CS 5104: Computability and Formal Languages
Syllabus
Spring, 2018

1 General Course Information

CRN	19269
Meeting Time	8:00 AM–9:15 AM; Tuesday/Thursday
Classroom	McBryde 318
Midterm Exam	In class, March 1, 2018
Final Exam	2:05 PM–4:05 PM, May 7, 2018

Instructor: Lenwood S. Heath

- **Office:** 2160J Torgersen Hall
- **Office Hours:** 2:00 PM–4:00 PM Tuesday/Thursday
- **Email:** `heath@vt.edu`

Web Site: `http://courses.cs.vt.edu/cs5104/Spring2018/index.php`

Piazza Signup: `http://piazza.com/vt/spring2018/cs5104`

Canvas: `https://canvas.vt.edu/`

Prerequisites: Mathematical maturity

Required Textbook: Introduction to the Theory of Computation (Third Edition). Michael Sipser. Thomson Course Technology, 2013. ISBN: 978-1-133-18779-0.

Books On Reserve: For current list, see library Web site here:

`http://addison.vt.edu/screens/Reserves.html`

2 Course Description

This course emphasizes *theoretical models of computation* and their analysis. The aim of analysis is to identify and prove the capabilities and limitations of particular models of computation. It is shown that there are problems that are *unsolvable,* that is, there are questions that cannot be answered by any model of computation. Limits on computation in the context of resource bounds are also investigated. Techniques (reductions) are developed to show that one model of computation is equivalent in power to another or that it is different in power from another. Models of computation that are covered include finite automata, pushdown automata, and Turing machines. Complexity theory is covered as well, especially the complexity classes P, NP, and NP-complete. Material covered in the lectures will be somewhat adapted to the interests of the class, especially later in the semester. Active student participation in class is expected. Students may be asked to solve problems on the board.

3 Grading Policy

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

Homework assignments: 10 at about 60 points each	600
Midterm exam: March 1, 2018	150
Final exam: May 7, 2018, 2:05 PM–4:05 PM	250

A typical homework assignment consists of one to two problems, posted on the course web site approximately one week before the due date. In some cases, the assignment may be a writing assignment based on readings from the literature or online.

All homework must be prepared with LaTeX[1] or other word processing system and submitted as a PDF to Canvas by 5:00 PM on the due date[2]. Solutions must be well-written with complete sentences and compelling arguments. Also, any required drawings must be drawn in a drawing program, not scanned and inserted. **No late homework will be accepted.**

[1] See LaTeX resources on the course web site.

[2] See Calendar on the course web site.

4 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

5 Readings

For most classes, there is a reading assignment (see Section 8) to be completed by class time. Each assignment consists of sections in the textbook. There will also be papers from the literature assigned from time to time.

6 Ethics

The Honor Code applies. All work submitted must be the student's own work. A student may solicit help with homework assignments only from the instructor. A student must complete the midterm and final exams without any outside help of any kind.

7 Announcement

If any student needs special accommodations because of a disability, please contact the instructor during the first week of classes.

8 Course Schedule

Dates	Reading Assignment	Topics
	January	
1/16–1/19	Chapter 0; Section 1.1	Introduction; deterministic finite automata
1/22–1/26	Sections 1.2–1.3	Nondeterministic finite automata; regular expressions
1/29–2/2	Sections 1.4, 2.1	Pumping lemma; context-free grammars
	February	
2/5–2/9	Sections 2.2, 3.1	Pushdown automata; Turing machines
2/12–2/16	Sections 3.2–3.3	Turing machines and algorithms
2/19–2/23	Section 4.1	Decidable languages
2/26–3/2	Section 4.2	The halting problem
	March	
3/1	**Midterm Exam**	**In class:** Topics through Chapter 3
3/5–3/9	Spring Break	
3/12-3/16	Sections 5.1–5.2	Reduction; Post correspondence problem
3/19–3/23	Section 5.3	Mapping reducibility
3/26–3/30	Sections 7.1–7.2	Time complexity; complexity class P
	April	
4/2–4/6	Sections 7.3–7.4	Complexity class NP; NP-completeness
4/9–4/13	Section 7.5	Proofs of NP-completeness
4/16–4/20	Sections 8.1–8.2	Savitch's Theorem; complexity class PSPACE
4/23–4/27	Chapter 10	Selection of sections as time allows
	May	
5/1	**Last Day of Class**	Review for final
5/7	**Final Exam**	**2:05 PM–4:05 PM:** Comprehensive exam

End of Syllabus