NAZARBAYEV UNIVERSITY
SCHOOL OF SCIENCE AND TECHNOLOGY

Course Syllabus (v 1.0)

CSCI 272 – Formal Languages

Spring 2019

Course Instructors

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Pre-Requisites

This is a required course for CS majors and is intended to be taken during the second year. Students pursuing a minor in CS who are interested in the mathematical foundations of computing are also encouraged to enroll. This course requires knowledge of computing fundamentals, as well as a firm foundation in mathematical thinking (i.e., set theory and proofs), and therefore CSCI 152 and MATH 251 (Discrete Mathematics) are prerequisites for this course.

Course Description

In this course, students will be introduced to formal languages and mathematical models of computation. The topics of finite state and pushdown automata, regular expressions, and context-free grammars will be covered, along with applications such as text processing and compilers. The later portion of the course will cover Turing machines and the Church-Turing Thesis.

Course Aims

The aims of the course are:

1) to familiarize students with how formal languages can be defined using mathematical formalisms such as regular expressions, grammars, and machine models of computation
2) to show students that there are classes of grammars that are strictly more expressive than one another, and to introduce techniques for determining which level a language belongs
3) to introduce students to the concepts of Turing Machines, the Church-Turing Thesis, and the halting problem, along with their historical context, and show why these concepts are fundamental to the theory of computation

Student Learning Outcomes

By the end of the course the student will be expected to be able:

1) to express formal languages using regular expressions, context-free grammars, finite-state automata, and pushdown automata
2) to show the expressive equivalence of different language formalisms
3) to be able to classify a language within the Chomsky Hierarchy using techniques such as the Pumping Lemma
4) to provide a Turing Machine description to accept a given language
5) to explain the significance of the Church-Turing Thesis
6) to explain why the Halting Problem cannot be solved computationally

Course Materials

There is no official textbook for the course. However, we will be referring to the following books over the course of the semester, which should be available for checkout in the library;

- Introduction to the Theory of Computation, Michael Sipser
- Elements of the Theory of Computation, Lewis and Papadimitriou

Class Structure

For CSCI 272, we will be using an approach that balances conceptual learning with group problem solving and active participation by the students. While the course is listed as a lecture-based course, not all class sessions will be devoted solely to exposition of the course materials by the instructors. We will often take some time during class for students to work through and discuss problems to in-class exercises, some of whose solutions will need to be submitted for a grade. Similarly, we will also have take-home exercises which should be physically submitted to the instructor or TAs at the beginning of class on the day they are due. The purpose of these exercises is not for the instructors to evaluate your knowledge, but for students to assess how well they understand the material and what they need to work on. As such, the grades for these exercises will be based on effort instead of overall correctness. These exercises will also serve as practice for the quizzes, and we will generally discuss the solutions to the exercises in class before the quizzes.

Seven paper-based quizzes are planned for this semester and are scheduled for every other Friday during your allotted lecture time. You will not be allowed to use computers, mobile devices, written notes, etc.—just your pen or pencil, and an eraser. We will not give make up quizzes this semester, but in cases where you must miss a quiz because of a validated reason (i.e., where you have a spravka validated by the Student Affairs office), you will be exempted from that quiz. We will drop the lowest quiz score from your average at the end of the semester in calculating your final grade.

There will be a comprehensive written final exam during the exam weeks. As with the quizzes, you will not be allowed to use computers, mobile devices, or written notes during the exams—just your pen or pencil, and an eraser.

Course Assessment

The final grade is calculated as follows:

- Homework and In-class Exercises 10%
- Quizzes (best 6 of 7) 50%
- Final Exam 40%

Final letter grades will be assigned using the following:

A	95 or above	C	65 up to 70
A-	90 up to 95	C-	60 up to 65
B+	85 up to 90	D+	55 up to 60
B	80 up to 85	D	50 up to 55
B-	75 up to 80	F	0 up to 50
C+	70 up to 75		

Course Policies

Attendance

As per university policy, all students are expected to attend class, and are required to be present at the beginning of the semester and continue to attend until the semester is completed. This includes final examinations. Students who do not attend the first two weeks of class can be dropped from the course.

Though attendance is not explicitly listed as a separate component of your final grade, not coming to class will indirectly have a negative impact on your grade. You also must be physically present to do in-class exercises and take the quizzes during the scheduled class times. Be sure to bring your student ID or other photo ID during quizzes, as well as the final exam.

Electronic Resources

CSCI 272 is a course on the classification and theory of languages, and thus does not have a programming component. However, you are expected to check your Nazarbayev University e-mail and Moodle course pages on a daily basis for updates and announcements about the course. Not checking your e-mail or the course Moodle page is not an excuse for missing an announcement.

Exercise Submission Policy

Exercises need to be submitted at the time and date specified by your instructors, generally at the beginning of class on the due date for take-home exercises, and at the end of class for in-class exercises. Any solutions submitted after the deadline will not receive any points.

Classroom Behavior

You are expected to act respectfully towards your fellow classmates, TAs, and instructors inside and outside of the classroom. We have a full class and a limited amount of space and so be mindful about not disrupting/annoying others. Come to class fully prepared in order to use the time as efficiently as possible. Talking on your phone, texting, chatting online, playing with your mobile devices, and talking excessively with your neighbors in the classroom are just a few examples of behavior that is not acceptable.

Acts of harassment or intimidation towards classmates, TAs, instructors, other students, staff, or anybody else will not be tolerated, and will result in a meeting with the Dean.

Grade Disputes

If you disagree with a grade, you may bring up the issue politely with your lecturer. Requests to modify a grade will be made via dedicated application forms. Persistent pestering and arguing about a grade once the matter is deemed settled constitutes harassment and will be reported. Further grade disputes should be brought to the attention of the Vice-Dean of Academic Affairs instead.

Academic integrity

Nazarbayev University and The School of Science and Technology have established high standards for academic integrity, using an approach in which students are trained to produce original work according to professional standards, and to properly cite and reference the work of others when it is appropriate to do so.

The specific guidelines are published in the NU Student Handbook. In particular,

- The assignments in this class are designed to introduce important concepts and techniques, and enable you to explore the material independently so as to gain insight and comprehension of the subject. Doing the work is much more important than getting the right answer.
- The course is designed such that the new material presented each lesson builds on the skills developed in the preceding days; thus, any action that interferes with this process (e.g., skipping lesson exercises, copying) will seriously impede your progress.
- You are welcome—and encouraged—to talk through concepts and ideas with your fellow students and to study with them, but do not give or receive direct help from your classmates on exercises unless otherwise instructed by the lecturers.
- Copying and facilitating copying others' work during a quiz is strictly prohibited. Even the appearance of cheating or inappropriate copying should be avoided.

In the event that academic misconduct is discovered, the student will at a minimum receive no credit for the work for the first offense, and the event reported to the Dean of your school. Egregious cases, or a second offense, can result in failure of the course and potential suspension or expulsion from the university.

When a student suspects that another student has violated the academic honesty policy, a report should be made to the one of the lecturers.

Preliminary Course Outline (Dates and topics are subject to change!)

Last day to add: Friday, January 11

Last day to drop: Friday, January 18

Last day to withdraw (with 'W'): Wednesday, March 27

Scheduled Quiz days are marked in red.

Week	Dates (tentative)	Topics and Assignments (tentative)
Week 1	Jan 9, 11	Preliminaries; Alphabets and languages
Week 2	Jan 14, 16, 18	Deterministic Finite Automata (DFAs); Nondeterministic Finite Automata (NFAs)
Week 3	Jan 21, 23, 25	Regular Expressions; Closure Properties of Regular Languages
Week 4	Jan 28, 30, Feb 1	Pumping Lemma for Regular Languages
Week 5	Feb 4, 6, 8	State minimization
Week 6	Feb 11, 13, 15	Context-free grammars (CFGs)
Week 7	Feb 18, 20, 22	Parse trees and derivations
Week 8	Feb 25, 27, Mar 1	Pushdown Automata (PDAs)
Week 9	Mar 4, 6, ~~8~~	Pumping Lemma for Context-Free Languages
Week 10	Mar 11, 13, 15	Deterministic PDAs; Chomsky Hierarchy
Spring Break	Mar 18-22	*NO CLASSES*
Week 11	Mar 25, 27, 29	Turing Machines; Turing Machine Variations
Week 12	Apr 1, 3, 5	Church-Turing Thesis; Universal TMs
Week 13	Apr 8, 10, 12	Undecidability and Unrecognizability;
Week 14	Apr 15, 17, 19	The Halting Problem; Course Review
Exam Weeks	Apr 22-27	**Final Exam (Time/Date TBA)**