CSC381: Introduction to Computer Science II

Dr. Robert Lowe

Spring, 2020

E-mail: robert.lowe@maryvillecollege.edu Office Phone: 865-981-8169
Office Hours: MWF 1:00PM – 2:00PM, TR 3:00PM – 4:00PM Class Hours: MWF 11:00 – 11:50
Office: SSC 214 Class Room: SSC 231

Course Description

A study of theoretical models of computing, including finite state machines, pushdown automata, context-free grammars, and Turing machines. The concepts of decidability, complexity theory, and NP-Completeness will be studied in depth.

Required Materials

- Various papers, which will be distributed in class.

Prerequisites

- CSC2310 Discrete Structures
- Courage

Course Goals

The big-picture goal of this course is for you to become well acquainted with abstract mathematical literature and learn how to treat mathematics as a participatory subject. We will be reading the papers which started our field, and along the way we will cultivate an appreciation for the literature, and we will also learn about the authors of these papers.

A successful student will:

1. Gain an appreciation for mathematical literature.
2. Learn to see the beauty of a well formed proof.
3. Learn to write beautiful proofs yourself.

4. Classify problems into decidable and undecidable problems.
5. Understand how computational theory relates to mathematics, the universe, and human beings.
6. Get a taste of the peer-review process.
7. Understand the underlying theory of computation.
8. View computer science as a mathematical discipline.
9. Realize that mathematicians are not divine beings who hand wisdom down from on high.
10. Learn to participate in making mathematical discoveries.

The more ambitious among you may even try to produce publishable results.

Course Structure

Methods of Instruction

- Lecture
- Reading
- Peer Review
- Discussion
- Presentations

Grading

Let A be a sequence $A = \langle \epsilon, \Sigma, \alpha, \phi, \rho, \sigma \rangle$ where

- $\epsilon :=$ Sequence of grades $\langle \epsilon_1, \epsilon_2, \ldots, \epsilon_{|\epsilon|} \rangle$ pertaining to grades on easy problems
- $\Sigma :=$ Sequence of grades $\langle \Sigma_1, \Sigma_2, \ldots, \Sigma_{|\Sigma|} \rangle$ pertaining to grades on harder problems
- $\alpha := \dfrac{|\epsilon| + |\Sigma| + |X|}{|P|}$ where X is a set of attempted but not solved problems and P is the set of all problems presented to the class.
- $\phi :=$ A sequence of grades $\langle \phi_1, \phi_2 \rangle$ pertaining to two peer reviewed papers
- $\rho :=$ The set of all contributions made to the class, either through posing problems, peer review, or discussion.
- $\sigma :=$ Is the grade of your final research presentation.

We define a function $g : A \mapsto x \in \mathbb{R} | 0 \leq x \leq 1$. Futhermore, we construct a Turing machine Z_g which computes the function g.

In order to arrive at the sought after function, Z_g first computes A' where $A' = \langle e, s, \alpha, p, f, r, \sigma \rangle$ where each $x \in A'$ corresponds to the like term in A, and where every $x \in A'$ satisfies the constraints $x \in \mathbb{R} | 0 \leq x \leq 1$. The simplest of these transformations are α and σ, which are simply a direct transcriptions from A. The transformations for e, s, f are accomplished through simple averaging of their corresponding sequences. This leaves the computation of p and r. Unfortunately, these mappings require a qualitative analysis which is not readily obtainable via conventional means due to the ambiguity of its definition and must be approximated by a stochastic process (your professor). Of course, this establishes that your grades are not strictly computable, and the proceeding can only therefore be an approximation of g, but as it is the best we can do we must proceed! Having established that Z_g cannot exist, we replace it with $\hat{Z}_g$ which approximates g via the means described above and with the addition of the approximate terms.

Having approximated A', we introduce $W = \langle 10, 20, 10, 30, 10, 20 \rangle$. Because W is a sequence of constants, it may be encoded into the internal configuration of $\hat{Z}_g$. The final computation in this approximation is performed by arithmetic and is well defined as:

$$\frac{\sum_{i=1}^{7} A'_i W_i}{100}$$

The real number obtained by this computation will be converted into one of the arbitrary elements in the grade alphabet using the well-known method.

Schedule

This is the tentative schedule for our course. Papers are introduced on the days bearng their full title, and discussions follow.

January 2020

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

- **Wed January 8** - Introduction & Cantor
- **Fri January 10** - *On an Elementary Question in the Theory of Manifolds* by Georg Cantor
- **Mon January 13** - Cantor Discussion
- **Wed January 15** - Cantor Discussion
- **Fri January 17** - On the Foundational Crisis and the Hilbert Program
- **Mon January 20** - *Principia Mathematica*
- **Wed January 22** - Discussion on Principia

- **Fri January 24** - Discusiion on Principia
- **Mon January 27** - *On Formally Undecidable Propositions of Principia Mathematica* by Kurt Gödel
- **Wed January 29** - Gödel Discussion
- **Fri January 31** - Gödel Discussion

February 2020

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

- **Mon February 3** - Gödel Discussion
- **Wed February 5** - Gödel Discussion
- **Fri February 7** - Gödel Discussion
- **Mon February 10** - *An Unsolvable Problem of Elementary Number Theory* by Alonzo Church
- **Wed February 12** - Church Discussion
- **Fri February 14** - Church Discussion
- **Mon February 17** - Church Discussion
- **Wed February 19** - Church Discussion
- **Fri February 21** - Church Discussion
- **Mon February 24** - *On Compuable Numbers With an Application to the Entscheidungsproblem* by Alan Turing
- **Wed February 26** - Turing Discussion
- **Fri February 28** - Turing Discussion

March 2020

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

- **Mon March 2** - Turing Discussion
- **Wed March 4** - Turing Discussion
- **Fri March 6** - Turing Discussion
- **Mon March 9** - Exploring Computability and Proof
- **Wed March 11** - Exploring Computability and Proof
- **Fri March 13** - Exploring Computability and Proof
- **Mon March 16** Spring Break
- **Wed March 18** Spring Break
- **Fri March 20** Spring Break
- **Mon March 23** - *Three Models for the Description of Langauge* by Noam Chomsky
- **Wed March 25** - Chomsky Discussion
- **Fri March 27** - *On Certain Formal Properties of Grammars* by Noam Chomsky
- **Mon March 30** - Chomsky Discussion

April 2020

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

- **Wed April 1** - Chomsky Discussion
- **Fri April 3** - Chomsky Discussion
- **Mon April 6** - *The Complexity of Theorem-Proving Procedures* by Stephen Cook
- **Wed April 8** - Cook Discussion

- **Fri April 10** Good Friday - College Closed
- **Mon April 13** - *Universal Sequential Search Problems* by Leonid Levin
- **Wed April 15** - The Cook Levin Theorem
- **Fri April 17** - The Cook Levin Theorem
- **Mon April 20** - The Cook Levin Theorem
- **Wed April 22** - The Cook Levin Theorem

Course Policies

Late Policy

No late work will be accepted under any circumstances (except as mercy and decency may dictate in extremely rare events).

Extra Credit

No extra credit will be given under any circumstances.

Excused Absences

In some cases, absences may be excused. These include:

- School Sanctioned Events (Sports, Concerts, etc.)
- Severe Illness
- Family Emergencies
- Court Appearance / Jury Duty

In the case of a school event, notice must be given at least one week prior to the absence. The notice must include a signed note from the faculty or staff member in charge of the event. This note must be given in physical form, electronic notes will not be accepted. In the case of illness, a doctor's note is required. Note that except in extreme circumstances, doctor's appointments do not qualify as a valid reason to miss a class. Please be respectful of the other students, and schedule appointments during your free time.

Family emergencies will require some form of proof. Where possible, you must give advance notice of missing a class. The exception to this would need to be fairly severe, and hopefully it will not come up. For court appearances and/or jury duty, you must provide a copy of your summons. You may redact any details you wish, save for the actual date and time of your appearance. Court appearances must be cleared at least one week in advance.

Communication and Extra Help

You are always welcome at office hours for help with any questions you may have about the course. For help at other times during the day, stop by or call my office to see if I'm available. You can also contact me by email, but often I can better help you face to face and may respond with a request that you come to see me. Note that I do not typically respond to email between 5 p.m. and 8 a.m. You may make appointments to see me at other times if your schedule does not permit you to attend my office hours.

Plagiarism and Cheating

You are expected to do your own work. Never submit the work of others, never give unauthorized assistance to others, do not use unauthorized aids during exams, and do not ask for help from other faculty members without the approval of your professor. Plagiarism and cheating are

serious offenses that will not be tolerated. Explanations regarding these offenses and how they are handled can be found in the MC Student Handbook at
https://www.maryvillecollege.edu/academics/catalog/handbook/section-nine/.
You are expected to read and understand these policies. Offenses on specific assignments, quizzes, or exams will result in a score of 0 on the relevant assignment, and a letter of censure will be placed in your college file. Repeat offenses will result in further disciplinary action, including the possibility of failing the course.

Students with Disabilities

Any student who feels s/he may need learning or physical accommodation(s) based on the impact of a disability should contact Services for Students with Disabilities to discuss your specific needs. Please contact 981-8124 to coordinate reasonable accommodations for students with documented disabilities. The Disability Services office is located in the Learning Center in the basement of Thaw Hall. Undocumented disabilities will not be accommodated.