

From Brains to Artificial Intelligence (Spring 2019)

- **Instructor:** Santiago Jaramillo
- **Office:** LISB 215
- **E-mail:** sjara@uoregon.edu
- **Class meetings:** MW 4:00pm-5:20pm, Straub 145
- **Office hours:** by appointment
- **GEs:** Caleb Holt (cholt@cas.uoregon.edu) and Anna Lakunina (alakuni3@uoregon.edu).
- No textbook required, all materials available on Canvas or online.
- **Lecture slides** can be found on Canvas under Files > Lectures.
 - These SVG files **do not** open directly on Canvas. You need to download each file and open it with a web browser.
 - Use the arrow keys (left/right) to advance through the slides.
- [Quick introduction to Canvas](#)

Course description

In this course, designed for non-science majors, we will discuss how the brain and artificial computing systems process information. The course will introduce students to the process of scientific reasoning, and discuss methodologies used by scientists to gain knowledge about how the nervous system works. The course also covers how scientists and engineers attempt to replicate these processes in computers and artificial intelligence systems. The course will illustrate parallels in information processing and computation between biological and artificial systems.

Readings and videos before class will provide background information. The main concepts and skills will be further developed through in-class activities in which students play the role of scientists and engineers solving problems about computation in biological and artificial systems. In the last part of the course, students will discuss the implications to society of intelligent machines and technologies for interfacing brains and machines.

Learning objectives

1. Gain a basic understanding of how the nervous system acquires and processes information.
2. Gain a basic understanding of how every-day computing devices process information and the approaches followed for designing intelligent machines.
3. Analyze and compare approaches for acquiring knowledge about how the brain works.
4. Develop the ability to formulate hypotheses and follow the scientific method to acquire new knowledge.
5. Become a critical reader of popular science writings.
6. Evaluate the impact of brain science and engineering to society.

Grading

- 10% - In-class question, class participation, survey.
- 20% - Weekly quizzes (the quiz with the lowest score will be ignored)
- 15% - Mid-term 1
- 15% - Mid-term 2
- 20% - Final project (5% for first part, 5% for second part, 10% for final part).
- 20% - Final exam

Grade	Percentage
A	90%-100%
B	80%-89%
C	70%-79%
D	60%-69%
F	59% and below

Class Courtesy

- Please arrive in class on time. Late arrivals distract the instructor and the other students.
- Please silence your cell phone during the class meeting times, and use your laptop only for class activities.
- Do not leave class early unless you have cleared it with the instructor in advance.
- I encourage you to ask questions if something presented in class was not clear or could not be heard.
- Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the quarter (or before) so that I may address you properly.

Open inquiry, freedom of expression, and respect for differences are fundamental to a comprehensive and dynamic education. We are committed to upholding these ideals by encouraging the exploration, engagement, and expression of divergent perspectives and diverse identities. Classroom courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. Our classroom is a learning environment, and as such should be a safe, inclusive and respectful place. Being respectful also includes using preferred pronouns for your classmates. Disrespecting fellow students and combative approaches are not acceptable. Please make me aware if there are classroom dynamics that impede your (or someone else's) full engagement.

Academic Honesty

Group discussions outside of class are encouraged. However, all work submitted as part of this course must be your own. The use of sources must be properly acknowledged. Copying or paraphrasing information from any source *without citation* is plagiarism. For more information, see <http://library.uoregon.edu/guides/plagiarism/students/index.html>

All students will be expected to adhere to the University's guidelines on academic integrity as outlined in the Student Conduct

Code: <https://policies.uoregon.edu/vol-3-administration-student-affairs/ch-1-conduct/student-conduct-code>. The consequences of academic dishonesty will be

taken seriously (e.g., an 'F' in the course and a report to the Office of Student Conduct) and are noted on student disciplinary records. If you are in doubt regarding any aspect of these issues, please come and speak with me.

Students with disabilities

If you have a documented disability and anticipate needing accommodations in this course, please make arrangements to meet with me. Please request that the Counselor for Students with Disabilities send a letter verifying your disability.

Campus resources to support your learning

If there are aspects of the instruction or design of this course that result in barriers to your participation, please notify me as soon as possible. Here are additional resources to support your learning:

- Accessible Education Center:** The University of Oregon is working to create inclusive learning environments. If needed, you are encouraged to contact the Accessible Education Center <https://aec.uoregon.edu>. If you are not a student with a documented disability, but you would like to share class issues that will impact your ability to learn, you are encouraged you to visit me during office hours so that we can strategize how you can get the most out of this course.
- Tutoring and Learning Center (TLC):** Drop-in math and writing support in addition to tutoring, study skills support, and Class Encore. Located in the 4th Floor Knight Library (541) 346-3226, tlc@uoregon.edu
- Counseling Center:** Call anytime to speak with a therapist who can provide support and connect you with resources. Located on the 2nd Floor of the Health Center(541)346-3227
- Center for Multicultural Academic Excellence (CMAE):** its mission is to promote student retention and persistence for historically underrepresented and underserved populations. The center develops and implements programs and services that support retention, academic excellence, and success at the UO and beyond. Contact: cmae@uoregon.edu
- The UO Access Shuttle** is an on-campus ride service provided at no cost to students with conditions that limit mobility. More information and a sign-up form can be found on the parking & transportation department website: <https://parking.uoregon.edu/content/access-shuttle>.

Discrimination and Harassment

Any student who has experienced sexual assault, relationship violence, sex or gender-based bullying, stalking, and/or sexual harassment may seek resources and help at <http://safe.uoregon.edu>. To get help by phone, a student can also call either the UO's 24-hour hotline at 541-346-7244 [SAFE], or the non-confidential Title IX Coordinator at 541-346-8136. From the SAFE website, students may also connect to Callisto, a confidential, third-party reporting site that is not a part of the university.

Students experiencing any other form of prohibited discrimination or harassment can find information at <http://respect.uoregon.edu> or <http://aaeo.uoregon.edu> or contact the non-confidential AAEO office at 541-346-3123 or the Dean of Students Office at 541-346-3216 for help. As UO policy has different reporting requirements based on the nature of the reported harassment or discrimination, additional information about reporting requirements for discrimination or harassment unrelated to sexual assault, relationship violence, sex or gender based bullying, stalking, and/or sexual harassment is available at Discrimination & Harassment.

Safe Ride: 541-346-7433 ext 2. <http://pages.uoregon.edu/saferide>

Safe Ride is an assault prevention shuttle that works to provide free, inclusive, and accessible alternatives to traveling alone at night for UO students, faculty, and staff.

Reporting

The instructor of this class is a Student-Directed Employee. As such, if you disclose to me, I will respond to you with respect and kindness. I will listen to you, and will be sensitive to your needs and desires. I will not judge you. I will support you. As part of that support, I will direct students who disclose sexual harassment or sexual violence to resources that can help. **I will only report the information shared to the university administration when you as the student requests that the information be reported** (unless someone is in imminent risk of serious harm or is a minor). Please note the difference between 'privacy' and 'confidentiality.' As a Student-Directed Employee I can offer privacy because I am not required to report certain information to the university. However, I cannot be bound by confidentiality in the same way that a counselor or attorney is. Confidential resources such as these means that information shared is protected by federal and state laws. Any information that I as a student-directed employee receive may still be accessed by university or court proceedings. This

means, for example, that I could still be called as a witness or required to turn over any related documents or notes that I keep.

Please note also that I am required to report all other forms of prohibited discrimination or harassment to the university administration. Specific details about confidentiality of information and reporting obligations of employees can be found at <http://titleix.uoregon.edu>.

Mandatory Reporting of Child Abuse

UO employees, including faculty, staff, and GEs, are mandatory reporters of child abuse. Child abuse pertains to individuals who are under the age of 18. This statement is to advise you that your disclosure of information about child abuse to the instructor may trigger my duty to report that information to the designated authorities. Please refer to the following links for detailed information about mandatory reporting: <https://hr.uoregon.edu/policies-leaves/general-information/mandatory-reporting-child-abuse-and-neglect>.

Course Syllabus

Week 1:

- Introduction to the course.
- Scientific methodologies and engineering approaches.
- Online quiz #1** (due Sunday)

Week 2:

- History of computing machines and brain science.
- Components and scales of computing systems.
- Online quiz #2** (due Sunday)

Week 3:

- How systems acquire information: how brains and machines see and hear.
- Representation of information: coding with bits and action potentials.
- Submit first report of final project** (due Sunday)

Week 4:

- Review.
- Mid-term exam #1** (Wednesday).
- Online quiz #3** (due Sunday)

Week 5:

- Transformations and computations in electronic systems.
- Transformations and computations in neuronal systems.
- Online quiz #4** (due Sunday)

Week 6:

- Parallels between biological and artificial memory.
- Biological and artificial mechanisms for learning.
- Online quiz #5** (due Sunday)

Week 7:

- Technologies (fiction and reality) for memory manipulation.
- Activities to prepare for second report of project.
- Submit second report of final project** (due Sunday)

Week 8:

- Review.
- Mid-term exam #2** (Wednesday).
- Online quiz #6** (due Sunday)

Week 9:

- No class on Monday: Memorial day.*
- Thinking machines: chess programs, IBM's Watson and self-driving cars.

Week 10:

- Neuroprosthetics and brain-machine interfaces.
- Review and conclusions: How far is reality from fiction?
- Submit final project** (due Wednesday)