Boston University Metropolitan College

Computer Language Theory

MET CS 662

Learn from Anywhere Course Format, Offered Simultaneously On Campus and Remote

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Wednesdays 6 pm to 7 pm or by appointment

Course Description

The goal of this course is to provide the student with a solid knowledge of the fundamental concepts and methods of the theory of computation as well as to outline modern research directions. Three different approaches for capturing the idea of computing in a formal mathematical way will be discussed finite state machines, grammars and recursive functions. At the end of the course students are expected to be able to interpret relate and apply the basic concepts of the theory of computation to problems from different areas of computer science.

Course Objectives

- Apply the algebra of theoretical machines to computing problems
- Possess knowledge of non-determinism in computational models.
- Remove nondeterminism from simple models when it is possible.
- Understand the basic problems of computability, decidability and the halting problem as well as the relationships among them.
- Apply the concept of a Turing machine to the decidability problem where possible.
- Understand the Church-Turing Thesis and its significance in computer science.
- Have a working knowledge of the Chomsky hierarchy of languages.
- Relate theoretical computer science topics to programming languages and other recursively enumerable sets.

Prerequisites

- Discrete Mathematics course (MET CS248 or equivalent.)
- Introductory computer programming class

Textbook

- P. Linz "An Introduction to Formal Languages and Automata" *any* edition, D.C. Heath and Co. (2001 - 2016). Available at Barnes & Noble or on-line.

References

- 1- H. R. Lewis, C. H. Papadimitriou "Elements of the Theory of Computation" Prentice Hall, 1981.

- *2*- J.E. Hopcroft, "Introduction to Automata Theory, Languages and Computations" Addison Wesley, 1979.

Courseware
All assignments course materials and announcements pertinent to the course can be found on Blackboard.

Fall 2020 COVID-19 Policies

Classroom Rotations: Classrooms on campus have new capacities that follow guidelines issued by state and local health and government authorities related to COVID-19 and physical distancing. Before the beginning of the class, and throughout the semester, I will be reaching out to students who have indicated that they want to attend the classroom in-person. Our classroom hold about 15 students, and therefore we will have two rotations of students that come to class on campus alternate weeks. You will be asked to attend remotely on the week that you have rotated out the classroom.

Compliance: All students returning to campus will be required, through a digital agreement, to commit to a set of Health Commitments and Expectations including face coverings, symptom attestation, testing, contact tracing, quarantine, and isolation. The agreement makes clear that compliance is a condition of being a member of our on-campus community.

You have a critical role to play in minimizing transmission of COVID-19 within the University community, so the University is requiring that you make your own health and safety commitments. Additionally, if you will be attending this class in person, you will be asked to show your Healthway badge on your mobile device to the instructor in the classroom prior to starting class, and wear your face mask over your mouth and nose at all times. If you do not comply with these rules you will be asked to leave the classroom. If you refuse to leave the class, the instructor will inform the class that they will not proceed with instruction until you leave the room. If you still refuse to leave the room, the instructor will dismiss the class and will contact the academic Dean's office for follow up.

Boston University is committed to offering the best learning environment for you, but to succeed, we need your help. We all must be responsible and respectful. If you do not want to follow these guidelines, you must participate in class remotely, so that you do not put your classmates or others at undue risk. We are counting on all members of our community to be courteous and collegial, whether they are with classmates and colleagues on campus, in the classroom, or engaging with us remotely, as we work together this fall semester.

Class Policies

1) **Attendance & Absences –** Students are expected to attend and sit through the entire class meetings. In case of an absence, the student is responsible to arrange for notes and missed announcements. Three (3) or more absences may result in a withdrawal from the class.

2) **Assignment Completion & Late Work** – Late assignment submission is not allowed, unless a permission is granted by the instructor prior to the deadline. Students should submit their work by the due date.

3) **Academic Conduct Code** – Cheating and plagiarism will not be tolerated in any Metropolitan College course. They will result in no credit for the assignment or examination and may lead to disciplinary actions. Please take the time to review the Student Academic Conduct Code:

http://www.bu.edu/met/metropolitan_college_people/student/resources/conduct/code.html.

NOTE: [This should not be understood as a discouragement for discussing the material or your particular approach to a problem with other students in the class. On the contrary – you should share your thoughts, questions and solutions. Naturally, if you choose to work in a group, you will be expected to come up with more than one and highly original solutions rather than the same mistakes.]

Grading Criteria

- Midterm 35% - Tuesday, October 28
- Final Exam 35% - Tuesday, December 15
- Assignments 30% - Check Blackboard for due dates

Class Meetings, Lectures & Assignments

Lectures, Readings, and Assignments subject to change, and will be announced in class as applicable within a reasonable time frame.

Lecture	Topic	Description
1	1.1	Mathematical preliminaries
2	1.2, 2.1, 2.2, 2.3	Basic concepts of languages, grammars and automata - DFAs - NDFAs and equivalence
3	3.1, 3.2, 3.3	Regulars expressions, regular grammars
4	4.1, 4.2, 4.3	Basic properties of regular languages
5	5.1, 5.2, 5.3	Context-Free (CTF) languages. Parsing and Ambiguity. Programming languages
6	6.1, 6.2, 7.1	Simplification of CTF grammars. Normal forms.
7	7.2, 7.3, 7.4	Pushdown automata (PA). Nondeterministic & deterministic PA. PA and CTF languages.
	Midterm Examination	
8	8.1, 8.2	Discuss exam. Properties of CTF languages. Pumping lemmas. Properties.
9	9.1, 9.2, 9.3	Turing Machines (TM). Standard TMs, Turing Thesis.
10	10.1, 10.2, 10.4, 10.5	Models of TMs (option stay, Semi-infinite tape, off-line, Multitape, Multidimensional, Nondeterministic, universal). Linear bounded Automata.
11	11.1, 11.2, 11.3, 11.4	Hierarchy of formal languages and Automata. Recursive and Recursively Enumerable Languages.

12	12.1, 12.2, 13.1	Limits of Algorithmic Computation. Problems that cannot be solved by TMs. Undecidable Problems for Recursively Enumerable Languages. Other Models of computation
	Final Examination	