COLLEGE OF ENGINEERING, UIC

CS 516, Responsible Data Science and Alg. Fairness, 4 credits

I. Instructor & Course Details

Instructor Name: Abolfazl Asudeh
https://www.cs.uic.edu/~asudeh/)
Email address: asudeh@uic.edu
Drop-In Office Hours (in-person): Mondays, 3:00 PM to 4:55 PM
Drop-In Hours location *(office number)*: 1131 SEO

Course Modality and Schedule *(UIC Syllabus Policy and HLC PRIORITY SECTION)*

This course is taught **ON CAMPUS**.

- DAYS and TIMES: **Mondays and Wednesdays, 5:00 pm-6:15 pm**
- LOCATION: **Thomas Beckham Hall 180G**

II. Course Information

Catalog Course Description and Prerequisite/Corequisite Statement

This course views data-driven and algorithmic decision making through the lens of responsibility and data ethics. It shall cover the important aspects of the timely research area of responsible data science. The course will empower the graduate students with tools to start exploring/conducting research in this area.

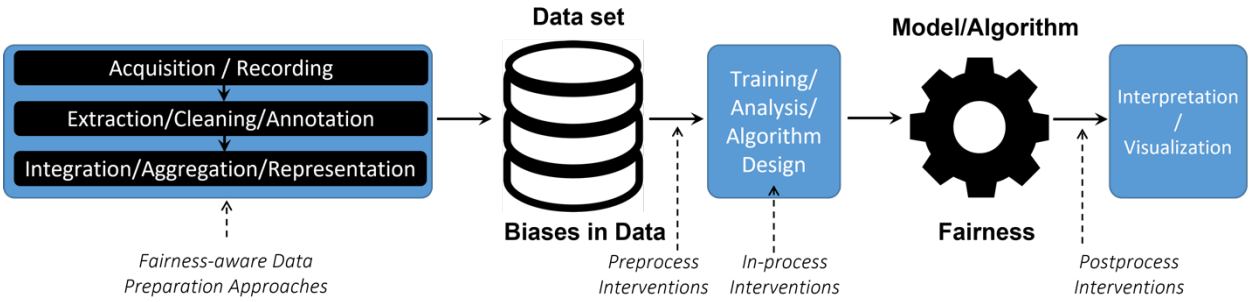
The course will explore different aspects of responsible data science and study the societal impacts of data-driven and algorithmic decision making. While a major focus of the course will be on Algorithmic Fairness, other aspects such as transparency and reliability (stability) will also be covered.

Credit: 4 graduate hours.

Prerequisites (**soft requirement**): The course will be accessible to students with a wide range of backgrounds, and we expect CS students working in a variety of applied areas to enroll for the course.

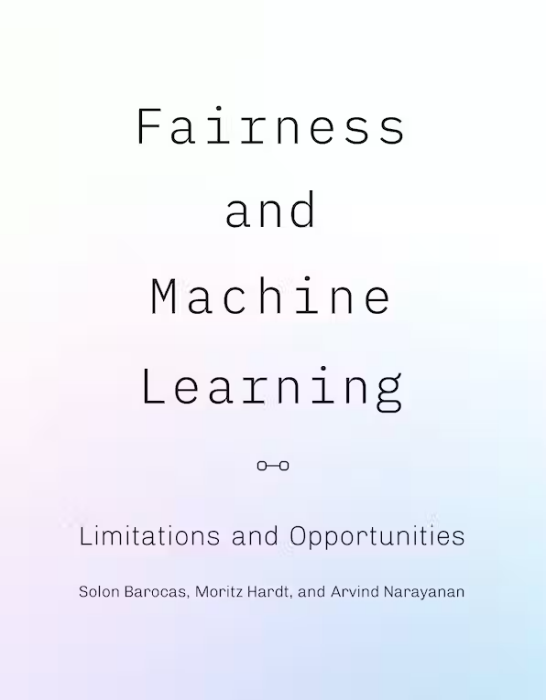
1. CS 401-Algorithms I or equivalent: an undergraduate background in algorithms analysis
2. CS 412 or CS 418 or equivalent: an undergraduate background in data science/machine learning

A high-level outline of topics:



- Introduction and background: Course outline, aspects of responsibility in data science through recent examples.
- Responsibility Terms: Fairness, Transparency, Stability, Equity, Diversity, etc.
- A Taxonomy of Fairness Definitions: Individual v.s. Group fairness, Statistical v.s. Societal Norms of Fairness, Fairness based on Model Independence v.s. Separation, Intersectional Fairness, Diversity as Fairness;
- Fairness in Machine Learning
- Fairness in Ranking and Recommendation
- Bias in Data
- Fairness-aware Data Curation
- Generative AI and Fairness
- Bias in Data Presentation
- Fair Algorithm Design
- Fairness-aware Data Structures

Required and Recommended Course Materials



- (TextBook) Barocas, Solon, Moritz Hardt, and Arvind Narayanan. ``**Fairness in machine learning. Limitations and Opportunities**''. ISBN 9780262048613, December 19, 2023. The MIT Press (Free Online: https://fairmlbook.org/).

Respect for Copyright
Please protect the copyright integrity of all course materials and content. Please do not upload course materials not created by you onto third-party websites or share content with anyone not enrolled in our course.

III. COURSE POLICIES & CLASSROOM EXPECTATIONS

Grading Policy and Point Breakdown

The final exam will be comprehensive. Each assignment will involve solving some exercise problems and/or writing programs implementing some algorithm. Assignments must be handed in class on the date specified. Discussions with other students about assignments is allowed, but the work handed in must be the student's own work.

Class Discussions/Participation	25%
Programming Assignment	30%
Research Project:	
■ Proposal (Motivation)	5%
■ Technical Merit	15%
■ Presentation	10%
■ Report	15%

Grading Policy

Course grades **will be curved as necessary**, based on each student's total numeric score for all coursework at the end of the semester. In general, the marking scheme for this class will be as follows:

A = 90-100; B = 80-89; C = 70-79; D = 60-70; F = Below 60.

These standards may be adjusted for certain exams or homework. These adjustments will be announced in class as the exam/homework is handed back.

Any request for reconsideration of any grading on coursework **must be submitted within one week of when it is returned**. Any coursework submitted for reconsideration may be regarded in its entirety, which could result in a lower score if warranted.

Depending on class performance, the scale may be adjusted to compensate (e.g. 89% may become an A) but at the very least, the cutoffs listed above are guaranteed (e.g. a 91% will not become a B). You can use this straight grading scale as an indicator of your minimum grade in the course at any time during the course. You should keep track of your own points so that at any time during the semester you may calculate your minimum grade based on the total number of points possible at that particular time.

Policy for Missed or Late Work

Late assignments: Late assignments will not, in general, be accepted. They will never be accepted if the student has not made special arrangements with me at least one day before the assignment is due. If a late assignment is accepted it is subject to a reduction in score as a late penalty.

Incompletes: The UIC Undergraduate catalog states that in addition to needing excellent justification for an incomplete, a student must also have been "making satisfactory progress" in the course.

Statute of limitations: No grading questions or complaints, no matter how justified, will be listened to one week after the item in question has been returned.

Cheating: Cheating will not be tolerated. All work you submitted must be entirely your own. Any suspicious similarities between students' work (this includes homework and exams) will be recorded and brought to the attention of the Dean. The MINIMUM penalty for any student found cheating will be to receive a 0 for the item in question, and dropping your final course grade one letter. The MAXIMUM penalty will be expulsion from the University.

Classroom Conduct: Classroom discussions and questions are a valuable part of the learning process and are encouraged. However, students who repeatedly talk among themselves disrupting the class lecture will be asked to leave.

Attendance / Participation Policy

Please email me if you face an unexpected situation that may impede your attendance, participation in required class and exam sessions, or timely completion of assignments.

Other Course Policies: *(UIC Syllabus Policy and HLC PRIORITY SECTION)*

Academic Integrity

UIC is an academic community committed to providing an environment in which research, learning, and scholarship can flourish and in which all endeavors are guided by academic and professional integrity. In this community, all members including faculty, administrators, staff, and students alike share the responsibility to uphold the highest standards of academic honesty and quality of academic work so that such a collegial and productive environment exists.
As a student and member of the UIC community, you are expected to adhere to the Community Standards of integrity, accountability, and respect in all of your academic endeavors. When accusations of academic dishonesty occur, the Office of the Dean of Students investigates and adjudicates suspected violations of this student code. Unacceptable behavior includes cheating, unauthorized collaboration, fabrication or falsification, plagiarism, multiple submissions

without instructor permission, using unauthorized study aids, coercion regarding grading or evaluation of coursework, and facilitating academic misconduct. Please review the UIC Student Disciplinary Policy for additional information about the process by which instances of academic misconduct are handled towards the goal of developing responsible student behavior.

By submitting your assignments for grading you acknowledge these terms, you declare that your work is solely your own, and you promise that, unless authorized by the instructor or proctor, you have not communicated with anyone in any way during an exam or other online assessment, and that submitted work is your own unless the assignment explicitly is intended to be done in a group. You are NOT ALLOWED to use Generative AI and Large Language Models (such as ChatGPT).

We use an automatic cheating-verification program that is capable of detecting partial logical similarities of answers. Don't even take the risk! Do NOT use or post to Chegg or any similar Website.

Plagiarism is a serious matter and will be treated as such. You may be penalized by failing the course. Any student caught will have a grade of zero on the assignment, will have a drop in their letter grade at the end of the semester, and will be reported to the Dean of Students. This applies to each offense. Details on this are given on the Academic Integrity page (link: https://dos.uic.edu/community-standards/academic-integrity/) and you can view the Student Disciplinary Policy at this link: https://dos.uic.edu/wp-content/uploads/sites/262/2018/10/DOS-Student-Disciplinary-Policy-2018-2019-FINAL.pdf).

We believe that each and every one of you is able to learn the material and complete assignments on your own! If you do find yourself struggling, please reach out to any of us on the instructional staff and ask for help rather than simply turning in work that you did not complete yourself. It is far better to earn a low score on the assignment than to have an Academic Integrity violation on your record, especially towards the beginning of your academic Career.=.

Email Expectations

Students are responsible for all information instructors send to your **UIC email and Blackboard accounts**. Faculty messages should be regularly monitored and read in a timely fashion. All critical announcements, changes to assignments, etc. will be announced with **Blackboard announcement**. We are assuming that you check your email regularly, at the very least once every 24 hours

IV. COURSE SCHEDULE

Tentative Weekly Schedule of Class Topics, Assignments, Due Dates

Date	Topic	Reading	Notes
Monday, January 13, 2025	Course Introduction		
Wednesday January 15, 2025	Motivation -- Potential Harms of Data-driven Systems	O'neil, Cathy. Weapons of math destruction: How big data increases inequality and threatens democracy. Crown, 2017.	
Monday, January 20, 2025	Martin Luther King Jr. Day -- No Classes		
Wednesday, January 22, 2025	Throught the lens of Fairness: An overview of Data Analytics System	Barocas, Solon, and Andrew D. Selbst. "Big data's disparate impact." Calif. L. Rev. 104 (2016): 671.	
Monday, January 27, 2025	(i) Different Aspects of Responsible AI. (ii) Fairness Definitions	Barocas, Solon, Moritz Hardt, and Arvind Narayanan. ``Fairness in machine learning. Limitations and Opportunities''. ISBN 9780262048613, December 19, 2023. The MIT Press (Free Online: https://fairmlbook.org/).	
Wednesday, January 29, 2025	Fairness Definitions; Fairness Interventions	https://fairmlbook.org/classification.html	
Monday, February 3, 2025	Fair ML: Preprocess Interventions	Mehrabi, Ninareh, et al. "A survey on bias and fairness in machine learning." ACM computing surveys (CSUR) 54.6 (2021): 1-35. [2] Caton, Simon, and Christian Haas. "Fairness in machine learning: A survey." ACM Computing Surveys 56.7 (2024): 1-38. [3] Pessach, Dana, and Erez Shmueli. "A review on fairness in machine learning." ACM Computing Surveys (CSUR) 55.3 (2022): 1-44.	Project Proposal Deadline

Wednesday, February 5, 2025	**Fair ML: Inprocess Interventions**		**Programming Assignment 1 posted**
Monday, February 10, 2025	**Fair ML: Causal Fairness**	**https://fairmlbook.org/pdf/causal.pdf**	
Wednesday, February 12, 2025	**Fair Ranking -- Part I: Score-based Ranking**	**[1] Zehlike, Meike, Ke Yang, and Julia Stoyanovich. "Fairness in ranking, part i: Score-based ranking." ACM Computing Surveys 55.6 (2022): 1-36. [2] Pitoura, Evaggelia, Kostas Stefanidis, and Georgia Koutrika. "Fairness in rankings and recommendations: an overview." The VLDB Journal (2022): 1-28.**	**Programming Assignment 1 Deadline**
Monday, February 17, 2025	**Fair Ranking -- Part II: Learned Ranking**	***Zehlike, Meike, Ke Yang, and Julia Stoyanovich. "Fairness in ranking, part ii: Learning-to-rank and recommender systems." ACM Computing Surveys 55.6 (2022): 1-41.***	**Programming Assignment 2 posted**
Wednesday, February 19, 2025	**Fair Recommendation. Bias in Data: Different Sources&Types of Bias**	**[1] Li, Yunqi, et al. "Fairness in recommendation: A survey." arXiv preprint arXiv:2205.13619 (2022). [2] Mehrabi, Ninareh, et al. "A survey on bias and fairness in machine learning." ACM computing surveys (CSUR) 54.6 (2021): 1-35.**	
Monday, February 24, 2025	**Bias in Data: Representation Bias**	**Shahbazi, Nima, et al. "Representation bias in data: A survey on identification and resolution techniques." ACM Computing Surveys 55.13s (2023): 1-39.**	**Programming Assignment 2 Deadline**
Wednesday, February 26, 2025	**Bias in Data: Data-centric Warnings Fairness-aware Data Curation: Data Imputation**	***[1] Shahbazi, Nima, and Abolfazl Asudeh. "Reliability evaluation of individual predictions: a data-centric approach." The VLDB Journal (2024): 1-28. [2] Feng, Raymond, Flavio Calmon, and Hao Wang. "Adapting fairness interventions to missing values." Advances in Neural***	

		Information Processing Systems 36 (2024)	
Monday, March 3, 2025	**Data Curation: Data Integration; Entity Matching**	**[1] Nargesian, Fatemeh, Abolfazl Asudeh, and H. V. Jagadish. "Tailoring data source distributions for fairness-aware data integration." Proceedings of the VLDB Endowment 14.11 (2021): 2519-2532. [2] Shahbazi, Nima, et al. "Through the Fairness Lens: Experimental Analysis and Evaluation of Entity Matching." Proceedings of the VLDB Endowment 16.11 (2023): 3279-3292. [3] Shahbazi, Nima, et al. "FairEM360: A Suite for Responsible Entity Matching." arXiv preprint arXiv:2404.07354 (2024).**	
Wednesday, March 5, 2025	**Data Curation: Query Rewriting; Minority Mining**	**[1] Shetiya, Suraj, et al. "Fairness-aware range queries for selecting unbiased data." 2022 IEEE 38th International Conference on Data Engineering (ICDE). IEEE, 2022. [2] Dehghankar, Mohsen, and Abolfazl Asudeh. "Mining the Minoria: Unknown, Under-represented, and Under-performing Minority Groups." arXiv preprint arXiv:2411.04761 (2024).**	
Monday, March 10, 2025	**GenAI for Data Curation: Chameleon; Entity Matching**	**Erfanian, Mahdi, H. V. Jagadish, and Abolfazl Asudeh. "Chameleon: Foundation models for fairness-aware multi-modal data augmentation to enhance coverage of minorities." arXiv preprint arXiv:2402.01071 (2024).**	
Wednesday, March 12, 2025	**GenAI&Responsibility: Overview**	**[1] Li, Yingji, et al. "A survey on fairness in large language models." arXiv preprint arXiv:2308.10149 (2023). [2] Gallegos, Isabel O., et al. "Bias and fairness in large language models: A survey." Computational Linguistics (2024): 1-79.**	

Monday, March 24, 2025	**Spring Break -- No Classes**		
Wednesday, March 26, 2025	**Spring Break -- No Classes**		
Monday, March 31, 2025	**GenAI&Responsibility: Fairness Interventions**	**Gallegos, Isabel O., et al. "Bias and fairness in large language models: A survey." Computational Linguistics (2024): 1-79.**	
Wednesday, April 2, 2025	**GenAI&Responsibility: Requal-LM; AXOLOTL; Input Reranking**	**[1] Ebrahimi, Sana, et al. "AXOLOTL: Fairness through Assisted Self-Debiasing of Large Language Model Outputs." In IEEE ICKG (2024). [2] Ebrahimi, Sana, Nima Shahbazi, and Abolfazl Asudeh. "REQUAL-LM: Reliability and Equity through Aggregation in Large Language Models." In NAACL (2024). [3] Dehghankar, Mohsen, and Abolfazl Asudeh. "Rank It, Then Ask It: Input Reranking for Maximizing the Performance of LLMs on Symmetric Tasks." arXiv preprint arXiv:2412.00546 (2024).**	
Monday, April 7, 2025	**Bias In (Cherry-picked) Data Presentation: Ranking; Trendlines; News Ordering**	**Asudeh, Abolfazl, et al. "Perturbation-based Detection and Resolution of Cherry-picking." A Quarterly bulletin of the Computer Society of the IEEE Technical Committee on Data Engineering 45.3 (2021).**	
Wednesday, April 9, 2025	**Fairness in Algorithm Design: Clustering**	**[1] Chhabra, Anshuman, Karina Masalkovaitė, and Prasant Mohapatra. "An overview of fairness in clustering." IEEE Access 9 (2021): 130698-130720. [2] Mehrdad Ghadiri, Samira Samadi, and Santosh Vempala. 2021. Socially Fair k-Means Clustering. In FAccT, 2021**	
Monday, April 14, 2025	**Fairness in Algorithm Design:**	**[1] Dehghankar, Mohsen, et al. "Fair Set Cover." In KDD 2025. [2] Asudeh, Abolfazl, et al. "Maximizing coverage**	

	Set Cover; Max Cover	**while ensuring fairness: A tale of conflicting objectives." Algorithmica 85.5 (2023): 1287-1331.**	
Wednesday, April 16, 2025	**Fairness-aware Data Structures: Fairhash**	**Shahbazi, Nima, Stavros Sintos, and Abolfazl Asudeh. "FairHash: A Fair and Memory/Time-efficient Hashmap." Proceedings of the ACM on Management of Data 2.3 (2024): 1-29. [2] Aumuller, Martin, et al. "Fair near neighbor search via sampling." ACM SIGMOD Record 50.1 (2021): 42-49.**	
Monday, April 21, 2025	**Project Presentation**		
Wednesday, April 23, 2025	**Project Presentation**		
Monday, April 28, 2025	**Project Presentation**		
Wednesday, April 30, 2025	**Project Presentation**		

Disclaimer

This syllabus is intended to give the student guidance on what may be covered during the semester and will be followed as closely as possible. However, as the instructor, I reserve the right to modify, supplement, and make changes as course needs arise. I will communicate such changes in advance through in-class announcements and in writing via Blackboard Announcements.

V. ACCOMMODATIONS

Disability Accommodation Procedures

UIC is committed to full inclusion and participation of people with disabilities in all aspects of university life. If you face or anticipate disability-related barriers while at UIC, please connect with the Disability Resource Center (DRC) at drc.uic.edu, via email at drc@uic.edu, or call (312) 413-2183 to create a plan for reasonable accommodations. To receive accommodations, you

will need to disclose the disability to the DRC, complete an interactive registration process with the DRC, and provide me with a Letter of Accommodation (LOA). Upon receipt of an LOA, I will gladly work with you and the DRC to implement approved accommodations.

Religious Accommodations

Following campus policy, if you wish to observe religious holidays, you must notify me by the tenth day of the semester. If the religious holiday is observed on or before the tenth day of the semester, you must notify me at least five days before you will be absent. Please submit this form by email with the subject heading: **"YOUR NAME: Requesting Religious Accommodation."**

VI. CLASSROOM ENVIRONMENT

Inclusive Community

UIC values diversity and inclusion. Regardless of age, disability, ethnicity, race, gender, gender identity, sexual orientation, socioeconomic status, geographic background, religion, political ideology, language, or culture, we expect all members of this class to contribute to a respectful, welcoming, and inclusive environment for every other member of our class. If aspects of this course result in barriers to your inclusion, engagement, accurate assessment, or achievement, please notify me as soon as possible.

Name and Pronoun Use

If your name does not match the name on my class roster, please let me know as soon as possible. My pronouns are *he/him*. I welcome your pronouns if you would like to share them with me. For more information about pronouns, see this page: https://www.mypronouns.org/what-and-why.

Community Agreement/Classroom Conduct Policy

- Be present **by turning off cell phones** and removing yourself from other distractions.
- Be respectful of the learning space and community. For example, **no side conversations** or unnecessary disruptions.
- Use preferred names and gender pronouns.
- **Assume goodwill in all interactions**, even in disagreement.
- Facilitate dialogue and value the free and safe exchange of ideas.
- Try not to make assumptions, have an open mind, seek to understand, and not judge.
- Approach discussion, challenges, and different perspectives as an opportunity to "**think out loud**," learn something new, and understand the concepts or experiences that guide other people's thinking.
- Debate the concepts, not the person.

- Be gracious and open to change when your ideas, arguments, or positions do not work or are proven wrong.
- Be willing to work together and **share helpful study strategies**.
- **Be mindful of one another's privacy**, and do not invite outsiders into our classroom.

Content Notices and Trigger Warnings

Our classroom provides an open space for a critical and civil exchange of ideas, inclusive of a variety of perspectives and positions. Some readings and other content may expose you to ideas, subjects, or views that may challenge you, cause you discomfort, or recall past negative experiences or traumas. I intend to discuss all subjects with dignity and humanity, as well as with rigor and respect for scholarly inquiry. If you would like me to be aware of a specific topic of concern, please email or visit my Student Drop-In Hours.

VII. RESOURCES: Academic Success, Wellness, and Safety

We all need the help and the support of our UIC community. Please visit my **office hours** for course consultation and other academic or research topics. For additional assistance, please contact your assigned college advisor and visit the support services available to all UIC students.

Academic Success

- UIC Tutoring Resources
- College of Engineering tutoring program
- Equity and Inclusion in Engineering Program
- UIC Library and UIC Library Research Guides.
- Offices supporting the UIC Undergraduate Experience and Academic Programs.
- Student Guide for Information Technology

Wellness

- **Counseling Services**: You may seek free and confidential services from the Counseling Center at https://counseling.uic.edu/.
- Access U&I Care Program for assistance with personal hardships.
- **Campus Advocacy Network**: Under Title IX, you have the right to an education free from any form of gender-based violence or discrimination. To make a report, email TitleIX@uic.edu. For more information or confidential victim services and advocacy, visit UIC's Campus Advocacy Network at http://can.uic.edu/.

Safety

- UIC Safe App—PLEASE DOWNLOAD FOR YOUR SAFETY!
- UIC Safety Tips and Resources
- Night Ride

- Emergency Communications: By dialing 5-5555 from a campus phone, you can summon the Police or Fire for any on-campus emergency. You may also set up the complete number, (312) 355-5555, on speed dial on your cell phone.

Syllabus Revision

The standards and requirements set forth in this syllabus may be modified at any time by the course instructor. Notice of such changes will be by Canvas announcement or email notice.

Disclaimer

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