

## **Biology 100 – From brains to intelligent machines**

Instructor: Santiago Jaramillo

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Class time: M,W 4pm-5:20pm

Class location: LIB101

Office Hours: Thursday 2-4pm (LISB 215)

Teaching assistants: Nick Ponvert <[nponvert@uoregon.edu](mailto:nponvert@uoregon.edu)>

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**Course materials:** All course materials will be available through Canvas.

No textbook is required for this course.

**Course prerequisites:** None.

### **Catalog description:**

Basic concepts on how brains and artificial systems process information. Analysis of the similarities, differences, and complementarity between these systems.

### **Expanded course description**

A course for non-science majors to introduce the concepts necessary to understand 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 learned 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.

## Student workload

In addition to four hours per week in class, students will spend, on average, eight hours per week on reading and preparing assignments. Work outside class will include assessment of assigned readings and videos, as well as preparing a final project.

## Grading

10% – In-class clicker questions

20% – Weekly online quizzes.

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

The final project is a written assignment that must be submitted in 3 parts as stated in the schedule. We are using i>clickers as a way to facilitate classroom participation and discussion. This grade will be a mixture of participation and accuracy of answers.

“A” grade corresponds to full participation in all class activities, the ability to apply knowledge from the course (demonstrated by high scores in exams), and high degree of detail in final project. “B” work shows evidence of effort but may not rise to the level of an “A” in one or more areas. “C” work has major deficiencies in several areas but the student had made an effort and mastered the basic topics. “D” work represents effort acceptable in at least one area, but deficient in others. “F” work is not acceptable, either because no aspect of the work rises to acceptable levels or major portions of the assignments are missing.

## Course schedule

### Week 1:

- Introduction to the course.
- Scientific methodologies and engineering approaches.
- Online quiz #1** (2017-04-09)

### Week 2:

- History of computing machines and brain science.
- Components and scales of computing systems.
- Online quiz #2** (2017-04-16)

### 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** (2017-04-23)

### Week 4:

- Review.
- Mid-term exam #1** (2017-04-26).
- Online quiz #3** (2017-04-30)

### Week 5:

- Transformations and computations.
- Decision-making and motor control in biological and artificial systems.
- Online quiz #4** (2017-05-07)

### Week 6:

- Parallels between biological and artificial memory.
- Biological and artificial mechanisms for learning.
- Online quiz #5** (2017-05-14)

## Week 7:

- Thinking machines: chess programs, IBM's Watson and self-driving cars.
- Statistical approaches to brain computation and machine intelligence.
- Submit second report of final project** (2017-05-21)

## Week 8:

- Review.
- Mid-term exam #2** (2017-05-24).
- Online quiz #6** (2017-05-28)

## Week 9:

- No class on Monday: Memorial day.*
- Technologies (fiction and reality) for memory manipulation. Implications of thinking machines.
- Submit final project** (2017-06-04)

## Week 10:

- Neuroprosthetics and brain-machine interfaces.
- Review and conclusions: How far is reality from fiction?

**Final exam:** Week of June 12-16, 2017.

## 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>

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.