IDS 2935: Algorithms: Uses and Abuses
Quest 2

I. General Information

Class Meetings

- Spring, 2024
- MWF, period 7
- MAT 0107

Instructor

- Philip Boyland
- Office: Little 338
- Office hours: MWF period 8
- Message me in Canvas (preferred) or boyland@ufl.edu

Important Note: This syllabus will change to meet the evolving needs of the class, so check back frequently.

Course Description

Algorithms are everywhere in our lives. They recommend videos, target ads, run factories, drive cars, run power grids, ... But what exactly is an algorithm and are the results of algorithms always accurate and fair?

In this course we will learn what an algorithm is, how to express it precisely, how to implement it, and how to analyze it. We will begin by studying common algorithmic activities in our lives and move on to the common arithmetic algorithms we learned in school. In the next step we will develop descriptive tools such as decision trees and finite state machines. This will be followed by the introduction of basic programming constructs like variables, assignments, loops, and conditionals and their use in pseudocode. We then learn some of the basic algorithms like sorting and searching. We will next look at more specialized tasks such as cryptography and compression. We will conclude with an introduction to neural nets. Each topic will be introduced and explained in a lecture and will be followed by a series of exercises to be done as a group then as homework.

Despite their undeniable benefit many questions have arisen concerning algorithm's fairness, accuracy and unintended consequences. It is often stated that algorithms are abstract and objective and thus morally neutral and so what matters is how we use them, but is that true? All the construction and implementation of an algorithm is created, at least initially, by a human programmer who brings their own perspective and inclinations to their work. An additional issue has arisen in with now widespread machine learning/AI algorithms. The internal structure and parameters are usually set using an optimization procedure based on a specific set of training data. The resulting internal structure of the

algorithm contains thousands of parameters and is so complex that it defies human analysis and thus cannot be the basis of a human value judgement on the algorithm's accuracy or fairness. The structure and outputs of the algorithms are highly dependent on the training data used to "teach" them. In addition, many modern large-scale algorithms are the proprietary property of corporations or governments and so are not subject to ordinary citizen's scrutiny. Given all this, what can individuals do to ensure that the algorithms that influence their lives are fair and accurate?

To properly investigate whether the judgements made by algorithms are fair and balanced we must also examine how individuals and society make decisions. Are these always fair and balanced? There is considerable research indicating that a great deal of human decision making is as much a black box as a large-scale neural network. We make use of heuristic short cuts and are subject to numerous sources of cognitive bias such as confirmation, risk aversion, and anchoring.

There will be readings assigned each week exploring the history and impact of algorithms on individuals and society as well as the nature and biases of human decision making. Each student will answer a list of assigned questions and bring them to class. On that day there will be discussions in small groups followed by reports to and discussion by the entire class.

The course will require no previous programming experience or exposure to any mathematics past High School, just the ability to think logically and systematically. It combines knowledge and methods of analysis from Computer Science, Ethics and Cognitive Science.

Quest and General Education Credit

- Quest 2
- Social & Behavioral Sciences

This course accomplishes the Quest and General Education objectives of the subject areas listed above. A minimum grade of C is required for Quest and General Education credit. Courses intended to satisfy Quest and General Education requirements cannot be taken S-U.

Resources

- *Grokking Algorithms*, by Aditya Bhargava, Manning Press, ISBN-10 **:** 1617292230, 2016
- If you want to learn python (which is **not** required), a very good free tutorial is at https://pythonnumericalmethods.berkeley.edu/notebooks/Index.html
- This is an excellent, free advanced undergraduate text on algorithms: https://jeffe.cs.illinois.edu/teaching/algorithms/

All readings and works will be available in Canvas.

II. Graded Work

Description of Graded Work

Algorithm Worksheets (30%): There will be a worksheets based on the algorithm described in lecture. It is to be worked on in groups and turned in at the end of class and graded. An additional worksheet focused on the readings and videos will be handed out.

Reading Worksheets (10%): A short series of questions based on the week's readings will be assigned on and turned in and graded. Students will be asked to summarize the author's arguments/points and comment on whether they agree or disagree as well as a few other questions relevant to the reading.

Participation (15%): Participation in the group work will be part of the grade as well as the presentations of the group's discussions .

Debate (5%): The class will be split into teams and assigned topics and format for a debate derived from course material. Each student will take at least one role in the debate. Students will be graded on the quality of their individual presentations as well as their team's efforts as a whole.

Midterm (25%): There will be a 50 minute midterm covering both the algorithms learned and some of the issues arising from the readings. The exam will be a combination of short answer and pseudocode.

Final project (15%): Each student will turn in a final project. They can explore further some of the societal and personal impacts of algorithms in a three page paper or describe in detail an algorithm not covered in class which can include executable code. The project must be approved 2 weeks before the due date.

Grading Scale

For information on how UF assigns grade points, visit: https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/

A	94 – 100%		C	74 – 76%
A-	90 – 93%		C-	70 – 73%
B+	87 – 89%		D+	67 – 69%
B	84 – 86%		D	64 – 66%
B-	80 – 83%		D-	60 – 63%
C+	77 – 79%		E	<60

Grading Rubric(s)

Equivalent numerical values for all rubrics: Excellent: 93-100, Good: 85-93, Average: 75-85, Insufficient: 65-75

Participation and Discussion Worksheet Rubric

	Excellent	Good	Average	Insufficient	Unsatisfactory
Knowledgeable: Shows evidence of having done the assigned work.					
Thoughtful: Evaluates carefully issues raised in assigned work.					
Considerate: Takes the perspective of others into account and listens attentively.					

Algorithm Worksheet Rubric

	Excellent	Good	Average	Insufficient	Unsatisfactory
Algorithm is correct, i.e. input produces proper output					
Clarity and concision of “implementation”					
Verbal description of algorithm is clear and intelligible					

Debate Rubric

	Excellent	Good	Average	Insufficient	Unsatisfactory
Shows that carefully prepared by reading and preparing speech					
Mastery of factual information					
Quality of presentation and persuasiveness of arguments					
Responds well to questions and counterarguments					

III. Annotated Weekly Schedule

Week	Topics, Homework, and Assignments
Week 1	• **Monday Lecture Topic and Summary:** Introduction: algorithms, bias and human decision making. • **Required Readings/Works**: *Algorithms* by J. Erickson, pages 1-4, 11-16 • **Assignment:** Algorithm worksheets and reading's analysis due Friday
Week 2	• **Monday Lecture Topic and Summary:** Arithmetic algorithms, history and cultural differences • **Required Readings/Works**: *A History of Algorithms* by J-L Chabert, pages 1-47 • **Assignment:** Algorithm worksheets and reading's analysis due Friday
Week 3	• **Monday Lecture Topic and Summary:** Describing algorithms I, finite state machines, decision trees/network – Algorithm ethics, first principles

Week	Topics, Homework, and Assignments
	• **Required Readings/Works**: Coeckelbergh, pages i-vii, 1-10 • **Assignment:** Algorithm worksheets and reading's analysis due Friday
Week 4	• **Monday Lecture Topic and Summary:** Describing algorithms II, pseudocode – Introduction to algorithmic bias • **Required Readings/Works**: *Algorithmic Bias and Fairness*, video lecture by Ava Soleimany, 43 minutes • **Assignment:** Algorithm worksheets and reading's analysis due Friday. Friday's worksheet will require the students to interview at least 3 other people soliciting their opinion and experience of the algorithms and bias discussed in the video.
Week 5	• **Monday Lecture Topic and Summary:** Sorting algorithms – survey of technology and data science • **Required Readings/Works**: *Thinking, Fast and Slow,* video lecture by Daniel Kahneman, Talks at Google, 60 minutes • **Assignment:** Algorithm worksheets and video's analysis due Friday
Week 6	• **Monday Lecture Topic and Summary:** Search algorithms—privacy issues. • **Required Readings/Works**: Coeckelbergh, Chapters 5 -7, pages 63-108 • **Assignment:** Algorithm worksheets and reading's analysis due Friday
Week 7	• **Monday Lecture Topic and Summary:** Recursion and iteration – Mathematics, algorithms and fairness • **Required Readings/Works:** Weapons of Math Destruction by Cathy O'Neil, Introduction and Chapter 1, pages 1-31 • **Assignment:** Algorithm worksheets and reading's analysis due Friday. Friday's worksheet will require the students to interview at least 3 other people soliciting their opinion and experience of the algorithms and bias discussed in the reading.
Week 8	• **Monday Lecture Topic and Summary:** Encryption algorithms – types of bias • **Required Readings/Works**: Wikipedia Article: "Algorithmic Bias" & Kahneman pages 19-30, 39-49. 59-70 • **Assignment:** Algorithm worksheets and reading's analysis due Friday
Week 9	• **Monday Lecture Topic and Summary:** Recursion and iteration – sources of bias • **Required Readings/Works**: Coeckelbergh, Chapter 8 -9, pages 109-144 • **Assignment:** Algorithm worksheets and reading's analysis due Friday
Week 10	• **Monday Lecture Topic and Summary:** Computing mathematical functions • **No Readings, Exam Preparation** • **Assignment:** Algorithm worksheets due Friday • **Midterm Exam on Friday**
Week 11	• **Monday Lecture Topic and Summary:** Algorithmic games – The three laws of robotics and algorithmic safety

Week	Topics, Homework, and Assignments
	• **Required Readings/Works**: Kahneman pages 71-88 & "Runaround" a short story by I. Asimov, 8 pages • **Assignment:** Algorithm worksheets and reading's analysis due Friday
Week 12	• **Monday Lecture Topic and Summary:** Compression algorithms – Ai in education • **Required Readings/Works**: "In the Age of A.I., Major in Being Human" by D. Brooks, 2/2/23, *New York Times,* 3 pages & "Artificial Intelligence Will Change Higher Ed for the Better" by Peter Jacobsen, 01/20/23, *Martin Center Online, 3 page &* Kahneman pages 89-105 • **Assignment:** Algorithm worksheets and reading's analysis due Friday
Week 13	• **Monday Lecture Topic and Summary:** Neural Nets I, basic structure • **No Readings, Debate preparation** • **Assignment:** Algorithm worksheets due Friday • **Debate on Friday**
Week 14	• **Monday Lecture Topic and Summary:** Neural nets II – learning and training data • **Required Readings/Works**: *Rome Call for AI Ethics,* 12 pages & Kahneman pages 110-154 • **Assignment:** Algorithm worksheets and reading's analysis due Friday
Week 15	• **Monday Lecture Topic and Summary:** Algorithms conclusion – unintended consequences • **Required Readings/Works**: "The Hilarious (and Terrifying?) Ways Algorithms Have Outsmarted Their Creators", by Eric Limer, 3/15/18, *Popular Mechanics,* 2 pages & *"*Optimizing Your Diet," video lecture by Aysegul Topcu, 30 minutes & The *Invisible Gorilla* video, 5 minutes • **Assignment:** Algorithm worksheets and reading's analysis due Friday. Final project due

IV. Student Learning Outcomes (SLOs)

Social and behavioral science courses provide instruction in the history, key themes, principles, terminology, and underlying theory or methodologies used in the social and behavioral sciences. These courses emphasize the effective application of accepted problem-solving techniques. Students will apply formal and informal qualitative or quantitative analysis to examine the processes and means by which individuals make personal and group decisions, as well as the evaluation of opinions, outcomes or human behavior. Students are expected to assess and analyze ethical perspectives in individual and societal decisions.

At the end of this course, students will be expected to have achieved the Quest and General Education learning outcomes as follows:

Content*: Students demonstrate competence in the terminology, concepts, theories and methodologies used within the discipline(s)*. *They will identify, describe, and explain key themes, principles, and terminology; the history, theory and/or methodologies used; and social institutions, structures and processes.*

Students will be able to explain the definition of an algorithm and describe precisely some basic ones using diagrams and pseudocode. They will also be able to identify and explain sources of bias as well as the advantages and disadvantages of using algorithms for decision making and mechanical control. In addition, students will be able to enumerate and explain some of the current understanding from Cognitive Science on how humans make decisions including the role of heuristics and shortcuts and the influence of various cognitive biases. Evaluated by algorithm and readings worksheets, discussions and presentations, midterm and final project.

Critical Thinking: *Students carefully and logically analyze information from multiple perspectives and develop reasoned solutions to problems within the discipline(s). They will apply formal and informal qualitative or quantitative analysis effectively to examine the processes and means by which individuals make personal and group decisions and assess and analyze ethical perspectives in individual and societal decisions.*

Students will be able to analyze basic algorithms and implement them by hand and be able evaluate algorithms for potential unfairness and inaccuracy. Students will also be able to examine their own and others decision making process for heuristics and cognitive bias. Assessment: There will be graded worksheets every week in which students analyze, describe, and implement basic algorithms as well as weekly readings with short written assignments exploring the basic issues of algorithmic ethics and the midterm and final project.

Communication: *Students communicate knowledge, ideas and reasoning clearly and effectively in written and oral forms appropriate to the discipline(s).* They will communicate knowledge, thoughts and reasoning clearly and effectively.

Students will learn precise and concise tools for expressing and communicating algorithms as well as explaining current research on human decision making. This will be done in class on worksheets and through the homework. In addition, students will communicate their understanding of the weekly readings in group discussions and oral presentations. Assessment: students will be graded on their algorithm worksheets, their answers to the discovery questions on the readings and their classroom participation, and the midterm and final project.

Connection: *Students connect course content with meaningful critical reflection on their intellectual, personal, and professional development at UF and beyond.*

Throughout the course students are required to not just understand, analyze and implement algorithms but to reflect on their fairness and accuracy. Through direct experimentation with search engines and chatbots, students will connect their personal experience with what they have learned about algorithms and their potential bias. Students will also reflect on the processes they have used to make major and minor life decisions. Evaluated by reflection questions on readings worksheets and discussion and presentations.

V. Quest Learning Experiences

1. Details of Experiential Learning Component

On specified days students will work in groups in class on worksheets in which they will analyze, describe and implement the algorithms from lecture. There will be an additional worksheet to do at home and turn in. There will also be a project in which students directly interface with search engines and chatbots and then analyze the accuracy and fairness of the result and try to discover the source of any bias. Students will also be required to come to class with the answers to the week's readings question sheet, discuss these in groups, and present the group's conclusions to the class.

2. Details of Self-Reflection Component

Throughout the course students are required to not just understand, analyze, and implement algorithms but to reflect on their fairness and accuracy. Students will also reflect on the processes they have used to make major and minor life decisions. In addition, students are encouraged to reflect on the societal benefits and drawbacks that come from widespread use of algorithms as well as the proper role of humans in an AI-dominated world.

VI. Required Policies

Attendance Policy

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at:
https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

Students Requiring Accommodation

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

UF Evaluations Process

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Counseling and Wellness Center

Contact information for the Counseling and Wellness Center: http://www.counseling.ufl.edu/ , 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

The Writing Studio

The writing studio is committed to helping University of Florida students meet their academic and professional goals by becoming better writers. Visit the writing studio online at http://writing.ufl.edu/writing-studio/ or in 2215 Turlington Hall for one-on-one consultations and workshops.

In-Class Recordings

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the

publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.