

Introduction to Mathematical Approaches to Language

LING 123

(fulfills *Foundations Mathematics Requirement*)

Social Sciences room 222, MW 9:30-10:45

Revisions to Nondiscrimination and Anti-harassment policy, and to Additional Resources for Students, approved by Faculty Senate, 12/8/20.

Revisions to Campus Safety information and links 4/7/23.

Description of Course

Humans use complex language. This is a—and perhaps even **the**—fundamental characteristic of our species. The goal of this course is to learn how to think mathematically by analyzing the structure underlying the languages we all speak and use to reason. Put another way, the goal of this course is to **equip you with mathematical tools by studying and formally modeling language**. We will learn concepts like set theory and basic logic from the ground up to help explore and understand puzzles which occur in any language in natural, everyday contexts. The notions we will use are not only very rich and powerful, but are also really intuitive to work with, though they do require care and precision. This course is an excellent opportunity to explore symbolic, mathematical tools that have power and precision (but with virtually no numbers!) to model accessible and intriguing data in the domain of natural human language.

Course Prerequisites or Co-requisites

None

Instructor and Contact Information

Eric Jackson, COMM 114A, ejackson1@arizona.edu

Office Hours: Mondays 2:00 – 4:00 in COMM 114A and on Zoom,

<https://arizona.zoom.us/j/87083516643?pwd=NmtYUUtjeW0yWlgrb1M4VUtpVVo2UT09>

Meeting ID: 870 8351 6643

Password: 898732

(Office hours on Sept 4th moved to Sept 5th and *only online*; no office hours the week of Sept 18th)

Teaching Assistant

Shahriar Hormozi, shahriarhormozi@arizona.edu

Office Hours: Available to meet but no fixed office hours; send an email with several suggested times that work for you and I'll choose one that works for me.

We can meet on or near campus, or in my Zoom room at <https://arizona.zoom.us/my/shahriar>

Course Format and Teaching Methods

This class will primarily involve in-person sessions for discussion and practice, but we'll have resources in a D2L course site where students will submit assignments and tests:

<https://d2l.arizona.edu/d2l/home/1339156>

Course Objectives

This course introduces students to concepts used to formally model natural human language, including:

- Thinking precisely about language, viewing all human language as a system with regular (but possibly very complex!) patterns linking forms and meanings
- Formal language theory, the Chomsky Hierarchy, regular languages, and context-free languages
- Semantics of natural language, including entailment, presupposition, and implicature
- Propositional logic
- Naive set theory and quantification

Expected Learning Outcomes

At the end of the course, successful students will be able to:

- define and manipulate sets, and perform set-theoretic reasoning.
- formally define a language.
- determine if an expression is properly part of a formal language (where the language is represented by a formalism like a *rule-based grammar*, an *automaton*, or a *regular expression*).
- frame arguments using propositional logic, and distinguish between valid and invalid arguments.
- represent statements, arguments, and properties of the world formally, selecting from a variety of available formal tools.
- write and critique simple logical proofs.
- understand the differences between entailment, presupposition, and implicature.
- discuss the advantages and limitations of available formal tools in given situations.
- demonstrate ability to analyze patterns in language. (Relates to Linguistics UG Program outcome #1)
- describe and address common misconceptions about language. (Relates to Linguistics UG Program outcome #3)
- communicate knowledge about linguistics orally or through writing. (Relates to Linguistics UG Program outcome #4)

Absence and Class Participation Policy

Participating in the course and attending lectures and other course events are vital to the learning process. As such, attendance is required at all lectures and discussion section meetings. The benefit you gain from this course is directly related to the time and effort that you put into it. Absences may affect a student's final course grade. If you anticipate being absent, are unexpectedly absent, or are unable to participate in class online activities, please contact me as soon as possible so we can find a way to minimize any negative impact this might have on your learning.

UA's policy concerning Class Attendance and Participation is available at:

<https://catalog.arizona.edu/policy/class-attendance-and-participation>

UA's policy regarding absences for any sincerely held religious belief, observance or practice is that they will be accommodated where reasonable; see

<http://policy.arizona.edu/human-resources/religious-accommodation-policy>.

Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored; see:

<https://deanofstudents.arizona.edu/absences>

To request a disability-related accommodation to this attendance policy, please contact the Disability Resource Center at (520) 621-3268 or drc-info@email.arizona.edu.

If you are experiencing unexpected barriers to your success in your courses, the Dean of Students Office is a central support resource for all students and may be helpful. The Dean of Students Office is located in the Robert L. Nugent Building, room 100, or call 520-621-7057.

Course Communications

Announcements will be made in person during our regularly scheduled class times and will be presented in writing on the class D2L site. Important information may occasionally be sent to your university email address. Students are responsible for checking for announcements if they miss a class session.

Required Texts or Readings

There is no required textbook for this course. ***This makes your attendance and participation in class sessions even more important!*** Optional readings, if any, will be made available in electronic form through the class D2L site.

Assignments and Examinations: Schedule and Due Dates

The due date and time for each assignment will be marked in D2L; times are always given in local Tucson time. ***Unless otherwise permitted by UA policy, late work will not be accepted.*** It's best to plan ahead, give yourself plenty of time to work, and submit what you have (even if it's incomplete) on time.

There will be 7 to 8 major written assignments that altogether comprise 30% of your final grade, roughly one every two weeks. My plan is to post new course material every Monday, which may include optional readings, other online resources or activities, and assignments (due in two weeks).

In-person sessions will be supplemented with short quizzes in D2L that will help you see how well you're understanding the concepts introduced by the lectures and point out topics you need to review. Quizzes can be attempted multiple times. Your cumulative quiz grade will comprise 30% of your final grade.

Midterm and Final Exam

There will also be two tests (i.e., a midterm and final), each of which comprises 20% of your final grade. The final will not be cumulative, but will cover just the new material after the midterm. Both tests will be done at home and submitted through D2L, like other assignments. We will not have an in-person final exam.

Grading Scale and Policies

Grade component	Description	Category weight
Unit assignments	Written assignments applying content from each unit; roughly one every two weeks.	30%
Midterm and final	Midterm will be due in week 8 and cover content from weeks 1-7; final will be due during finals week and will cover content from weeks 9-16.	40%
Quizzes	Roughly weekly; can be attempted multiple times.	30%

Students will receive a final course grade of A, B, C, D, or E. The following minimum percentages will guarantee the corresponding letter grades.

A: 90% – 100%

B: 80% – 89.9%

C: 70% – 79.9%

D: 60% – 69.9%

E: 0% – 59.9%

Incomplete (I) or Withdrawal (W)

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at <http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete> and <http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal> respectively.

Dispute of Grade Policy

Students have two days to appeal the grade they receive on an assignment, starting from the time grades are posted in D2L for that assignment.

Scheduled Topics/Activities

Our course schedule will follow this plan (though precise details and dates are subject to modification):

Module	Dates	Description
Thinking formally about language	weeks 1-2	What is language and meaning like? What benefit do we gain by formalizing it?
Formal language theory	weeks 3-6	The Chomsky Hierarchy Regular languages, Context-free languages
Review and midterm	week 7-8; test distributed Oct 12, due 7:59pm Oct 15	includes review; test submitted in D2L (Why not due at midnight? I want you to get good sleep before class on Oct 16!)
Semantics: Foundations	weeks 9-10	Entailment, presupposition, and implicature
Semantics: Propositional logic	weeks 11-12	The syntax and semantics of propositions Applications of propositional logic
Semantics: Set theory	weeks 13-14	Naive set theory and quantification
Review and Final	week 15-16; test distributed Dec 6, due 12:30pm Dec 14	due in D2L by the end of our scheduled final exam time

Course materials will be updated in the D2L course site shortly before or after each class session.

Classroom Behavior Policy

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).

Students are asked to refrain from disruptive conversations with people sitting around them during lecture. Students observed engaging in disruptive activity will be asked to cease this behavior. Those who continue to disrupt the class will be asked to leave lecture or discussion and may be reported to the Dean of Students.

Threatening Behavior Policy

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See

<http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>.

Notification of Objectionable Materials

I don't expect there will be any material in this course that students would find objectionable. If you find any of the course materials objectionable, please speak with the instructor to voice concerns and to provide feedback.

Accessibility and Accommodations

At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268, <https://drc.arizona.edu/>) to establish reasonable accommodations.

Code of Academic Integrity

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, ***graded work or exercises must be the product of independent effort unless otherwise instructed***. It doesn't make sense to outsource training for a marathon to someone else, or to outsource practicing a musical instrument to someone else; ***if you want to do those things, you need to be the one putting in the time and effort so that you get the benefit***. In precisely the same way, you're here in this class to train and develop your own mind and your own intellectual skills.

Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: <http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity>.

Taking ideas put forward by someone else and presenting them as your own is plagiarism. The University Libraries have resources to avoid plagiarism: <http://new.library.arizona.edu/research/citing/plagiarism>.

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA email to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

Nondiscrimination and Anti-harassment Policy

The University of Arizona is committed to creating and maintaining an environment free of discrimination. In support of this commitment, the University prohibits discrimination, including harassment and retaliation, based on a protected classification, including race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, or genetic information. For more information,

including how to report a concern, please see

<http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

Additional Resources for Students

UA Academic policies and procedures are available at <http://catalog.arizona.edu/policies>

Campus Health

<http://www.health.arizona.edu/>

Campus Health provides quality medical and mental health care services through virtual and in-person care.

Phone: 520-621-9202

Counseling and Psych Services (CAPS)

<https://health.arizona.edu/counseling-psych-services>

CAPS provides mental health care, including short-term counseling services.

Phone: 520-621-3334

The Dean of Students Office's Student Assistance Program

<http://deanofstudents.arizona.edu/student-assistance/students/student-assistance>

Student Assistance helps students manage crises, life traumas, and other barriers that impede success. The staff addresses the needs of students who experience issues related to social adjustment, academic challenges, psychological health, physical health, victimization, and relationship issues, through a variety of interventions, referrals, and follow up services.

Email: DOS-deanofstudents@email.arizona.edu

Phone: 520-621-7057

Survivor Advocacy Program

<https://survivoradvocacy.arizona.edu/>

The Survivor Advocacy Program provides confidential support and advocacy services to student survivors of sexual and gender-based violence. The Program can also advise students about relevant non-UA resources available within the local community for support.

Email: survivoradvocacy@email.arizona.edu

Phone: 520-621-5767

Campus Pantry

Any student who has difficulty affording groceries or accessing sufficient food to eat every day, or who lacks a safe and stable place to live and believes this may affect their performance in the course, is urged to contact the Dean of Students for support. In addition, the University of Arizona Campus Pantry is open for students to receive supplemental groceries at no cost. Please see their website at: campuspantry.arizona.edu for open times.

Furthermore, please notify me if you are comfortable in doing so. This will enable me to provide any resources that I may possess.

Preferred Name & Pronoun

This course affirms people of all gender expressions and gender identities. If you prefer to be called a different name than what is on the class roster, please let me know. Feel free to correct instructors on your preferred gender pronoun. If you have any questions or concerns, please do not hesitate to contact me directly in class or via email (instructor email). If you wish to change your preferred name or pronoun in the UAccess system, please use the following guidelines:

Preferred name: University of Arizona students may choose to identify themselves within the University community using a preferred first name that differs from their official/legal name. A student's preferred name will appear instead of the person's official/legal first name in select University-related systems and documents, provided that the name is not being used for the purpose of misrepresentation. Students are able to update their preferred names in UAccess.

Pronouns: Students may designate pronouns they use to identify themselves. Instructors and staff are encouraged to use pronouns for people that they use for themselves as a sign of respect and inclusion. Students are able to update and edit their pronouns in UAccess.

More information on updating your preferred name and pronouns is available on the Office of the Registrar site at <https://www.registrar.arizona.edu/>.

Safety on Campus and in the Classroom

For a list of emergency procedures for all types of incidents, please visit the website of the Critical Incident Response Team (CIRT): <https://cirt.arizona.edu/case-emergency/overview>

Familiarize yourself with the Social Sciences Building Evacuation and Active Shooter plans specific to room 222. You can find information for this and other campus buildings at the UA Public Map: <https://map.arizona.edu/>

You may also watch the video that is part of the *Active Shooter Preparedness Training*, available at https://arizona.sabacloud.com/Saba/Web_spf/NA7P1PRD161/common/learningeventdetail/crtfy0000000000003560

Confidentiality of Student Records

You have a right to privacy concerning your academic records, which includes your activities, assignments, and performance in this class. You can find more information at <http://www.registrar.arizona.edu/ferpa>

Subject to Change Statement

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor. Supplementary materials