CS4100: Mon - Thu, 9:50 am - 11:30 am, Richards Hall 458
CS5100: Mon - Thu, 11:40 am - 1:20 pm, Hurtig Hall 130

Instructor: Raj Venkat
Email: r.venkatesaramani@northeastern.edu
Office: Meserve 303

Course Webpage: venkat.prof/CS4100 or venkat.prof/CS5100
24/7 Q&A: Campuswire (group join code 1097)
Submissions: Gradescope (See individual HW instructions)

Contents

1 Overview

1.1 Course Description

Computers are incredibly dumb. However, they can be programmed to appear incredibly clever using fancy mathematics. This introductory course on Artificial Intelligence covers: a) search, planning, constraint-satisfaction problems, and games, b) how to work with uncertainty in the environment, c) foundations of ML, reinforcement learning, NLP, and recent developments, d) ethical questions about the use of AI.

1.2 Required Background

Students are expected to have strong programming foundations, preferably in Python 3, which will be extensively used in this course. Prior formal coursework in algorithms is advisable. We will also rely on fundamentals of linear algebra, probability, and some preliminary calculus. While these are not formal prerequisites, students without prior experience should expect to spend additional time outside of lectures/assignments to build these foundations within the first 2 weeks, with the help of provided resources.

1.3 Attendance Policies

The last 2-3 lectures of the semester will be devoted to in-class final project presentations. Note that these dates are different for CS4100/5100 - please refer to the academic calendar on the Registrar's website. Attendance is mandatory for all students and will be recorded during this time. Exceptions will only be granted for genuine and unforeseen emergencies. Please plan your end-of-semester travel accordingly. Travel plans for this period booked prior to the start of the semester are not a valid reason to request an exemption to this policy; if such travel is unavoidable, students are advised to take this course in a later semester, when they are able to be present in Boston for the whole duration of the course.

1.4 Rigor, Engagement & Support

The material presented in this course is inherently mathematical and often quite complex, and the best way to learn is to engage with me during lectures and take detailed notes. While I do not record attendance during the rest of the semester, students are strongly advised to regularly attend class. Past iterations of this course have shown that students who regularly attend lectures and office hours, and engage deeply with the final project, achieve positive outcomes in terms of course performance and satisfaction, as well as offers for internships/co-ops in AI/ML related roles.

In addition to being your instructor, I hope you also think of me as an advisor/mentor whom you can freely talk to for any reason[1]. I am open to questions about anything that has to do with your education, even if it does not strictly fall within the scope of CS5100. I strive to foster a nonjudgmental learning environment at all times, and I am never inconvenienced by a student reaching out for support.

[1] You should be aware that faculty are mandatory reporters at Northeastern. See section 4.2.

1.5 Time Management, Grading, Regrade Requests

A college degree or graduate school is as challenging as it is rewarding. You are bound to have conflicting deadlines from multiple courses and co-op related activities, but a crucial part of your learning experience is figuring out a time-management strategy that allows you to deliver on all fronts. Graduate school, in particular, also places significant emphasis on the precision of writing and a student's ability to meet all expectations communicated through instructions.

Requests for extensions to submissions due to poor time management will be denied. Choosing to prioritize a different course, or co-op applications and interviews, etc. is your prerogative, but you do so with the understanding that no additional flexibility will be provided outside of course policies, except in genuine emergency situations. I also expect students to read and adhere to any provided assignment instructions, and expectations communicated through course announcements throughout the semester.

Regrade requests are intended to address potential grading errors, not to serve as an avenue for negotiation. Rubrics are designed with expected outputs and writing quality in mind, developed in close collaboration with the TA team to reflect both course standards and student perspectives. These rubrics are applied fairly and consistently across the class. While effort is valuable, it is inherently subjective and varies greatly among students. There is no way for me to evaluate effort objectively. If you believe there was an oversight in grading - such as missing points for a rubric item that your answer addressed, or if something was overlooked - please feel free to submit a regrade request.

Please note that submitting a regrade request may result in the entire question being regraded from scratch by me. While I strive for fairness and consistency, my experience often allows me to identify more nuanced mistakes that may have been overlooked during the initial grading by the TA team. As a result, a regrade could lead to an increase in your score, but it could also result in a decrease if additional errors are found. I encourage you to carefully review your submission and the rubric before deciding to request a regrade.

1.6 Late Joiners

Please note that by joining the course late, you knowingly accept the responsibility of catching up on missed material and should not expect any preferential treatment or adjustments to deadlines. For any assignments due before the add deadline, you will have 5 days from your join date to submit them. For any assignments released on or after the add date, no additional extensions will be provided. You will need to work on multiple submissions in parallel if you join late.

Please stop by my office hours, or book an appointment with me, and I will be more than happy to briefly review content (provided you go over the relevant class notes first) and point you to the right resources. TA office hours will prioritize assignment-related questions over content review for late joiners.

1.7 Textbook(s)

This course does not have a *required* textbook, and my course content is curated from several different sources, many of them not textbooks. However, you will find the following texts useful. Except for the first book in this list, the remaining are made freely available online by the respective authors.

- Artificial Intelligence: A Modern Approach, Pearson
- Artificial Intelligence 2E: Foundations of Computational Agents, Cambridge University Press
- Mathematics for Machine Learning, Cambridge University Press
- Dive into Deep Learning, Forthcoming at Cambridge University Press

1.8 Tentative Lecture Plan

For an updated list of topics, slides, readings, and notes, please visit the course website. Topics are subject to change, depending on class progress, latest happenings, popular demand, etc. If there is a specific topic you would like me to cover, please reach out to me, and I would be happy to try and devote some time to it towards the end of the semester.

1.9 Software

We will use Python 3 for all programming assignments. These resources may be useful:

- Prof Felix Muzny's Computational Thinking in Python
- Learn Python 3
- GitHub Quickstart

If you have limited or no Python or GitHub experience, please reach out to the TAs or the instructor early in the semester. This will enable us to work with you and provide additional guidance in a timely manner.

1.10 Components & Grading

Grades will be based on the following split over course load:

- **Project: 40%**
  (in-class presentation, final report, modular and reusable code in GitHub repo)
- **Programming Assignments: 30%**
  (3 assignments, NOT equally weighted)
- **Problem Sets: 20%**
  (3 problem sets, NOT equally weighted)
- **Assignment 0 + Labs: 10%**
  (graded on completion)

i. Alternative (Research) Pathway

With the instructor's permission, students have the option to substitute the course final project requirement with a research-intensive evaluation worth 40%, consisting of two parts: **a)** a research paper presentation, to be completed by May 31 (by appointment) worth 20%, and **b)** an end-of-semester *viva voce* - a one-on-one, whiteboard-interview-style oral examination including, but not limited to, lecture content and provided materials, worth the remaining 20%, to be completed by June 18 (by appointment).

While you will not be expected to know every latest AI technique or ML model in existence, the oral exam will test your ability to apply known concepts to novel and unseen scenarios, and learn and adapt new techniques on the fly. A breadth of knowledge beyond course content is likely to give you an advantage in the oral exam. **This pathway is designed to be significantly more challenging**, and will require reading broadly beyond provided course materials in preparation. This pathway is intended to serve students considering or interested in pursuing a Ph.D. in the future, but is open to anyone up for a challenge!

ii. Project Pathway Expectations

If a student on the regular project pathway is repeatedly reported by their group as not meeting regular deliverables, their only remaining option to avoid a failing grade will be to switch to the research-intensive pathway. Please note that such a switch will be accompanied by a very high workload in a short time span, and is a situation best avoided.

iii. Final Grades and Rounding Scheme

Final grades will be assigned based on the following scale (note open and closed intervals). Natural rounding will be used, i.e., percentages $\geq x.5$ get rounded up to the next integer, $x + 1$ (94.5 becomes 95, 94.4 does not).

CS4100

A	[93, 100]
A-	[90, 93)
B+	[87, 90)
B	[82, 87)
B-	[80, 82)
C+	[77, 80)
C	[72, 77)
C-	[70, 72)
D+	[67, 70)
D	[62, 67)
D-	[60, 62)
F	[0, 60)

CS5100

A	[93, 100]
A-	[90, 93)
B+	[87, 90)
B	[82, 87)
B-	[80, 82)
C+	[77, 80)
C	[72, 77)
C-	[70, 72)
F	[0, 70)

2 Class Policies

2.1 Homework Submissions & Grading

- All homework submissions and labs must be uploaded to Gradescope by 6:00 pm Eastern on the due date. Written submissions must be in PDF format.
- All written solutions **must** be typed (i.e., no scans of handwritten assignments will be accepted). Scanned figures are only permitted where explicitly specified in the assignment instructions. Any such figures must be clear and perfectly legible.
- The use of LaTeX to typeset mathematical equations is highly encouraged. Overleaf is an excellent browser-based LaTeX editor with real-time compilation capabilities. Overleaf Professional is free to all Northeastern students.
- It is encouraged that you collaborate with your classmates to review course content, notes and other reading material. However, any such collaborations must be kept strictly conceptual, and not involve any actual assignment problems. I recommend re-using examples from lecture, or reaching out to the instructor/TAs if in doubt.
- **If you do discuss any concepts with a classmate, you must list all such collaborators on your submission. You must write all solutions by yourself, in your own words, and are strictly forbidden from sharing written solutions or code.**
- The TAs and instructors reserve the right to ask you to explain your solutions, and inability to do so may result in academic penalties (sec. 2.2, 2.3).
- **Grading**: All grades will be released via Gradescope.
- **Regrade Requests**: All regrade requests must be submitted within 1 week of receiving your grade. Requests for all submissions must be submitted from within Gradescope. Requests submitted via email will almost certainly be missed.

2.2 Policy on the use of Generative AI

- For programming submissions (except assignment 0), students may use any AI tool available to them, as long as they are appropriately cited (a code comment will suffice). While the same policy applies to labs, I advise against using AI for these.
- Students may **not** use generative AI to complete problem sets in any capacity. These are intended to test students' ability to demonstrate mastery of techniques learnt in the course by a) presenting sound and rigorous theoretical analysis, and b) critically analyzing code. Any indication of the use of AI tools in the written submissions will constitute a violation of academic integrity, and be subject to academic penalties (see sec 2.3).
- The TAs and I reserve the right to refuse help with debugging code that was found online or generated by AI tools, if you cannot sufficiently explain it.

- The use of AI solely to rephrase sentences and improve writing clarity, etc. - while an acceptable use case - makes it difficult for instructors to discern whether the entire answer was AI-generated. Therefore, if AI is used in this manner, students are **required** to submit an additional appendix at the end of their submission with their corresponding originally written answers. Failure to include such an appendix will be treated as an academic integrity violation.
- The appendix is aimed only at helping me understand the usage patterns of AI tools. Points will **not** be taken off for using AI to improve writing when disclosed as per the policies above. Please feel free to clarify policies with me when in doubt.

2.3 Academic Integrity

- Please familiarize yourself with Northeastern University's Academic Integrity Policy.
- Sharing or discussing assignment solutions or code in any form is strictly forbidden. Searching for solutions online is okay, but must be clearly and appropriately cited. Any conceptual discussions held with classmates must be clearly disclosed in the assignment submission by all parties.
- Any violation of academic integrity (as outlined by all homework policies above) will result in the following penalties:
  - Academic penalties up to, and including, a grade of **F** for the course.
  - A report of the violation will be filed with OSCCR, where outcomes can range from warnings or academic probation to dismissal from the University.
  - **Graduate students:** A report of the violation will also be filed with the Khoury Graduate Academic Integrity Committee, which leads to an immediate and permanent loss of TA/Co-op privileges, and can include dismissal from the program. **This is in addition to OSCCR, and specific to Khoury College.**
  - International students should note that they do not have the option to withdraw from the course upon receiving an F grade due to F-1 visa credit requirements. Dismissal may cause the student to be in violation of their visa status.
- Recognize that most violations are easily avoided by simply acknowledging any difficulties you may be having with the course and seeking help from your professor in a timely fashion. We're here to help you learn.
- International students often report suffering from cultural shock, homesickness, and being overwhelmed by a new education system. However, cheating is never the right solution. I want to assure you that I will never be inconvenienced by a student reaching out for help, or think poorly of a student for asking me lots of questions.

  I was in your shoes not that long ago, and I am happy to talk to you about any of these issues and offer you my support and guidance. However, it is imperative that this conversation happens in the absence of an academic integrity violation. Once a violation is identified, I will have no choice but to report it in the interest of fairness.

2.4 Late Policy

- Programming assignment and problem set deadlines will be on Fridays at 6:00 pm Eastern. Students will receive an automatic extension until Sunday 6:00 pm, without penalty. Deadlines for labs, and any submissions related to the final project are absolute, and no extensions will be provided for these deliverables.
- Treat the automatic extensions to problem sets/programming assignments as a fall-back for genuine emergencies - assignments in this course take a significant amount of time to complete. **No office hours are offered during the extension period.**
- Requests to submit assignments after the late deadline due to last-minute difficulties will be ignored. It is your responsibility to ensure that the correct files are properly uploaded, submitted, and reflected in Gradescope well in advance of the deadline.
- Beyond the automatic late deadline, I will not grant further extensions, except in the case of limited and verifiable emergency situations, or University and DRC-sanctioned accommodations. It is imperative that you communicate with me (or the TA team) early on when circumstances permit.
- In case you are close to the late deadline, and feel that you will be unable to submit an assignment in time, please reach out to me. Depending on your circumstances, I may not be able to give you an extension, but I will certainly offer you the right resources to help you make the most of your assignment.
- Do not succumb to the temptation to copy from a classmate in order to salvage your grade close to a deadline - while it may seem like an easy way out at the time, doing so will only result in a much worse, irreversible outcome for both parties.

2.5 Classroom Environment

- Digital devices are permitted for note-taking purposes and to engage with course material such as lecture slides, or in-class activities as instructed. However, any use of laptops/tablets must not be disruptive to your classmates. No phones please.
- To create and preserve a healthy classroom atmosphere that facilitates teaching and learning, all participants share a responsibility in creating a civil, nonjudgmental, and non-disruptive forum for the discussion of ideas. Students are expected to conduct themselves at all times in a manner that does not disrupt teaching or learning.
- Your comments to others should be constructive and free from any harassing or disrespectful statements. You are welcome to disagree with other students and the instructor, but such disagreements need to be respectful, and based on facts, evidence and documentation (rather than prejudices and personalities).
- The instructor reserves the right to interrupt conversations that deviate from these expectations. Repeated unprofessional or disrespectful conduct will be treated as a violation of the Code of Student Conduct.

3 Office Hours & the TA Team

Campuswire is a Piazza alternative that we will be using as the class forum, and for online support. All course announcements will be posted on Campuswire. TAs offer a mix of in-person and online office hours. Check the course website for timings.

Instructor - Raj

- In-person, Meserve 303, Monday, 2:00 pm - 4:00 pm.
- To schedule appointments outside of office hours, visit my appointments page.
- If you decide to swing by on a whim and my office door is open, feel free to bug me.

Teaching Assistants

- **CS4100**
  - Andrei Biswas (biswas.and@northeastern.edu)
  - Hasnain Sikora (sikora.h@northeastern.edu)
  - Rishi Srikaanth (srikaanth.r@northeastern.edu)
  - Nathan Partlan (partlan.n@northeastern.edu)
- **CS5100**
  - Justin Feldman (feldman.jus@northeastern.edu)
  - Prajwal Athreya (athreya.p@northeastern.edu)
  - Jithin Veeragandham (veeragandham.j@northeastern.edu)

Please consult TAs for your respective section throughout the semester - TAs from the other section will not have access to your submissions, and may not be able to help you as well. While the occasional cross-consultation is fine, TAs will, in general, prioritize students from their own sections.

4 Campus Resources

4.1 Healthcare, Counseling, and Wellness

Your health and well-being are paramount, above any and all course deliverables. There is a wide range of support services on campus to ensure your success, and I encourage you to reach out to these resources as appropriate. If I can help connect you, please don't hesitate to reach out to me!

- University Health and Counseling Services
- Find@Northeastern
- WeCare
- Support Groups and Workshops

4.2 Title IX

- Title IX of the Education Amendments of 1972 protects individuals from sex or gender-based discrimination, including discrimination based on gender identity, in educational programs and activities that receive federal financial assistance.
- Northeastern's Title IX Policy prohibits Prohibited Offenses, which are defined as sexual harassment, sexual assault, relationship or domestic violence, and stalking. The Title IX Policy applies to the entire community, including students, faculty, and staff of all genders.
- If you or someone you know has been a survivor of a Prohibited Offense, confidential support and guidance can be found through University Health and Counseling Services staff and Center for Spiritual Dialogue and Service clergy members. By law, those employees are not required to report allegations of sex or gender-based discrimination to the University.
- Alleged violations can be reported non-confidentially to the Title IX Coordinator within The Office for University Equity and Compliance (OUEC) by either filling out the Discrimination Complaint Form, via email to the OUEC (less secure) at titleix@northeastern.edu and/or through NUPD (Emergency 617-373-3333; Non-Emergency 617-373-2121). Reporting Prohibited Offenses to NUPD does NOT commit the victim/affected party to future legal action.
- Faculty members are considered "responsible employees" at Northeastern, i.e., they are **required** to report all allegations of sex or gender-based discrimination to the Title IX Coordinator. Note that faculty are mandatory reporters, but not arbiters of situations that may arise. In case of an emergency, please call NUPD's emergency line (617-373-3333) or 911 as appropriate. Please visit the Title IX webpage for a complete list of reporting options and resources both on-campus and off-campus.

4.3 Disability Accessibility Services

Students with disabilities who wish to receive academic services and/or accommodations should visit Disability Accessibility Services at 20 Dodge Hall, or call 617-373-2675. If you have not already done so, please have the accommodations letter sent to me early in the semester so that I can best serve your needs.