Law and Algorithms – Spring 2023 Syllabus

A joint class between the School of Law and the faculty of Computing and Data Sciences
CDS 657 & 457 / JD 673

This cross-cutting and interdisciplinary graduate course, taught jointly between the School of Law, the Faculty of Computing and Data Sciences, and the Department of Computer Science, investigates the role that algorithms and automated decision-making systems play in law and society. The course connects legal and computational concepts of transparency, trustworthiness, privacy, secrecy, bias, discrimination, and fairness through a series of case studies that present recent applications of technology to legal and regulatory situations and explore the challenges in regulating algorithms and using algorithms in legal systems.

Legal concepts explored will include evidence and expert witnesses, anti-discrimination law concepts of disparate impact and disparate treatment, regulation of voting and the census, sectoral information privacy regimes, and public access and transparency laws. Computational concepts explored will include software design and development, artificial intelligence and machine learning, differential privacy, and zero-knowledge proofs.

Grades will be based on a series of assignments that correspond with each case study, to be completed collaboratively in mixed teams of law and computing/data science students.

1. Instructor Information

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Please use email or Microsoft Teams to schedule a time to meet. Note that meetings will likely be a mix of in-person or over Zoom.

2. Course Websites

For course readings: https://cs-people.bu.edu/kaptchuk/teaching/ds457/sp23-classpage.html
For class discussions and announcements: see our Microsoft Teams page.

We have opted to use Microsoft Teams as our main base of operation as it is available to all students at the university. CS & CDS students don't have access to Law's default platform (Blackboard) and Law students don't have access to CS & CDS' default platform (Piazza). You will be invited to join the Microsoft Teams channel through your @bu.edu email accounts. More information about BU's use of Teams can be found here, and we recommend that you download the desktop version of the app to make your access easier. (You may, but are not expected, to download a smartphone version of the app at the same link.)

Please refer to these resources for the most recent assignments and reading material. We will try to avoid alterations to class material with less than a week's notice. If there ever are last-minute changes, we will let you know.

3. Course Information

Meetings: Thursdays, 2:10—4:10pm, Jan. 19 to April 20 (except March 9)
Location: BU Law Tower, Room 203 (***note the changed room from the earlier syllabus***)
Credit Hours: For CDS 457 & 657: 4 Credits
For JD 673: 3 Credits

To account for the difference in credits, CDS/CS students will have an additional assignment at the end of the semester and obligations related to review of readings for each class day. More information will be distributed separately.

For the law students, per ABA guidelines you should anticipate a workload of roughly 42.5 hours per credit for the semester, which includes both in-class and out-of-class time. For elaboration, you may consult BU Law's Credit Hour Policy.

4. Course Objectives

The goal of this class is to help both law and computer/data sciences students to understand the importance of the other's field to their home discipline, and how law and algorithms work in concert to regulate human behavior. We specifically expect that students will:

- Learn and appreciate the complicated relationship between law and algorithmic systems, and how the two act as interrelated regulators with different systems of adjudication and affordances for human input.
- Understand the fundamental systems of law as they relate to algorithmic regulation including basics of the common law system, as well as the rules and policies that inform the legal domains addressed in our case studies, including evidence, administrative law, legislation, criminal procedure, intellectual property, anti-discrimination law, election law, and information privacy.
- Understand the fundamental systems of computing and data sciences as they relate to law and policy questions, including computational thinking, probabilities, optimization, cryptography, artificial intelligence and machine learning, zero-knowledge proofs, differential privacy, and risk-limiting audits.
- Examine how both law and computer/data science reinforce and counter broader powers within social systems, including how both can perpetuate or mitigate bias and discrimination in criminal, civil, and administrative systems.
- Consider the limitations of both law and computing systems, including how to spot errors, pitfalls, overlooked values, and other shortcomings in both software and legal systems, and how one might address those shortcomings.
- Learn how to communicate concepts from their home discipline to those working in either law or computer/data science, and how to collaborate across disciplines to achieve mutual goals and policy outcomes.

5. Prerequisites

There are no course prerequisites and no prior cross-disciplinary experience is required to participate in this course. What do we expect, though, is that each student come willing to work hard to understand the other side's discipline and how it relates to your home discipline. We discuss more about good cross-disciplinary collaboration in Section 9 below.

For law students, we ask that you come to the class with an open mind for computer science and mathematical thinking and vocabulary, and a willingness to explore the way in which algorithms practically operate in computational systems.

For CS/CDS students: we think you will get the most out of this course if you have a good grasp of computer systems, algorithms and their analysis, AI basics, and computer security. We also ask that you come to the class with an open mind for understanding legal thinking and language, as well as the social aspects of information systems. Finally, we ask that you come to the class willing to complete assignments that may be different from other CS/CDS courses, including completing significant amounts of reading and persuasive essay writing.

While this is primarily a graduate level course, advanced undergraduate students in CS and CDS may enroll after receiving permission from the instructors.

6. Course Materials

There are no required textbooks for this course, and all class material will be free. Readings will be made available through the course websites. The specific readings will be released over the course of the semester, so please refer to the website for the latest information. And because the material will change, do not read more than a week ahead without checking with the instructors first.

For the caselaw readings we'll have this semester we are using the OpenCasebook platform, which allows you to both read our excerpt of the case and click through to see what we're omitting. Unless otherwise indicated, students will be expected only to read/view the article, case excerpt, or blog post indicated, and not any other content on the site.

There may also be optional readings associated with each class day. Optional readings are, indeed, optional. We've selected them because we think they may be interesting or engaging, but you are not required to read them.

The quality of an interdisciplinary class like this really rises and falls on whether the students have done the reading, and we really appreciate the CDS students changing up their usual method of class preparation by doing the reading before each class, and reflecting on the content therein. (We appreciate that from the law students too, of course, but it is more generally expected in legal education.) We ask that all students come to class having carefully read what is assigned and prepared to discuss the readings in class.

7. Classroom Attendance and Expectations

The heart of this class is to provide a forum in which the disciplines of law and computer/data science can learn from each other. That learning is best fostered by active and engaged student participation. To that

end, *we ask that students attend each of the thirteen class sessions and actively participate in* ***every*** *class*. (More on class participation below.)

We are aware that unavoidable conflicts do come up, especially in these times. If one does arise, please contact one of the instructors in advance of the class so we can discuss it. We expect that no student will miss more than two days of class, barring highly unusual circumstances.

Boston University is now back to fully on-campus instruction, but public health concerns remain top of mind, especially with new emergent variants. Please follow all university COVID protocols. Specifically:

- Do not attend class if you show even light COVID symptoms (fever, cough or other respiratory issues, nausea, etc.) or if you have any reason to believe that you are contagious with COVID or have been exposed. Please err on the side of absence; we want to do all we can to protect each other. In the event that you are experiencing symptoms, please inform the instructors before class begins.
- Follow all university- and government-issued COVID protocols, including all requirements related to masking and social distancing.

As you surely know by now, the public health situation with COVID can change abruptly. Please be ready for changes to the classroom format and presentation, including a move to virtual classes if required by the University.

We follow BU's policy on absences for religious observance.

We can record missed classes by request or as needed under a classroom accommodation (see below). In the class participation section below, we discuss how you can still participate asynchronously on days that you miss class.

8. Assignments and Grading

There is no exam for this course. Your performance in the above objectives will be evaluated through active participation in weekly classes, as well as in assignments that engage with our four case studies. Your grade is specifically based on the following:

8.1. Participation (25% of Grade)

You will be expected to have read the assigned readings each week and participate actively in class discussion with substantive contributions. You satisfy this requirement by making *at least one substantive contribution every week*, in one of two ways:

- during the class session, or
- on the Microsoft Teams page in the section for the day's class.

If you choose to participate by making a substantive contribution before class on Microsoft teams, please be sure to post your comment far enough in advance that other students will have time to react to what you say. Adding a comment on Teams is a great way to contribute if you will miss a class or if you prefer written contributions to oral discussion.

8.2. Written Projects (75% of Grade, Split Evenly Across Five Assignments)

Over the course of the semester, students will complete five short projects in mixed Law/CDS teams of three to four students (with each team including at least one Law and one CDS student). You will be randomly assigned to one team for the first two assignments, and then a second team for the final three assignments.

As you will see, these projects will focus on one of the five primary topics that we will explore in this course through our case studies — transparency, trust, privacy, bias, and fairness. The team will be asked to prepare an assignment that addresses a prompt related to the current module and provide both legal and computational analysis on the problem presented. We will expect the project to engage with the relevant written material for the case study, conduct external research as is appropriate for the assignment, and present a response in a way that thoughtfully engages with existing literature and solutions, including any possible consequences or shortfalls in their response.

Further details on each project will follow. Subject to modification based on the pace of the course, the deadlines for each project will be:

A. Trustworthiness & Transparency – due ***before class on February 9***
B. Balancing Secrecy & Trust – due ***before class on March 2***
C. Formalizing Notions of Privacy – due ***before class on March 23***
D. Bias, Differentiation, and Discrimination – due ***before class on April 6***
E. The Overarching Goal of Fairness – due ***before class on April 20***

Students interested in further developing their projects into a more substantial (and potentially publishable) work are welcome to discuss their goals with one of the instructors. We have had successful public papers arise from prior versions of this class.

For law students, though, please note that we do not expect any of these written projects to be enough to satisfy the Law School's upper-level writing requirement, though we can discuss how you can meet that requirement through an alternative assignment.

Assignments will be submitted as Google Docs, and instructions for submission will be included with each assignment.

9. Collaboration Across Disciplines and Assignment Expectations

One key goal of this class is to provide students from either discipline with tools and language that will enable them to meaningfully interact with professionals from the other discipline. For this purpose, we have designed the assignments in this class to center around joint group projects where each group has both law and CS/CDS students. The projects are intentionally open-ended and require depth of understanding on both disciplines, with the explicit goal of fostering lively collaboration and brainstorming within groups.

We also recognize that the open-ended and interdisciplinary character of the projects can lead to some uncertainty and concerns about the roles of students in group projects, and concerns about unequal contribution to projects. Despite interdisciplinary collaboration being a standard part of professional life,

we know that your prior academic experience provides little frame of reference on what's expected of you.

To that end, we expect *all students* to:

- Have read the material from the class days relevant to the assignment in full, as well as the assignment prompt.
- Prepare thoughts as to how you would respond to *all* the prompts in the assignment, and to do so ahead of any discussion meeting that your team may schedule. You should enter your first team meeting with some developed opinions on all aspects of the assignment.
- Engage thoughtfully with your peers across disciplines and collaborate as a team to address the prompts of the assignment.
- Contribute in roughly equal portion to the drafting of the final assignment.
    - *Note:* there can be a temptation in drafting to break these assignments into sections, divide the sections among the students, and have each student write an equal amount in each section. We advise against this, and found this approach to produce lower quality work (and grades) in prior iterations of this course. A thoughtful response to an assignment may require considerably more attention on some of these prompts over others depending on their relative importance. It will often be better to have collaborative writing across all sections.

We expect the CS and CDS students to pay special attention to the computational and CS properties of assignments, to take the lead on any supplemental research needed in the areas of CS and data sciences, and to provide their expert thoughts regarding the computational issues present in the assignment.

We expect the law students to pay special attention to legal and regulatory aspects of assignments, to take the lead on any supplemental research needed in the law, and to provide their expert thoughts regarding the legal and regulatory issues present in the assignment.

We do not want any student:

- Drafting the entire assignment on behalf of the group or serving as the "final editor" of the others' work.
- Confining their opinions only to some of the portions of the assignment.
- Missing internal team deadlines or delaying the team's timely completion of assignments.

And finally, a few level-setting notes on the assignments themselves:

1. We expect the documents to have generous citations, but we do not need sentence-by-sentence citation support like you might see in formal legal writing. Instead, reference the literature as you debate or engage with it, or as you are relying on it to make a substantive factual point.
2. Similarly, we have intentionally not asked for a particular citation format. The most important thing for us is that we can see and understand what literature you are using to make your points, and (when the work is paginated) where in the work we can find the specific substantive support.
3. These are consensus documents. No submission will perfectly capture the views of any one individual on the team, nor should they. We expect some disagreement along the way and some effort made to debate and reach a consensus view.

4. If there is a disagreement on a key question and you are unable to reach a consensus after debate, you may indicate as such in the assignment by presenting the conflicting views and their relative strengths/weaknesses.
5. While we hope there won't be, if there is an interpersonal issue on the team and you are unable to resolve it, please let us know as soon as possible. There is more we can do to remedy that situation if we catch it well in advance of an assignment deadline.
6. If you'd like a little extra coaching with your writing don't forget that BU has its Educational Resource Center that provides writing and other academic skills assistance.

10. Accommodations

Boston University is committed to equal access for students with disabilities. If you have a specific disability and require accommodations in this class, please submit the BU Disability & Access Services (DAS) online Intake Form and contact BU DAS to make an appointment by calling (617) 353- before the start or early in the semester, so that appropriate accommodations can be made in a timely manner. BU DAS will provide the Law Registrar with a letter of approved accommodations. Faculty are only informed of accommodations that may affect the operation of the classroom. Contact information for BU DAS is as follows: (617) 353-3658 V/TTY or access@bu.edu. All discussions with, and written materials provided to, BU DAS will be kept confidential.

An overview of the class-by-class topics follows.

Course Topics

Please note that this is a general overview of the topics we'll have in class this year. The substance is likely to change, so *please refer to the course website for all topics and readings.*

Introduction

We will use our first class to get some core concepts unpacked from both the legal and technical fields. For your new domain, this will serve as an exposure to the key concepts and methods within either law and computation, and how you can begin to approach the questions in that area of study. For your home domain, this will be a chance to think anew about the fundamentals of your discipline.

- *Class 1: Intro to Law, Intro to Algorithms (Jan. 19).* We start the year with a big step back. What even is "law"? What is an "algorithm"? What are some of the fundamental powers and affordances of these two fields? What are their shortcomings? Who wields power in each system, whose values are centered, and who is overlooked?

Module 1: Trustworthiness & Transparency

Our first module of the course will investigate how we assess an algorithm's trustworthiness, and what sorts of insights or transparency into an algorithm's construction and use are needed when an algorithm encounters a legal process. We will focus on the use of *probabilistic genotyping* software—that is, software that estimates the statistical likelihood that a DNA sample (usually one that is too degraded to go through traditional DNA tests) is a match for a particular person. Legal concepts in this module will include evidence in criminal proceedings, due process, and the role of expert witnesses. Computational concepts will include software and software stack development, software verification and validation, and sources of error in programming.

- *Class 2: The Development and Legal Protection of Software (Jan. 26).* This class will build upon our foundations in both law and algorithms and tee up our discussion of a particular probabilistic algorithm. On a theoretical level, we will begin to unpack how the formal and mathematical world of computer science and the procedural and adversarial world of law each approach questions of uncertainty and probability. On a practical level, we will discuss how software is built, how flaws can come into software construction, and how our default protections in intellectual property law (and especially trade secrets law) can put our desire to create an economic incentive for software development at loggerheads with our desire to understand how software is operating.

- *Class 3: Putting the TrueAllele Algorithm on Trial (Feb. 2).* With our knowledge on how software is built and protected, we turn to a particular probabilistic forensic algorithm called TrueAllele. We look at how the rules of evidence and criminal procedure, including the role of scientific expert witnesses, have been applied to interrogate the reliability of TrueAllele. We will also do an in-class exercise to explore what form of transparency seems best suited for probabilistic genotyping algorithms.

The Module 1 assignment will be due before class on February 9.

Introduction to Privacy Concepts

While we will do a whole module on privacy later in the semester, before diving into the next handful of topics it will be important to lay a conceptual foundation around legal and technical notions of privacy. So, we will take one class to lay out the general privacy domain before turning to our next module.

- *Class 4: Foundational Concepts in Privacy and Secrecy (Feb. 9).* We will unpack what both law and computer science mean by "privacy," and how it is distinct from related concepts like "secrecy," "security," or "encryption." We'll unpack some of the technical concepts that will be foundational to our understanding of these concepts—including encryption, hashes, signatures, and zero-knowledge proofs—and explore how some of the same mathematical foundations can be utilized in ways that amplify or deteriorate different legal notions of privacy.

Module 2: Balancing Secrecy & Trust

As we will see from our module on transparency and trustworthiness, it is very hard to get perfect insight into how a complex system (either legal or computational) is operating, and even if one could, it would simply take too much time to verify every system we encounter. And of course, there are times where full transparency will result in social harms. We therefore need some notion of trust—that is, reliance on a claim of a person or machine without independent validation. But where to place that trust, and how to calibrate that trust, is a difficult question. We'll explore that question through the world of election law, and in particular, the facilitation of the vote and vote count. Legal topics in this module will be primarily related to election administration and related cybersecurity laws. CS/CDS concepts will include software security, risk limiting audits, and "end-to-end voter verifiable" systems.

- *Class 5: Trust in Vote Architecture, Trust in Vote Tallies (Feb. 16).* In a democratic republic like ours so much comes down to votes, and in particular our participation and trust in elections. Today we examine the security, privacy, and accountability properties we expect out of a voting system, and how they map onto our systems of voting. We will look at the different technologies that are used for voting, and the ways in which votes are counted at the conclusion of an election.

- *Class 6: The Challenge of "Proof of Inclusion" (Feb. 23).* While the material from class 5 will likely have you feeling pretty good about how we conduct elections (especially those with optical scan paper ballots), there is an identified value to a good voting scheme that's currently missing. No voting system in the United States employs "proof of inclusion," that is, some way for me to verify that *my* ballot was included in the reported totals. We'll explore some alternative voting schemes that provide that guarantee on a technical level and explore whether the addition of that value using one of these schemes would improve or harm our overall trust in the system.

The Module 2 assignment will be due before class on March 2.

Module 3: Formalizing Notions of Privacy

We now dive deeper into privacy. We look more at "formal" or technical definitions of privacy versus legal definitions of privacy. We will explore the growing literature on anonymization and "reidentification science," and the technical concept of *differential privacy*. We'll explore how differential privacy has been

deployed in a few different legal domains, including under sectoral data privacy laws and, most significantly, as a part of the 2020 decennial census.

- *Class 7: Anonymization, Identification, and Differential Privacy (March 2).* Much of privacy law in the United States assumes that some information is "personally identifiable" and some is instead "anonymized," and draws different rules for those two categories. But a wealth of computational literature over the past two decades has shown that distinction is not a clean line, and much of what we think of as "anonymized" data is in fact re-identifiable under many conditions. This has led to the adoption of a rigorous mathematical concept of privacy, "differential privacy," which carefully injects noise into datasets in a way that allows for aggregate insights while not permitting an observer to prove anything about the truth of any particular row of data. We will explore how differential privacy works, its privacy guarantees, and how well it holds up when disclosing information under different sectoral information privacy laws.

No class March 9 – Spring Break

- *Class 8: Bringing Differential Privacy to the Census (March 16).* The decennial national census is a profound moment of data collection, which generates over a billion pieces of information about the United States population. In law it is used to apportion members of Congress between states and draw up both congressional and local districts. And for the social sciences, census data is the backbone to a staggering amount of empirical research. The Census Bureau wants to collect granular information about the population but has very strict laws against disclosing individually-identifiable information. To balance those concerns, the Bureau chose to employ differential privacy for the 2020 count. That led to a lot of pushback, alterations of the plan by the Bureau, and even a lawsuit from the State of Alabama. We'll use this deployment of differential privacy to examine what we trade off as we move to formal notions of privacy.

The Module 3 assignment will be due before class on March 23.

Module 4: Bias, Differentiation, and Discrimination

Voting is one of several areas of activity where we have specific anti-discrimination laws, and next we will broaden out from voting to look at anti-discrimination laws more generally. Concerns about bias in technology have become an area of robust national attention, especially when considering the use of more emergent and unpredictable algorithms like artificial intelligence and machine learning systems for housing, employment, credit-worthiness, and other determinations. For this module we'll dig into AI/ML models, the various ways they can inject bias into a decision-making system, the mechanics of laws that prohibit discrimination in these domains, and just how challenging it can be to computationally and legally "de-bias" an algorithm.

- *Class 9: Artificial Intelligence and Anti-Discrimination Laws (March 23).* We'll begin exploring the interplay of law with artificial intelligence and machine learning, through the lens of federal anti-discrimination laws. We'll unpack what AI/ML systems are, how they work, and how bias can enter such systems. We'll also look at the general regulatory structure of anti-discrimination law and its concepts like "disparate treatment," "disparate impact," and the mechanics of proving algorithmic discrimination under these laws.

- *Class 10: Mitigating Bias in AI (March 30).* Even if you know how to detect bias in an algorithmic system, the act of correcting that bias ends up being harder than one might think. Anti-discrimination law's tendency to see any differentiation on the basis of a protected class as potentially actionable makes it very difficult to know when corrective measures to address disparate treatment may be viewed as unlawful disparate impact. And efforts to computationally design systems to avoid disparate impact may result in unlawful quotas or miss the various ways discrimination extends beyond the so-called "four fifths rule" from disparate impact caselaw. We'll explore these tensions with an in-class simulation of trying to de-bias an employment algorithm.

The Module 4 assignment will be due before class on April 6.

Module 5: The Overarching Goal of Fairness

As we draw to a close in the semester, we will look at the highly contentious question of what we generally expect algorithms to do when used in social settings. Very often we shorthand our expectations to a requirement that algorithms be "fair," but what does that even mean? How is fairness similar to or distinct from the concerns around bias, transparency, trustworthiness, and the other values above? What are our criteria for evaluating whether an algorithm is fair, and what are the tradeoffs we are making when we come up with those criteria? To explore this, we will turn to one of the most famous collisions between law and algorithms: the COMPAS criminal risk assessment algorithm, and its use in both bail and sentencing determinations in criminal law.

- *Class 11: The COMPAS Algorithm and the Optimization Paradox (April 6).* In many ways the contemporary discussion of algorithmic accountability kicked off with the 2016 exposé in *Pro Publica* about COMPAS, and the substantial fairness issues in the algorithm. We'll review the COMPAS story and how the Supreme Court of Wisconsin approached fairness challenges to the use of the algorithm. We'll also review a curious statistical issue that emerged from the COMPAS saga around the inherent tradeoffs that must be made between an algorithm's predictive value and its error rates.

- *Class 12: Is There a "Right" Way to Use Algorithms in Criminal Sentencing? (April 13).* The errors of COMPAS were clear, but it is equally clear that there will be continued calls to use such algorithms in criminal sentencing to safeguard against human errors and unfairness. So, should we? What should that look like? On what data should those algorithms base their risk assessments? What safeguards, limits, and standards should apply? Or, should we abandon them entirely, and would that leave us in a more fair space?

The Module 5 assignment will be due before class on April 20.

Synthesis

Finally, we'll close our class by discussing how we can intelligently address issues at the intersection of law and algorithms, and what lessons we can take from these case studies.

- *Class 13: Law and Algorithms (April 20).* We'll examine some of the big-picture proposals for algorithmic regulatory reform, and discuss which proposals we think best capture all of the competing values and concerns that we've identified over the semester.