CSE 240: Artificial Intelligence

Leilani H. Gilpin

Winter, 2023

### COURSE INFORMATION

Artificial Intelligence (AI) is defined as any task performed by a program or a machine. If a human carried out the same activity, we would say the human had to apply intelligence to accomplish the task. This course provides background for major topics needed to research in the field of AI. The broad topics covered in this course are divided into three main areas:

* Planning and Search Algorithms
* Decision Making (including Reinforcement Learning (RL))
* Machine Learning (ML)

### INSTRUCTOR INFORMATION

Leilani H. Gilpin (she/her), Assistant Professor of CSE

Email: [lgilpin@ucsc.edu](mailto:lgilpin@ucsc.edu)

Office: E2 347B

I am excited about teaching intelligent systems to explain themselves. I joined the faculty of UCSC in 2021 as an Assistant Professor in Computer Science and Engineering. I previously developed a new, short course on AI and global risks at MIT, and was a teaching assistant for Large Scale Symbolic Systems. I typically teach AI (CSE 140, CSE 240) and responsible data science (CSE 246).

| Course Name | Days/Times | Location |
| --- | --- | --- |
| CSE 240 | Tu/Th 9:50am-11:25am | Thim Lecture 001 |

### LEARNING OUTCOMES

Students completing this course should be able to:

* choose the appropriate representation for an AI problem or domain model,
* choose the proper algorithm for reasoning within an AI problem domain,
* implement and debug core AI algorithms in a clean and structured manner,
* design and analyze the performance of an AI system or component,
* describe AI algorithms and representations, explain their performance, and critically read papers on AI systems.

### PREREQUISITES/COREQUISITES

Students should have working knowledge of probability, linear algebra, and ability to (learn to) program in Python.

* For a refresher on probability; I recommend the MIT OpenCourseware probability [course](https://ocw.mit.edu/resources/res-6-012-introduction-to-probability-spring-2018/). There are lecture videos, notes, and online slides.
* For a refresher on linear algebra; I recommend Gil Strang’s MIT Linear Algebra [lectures](https://www.youtube.com/watch?v=ZK3O402wf1c&list=PL49CF3715CB9EF31D&index=1). They are all on Youtube, the first 1-3 lectures are sufficient background.
* For learning python, one good resource is [Think Python](https://www.greenteapress.com/thinkpython/html/) (the first few chapters).

### REQUIRED MATERIALS, TEXTBOOKS AND TECHNOLOGY

Russell and Norvig, [Artificial Intelligence, A Modern Approach (Links to an external site](http://aima.cs.berkeley.edu/)). Prentice-Hall, Fourth Edition. ISBN 0-13-604259-7 is the recommended text (aka the Purple Book). You may also use the third edition (the Blue Book). You may, at your own risk, use the Second edition (2E - aka the Green Book). The second edition has most of what you need; the third and fourth editions have improved pseudo-code and better sections on learning. The first edition (the Red Book) is too different to use.

### COMMUNICATION

We (the teaching team) are excited to meet with you! There are many ways to contact and interact with the teaching team. One way is weekly office hours:

* Instructor: Leilani H. Gilpin ([lgilpin@ucsc.edu](mailto:lgilpin@ucsc.edu))
  + Location: E2 347B
  + Office hours: TBD

If you need to contact me about the course structure, personal concerns, urgent requests, etc., the best way for you to reach me is by email--I try to reply to all emails within 24 hours on weekdays and 48 hours on weekends/holidays (but usually faster). When you email me, please include your problem in the subject and be as specific as possible with whatever you need help with. This helps me prioritize your emails so I can respond in less time.

I also highly encourage you to come by office hours and utilize the class Piazza. **Piazza will be the main form of communication for the course.**

### ASSIGNMENTS & ASSESSMENT

The course will be structured around a set of homework assignments, quizzes, and class participation.

#### Class Participation + In-Class Exercises

In this class, your accountability to your education will earn you points: showing up and participating will account for 5% of the grade. This course is designed to be **in-person**. Therefore, students are expected to attend lectures (see notes on [excused absences](#_7i8k4wa1u1) below). There will be occasional in-class exercises; participation in class discussions and online discussions is encouraged. **Class participation will be evaluated via the completion of in-class exercises, which we will collect immediately after class.**  If you must miss a class due to [Covid-19](#_n95xca3xa2s1) or an [excused absence](#_7i8k4wa1u1), please let us know so this will not affect your class participation evaluation.

Since this is an in-person class, students must arrive on time to class. Cell phone use during class is not permitted; it not only distracts the student, it also distracts students around you[[1]](#footnote-0).

CSE 240 is an in-person class. I do not recommend that remote students take the class because they will have a significant disadvantage and studies show that their learning outcomes will not be as high as their in-person peers.

* If you absolutely cannot attend a lecture in person, you can attend on zoom and/or watch the lecture capture and submit the class exercises remotely (canvas or email).
* For those few exceptional remote students[[2]](#footnote-1), they will be evaluated on participation via the class exercises submitted online, as well as Piazza discussion and engagement.

We will use Piazza for course communication, we will keep you posted if that changes. Irrespective of which platform we use for discussion, there are a few baselines for good Piazza etiquette:

* Please be respectful and constructive in all communications, whether to students or to teaching staff. Please **read posts** -- you are responsible for reading posts, important logistics information and more will be published on piazza. Further, before asking a question, check to see if it has already been answered, and if so, remember to link to previously posted useful answers.
* Further, please be sure to take some time to think about your problem or issue before posting. Consider using the “30 minute rule”: spend at least 30 minutes trying to figure things out on your own before posting. We definitely want you to get the help you need, as soon as possible, but occasionally we see students who post as soon as they have some small issue or hiccup. The point of class assignments is for you to have to think, and sometimes that's hard (but most of all, it's fun too!
* On the other hand, clarification questions, etc. are totally welcomed, and should be asked immediately. Further **UNDER NO CIRCUMSTANCES should code be posted on Piazza**. If you need help with code, you should attend office hours or the discussion sections.
  + Also, remember that while you may post anonymously to the class, the instructors always see who is posting. Again, the goal is for Piazza to be a useful, pleasant, positive environment for all!

##### Excused Absences

Any student who needs to be excused for a prolonged absence (2 or more consecutive class meetings), including the final exam should contact Prof. Gilpin by email or piazza.

Any student who must miss a class due to religious holidays should also notify the instructor in office hours or by email (lgilpin@ucsc.edu) during the first two weeks of class.

### GRADING POLICY AND RUBRIC

| **Item** | **Weight** |
| --- | --- |
| Class Participation + In-Class Exercise | 5% |
| Assignments | 50% |
| Quizzes | 45% |

| **Grade Scale** | **Percentage** |
| --- | --- |
| A | [93 - 100]% |
| A- | [90 - 93)% |
| B+ | [87 - 90)% |
| B | [83 - 87)% |
| B- | [80 - 83)% |
| C+ | [77 - 80)% |
| C | [73 - 77)% |
| C- | [70 - 73)% |
| D+ | [67- 70)% |
| D | [63 - 67)% |
| D- | [63 - 60)% |
| F | [0 - 60)% |

These cutoffs represent grade minimums. We may adjust grades upward based on class participation, extra credit, etc. The grade of A+ will be awarded at the professor's discretion based on exceptional performance.

#### Re-grading Policy

The majority of the grading will be done by the TAs. If you think there has been a mistake in grading your homework or exam, please submit a regrade request explaining in writing, precisely and concisely, the grading error that has occurred, to the TA. Such a request must be made no later than 1 week after the material in question was returned to the class. Any request to have an assignment regraded may result in the entire assignment in question being regraded, possibly resulting in a loss of points.

### INSTRUCTOR FEEDBACK

The majority of the feedback and grading will be done by the TAs. Programming assignments will be autograded, and students will have access to the autograder ahead of time to check their work.

### STUDENT FEEDBACK

At the middle of the quarter, you will be asked to complete an informal course feedback form. This will be an in class exercise, which will be reviewed by the teaching team. This feedback will help us consider modifications during the last half of the course to make the learning experience more effective.

At the end of the quarter you will be asked to complete a Student Experience of Teaching survey for this course. SETs provide an opportunity for you to give valuable feedback on your learning that is honest and constructive. This anonymous feedback will help me consider modifications to the course that will help future students learn more effectively.

### COURSE SCHEDULE

| **Week** | **Reading and Activities** | **Deliverables** |
| --- | --- | --- |
| 1 | * Introduction to AI (Chapter 1) * Structure of Agents (Chapter 2) * Solving problems by searching (Chapter 3 until 3.5)   + Uninformed search strategies     - BFS     - DFS     - ID-DFS     - UCS   + Informed search strategies (Chapter 3.5 and onwards) | Assignment 0 |
| 2 | RN Chapter 5:   * Adversarial games * minimax algorithm * alpha-beta pruning | Assignment 1 |
| 3 | RN Chapter 5:   * minimax algorithm * alpha-beta pruning * Heuristic minimax algorithm | Quiz 1 |
| 4 | * Stochastic games   + Expectimax search algorithm * Search in complex environments   + Hill climbing   + Simulated annealing   + Local beam search   + Evolutionary algorithm | Assignment 2 |
| 5 | * Constraint satisfaction problems   + Examples of CSP   + Inference in CSP   + Backtracking search for CSP   + Local search for CSP   + Structure of problems for solving CSP     - cutset conditioning     - Tree decomposition | Assignment 3 |
| 6 | * Continuation of CSP * Quantifying uncertainty    + Conditional probability   + Joint distribution   + Independence   + Bayes' rule * Naive Bayes model | Quiz 2 |
| 7 | * Introduction to Bayesian Networks * Markov Decision Process | Assignment 4 |
| 8 | MDPS  Reinforcement Learning | Assignment 5 |
| 9 | * Learning from samples * Perceptron learning * Regression | Quiz 3 |
| 10 | * Neural networks * Deep reinforcement learning | Assignment 6 |

All readings are from Russell and Norvig.

### FINAL EXAM DATE AND TIME

There will be no final exam.

### COVID-19 INFORMATION:

There is a very small number of exceptions for **in-person** instruction for undergraduate students that are (1) graduating and (2) not physically located in Santa Cruz to attend the course. This course is meant for **in-person instruction and learning.** Things are changing everyday, but here is what we can expect from each other during these uncertain times:

* **What we can expect from each other:** Each individual at UC Santa Cruz should behave with the best interests of the community. Please take care to comply with the university guidelines about masking in indoor and outdoor settings, testing as required by the campus vaccine policy, self-isolating in the event of an exposure, and respecting others’ comfort with distancing.
  + If you forget your mask, you can ask me for one; there is a limited supply of disposable masks in each classroom.
  + If you are ill or suspect that you may have been exposed to someone who is ill, or if you have symptoms that are consistent with those of COVID-19, please err on the side of caution: stay home until you are well and/or have tested negative after an exposure.
* **What you can expect from me**: I have designed our course following the campus guidance and with current public health guidelines in mind. However, these guidelines may change with changes in infection rates or the emergence of new variants. If updated public health recommendations and university requirements make our current course format unfeasible, or if I experience a need to self-isolate, I will alter the course format. This may include moving in-person sessions to Zoom, modifying course assignments to work in a remote format, and reconfiguring exams (if applicable). I will communicate clearly with you via email or Canvas announcement about any changes that occur. I will provide as much advance warning as possible and give you all the information you need to transition smoothly to the new format. If you have questions about the changes, please reach out to me so I can answer them.
* **What I expect from you:** If you experience an illness or exposure that requires you to miss class sessions or to attend remotely, please communicate with me as soon as possible and I will provide you with Zoom links for the course and alternative assignments on Canvas to allow you to continue making progress in the class.

### ACADEMIC INTEGRITY

All members of the UCSC community benefit from an environment of trust, honesty, fairness, respect, and responsibility. You are expected to present your own work and acknowledge the work of others in order to preserve the integrity of scholarship.

Academic integrity includes:

* Following exam rules
* Using only permitted materials during an exam
* Viewing exam materials only when permitted by your instructor
* Keeping what you know about an exam to yourself
* Incorporating proper citation of all sources of information
* Submitting your own original work

Academic misconduct includes, but is not limited to, the following:

* Disclosing exam content during or after you have taken an exam
* Accessing exam materials without permission
* Copying/purchasing any material from another student, or from another source, that is submitted for grading as your own
* Plagiarism, including use of Internet material without proper citation
* Using cell phones or other electronics to obtain outside information during an exam without explicit permission from the instructor
* Submitting your own work in one class that was completed for another class (self-plagiarism) without prior permission from the instructor.
* Violations of the Academic Integrity policy can result in dismissal from the university and a permanent notation on a student’s transcript. For the full policy and disciplinary procedures on academic dishonesty, students and instructors should refer to the [Academic Misconduct page](https://www.ue.ucsc.edu/academic_misconduct) at the [Division of Undergraduate Education](https://ue.ucsc.edu/).

### ACCESSIBILITY

UC Santa Cruz is committed to creating an academic environment that supports its diverse student body. If you are a student with a disability who requires accommodations to achieve equal access in this course, please submit your Accommodation Authorization Letter from the Disability Resource Center (DRC) to me privately during my office hours or by email, preferably within the first two weeks of the quarter. At this time, I would like us to discuss ways we can ensure your full participation in the course. I encourage all students who may benefit from learning more about DRC services to contact the DRC by phone at 831-459-2089 or by email at [drc@ucsc.edu](mailto:drc@ucsc.edu).

### INTELLECTUAL PROPERTY

The materials in this course are the intellectual property of their creators. As a student, you have access to many of the materials in the course for the purpose of learning, engaging with your peers in the course, completing assignments, and so on. You have a moral and legal obligation to respect the rights of others by only using course materials for purposes associated with the course. For instance, you are not permitted to share, upload, stream, sell, republish, share the login information for, or otherwise disseminate any of the course materials, such as: video and audio files, assignment prompts, slides, notes, syllabus, simulations, datasets, discussion threads. Conversely, any materials created solely by you (for example, your videos, essays, images, audio files, annotations, notes) are your intellectual property and you may use them as you wish.

### RELIGIOUS ACCOMMODATION

UC Santa Cruz welcomes diversity of religious beliefs and practices, recognizing the contributions differing experiences and viewpoints can bring to the community. There may be times when an academic requirement conflicts with religious observances and practices. If that happens, students may request the reasonable accommodation for religious practices. The instructor will review the situation in an effort to provide a reasonable accommodation without penalty. You should first discuss the conflict and your requested accommodation with your instructor early in the term. You or your instructor may also seek assistance from the [Dean of Students office](https://deanofstudents.ucsc.edu/).

### ALL-GENDER RESTROOMS

UC Santa Cruz is committed to the well-being of all students and cares about all students feeling safe and welcome, regardless of their gender identity, expression, and/or embodiment. The [Lionel Cantú Queer Center](https://queer.ucsc.edu/index.html) has worked with students and campus staff to create more safe and accessible restrooms for transgender and genderqueer students, staff, faculty, alumni, and UCSC visitors. A [complete list of all-gender restrooms](https://genderinclusive.ucsc.edu/inclusive%20facilities/images/gif-list-5-17-17.pdf) on campus was compiled and is maintained by the Cantú Queer Center.

### PRINCIPLES OF COMMUNITY

The University of California, Santa Cruz expressly prohibits students from engaging in conduct constituting unlawful discrimination, harassment or bias... [More here](https://reporthate.ucsc.edu/principles-and-policies/index.html). I am committed to providing an atmosphere for learning that respects diversity and supports inclusivity. We need to work together to build this community of learning. I ask all members of this class to:

* be open to and interested in the views of others
* consider the possibility that your views may change over the course of the term
* be aware that this course asks you to reconsider some “common sense” notions you may hold
* honor the unique life experiences of your colleagues
* appreciate the opportunity that we have to learn from each other
* listen to each other’s opinions and communicate in a respectful manner
* keep confidential discussions that the community has of a personal (or professional) nature
* ground your comments in the texts we are studying. Refer frequently to the texts and make them the focus of your questions, comments, and arguments. This is the single most effective way to ensure respectful discussion and to create a space where we are all learning together.

### TITLE IX/CARE ADVISORY

UC Santa Cruz is committed to providing a safe learning environment that is free of all forms of gender discrimination and sexual harassment, which are explicitly prohibited under Title IX. If you have experienced any form of sexual harassment, sexual assault, domestic violence, dating violence, or stalking, know that you are not alone. The Title IX Office, the Campus Advocacy, Resources & Education (CARE) office, and Counseling & Psychological Services (CAPS) are all resources that you can rely on for support.

Please be aware that if you tell me about a situation involving Title IX misconduct, I am required to share this information with the Title IX Coordinator. This reporting responsibility also applies to course TAs and tutors (as well to all UCSC employees who are not designated as “confidential” employees, which is a special designation granted to counselors and CARE advocates). Although I have to make that notification, you will control how your case will be handled, including whether or not you wish to pursue a formal complaint. The goal is to make sure that you are aware of the range of options available to you and that you have access to the resources you need.

Confidential resources are available through [CARE](https://care.ucsc.edu/). Confidentiality means CARE advocates will not share any information with Title IX, the police, parents, or anyone else without explicit permission. CARE advocates are trained to support you in understanding your rights and options, accessing health and counseling services, providing academic and housing accommodations, helping with legal protective orders, and more. You can contact CARE at (831) 502-2273 or care@ucsc.edu.

In addition to CARE, these resources are available to you:

* If you need help figuring out what resources you or someone else might need, visit the [Sexual Violence Prevention & Response (SAFE) website](http://safe.ucsc.edu/), which provides information and resources for different situations.
* [Counseling & Psychological Services (CAPS)](https://caps.ucsc.edu/) can provide confidential counseling support. Call them at (831) 459-2628.
* You can also report gender discrimination and sexual harassment and violence directly to the University’s [Title IX Office](https://titleix.ucsc.edu/), by calling (831) 459-2462 or by using their [online reporting tool](https://titleix.ucsc.edu/about/staff-contact-us.html).
* Reports to law enforcement can be made to the UC Police Department, (831) 459-2231 ext. 1.
* For emergencies, call 911.

### REPORT AN INCIDENT OF HATE OR BIAS

The University of California, Santa Cruz is committed to maintaining an objective, civil, diverse and supportive community, free of coercion, bias, hate, intimidation, dehumanization or exploitation. The Hate/Bias Response Team is a group of administrators who support and guide students seeking assistance in determining how to handle a bias incident involving another student, a staff member, or a faculty member. To report an incident of hate or bias, please use the following form: [Hate/Bias Report Form](https://ucsc-advocate.symplicity.com/care_report/index.php/pid596509?).

### STUDENT SERVICES

[Counseling and Psychological Services](https://caps.ucsc.edu/)

Many students at UCSC face personal challenges or have psychological needs that may interfere with their academic progress, social development, or emotional wellbeing. The university offers a variety of confidential services to help you through difficult times, including individual and group counseling, crisis intervention, consultations, online chats, and mental health screenings. These services are provided by staff who welcome all students and embrace a philosophy respectful of clients’ cultural and religious backgrounds, and sensitive to differences in race, ability, gender identity and sexual orientation.

[Student Success and Engagement Hub](https://studentsuccess.ucsc.edu/)

The Division of Student Success provides campus-wide coordination and leadership for student success programs and activities across departments, divisions, the colleges, and administrative units.

[Tutoring](https://lss.ucsc.edu/) and Learning Support

At Learning Support Services (LSS), undergraduate students build a strong foundation for success and cultivate a sense of belonging in our Community of Learners. LSS partners with faculty and staff to advance educational equity by designing inclusive learning environments in Modified Supplemental Instruction, Small Group Tutoring, and Writing Support. When students fully engage in our programs, they gain transformative experiences that empower them at the university and beyond.

[Slug Support Program](https://deanofstudents.ucsc.edu/slug-support/program/index.html)

College can be a challenging time for students and during times of stress it is not always easy to find the help you need. Slug Support can give help with everything from basic needs (housing, food, or financial insecurity) to getting the technology you need during remote instruction.

To get started with SLUG Support, please contact the [Dean of Students](https://deanofstudents.ucsc.edu/about/index-aboutdos.html) Office at 831-459-4446 or you may send us an email at [deanofstudents@ucsc.edu](mailto:deanofstudents@ucsc.edu).

Slug Help/[Technology](https://its.ucsc.edu/index.html)

The ITS Support Center is your single point of contact for all issues, problems or questions related to technology services and computing at UC Santa Cruz. To get technological help, simply email help@ucsc.edu.

On-Campus Emergency Contacts

Slug Help/[Emergency Services](https://www.ucsc.edu/help/). For all other help and support, including the health center and emergency services, start [here](https://www.ucsc.edu/help/). Always dial 9-1-1 in the case of an emergency.

1. Arnold L. Glass & Mengxue Kang (2019) Dividing attention in the classroom reduces exam performance, Educational Psychology, 39:3, 395-408, DOI: [10.1080/01443410.2018.1489046](https://doi.org/10.1080/01443410.2018.1489046) [↑](#footnote-ref-0)
2. Graduating students that are not physically located in Santa Cruz may take the course remotely. [↑](#footnote-ref-1)