

UNIVERSITY OF MAINE  
COS 470/570: INTRODUCTION TO COMPUTER SCIENCE  
SPRING 2019

## SYLLABUS

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Time: 2–3:15 TTh	Instructor: Roy M. Turner
Location: 116 Neville Hall	Contact: rturner.maine.edu

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**Office hours:** TTh 1–2, 240 Boardman

**Web site:** [MaineSAIL.umcs.maine.edu/COS470](http://MaineSAIL.umcs.maine.edu/COS470)

**Grades:** On Blackboard

**Slack:** [cos470umaine.slack.com](https://cos470umaine.slack.com)

**Faculty information:** Roy M. Turner, Associate Professor of Computer Science

**Phone:** 207-581-3909

**Email:** [rturner@maine.edu](mailto:rturner@maine.edu) ← quickest response

**Office:** 240 Boardman Hall

**Office hours:** 1–2 TTh or by appointment

### Textbooks:

**Required:** *AI: A Modern Approach* (3<sup>rd</sup> ed.), Stuart Russell & Peter Norvig. Hardcover at (UMaine Bookstore, Amazon), paperback (Amazon; not completely sure this is exactly the same, so you'd have to take your chances); rental (Amazon); online (purchase or rental, Amazon; also via VitalSource ([vitalsource.com](http://vitalsource.com))).

**Online:** *Deep Learning with Python*, Françoise Chollet, 2018, Manning Publication Co. Available free (in HTML format) online at [www.manning.com/books/deep-learning-with-python](http://www.manning.com/books/deep-learning-with-python).

**ADA notice:** If you have a disability for which you may be requesting an accommodation, please contact Disabilities Services, 121 East Annex, 581-2319, as early as possible in the term.

**Course description:** It seems as if it is impossible to pick up a magazine, newspaper, or even technical journal recently without stumbling upon some article referencing artificial intelligence (AI). It is arguably the fastest-growing area of science/technology at the moment, thanks in large part to the research and development efforts of some of the largest and best-known corporations in the world. Image recognition, personal digital assistants, self-driving cars, human-level performance in extremely computationally-hard games such as Go, machine translation, natural language processing, planning space missions, deep learning, data mining, and, of course, web search,<sup>1</sup> are all AI applications that either are or that will soon be common in our everyday lives. AI technology is already economically important, and it will be a dominant feature of the economy for the foreseeable future. And, of course, it is a staple of science fiction books and movies, from *Forbidden Planet* to *2001: A Space Odyssey* to *Ex Machina*.

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<sup>1</sup>Indeed, it can be argued that Google is and always has been essentially an AI company; in fact, one of the authors of the textbook is Research Director at Google.

But what *is* AI? One way to define AI is as the part of computer science concerned primarily with giving computer programs abilities similar to those human abilities that require intelligence. Examples include: playing games, proving theorems, planning courses of action, and solving problems. Another definition is that AI is concerned with providing computer programs with abilities that, while they may be simple for humans or even other animals, are extraordinarily difficult to achieve using standard computer science techniques. Examples include understanding and generating a natural language (e.g., English), recognizing an image, commonsense reasoning, and learning. Still third definition is that AI is the field seeking to create non-biological human-level (or above) intelligence. These “definitions” of AI are really closer to aims of the field or goals of researchers in the field. Another part of AI has to do with examining, through the use of computers, intelligence itself.

**Course goals:** AI is an extremely broad and diverse field—far too broad to cover completely in a semester-long course such as this one. Consequently, the overall goal of this course is to give the student an overview of the field in general while at the same time providing depth in the most fundamental areas. The course aims to prepare you to understand what AI is and how it is used in its expanding areas of application. It will help you prepare you to understand how AI can be used in your own work, to take advanced courses in the field, and to begin working on AI research projects. It is a hands-on course; there is some sentiment in the field that to truly understand AI techniques, one must implement them. Thus, you will have both the chance to program a variety of AI techniques as well as to concentrate on a semester project.

**Instructional objectives:** By the end of the course, you should have a general knowledge of the field of AI. You should be able to recognize when AI techniques are necessary to solve a problem. You should be able to apply standard AI techniques to solve problems. You should be able to evaluate new techniques you encounter. You should be knowledgeable enough to take an advanced course in AI or one of AI’s subfields. You will also be fluent in using Lisp to write simple AI programs and Keras to specify introductory-level networks for deep learning. As or more important, you will be prepared to understand the “brave new world” that is likely to be permeated by AI technology in the coming years.

**ABET student outcomes addressed:**

- SO 1: Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.
- SO 2: Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of computer science.
- SO 3: Communicate effectively in a variety of professional contexts.
- SO 6: Apply computer science theory and software development fundamentals to produce computing-based solutions.

**Assignments for all students:** Programming and written assignments, semester project, journal. The purpose of the programming and written assignments is to increase and deepen your understanding of the concepts covered in class and to give you a better understanding of the unique challenges and techniques of AI programming and knowledge representation. The semester project will give you a chance to delve into some area of AI in depth. The project will be described in class. It is possible to do the project by yourself or with other students. Journal assignments will be given from time to time to give you a chance to think more deeply about what is being covered and to give feedback about the course. I will describe the journal in more detail in class.

**Assignments for COS 570 students:** In addition to the assignments for all students, COS 570 students will have additional assignments. These will typically be either additional programming assignments, exercises from the book, assignments to read a scientific paper or a chapter in the text and prepare a report on it, and so forth. In addition, if you are a COS 570 student, your work is expected to be of higher quality and with more depth than 470 students, and you will be graded accordingly.

**Grading:** Grades will be assigned based on written homeworks, programming assignments, the course project, your blog, and the tests. Grades will be assigned based on the following percentages:

In-class work, homework, blog, and programming assignments:	25%
Project:	25%
Prelim I:	15%
Prelim II:	15%
Final exam:	20%

Grades will be assigned in the usual manner: 90–100 is an A, 80–89 a B, etc., with anything below 60 being an F. Plus and minus grades will be used, and grades will be assigned based on the guidelines published in UM’s *Handbook for the Faculty of Instruction*, paraphrased here:

A: Top-quality work. A definite encouragement to the advanced student that he or she is potentially a very good prospect for graduate work insofar as ability to master material, but not necessarily to pursue research, is concerned. A is given to students who excel in many ways in meeting the course objectives.

B: Indicates that the student has excelled in meeting the course objectives in some way, such as exhibiting superior insight into and mastery of the material or taking the initiative in going beyond what the instructor suggests for satisfactory work. A student should find it necessary to achieve a B rather than merely to receive it as an average student. B is a grade for students who stand out above those in the C group. B means that the student’s work is particularly commendable and praiseworthy.

C: A respectable grade for any undergraduate student in any course. It implies that the student has been successful in meeting the course objectives. It implies approval by the University of the student’s progress toward graduation. It represents a satisfactory level of work for both non-major and major students. [Note that a C is *not* a satisfactory grade for a graduate student!]

D: Low-level passing work for any undergraduate student. It should warn the student that he or she will be unlikely to achieve success in the next course of a sequence unless greater effort is forthcoming. D indicates that the course objectives have been poorly met as a result of lack of work or insufficient ability. The D grade warns the student that unsatisfactory progress is being made toward a college degree. The D grade is a failing grade for graduate students.

F: A failing grade for all students.

A word about how I grade on tests is in order, especially if this is your first class with me. In an effort to grant more partial credit, I grade each question on tests qualitatively, using the following grades, where  $n$  equals the points possible for a question:

Grade	Points	Grade	Points
✓ or ok	$n$	C+:	$0.78n$
A+:	$0.98n$	C:	$0.75n$
A:	$0.95n$	C-:	$0.72n$
A-:	$0.92n$	C/D:	$0.70n$
A/B:	$0.90n$	D+:	$0.68n$
B+:	$0.88n$	D:	$0.65n$
B:	$0.85n$	D-:	$0.62n$
B-:	$0.82n$	F:	$0.60n$
B/C:	$0.80n$	A number $x$ :	$x$

**Class format:** The classes will be a combination of lecture and active learning, depending on the material. Online lectures (mine and others’) may be assigned from time to time, especially in those cases where the material is best served by having a “flipped classroom” style. In these cases, it is imperative you watch the lecture prior to coming to class.

**Class schedule:** See last page of syllabus.

**Make-up classes:** I will likely be out of town for at least one class this semester, as seen in the schedule below. Other absences will be announced if they arise, and there may be no classes those days. However, I may schedule make-up classes, prepare online lectures, or have guest lecturers to make up for the missed time.

**Programming:** Two languages will be used for programming assignments in this course, Lisp and Python. Historically, symbolic artificial intelligence has been done predominantly in the Lisp programming language. Although it is the second oldest programming language in use, it remains the premier language for symbolic and functional programming. Consequently, all programming assignments in the symbolic AI portion of the course will be done in Common Lisp. This also helps achieve one of the School’s goals of exposing students to a range of programming languages. I will not devote class time to Lisp, but a help/review session will be scheduled early in the semester to summarize the features of the language. There are very good textbooks available, both online and in hardcopy form (some free),<sup>2</sup> and there are also online tutorials. In addition, Guy Steele’s *Common Lisp: The Language*, which is the definition document for Common Lisp, is available online as well, although this should be used as a reference book, *not* a textbook.

You may use any Common Lisp you like. The Lisp you use, however, must be compliant with Guy Steele’s *Common Lisp: The Language* (2<sup>nd</sup> edition). If you are uncertain about whether a Lisp you have access to is a Common Lisp, ask me. Lisp interpreters (and/or compilers) and integrated development environments are available free online. I suggest using either Franz, Inc.’s free version of Allegro Common Lisp (ACL) or Steel Bank Common Lisp (SBCL). A separate information packet discusses in more detail how to acquire and use Lisp.

With respect to the integrated development environment (IDE) to use, I *strongly* suggest using GNU Emacs with Slime (for SCBL) or some other interface package (for ACL, e.g.). Though the learning curve can be somewhat steep, it will be well worth your time; Emacs and Lisp have a very long history together (Emacs is mainly programmed in a version of Lisp, and Lisp’s first IDE was a version of Emacs), and consequently they play nice with each other.

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<sup>2</sup>I highly recommend Paul Graham’s *ANSI Common Lisp* or Peter Seibel’s *Practical Common Lisp*, which is available for free at [www.gigamonkeys.com/book](http://www.gigamonkeys.com/book).

I would *not* recommend Eclipse, I certainly would not suggest not using an IDE, and never, ever write your code in a word processor (but you knew that already, right?).

You will use Python for the material having to do with neural networks/deep learning. The Keras package, with either a TensorFlow or Theano backend will be used, and so you should make sure that you have Python installed with the Keras, and either TensorFlow or Theano Python packages installed as well. I will provide more information about this later.

For your project, you can use either Python or Lisp; other languages will be considered on a case-by-case basis, if needed.

**Robots:** A few simple, low-cost robots are available for your use during the course. These are from Georgia Robotics, and consist of a “Scribbler” robot base and an IPRE Fluke add-on board that provides some additional functionality. You should check a robot out from me to use during the semester—some programming assignments may require this, and you may want to use the robot in your final project. You are responsible, of course, for any damage to the robot. They are programmed in Python, and a Lisp interface to the robots *may* be made available.

**Plagiarism and cheating:** Plagiarism and cheating are violations of UM’s Student Conduct Code and will not be tolerated in this class. Such behavior will result in *at least* the penalty of a zero for the affected assignment/test, and possibly an F in the course. In addition, such an offense may be reported to the appropriate offices for disciplinary action (which can include expulsion from the University).

It is sometimes a fine line between collaboration that is acceptable (or even desired) on a programming project or homework and cheating. I encourage students to talk together about the course and the course assignments. However, all work turned in, with the exception of group projects or group assignments (if any) should be your own. If you feel that the ideas behind some portion of an assignment are due to another student, you should note that in the assignment you turn in. If you have a question about what constitutes cheating, you should talk to me in advance of turning in the assignment.

And, of course, no collaborative work is permissible on prelims or the final exam!

**Reading:** This class will move **fast**. If at all possible, you should read the assigned readings before coming to the classes for which they are assigned—especially if I have announced that the material will be covered via active learning exercises rather than lecture. Readings also may be the subject of test questions.

**Class attendance:** Attendance at all classes is expected. There is a substantial amount of material that will be covered in class that is may not be in the books, so it is to your advantage to attend class. In addition, some classes will have participatory components that you will not get credit for if you do not attend. I strongly encourage participation in class discussion. If you have to miss a class, *you*—not me—are responsible for finding all the information presented from fellow students, including any announcements that may have been made.

**Late policy:** The due date for each assignment will be announced when assigned. By default, all assignments are due by 4:30 pm of the day due if the assignment is a hardcopy assignment (it is easier for all concerned if you turn the assignments in class that day, however), midnight if it is electronic. Late penalties, unless otherwise announced, will be a **letter grade a day**, and assignments will not be accepted more than 5 days late. Saturdays, Sundays, and holidays

**do** count as days late. If you need to hand a hardcopy in on a weekend or holiday: (1) send an electronic copy to me at the time you want to hand it in and (2) give me the hardcopy the following business day.

If you feel you need an extension on an assignment for a valid reason, you must contact me as soon as possible about it. The default policy is to grant no extensions.

**Civility:** You are expected to conduct yourself in a manner that is civil and respectful to the other students and to me. If not, I may ask you to leave class.

## Campus Policies

**Academic Honesty Statement:** Academic honesty is very important. It is dishonest to cheat on exams, to copy term papers, to submit papers written by another person, to fake experimental results, or to copy or reword parts of books or articles into your own papers without appropriately citing the source. Students committing or aiding in any of these violations may be given failing grades for an assignment or for an entire course, at the discretion of the instructor. In addition to any academic action taken by an instructor, these violations are also subject to action under the University of Maine Student Conduct Code. The maximum possible sanction under the student conduct code is dismissal from the University.

**Students with disabilities statement:** If you have a disability for which you may be requesting an accommodation, please contact Student Accessibility Services, 121 East Annex, 581.2319, as early as possible in the term. Students who have already been approved for accommodations by SAS and have a current accommodation letter should meet with me privately as soon as possible.

**Course Schedule Disclaimer (Disruption Clause):** In the event of an extended disruption of normal classroom activities, the format for this course may be modified to enable its completion within its programmed time frame. In that event, you will be provided an addendum to the syllabus that will supersede this version.

**Observance of Religious Holidays/Events:** The University of Maine recognizes that when students are observing significant religious holidays, some may be unable to attend classes or labs, study, take tests, or work on other assignments. If they provide adequate notice (at least one week and longer if at all possible), these students are allowed to make up course requirements as long as this effort does not create an unreasonable burden upon the instructor, department or University. At the discretion of the instructor, such coursework could be due before or after the examination or assignment. No adverse or prejudicial effects shall result to a student's grade for the examination, study, or course requirement on the day of religious observance. The student shall not be marked absent from the class due to observing a significant religious holiday. In the case of an internship or clinical, students should refer to the applicable policy in place by the employer or site.

**Sexual Discrimination Reporting:** The University of Maine is committed to making campus a safe place for students. Because of this commitment, if you tell a teacher about an experience of **sexual assault, sexual harassment, stalking, relationship abuse (dating violence and domestic violence), sexual misconduct or any form of gender discrimination**

involving members of the campus, **your teacher is required to report** this information to the campus Office of Sexual Assault & Violence Prevention or the Office of Equal Opportunity.

**If you want to talk in confidence** to someone about an experience of sexual discrimination, please contact these resources:

**For *confidential resources on campus*: Counseling Center: 207-581-1392 or Cutler Health Center: at 207-581-4000. For *confidential resources off campus*: Rape Response Services: 1-800-871-7741 or Spruce Run: 1-800-863-9909.**

**Other resources:** The resources listed below can offer support but may have to report the incident to others who can help:

**For *support services on campus*: Office of Sexual Assault & Violence Prevention: 207-581-1406, Office of Community Standards: 207-581-1409, University of Maine Police: 207-581-4040 or 911. Or see the OSAVP website for a complete list of services at <http://www.umaine.edu/osavp/>**

Class	Date	Topic from the standpoint of the AI system:	Subtopic	Readings/Videos	Homework	
1	Tue 01/22	What is AI?		RN 1, 2; DL 1		
2	Thu 01/24	How can I achieve my goals?	Search basics	RN 3.1-3.4	Search	
	Tue 01/29	NO CLASS		Video: search		
3	Thu 01/31		Heuristic search	RN 3.5-3.6		
4	Tue 02/05		A*, other searches	RN 4.2-5		
5	Thu 02/07		Using constraints to guide search	RN 6		
6	Tue 02/12		How to win a game?	RN 5		Games
7	Thu 02/14	How can I "think"? (part 1)	Logic	RN 7-8		
8	Tue 02/19		Theorem proving	RN 9	RTP	
	Thu 02/21	<b>PRELIM I</b>				
9	Tue 02/26	How can I learn to understand input?	Symbolic learning	RN 18.1-3		
10	Thu 02/28		Neural network basics	RN 18.7, 18.9; DL 2, 3.1		Neural nets
11	Tue 03/05		Tensors, Keras, examples	DL 3.2 - 3.6		
12	Thu 03/07		Unsupervised learning			
13	Tue 03/12	How can I use knowledge about the world?	Symbolic knowledge representation, rules	RN 12		
14	Thu 03/14		Structured KR, description logic	RN 12.5.2	KREP	
	Tue 03/19	<b>SPRING BREAK</b>				
	Thu 03/21					
15	Tue 03/26	How can I deal with uncertainty?		RN 13, RN 14.1-14.5		
16	Thu 03/28	How can I understand complex/realistic input?	Vision/image recognition	RN 24; DL 5		CNETs
17	Tue 04/02		Natural language processing	RN 22-23.4		
18	Thu 04/04		Neural approaches (LSTMs)	DL 6		
	Tue 04/09	<b>PRELIM II</b>				
19	Thu 04/11	How do I take action?	Reactive agents	RN 25.7	Behavior-based control	
20	Tue 04/16		Planning - POP	RN 10-11		
21	Thu 04/18		Forward planning, advanced			Planning
22	Tue 04/23		Reinforcement learning	RN 21, paper		
23	Thu 04/25	Can I be creative?		DL 8, paper		
24	Tue 04/30	How can I work effectively in a group?	Multiagent systems		Using GANs	
25	Thu 05/02	What is the future of AI?		RN 26-27; DL 9.2-9.3		