

CSC540: Theory of Computation II

Course Syllabus- Winter 2019

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Course web-site: <http://www.csc.calpoly.edu/~hghariby/CSC540>

Office hours: Mondays and Tuesdays: 1–2³⁰, Wednesdays: 2–3; Thursdays: 1–2

Note: at times office hours may be re-arranged (you will get an advance notice)

I. Prerequisites:

The following two prerequisites are strictly required:

1. Completion of CSC445, Theory of Computation I
2. Graduate standing or consent of the instructor

You are **expected to have:**

- Solid knowledge background in Theory of Formal Languages and Automata
- Familiarity with the Theory of Decidability
- Familiarity with the Theory of Computability

II. Textbook (recommended):

Thomas A. Sudkamp, *Languages and Machines: An Introduction to the Theory of Computer Science*, 3-rd edition, Addison-Wesley, 2005, ISBN 0-321-32221-5

III. Objectives:

- To study advanced topics in Theory of Computation
- To learn to prepare and make oral presentations on theoretical topics
- To learn to teach theoretical material and assess the results

IV. Course format:

This course is conducted in a **seminar** style and consists of student presentations. During the quarter each student is responsible for 3 presentations: a “*lecture*”, a “*topic*” and a “*profile*” presentation. A “*lecture*” is prepared and presented by a team of two students, a “*topic*” may be prepared and presented individually or in a team of two, and a “*profile*” is an individual work. Note that “*lecture*” and “*topic*” presentations are accompanied with a quiz (see details on page 2). The class (only students in attendance) and the instructor evaluate each presenter’s work and performance; a presenter’s grade is calculated based on these evaluations: the average of student evaluations makes the 75% and the instructor’s evaluation makes the 25% of this grade.

ATTENTION!

1. A **penalty** is applied for presentations that are shorter than required: if a presentation is $x\%$ shorter then respectively $x\%$ of the full credit is *deducted* from the grade. A presentation that lasts **less than** $\frac{1}{4}$ of the required time is considered **unacceptable** and gets 0 as a grade.
2. A presentation can be **re-scheduled** but only if it is swapped with another presentation of the same kind. This will be allowed **ONLY** if **presenters** make arrangements amongst themselves (only after all agreements are made, notify me about the changes). Note that when swapping *lectures*, the presenters have to swap not only the dates but also the assigned topics.

Note: For **documented** cases (see me with the document in hand) and extreme emergencies other arrangements can be made.

Details on the format and the content of your presentations:

"Lecture" presentations: This is a **50-minute pair** presentation followed by a **quiz**. Students form pairs and each pair is assigned a topic from the textbook to **teach** to the class; *the assignment is given 1 week prior to the presentation date*. Each pair must prepare and present the assigned topic to the class, as well as prepare, conduct, and grade a written quiz on the presented material. The goal of the quiz is to check students' understanding of presented concepts and whether they can apply what they learned. The quiz should be about **15 minutes** long and contain **6-10 questions** including not only short-answer questions but also **small exercise(s)**. Presenters will receive a grade for the quiz based on the evaluations of the *quality* of the quiz (evaluation formula: 75%-class average + 25%-instructor).
Attention: both partners must have **equal** contribution in preparation and presentation.

"Topic" presentation: This is a **20-minute** presentation followed by a **quiz**. The goal of this presentation is to introduce a new topic to the class. The goal of the quiz is to check if students were attentive and following you; the quiz should be about **5 minutes** long and contain **5-8 questions** (you may have only short-answer questions). You are allowed to work on this assignment **alone or in a pair**.
Attention: 1. If it is a **pair** work, the presentation and the quiz must be **twice** the size, i.e. **40 minute** presentation and about a **10 minute** quiz with **10-16 questions**.
2. In pair work both must participate in preparation and presentation **equally**.

The **subject matter of this presentation** needs to fall under one of the following topics:

- Automata theory: classic abstract machines, newer additions (e.g. cellular automata), alterations of classic machines (e.g. classic machines with additional functionalities).
- Formal language theory. Programming language theory.
- Theory of computability.
- Theory of decidability.
- Theory of recursive functions.
- λ -Calculus.
- Complexity theory. NP-complete problems.
- Applications of Theory of Computing in other fields and disciplines.

The choice of the topic of this presentation is completely up to you. Here are 2 options.

OPTION 1: Presentation of a **research paper** in Theory of Computation

OPTION 2: Introduction of a **topic/area** in Theory of Computation that's not covered in CSC445 (e.g. cellular automata, λ -calculus, recursive functions, etc.).

By **research paper** we understand one of the following:

1. A classical research paper in Theoretical CS listed in the Bibliography of our textbook.
Note: every chapter in the textbook ends with a "Bibliographic Notes" section where the author summarizes the chapter and cites all classic papers relevant to that chapter.
2. A paper in Theory of Computation that is not listed in the Bibliography of our textbook: this can be a paper by a renowned theoretician (may not be peer-reviewed) or a current peer-reviewed paper published in a Theoretical CS journal or conference proceedings.

However: You must get **my approval** to present such paper (need to show it to me first).

Attention: obtaining the paper is the student's responsibility.

“Profile” presentation: This is a **20-minute presentation** summarizing the **work** and the life of a classic theoretician-computer scientist (the **emphasis is on the work**). Each student will pick a scientist from the following list.

1. Charles **Babbage** (concept of computing machine, mechanical computers)
2. John Warner **Backus** (programming languages)
3. George **Boole** (Boolean algebra)
4. Georg **Cantor** (set theory)
5. Noam **Chomsky** (formal languages and grammars)
6. Alonzo **Church** (λ -calculus, computability, decidability)
7. Steven Arthur **Cook** (NP-completeness)
8. Edsger **Dijkstra** (programming languages, algorithms)
9. Seymour **Ginsburg** (automata theory, formal language theory)
10. Kurt **Gödel** (computability)
11. Juris **Hartmanis** (computational complexity theory)
12. David A. **Huffman** (finite state machines, Huffman code)
13. Richard M. **Karp** (theory of algorithms, NP-completeness)
14. Stephen Cole **Kleene** (regular expressions, recursion theory, computability)
15. Donald Ervin **Knuth** (theoretical computer science, algorithms and algorithm analysis)
16. Ada **Lovelace** (mechanical computers, analytical engine)
17. Peter **Naur** (structure and performance of computer programs and algorithms)
18. Emil Leon **Post** (mathematical model of computation, recursion theory)
19. Michael Oser **Rabin** (finite automata, computational complexity)
20. Dana **Scott** (automata theory, programming languages)
21. Alan Mathison **Turing** (the concept of algorithm and computability)
22. John **von Neumann** (set theory, game theory, early computers)

Note: To present a theoretician who is not on this list, you need to get **my approval**.

V. Attendance:

Attendance is a **very important** factor for a **seminar** course and is highly weighed in the course grade calculation; missing a presentation means learning one less topic.

Your attendance will be checked and registered for **EACH** presentation separately.

- For **documented** special cases you may get my permission to miss a class (see me in advance with the document in hand).
- In case of **extreme emergencies** that are beyond your control, contact me ASAP (phone, email)

Being late, leaving early, or stepping out of the room for a period of time, means missing out on a portion of the presentation, and therefore these actions **will trigger a penalty**. Besides, this type of behavior is disrespectful and disruptive for the presenter, as well as for other students. Here are **penalties** for missing a portion of a talk (*a portion means **cumulative sum** of pieces*):

1. Missing a portion of a “lecture” presentation:
 - if you miss 5-10 minutes, you will lose quarter of the credit for attendance
 - if you miss 11-20 minutes, you will lose half of the credit for attendance
 - if you miss more than 20 minutes, you will lose the **whole** credit for attendance
2. Missing a portion of a “profile” or “topic” presentation:
 - if you miss 4-6 minutes, you will lose quarter of the credit for attendance
 - if you miss 7-10 minutes, you will lose half of the credit for attendance
 - if you miss more than 10 minutes, you will lose the **whole** credit for attendance

Attention: you will **NOT** be allowed to take a quiz if you miss half of a “lecture” or a “topic”.

VI. Presentation schedule:

Presentations will start on Monday of the 2nd week. In the first half of the quarter we will have one “lecture” and one “profile” presentations per class day. In the second half of the quarter we will have one “profile” and *either* two individual *or* one pair “topic” presentations per class day.

VII. Peer evaluation:

The evaluation of presenters’ performance is a part of each student’s class work. **It is every student’s responsibility to fill in and submit an evaluation form for each presentation and for each quiz.** The peer evaluation is very important; not only it serves as an assessment tool, but it also provides feedback which can be very helpful to the presenter in their future talks.

VIII. Grading:

Your grade for the course will be calculated based on the following distribution:

1. Quizzes: 20% (“lecture” quiz: 13%; “topic” quiz: 7%)
2. Presenting: 40% (“lecture”: 15%; “topic”: 15%; “profile”: 10%)
3. Attendance: 40% (“lecture”: 20%; “topic”: 10%; “profile”: 10%)

IX. Electronic announcements:

- a) *Via course web site:* On our course web site I will post schedules of upcoming presentations (separate schedule for each type presentation). Make sure to regularly check these schedules.

Note: it is your responsibility to stay in sync with the schedule of the course.

- b) *Via e-mail:* The class will have an official mailing list (all students enrolled in the class are automatically subscribed to that mailing list). Occasionally I will send an email to the class; usually these are class related announcements – schedule changes, office hour shifts, etc.

Note: it is your responsibility to read class-related email.

X. Students with Disabilities

If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and the Disability Resource Center ASAP.

XI. Classroom civility:

1. Out of respect for your classmates, with the exception of presenters **during** their presentation, **NO computers, NO cellphones, and NO other devices** will be allowed. Multitasking and use of laptops and other devices are found to be hindering for both users and those near them.
<http://www.sciencedirect.com/science/article/pii/S0360131512002254>
<http://www.cbc.ca/news/technology/laptop-use-lowers-student-grades-experiment-shows-1.1401860>
2. The following is considered **disruptive behavior** and should be avoided:
 - Arriving late
 - Cell phones going off in class
 - Packing up before the class is dismissed
 - Chatting with neighbors
 - Stepping in and out of the room during the presentation
 - Eating in class
 - Sleeping in class
3. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

XII. Cheating Policy:

Academic dishonesty, cheating, and plagiarism are considered serious violations of expected student behavior. Students involved in such cases (**ALL parties**) will be **reported to the Office of Student Affairs** and will be **expelled from the course with a grade F**.