately one week before the due date. A problem may require a mathematical proof or a construction. Some of the problems may come from the textbook (Appendix B).

All homework must be prepared with LaTeX[1] and submitted as a PDF to Canvas by 5:00 PM on the due date[2]. Also, any required drawings should be drawn in a drawing program. As an alternative, a neatly drawn figure may be scanned and inserted into the LaTeX solutions.

Late Homework Policy.   **No late homework will be accepted. There will be 10 homework assignments; all scores will count towards the final 1000-point scale.**

Final Exam.   The final exam will be an in-class exam.

Timeframe: December 14, 10:05–12:05.

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[1]See LaTeX resources on the course web site. A popular alternative to installing LaTeX is the Overleaf web site for editing your LaTeX file. Just use the university-supported service at `https://www.overleaf.com/`.

[2]See Calendar on the course web site.

Table 1: Letter grading scale based on 1000 total points available.

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

Grading Scale.   See Table 1 for the course grading scale.

4   Accommodations Announcement

If any student needs special accommodations because of a disability, please verify with the instructor that he has received the required accommodations letter.

5   Manner of Instruction

The manner of instruction for this class is face-to-face in 2003 Pamplin Hall. There will be no online instruction.

6   Use of Generative AI

Students are not allowed to use generative AI to create any graded work that is submitted for the course.

7   Readings

For most classes, there is a reading assignment (see the course web site) to be completed by class time. Each assignment consists of sections or chapters in the required textbook.

8 Planned Topics

See the Weekly Schedule on the course web site for additional details on what will be covered when.

- **Chapters 1 and 2.** Introduction

- **Appendix A.** A Chapter-Long Text on Discrete Mathematics

  STATE

- **Chapter 3.** Pure State-Based Computational Models

- **Chapter 4.** The Myhill-Nerode Theorem: Implications and Applications

- **Chapter 5.** Online Turing Machines and the Implications of *Online* Computing

- **Chapter 6.** Pumping: Computational Pigeonholes in Finitary Systems

  ENCODING

- **Chapter 9.** Countability and Uncountability: The Precursors of *ENCODING*

- **Chapter 10.** Computability Theory

- **Chapter 11.** A Church-Turing Zoo of Computational Models (Selections)

  NONDETERMINISM

- **Chapter 13.** Nondeterminism as Unbounded Parallelism

- **Chapter 14.** Nondeterministic Finite Automata

- **Chapter 16.** Complexity Theory

9 Your Mental Health and Well-Being

Here is a timely statement from Dr. Christopher Flynn, Director of the Mental Health Initiatives:

> As awareness of mental health concerns in the college population grows, student advocacy groups at Virginia Tech have banded together as the Mental Health Coalition. One of the groups is **Active Minds at Virginia Tech**, and it seeks to raise awareness and fight stigma about mental health; to that end, Alyssa Wills and Saad Khan, two officers of Active Minds, have requested that faculty include the following statement regarding resources for students at Virginia Tech in their syllabi each semester. This statement has the approval of all student groups in the Mental Health Coalition as well as the professionals in each of the offices included below.

Here is the requested statement:

Supporting the mental health and well-being of students in this class is of high priority to the instructor and to 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:
  - 540-231-6557 to schedule an appointment and/or 24/7 crisis support
  - `http://www.ucc.vt.edu/` for more information
- · Dean of Students Office:
  - 540 231-3787 for general advice
  - 540-231-6411 for after-hours crisis
  - `http://www.dos.vt.edu/` for more information
- Hokie Wellness:
  - `http://www.hokiewellness.vt.edu/` for more information about health and wellness workshops and consultations
- Services for Students with Disabilities (SSD):
  - 540-231-3788 or `http://www.ssd.vt.edu/` for more information about accommodations and other disability-related supports

For a full listing of campus resources check out:

`http://www.well-being.vt.edu/`

Please also feel free to speak with the instructor, who also does care about your well-being.

10 Ethics

The Honor Code applies. All work submitted must be the student's own work. Students may solicit help only from the instructor or the teaching assistants. In the case of research work on teams, all work submitted or presented must be only the work of the team.

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. Ignorance of the rules does not exclude any member of the University community from the requirements and expectations of the Honor Code.

Academic integrity expectations are the same for online classes as they are for in person classes. The use of technology assists such as Chegg, CourseHero, and GroupMe must be avoided. The Honor System is able to effectively investigate the use of these web sites. All university policies and procedures apply in any Virginia Tech academic environment, and all students are expected to follow them.

For additional information about the Honor Code, please visit:

> `https://www.honorsystem.vt.edu/`

Honor Code Pledge for Assignments: The Virginia Tech honor code pledge for assignments is as follows:

> ''I have neither given nor received unauthorized assistance on this assignment.''

The pledge is to be written out on all graded assignments at the university and signed by the student. The honor pledge represents both an expression of the student's support of the honor code and a commitment to uphold the academic standards at Virginia Tech.

Here are some more detailed considerations.

1. All assignments submitted shall be considered "graded work" and all aspects of your coursework are covered by the honor code. All projects and homework assignments are to be completed individually unless otherwise specified.

2. The Academic Integrity expectations for Hokies are the same in an online class as they are in an in-person class. Hokies are expected to meet the academic integrity standards at Virginia Tech at all times.

3. Commission of any of the acts in the list below shall constitute academic misconduct. This listing is not, however, exclusive of other acts that may reasonably be said to constitute academic misconduct. Clarification is provided for each definition with some examples of prohibited behaviors in the Undergraduate Honor Code Manual located at `https://www.honorsystem.vt.edu/`.

   Acts of Misconduct

   - **CHEATING:** Cheating includes the intentional use of unauthorized materials, information, notes, study aids or other devices or materials in any academic exercise, or attempts thereof.

   - **PLAGIARISM:** Plagiarism includes the copying of the language, structure, programming, computer code, ideas, and/or thoughts of another and passing off the same as one's own original work, or attempts thereof.

   - **FALSIFICATION:** Falsification includes the statement of any untruth, either verbally or in writing, with respect to any element of one's academic work, or attempts thereof.

   - **FABRICATION:** Fabrication includes making up data and results, and recording or reporting them, or submitting fabricated documents, or attempts thereof.

- **MULTIPLE SUBMISSION:** Multiple submission involves the submission for credit — without authorization from the instructor receiving the work — of substantial portions of any work (including oral reports) previously submitted for credit at any academic institution of attempts thereof.

- **COMPLICITY:** Complicity includes intentionally helping another to engage in an act of academic misconduct, or attempts thereof.

- **VIOLATION OF UNIVERSITY, COLLEGE, DEPARTMENTAL, PROGRAM, COURSE, OR FACULTY RULES:** The violation of any University, College, Departmental, Program, Course, or Faculty Rules relating to academic matters that may lead to an unfair academic advantage by the student violating the rule(s).

4. Lecture notes, assignments, quizzes, tests, exams, solutions, and other materials distributed to or generated in this class are intended for use only by students enrolled in this CRN (section) this semester. Without the instructor's written permission, no one may show, give, or otherwise make such class materials available to anyone not enrolled in this CRN this semester. Prohibited activities include, but are not limited to, uploading a test, uploading solutions to problems, and submitting such class materials for online posting. The prohibition on sharing solutions applies to all solutions, regardless of who wrote the solutions.

5. Academic Misconduct Sanctions:

   Here is this instructor's personal statement on honor code sanctions:

   > If you have questions or are unclear about what constitutes academic misconduct on an assignment, please speak with me. I take the honor code very seriously in the course. The normal sanction I will recommend for a violation of the Honor Code is an F* sanction as your final course grade. The F represents failure in the course. The "*" is intended to identify a student who has failed to uphold the values of academic integrity at Virginia Tech. A student who receives a sanction of F* as their final course grade shall have it documented on their transcript with the notation "FAILURE DUE TO ACADEMIC HONOR CODE VIOLATION." You would be required to complete an education program administered by the Honor System in order to have the "*" and notation "FAILURE DUE TO ACADEMIC HONOR CODE VIOLATION" removed from your transcript. The "F" however would be permanently on your transcript.