CS 3823 - Theory of Computation: Syllabus

Dimitris Diochnos
The University of Oklahoma, School of Computer Science

FALL 2019

Time and Location

Tuesdays & Thursdays, 3:00pm-4:15pm,

Website: http://www.cs.ou.edu/~diochnos/teaching/2019F/CS3823/

Canvas: Canvas will be used in order to distribute homework assignments and potentially other reading materials.

Instructor

Dimitris Diochnos, 244 Devon Energy Hall (DEH), `diochnos@ou.edu` .

Teaching Assistants

The following two students, listed alphabetically by last name, are going to be teaching assistants for the course: **Krishna Atluri** (`12krishna`) and **Mohammad Mukhtaruzzaman** (`mukhtar`). Inside parentheses you can see the username of the students such that if you append `@ou.edu` you can send an email to them directly.

Office Hours

We will hold office hours at the following dates and times.

Tuesday Krishna Atluri (12krishna), **10.30am-12.30pm** at 115 DEH.
Dimitris Diochnos (diochnos), **4.30pm-6pm** at 244 DEH.

Wednesday Mohammad Mukhtaruzzaman (mukhtar), **11.00am-1.00pm** at 115 DEH.

Thursday Dimitris Diochnos (diochnos), **12.30pm-2pm** at 244 DEH.

Prerequisite Background

The prerequisites for the course are CS 2413 and CS 2813 or MATH 2513 or CS 5005 or DSA 5005.

Topics and Course Description

(As listed in the undergraduate catalog:) Introduction to abstract machine theory and formal language theory. Topics include Turing machines, finite/pushdown automata, deterministic versus nondeterministic computations, context-free grammars, and mathematical properties of these systems.

Schedule of Classes

The syllabus is continuously updated and subject to change. We will cover the material at a pace that is comforable. Our **first meeting** is on **Tuesday, August 20, 2019** and our **last meeting** is on **Thursday, December 5, 2019**. Note however, that the last two classes on Tuesday, December 3 and Thursday, December 5, we will not be teaching new material, but rather we will be doing a review.

We will cover most of the Chapters 1-10 of the textbook well as some topics not covered in the book.

The **final exam** is **in-class** (George Lynn Cross Hall, 0123) on **Monday, December 9, 2019** between **4:30pm and 6:30pm**. **I will not accommodate rescheduling of the exam because you have a coflict with another course. Be wise and enroll in this class only if you can have the final exam at the above date and time.**

This course is a theory course and our primary focus is on abstract, theoretical ideas, though we may touch on relevant applications at various points (and especially in the topics discussed in the end)

Textbook, Notes and Related Reading Materials

Textbook. The textbook for the course is ***An Introduction to Formal Languages and Automata (6th Edition)***, by Peter Linz [6].

Other Books of Interest.
- *Introduction to the Theory of Computation (3rd Edition)*, by Michael Sipser [9].
- *Computability and Unsolvability*, by Martin Davis [1].
- *Computational Complexity*, by Christos Papadimitriou [7].
- *Computers and Intractability: A Guide to the Theory of NP-Completeness*, by Michael Garey and David Johnson [4].

Another book of interest, which can be inspiring providing patterns for problem-solving strategies, is the one by George Pólya,
- *How to Solve It: A New Aspect of Mathematical Method* [8].

There are also two interesting books by Leslie Valiant that give a good flavor of the other course that I am teaching in computational learning theory and to some extent show connections between the theory of machine learning and artificial intelligence on one hand, and the theory of computation on the other hand. These two books are,
- *Probably Approximately Correct: Nature's Algorithms for Learning and Prospering in a Complex World* [10],
- *Circuits of the Mind* [11].

Finally, due to the close interaction of modern mathematics and complexity theory, other fun books that revolve around mathematics, or the history of mathematics, also come to mind and one can enjoy in their free time.
- *Logicomix: An epic search for truth*, by Apostolos Doxiadis and Christos Papadimitriou [3].
- *The Parrot's Theorem: A Novel*, by Denis Guedj [5].
- *Uncle Petros and Goldbach's Conjecture: A Novel of Mathematical Obsession*, by Apostolos Doxiadis [2].

Grading

Grading will be based on the following:

- **50% homework assignments**,

- **30% midterm exams (15% each midterm)**,

- **20% final exam**.

Grades may also be adjusted slightly upward or downward depending on class participation. This is the first time that I am teaching the course, therefore my estimates may be slightly off. However, I expect grading to be along the lines shown in the table below:

percentage	grade
near the top	A+
$\geqslant 93\%$	A
$\geqslant 90\%$	A-
$\geqslant 86\%$	B+
$\geqslant 83\%$	B
$\geqslant 80\%$	B-
$\geqslant 76\%$	C+
$\geqslant 73\%$	C
$\geqslant 70\%$	C-
$\geqslant 66\%$	D+
$\geqslant 63\%$	D
$\geqslant 60\%$	D-
otherwise	F

Examinations

- We will have **two midterm exams**, both are going to be in-class.
- The **final exam** is **in-class** on **Monday, December 9, 2019** between **4:30pm and 6:30pm**.
- Exams will be <u>closed-book</u> written exams.

Important: You will not be able to take the exam another day because you have a conflict with another course. Make sure you understand this now and choose wisely the courses in which you enroll.

Homework Assignments

There will be 5-7 homework assignments.

The assignments will be weighted roughly evenly. In other words the contribution for the 50% of your grade based on homework assignments will be computed by adding up all the grades that you receive from the individual assignments and then dividing by the maximum amount of grades that you could gather from all these assignments.

Collaboration Policy

Students may form **groups of up to 6 people** and work together on the homework assignments.

- Collaborators (in case you form a group) must be named (together with their university IDs) at the top of every assignment.

- The study groups are intended to foster collaborations, encourage brainstorming, create excitement, and make the learning process more fun. Each study group should meet regularly (say once or twice per week throughout the semester). Everyone in the study group should contribute fairly to the overall group effort. Ideally, equal group effort should be put by everyone in the group in each assignment. Please form your study groups early in the semester (by the second week) and meet regularly.

- Students are allowed to leave the initial group where they were members of, but can not form or join a different group. Therefore, from the point in time where one leaves from the initial group they were members of, then they will deliver the solutions to the homework assignments alone until the end of the course. An exception to this rule is if you are asked by a TA or an instructor to change to a different group; but most likely this will not happen to any one of you during the course.

- Form groups before you submit the first homework assignment.

General Remarks. Please note the following two.

- **If you are unsure if something is permitted, consult with me before doing it.**

- **For exams** (whether midterms or final), **students are required to work alone** and follow the stated rules exactly.

Late Work Policy

Nothing can be turned in late.

We will be using an electronic system (Canvas) for the students' submissions and therefore it is your responsibility to turn in your homework (or an exam, should this be the case) on time. You are allowed to upload multiple copies of your work, so always make sure that you have submitted something. **We will not accept homework (or exams) to be turned in late.**

General Policies by the University of Oklahoma

OU is committed to creating a learning environment that meets the needs of its diverse student body. If you anticipate or experience any barriers to learning in this course, please feel welcome to discuss your concerns with me.

Academic Misconduct. Academic misconduct hurts everyone but particularly the student who does not learn the material. All work submitted for an individual grade should be the work of that single individual and not his/her friends. It is fine to ask a fellow student for help as long as that help does not consist of copying any computer code, or solutions to other assignments. Students working on joint projects may certainly help one another and are expected to share code within the project group. However, they may not share beyond the group.

1. Collaboration is encouraged for homework and projects. For the projects, you will work within your groups. For the homework, you may form study groups so long as each homework is in your own words. Write your study partners' names on your homework when you turn it in. **Return only one writeup for each group of people.**

2. Do not show another student (or group) a copy of your projects or homework before the submission deadline. The penalties for permitting your work to be copied are the same as the penalties for copying someone else's work.

3. Make sure that your computer account is properly protected. Use a good password, and do not give your friends access to your account or your computer system. Do not leave printouts or thumb drives around a laboratory where others might access them.

Upon the first documented occurrence of academic misconduct, I will report it to the Campus Judicial Coordinator. The procedure to be followed is documented in the University of Oklahoma Academic Misconduct Code[1]. In the unlikely event that I elect to admonish the student, the appeals process is described in http://www.ou.edu/integrity.

Project code. Your project code and writeups must be written exclusively by you or your group. **Use of any downloaded code or code taken from a book (whether documented or undocumented) is considered academic misconduct and will be treated as such.** Exceptions from this policy (such as a project that builds on an existing open-source project) may be granted but you MUST speak with me first.

Classroom Conduct. Disruptions of class will not be permitted. Examples of disruptive behavior include:

- Allowing a cell phone or pager to repeatedly beep audibly.
- Playing music or computer games during class in such a way that they are visible or audible to other class members.
- Exhibiting erratic or irrational behavior.
- Behavior that distracts the class from the subject matter or discussion.
- Making physical or verbal threats to a faculty member, teaching assistant, or class member.
- Refusal to comply with faculty direction.

In the case of disruptive behavior, I may ask that you leave the classroom and may charge you with a violation of the Student Code of Responsibilities and Conduct.

Class Web Page. The main web page for the class is

http://www.cs.ou.edu/~diochnos/teaching/2019F/CS3823/index.php

Login to the Canvas website using your 4+4 (first four letters of your last name followed by the last four digits of your student number), using your standard OU password. If you have difficulty logging in, call 325-HELP. This software provides a number of useful features, including a list of assignments and announcements, an electronic mailing list, newsgroups, and grade book. All handouts are available from Canvas. You should check the site daily. When I update the site, I will post an announcement telling you what has been added and where it is located.You are responsible for things posted on the site with a 24 hour delay.

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[1]http://www.ou.edu/studentcode

Class Evaluations. The College of Engineering utilizes student ratings as one of the bases for evaluating the teaching effectiveness of each of its faculty members. The results of these forms are important data used in the process of awarding tenure, making promotions, and giving salary increases. In addition, the faculty uses these forms to improve their own teaching effectiveness. The original request for the use of these forms came from students, and it is students who eventually benefit most from their use. Please take this task seriously and respond as honestly and precisely as possible, both to the machine-scored items and to the open-ended questions

Class Email Alias. Urgent announcements will be sent through email. It is your responsibility to:

- Have your university supplied email account properly forwarded to the location where you read email.

- Make sure that your email address in Canvas is correct, and forwards email to the place where you read it. I'll send out a test message during the first week of class. If you do not receive this message, it is your responsibility to get the problem resolved immediately.

- Have your email program set up properly so that replying to your email will work correctly the first time. You can send email to yourself and reply to yourself to test this.

If you need assistance in accomplishing any of these tasks, contact 325-HELP.

Newsgroups and Email. The newsgroup on Canvas should be the primary method of communication, outside of class. This allows everyone in the class to benefit from the answer to your question. If you email me a question of general interest, I may post your question and my answer to the newsgroup. Matters of personal interest should be directed to email instead of to the newsgroup, e.g. informing me of an extended personal illness. Posting guidelines for the newsgroup are available on Canvas.

Religious Holidays. It is the policy of the University to excuse the absences of students that result from religious observances and to provide without penalty for the rescheduling of examinations and additional required classwork that may fall on religious holidays.

Incompletes. The grade of I is intended for the rare circumstance when a student who has been successful in a class has an unexpected event occur shortly before the end of the class. I will not consider giving a student a grade of I unless the following three conditions have been met.

1. It is within two weeks of the end of the semester.

2. The student has a grade of C or better in the class.

3. The reason that the student cannot complete the class is properly documented and compelling.

Accommodation of Disabilities. The University of Oklahoma is committed to providing reasonable accommodation for all students with disabilities. Students with disabilities who require accommodations in this course are requested to speak with the professor as early in the semester as possible. Students with disabilities must be registered with the Office of Disability Services prior to receiving accommodations in this course. The Office of Disability Services is located in 730 College Ave, phone 405/325-3852 or TDD only 405/325-4173.

Adjustments for Pregnancy/Childbirth Related Issues. Should you need modifications or adjustments to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact me as soon as possible to discuss. Generally, modifications will be made where medically necessary and similar in scope to accommodations based on temporary disability. Please see http://www.ou.edu/eoo/faqs/pregnancy-faqs.html for commonly asked questions.

Title IX Resources. For any concerns regarding gender-based discrimination, sexual harassment, sexual misconduct, stalking, or intimate partner violence, the University offers a variety of resources, including advocates on-call 24.7, counseling services, mutual no contact orders, scheduling adjustments and disciplinary sanctions against the perpetrator. Please contact the Sexual Misconduct Office 405-325-2215 (8-5) or the Sexual Assault Response Team 405- 615-0013 (24.7) to learn more or to report an incident.

Add/Drop/Withdrawal Deadlines. Please consult the OU academic calendar (as well as the policies of the School of Engineering) for the following deadlines:

- **Add a course**
- **Drop a course without penalty (course removed from transcript)**
- **Drop a course with a W on transcript**

References

[1] Martin D. Davis. *Computability and Unsolvability.* Dover, 1982.

[2] Apostolos Doxiadis. *Uncle Petros and Goldbach's Conjecture: A Novel of Mathematical Obsession.* Bloomsbury USA, 2001.

[3] Apostolos Doxiadis and Christos Papadimitriou. *Logicomix: An epic search for truth.* Bloomsbury USA, 2009.

[4] Michael R. Garey and David S. Johnson. *Computers and Intractability: A Guide to the Theory of NP-Completeness.* W. H. Freeman & Co., New York, NY, USA, 1979.

[5] Denis Guedj. *The Parrot's Theorem: A Novel.* St. Martin's Griffin, 2002.

[6] Peter Linz. *An Introduction to Formal Languages and Automata.* Jones & Bartlett Learning, sixth edition, 2017.

[7] Christos H. Papadimitriou. *Computational Complexity.* Addison-Wesley, 1994.

[8] George Pólya. *How to Solve It: A New Aspect of Mathematical Method.* Princeton University Press, 1971.

[9] Michael Sipser. *Introduction to the Theory of Computation.* Cengage Learning, third edition, 2012.

[10] Leslie Valiant. *Probably Approximately Correct: Nature's Algorithms for Learning and Prospering in a Complex World.* Basic Books (AZ), 2013.

[11] Leslie G. Valiant. *Circuits of the Mind.* Oxford University Press, Inc., New York, NY, USA, 1994.