Reasoning for Humans: Clear Thinking in an Uncertain World

Instructor:	Eric Pacuit (pacuit.org)
Semester:	Spring 2020
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Course Website:	TBA
Office:	Skinner 1103A
Office Hours:	TBA
Class Times:	MW 12:00pm - 12:50pm
Class Location:	TBA

Course Description

In this course, students will use methods from logic and probability to study philosophical questions about the nature of reasoning and to analyze experiments about how humans reason. Students will learn to identify some common reasoning errors, learn to identify arguments and their parts, study the concepts used to evaluate arguments, and learn the basic elements of deductive logic and probability theory. There will be an emphasis on the relation between deductive logic, probability, and inductive logic. Class meetings will include lectures, discussions, and small group work. The goal is to develop a broad understanding of the principles that guide human reasoning.

Reasoning is a transition in thought, where some beliefs (or thoughts) provide grounds or reasons for coming to another. What makes certain transitions of thought rational or reasonable while others are considered irrational or erratic? This question has been a major focus of investigation in many different research areas, such as philosophy, logic, artificial intelligence, cognitive science, and psychology. This course is an introduction to logic and probability with a focus on understanding applications to the study of the foundations of human reasoning. There will be readings from the different disciplines mentioned above; however, no prior knowledge of any of these fields is presupposed.

Prerequisites

There are no prerequisites for this course. An important objective of the course is to introduce the mathematical background on logic and probability that is needed to engage with the literature on reasoning.

Literature

The readings for the course will be taken from the following textbooks. The chapters will be available on the course website. In addition, online interactive notes will be made available by the instructor.

- J. Adler and L. Ripps (eds.), *Reasoning: Studies of Human Inference and its Foundations*, Cambridge University Press, 2008 (especially the introductory survey by J. Adler, pgs. 1 - 34).
- D. Easley and J. Kleinberg Chapter 16 (Information Cascades) from *Networks, Crowds and Markets*, Cambridge University Press
- G. Harman, Chapter 1: Rationality by (pgs. 9 - 27) from *Reasoning, Meaning and Mind*
- I. Hacking, *Introduction to Probability and Inductive Logic*, Cambridge University Press, 2001 (Chapter 6)
- D. Kahneman, *Thinking, Fast and Slow by Daniel Kahneman*, Farrar, Straus and Giroux, 2011
- B. Skyrms, *Choice and Chance: An Introduction to Inductive Logic*, Cengage Learning, 1999
- K. Stenning and M. van Lambalgen, *Human Reasoning and Cognitive Science*, The MIT Press, 2008
- E. Yudkowsky, *An Intuitive Explanation of Bayes' Theorem*, available at `http://yudkowsky.net/rational/bayes`

Grading Policy

The course requirements are:

- **Participation** (25% of your final grade): During the lectures, there will be short polls and one-question quizzes (there may be more than one during a single lecture). Since these are designed to encourage participation, make-ups will not be offered. Each questions/poll will be worth 1 point (0.5 points for participation and 0.5 points for correctness). Each student can use 10% of the total points for unexcused absences (e.g., if there are 50 total points, students will receive 5 extra credit points).

- **Quizzes** (25% of your final grade). There will be 6-10 short online quizzes given throughout the semester. Since the quizzes are designed, in part, to ensure that students keep up with the reading, make-up quizzes will not be offered. The lowest quiz score will be dropped.

- **Sections** (15% of your final grade). There are weekly sections. Sections are a chance to review and discuss the material for the week, clear up any confusions about the material, and ask for help on the online quizzes. Sections will be run by the teaching assistant(s). Participation at your section is required. The grade will be based on short quizzes and worksheets completed during sections. Please consult Testudo for the time and locations of your section.

- **Exams** There will be 3 exams given during the semester:

  Exam 1 (10% of your final grade): Logic and reasoning

  Exam 2 (10% of your final grade): Probability and inductive logic

  Final exam (15% of your final grade): The final will be cumulative and given as an in-class exam given during finals week. A study guide will be provided during the last week of the semester. The exam will be held during exam week. Consult Testudo for the date, time and location of the final exam.

See undergraduate catalogue for description of grades, e.g., A+, A, A-, etc.: `http://www.umd.edu/catalog/index.cfm/show/content.section/c/27/ss/1584/s/1534`. Your final grade may be curved.

Schedule

Below is a tentative schedule for the semester. A more detailed schedule, including links to the reading material, can be found on the course website.

Introduction and Course Overview

- Introductory remarks and course overview

  Reading: Chapter 1: Rationality by G. Harman (pgs. 9 - 27) from *Reasoning, Meaning and Mind*; Introduction: Philosophical Foundations by J. Adler, from *Reasoning: Studies in Human Inference and Its Foundations*

Part 1: Logic

- Topics: Arguments, Boolean connectives, truth-tables, valid arguments, logical equivalence, inference rules

  Reading: Online notes prepared by the instructor; Skyrms Chapter 1

- Topics: The Wason Selection Task; non-monotonicity; closed-world reasoning; conditional reasoning; brief introduction to non-standard logics

  Reading: Stenning and van Lambalgen, Chapter 2 (Anatomy of Logic) and Chapter 3 (A Little Logic Goes a Long Way)

- **Exam 1**

Part 2: Probability and Inductive Logic

- Topics: Introduction to inductive logic

  Reading: Skyrms Chapter 2

- Topics: Axioms of probability, stochastic truth-tables, conditional probability, Bayes rule, reasoning with probabilities

  Reading: Online notes prepared by the instructor; Skyrms Chapter 6

- Topics: Monty Hall puzzle/three prisoner's puzzle; the conjunction fallacy; the base-rate fallacy; Simpson's paradox; the ravens paradox

  Reading: Skyrms Chapter 4; Chapter 15 from *Thinking Fast and Slow* by D. Kahneman; Journal articles on the conjunction fallacy

- Topics: Interpretations of probability

  Reading: Skyrms, Chapter 7

- **Exam 2**

Part 3: Topics in Bayesian Epistemology (time permitting)

- The problem of induction
- The Grue paradox
- The lottery and preface paradox
- Information cascades/belief polarization

Concluding Remarks

- Concluding remarks and review for the final exam

Learning Outcomes

This course satisfies the GenEd Analytic Reasoning requirement. Courses in Analytic Reasoning will foster a student's ability to use mathematical or formal methods or structured protocols and patterns of reasoning to examine problems or issues by evaluating evidence, examining proofs, analyzing relationships between variables, developing arguments, and drawing conclusions appropriately. The learning outcomes for this course are:

- *Demonstrate proficient application of the skills required by the Mathematics Fundamental Studies requirement, including the ability to communicate using formal or mathematical tools.*

  Students will be introduced to basic topics in logic and probability. In addition to providing written solutions to problems testing their understanding of logic and probability, students will be required to discuss their solutions with other students and to present their solutions to the class during the sections.

- *Distinguish between premises and conclusions, or between data and inferences from data.*

  One of the main objectives of the course is the formal study of arguments. The first step in a logical analysis of arguments is to distinguish between premises and conclusions. Using probability to study reasoning and arguments requires students to distinguish between data and inferences from data. The problems from the online quizzes and the exams will assess the student's ability to distinguish between both premises and conclusions and between data and inferences from data.

- *Apply appropriate analytical methods to evaluate inferences and to reason about complex information.*

  An important part of the course is to use logic and probability to explain experiments about humans reasoning and to understand philosophical puzzles and paradoxes about reasoning. Students will be required to write short essays discussing how logical and probabilistic methods can help to explain the experiments and philosophical puzzles and paradoxes.

- *Systematically evaluate evidence for accuracy, limitations, and relevance, and identify alternative interpretations of evidence.*

  An important theme throughout the course is to evaluate experimental evidence about how humans reason and whether logical and probabilistic inference faithfully captures human reasoning. The students will learn critically evaluate these experiments and to provide alternative interpretations of the experimental evidence.

- *Use formal, analytical, or computational techniques to address real-world problems.*

  The main objective of the course is to examine the extent to which formal models of reasoning (using logic or probability) faithfully captures human reasoning. The

readings and class discussions will focus on the the use of logic and probability to evaluate and improve critical reasoning.

Course Policies

A full list of course-related policies and relevant links to resources may be found at:

`http://www.ugst.umd.edu/courserelatedpolicies.html`.

Communication about this Course

I will use email to convey important information, and students are responsible for keeping their email address up to date, and must ensure that forwarding to another address functions properly. Failure to check email, errors in forwarding, and returned email are the responsibility of the student, and do not constitute an excuse for missing announcements or deadlines.

Class Cancelations

The University may be closed in the event of an emergency, in which case class will be cancelled. To find out if the University is closed you can check its main site (`http://www.umd.edu`), its emergency preparedness site (`http://www.umd.edu/emergencypreparedness/`), or call the "snow phone line" at 301-405-7669 (which covers more than just snow caused closings). If class is cancelled while the University remains open, then there will be an announcement posted on the course ELMS page.

Emergency protocol: In the case of an extended closure to the University (e.g., because of inclement weather), consult the ELMS course page for announcements and changes to any due dates.

Attendance and Absences

Students are expected to attend classes regularly. Consistent attendance offers students the most effective opportunity to gain command of course concepts and materials. Events that justify an excused absence include: religious observances; mandatory military obligation; illness of the student or illness of an immediate family member; participation in university activities at the request of university authorities; and compelling circumstances beyond the student's control (e.g., death in the family, required court appearance). Absences stemming from work duties other than military obligation (e.g., unexpected changes in shift assignments) and traffic/transit problems do not typically qualify for excused absence. Students claiming an excused absence must notify the course instructor in a timely manner and provide appropriate documentation. The notification should be provided either prior to the absence or as soon afterwards as possible. In the case of religious observances, athletic

events, and planned absences known at the beginning of the semester, the student must inform the instructor during the schedule adjustment period. All other absences must be reported as soon as is practical. The student must provide appropriate documentation of the absence. The documentation must be provided in writing to the instructor by the means specified in this syllabus. The full university attendance/absence policy can be found here: `http://www.ugst.umd.edu/courserelatedpolicies.html`.

Academic Integrity

The UMD Honor Code prohibits students from cheating on exams, plagiarizing papers, submitting the same paper for credit in two courses without authorization, buying papers, submitting fraudulent documents and forging signatures. On every examination, paper or other academic exercise not exempted by the instructor, students must write by hand and sign the following pledge:

> *I pledge on my honor that I have not given or received any unauthorized assistance on this examination (or assignment).*

Allegations of academic dishonesty will be reported directly to the Student Honor Council: `http://www.shc.umd.edu`

Disability Support

Students with a documented disability should inform the instructors within the add-drop period if academic accommodations will be needed. NB: You are expected to meet with your instructor in person to provide them with a copy of the Accommodations Letter and to obtain your instructor?s signature on the Acknowledgement of Student Request form. You and your instructor will plan together how accommodations will be implemented throughout the semester. To obtain the required Accommodation Letter, please contact Disability Support Service (DSS) at 301-314-7682 or dissup@umd.edu

Copyright Notice

Class lectures and other materials are copyrighted. They are the property of the instructor - do not sell them, do not post them on a website. They may not be reproduced for anything other than personal use without written permission from the instructor. Copyright infringements may be referred to the Office of Student Conduct.

Academic Accommodations for Students who Experience Sexual Misconduct

The University of Maryland is committed to providing support and resources, including academic accommodations, for students who experience sexual or relationship violence as

defined by the University's Sexual Misconduct Policy. To report an incident and/or obtain an academic accommodation, contact the Office of Civil Rights and Sexual Misconduct at 301-405-1142. If you wish to speak confidentially, contact Campus Advocates Respond and Educate (CARE) to Stop Violence at 301-741-3555. As 'responsible university employees' faculty are required to report any disclosure of sexual misconduct, i.e., they may not hold such disclosures in confidence. For more information: `http://www.umd.edu/ocrsm/`

Diversity

The University of Maryland values the diversity of its student body. Along with the University, I am committed to providing a classroom atmosphere that encourages the equitable participation of all students regardless of age, disability, ethnicity, gender, national origin, race, religion, or sexual orientation. Potential devaluation of students in the classroom that can occur by reference to demeaning stereotypes of any group and/or overlooking the contributions of a particular group to the topic under discussion is inappropriate.

For information on elms, counseling, health, learning workshops, tutoring, writing help, student rights in undergrad courses, questions about graduation or add/drop/withdraw, please see `http://www.ugst.umd.edu/courserelatedpolicies.html`.