CSC 720: Artificial Intelligence II

Spring 2015
Tentative Syllabus

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Instructor:

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Office hours: see the instructor's website or office nameplate

Course time, place, and credits:

Monday-Wednesday 2:20-3:35 PM
EB2, Room 1228
3 credit hours
URL: http://moodle.wolfware.ncsu.edu/

Reference texts:

Primary
Knowledge Representation and Reasoning
Ronald Brachman and Hector Levesque
San Francisco: Morgan Kaufmann, 2004, ISBN 1558609326. $70

Secondary
Artificial Intelligence: A Modern Approach (3rd ed.)
Stuart J. Russell and Peter Norvig
New York: Prentice Hall, 2010, ISBN 0-13-604259-7. $80

Course summary

The following description from the course catalog is out of date.

> A second course in artificial intelligence emphasizing advanced concepts of AI including logic programming, automatic programming, natural language understanding, visual perception by machine, learning and inference, intelligent computer-aided instruction, knowledge representation, robotics and other topics to be chosen by instructor. Students asked to write programs in AI programming language such as LISP and PROLOG.

The current course can be summarized as follows. Students in this course examine some fundamental concepts of artificial intelligence, focussing on agents and their interactions with their environments, knowledge representation and acquisition; reasoning and decision making; individual and collaborative action; and philosophical and mathematical foundations. The course emphasizes the pervasive role of rationality in all these areas, and seeks to understand this concept and others in terms of the philosophical, mathematical, logical, economic foundations of questions and theories about mind. The examination concentrates on developing skill in identifying and precisely formulating ideas, problems, and solutions. The examination proceeds against a backdrop of assumed knowledge of basic computational methods for implementing artificial agents.

Course outcomes

At successful completion of the course, the student will be able to explain foundational and frontier problems and compare and evaluate approaches toward representation, reasoning, action, and learning. Specific knowledge will include

- Theories of the nature of intelligent agents and their interactions with their environment;
- Theories of ideal individual and group rationality based on logic, economics, and psychology, along with their comparative strengths and weaknesses;
- Theories of limited rationality from game theory and economics, psychology, and artificial intelligence, and their connection to practical techniques for representation, reasoning, and action;
- Mathematical formalization and application of these theories to decision analysis and system control, organizational design, multi-agent systems, adaptation to changing circumstances, and the structure of individual agent psychologies;
- Fundamental issues and hard problems in knowledge representation and natural language interpretation;
- Methods for specifying the knowledge, behavior, control, and character of rational agents;
- Theories of approximation in learning and decision making, including what is learnable, what decisions are possible, and the prospects for pervasive automation of human activities;

- Methods for inferring the knowledge underlying observed behavior of rational agents;
- Rational methods of deliberation and decision-theoretic planning;
- Theories of personhood, consciousness, emotion, freedom, and morality and their relation to theories of rationality and knowledge.

The successful student will also be able to identify, explain, and initiate investigation of open problems in artificial intelligence and the rational analysis of automated systems.

Prerequisites

Enrollment is restricted to students having had CSC 520 (Artificial Intelligence I). Other students must seek the permission of the instructor before taking the course.

The primary knowledge prerequisite is familiarity with the basic concepts and techniques of artificial intelligence, including concepts of logical and probabilistic knowledge representations, automated reasoning, search, planning, and learning methods. The secondary knowledge prerequisite is a grasp of the relevant mathematical methods, including logic, probability, algebra, and multivariate calculus.

Course organization

Instruction will involve lectures, readings, discussions, written and oral student presentations of readings, and a term project proposal, report, and presentation.

Lectures, readings, and discussion

Lectures will introduce and summarize elements of the topics under discussion, illustrating the conceptual methods employed in the subject, and providing a starting point for discussions of readings.

Readings will extend acquaintance with the concepts introduced in lecture. Some readings will be taken from the textbook, but more from the relevant literatures. Readings beyond the suggested ones can form portions of some term projects.

Discussions of readings will serve to develop understanding of concepts and their limitations and to stimulate discussion. Many weeks will contain one meeting devoted to lecture and one meeting devoted to discussion of readings. Each discussion will begin with presentations by students of the readings assigned for the week.

Readings are grouped into sets by topic. Each reading set constitutes an assignment for every student the course. Students are expected to read at least one of the assigned papers or supplementary papers, and such readings must be in addition to the paper the student is presenting, if the student is presenting a paper from that set.

Class presentations

In addition to the class readings, each student will be responsible for making one or more presentations of assigned readings over the course of the semester. The number and format of assigned presentations depends on class enrollment and circumstances.

Students presenting readings should read the assignments carefully enough to have a good grasp of the ideas and techniques presented, and to be able to identify and explain the strengths and weaknesses of the approaches, including open problems, novel applications, and dubious presuppositions. Ideally, the presenter should be able to both present the main ideas of the reading as the author might present it, as well as present a critique or appreciation of the reading as a competing researcher might do.

Presenting the main ideas does not mean presenting all details. Part of the task in presenting a paper is selecting which portions deserve presentation. In general, a presentation should not simply recapitulate entire paper, especially if the paper is a long one. One should instead pick and choose the most interesting and important bits, presenting illuminating examples, problems, and questions. A summary that communicates the main ideas along with a deeper discussion of selected examples and problems usually is better than one that gives a broad summary of everything in the paper but details about nothing.

Analytical summaries and critiques

Each student assigned a paper for class presentation will also prepare a short written analytical summary and critique of the paper. The summary should not simply replicate the abstract of the assigned paper, but instead clearly state and critique the main ideas of the paper, as in the guidance for the class presentation just described. That is, the analytical summary might aim to pick out some particular element of the paper and show how it illustrates the strengths and weaknesses of the paper, rather than merely giving a high-level overview of the paper.

One should aim to write analytical summaries and critiques that are two pages long. Writing clearly and briefly requires the student to think very carefully about just what are the ideas of the paper, and how to express the main points and critiques directly, and one should make every effort to avoid substituting additional length for clearer identification of these main ideas. Summaries under two pages will not be accepted; neither will be summaries over four pages long. Summaries can include illustrations when these are absolutely essential, but the text of the summary must identify and explain the key points and lessons of the illustrations.

Term projects

Individual term projects should exercise the student's understanding of the material at a level that provides a possible basis for future investigation or publication. Projects related to planned or ongoing thesis work are acceptable, but should complement rather than duplicate the thesis work.

The instructor poses no *a priori* limitation on the topic or scope of term projects, but expects topics that permit completion during the semester. Suggestions for term projects include the following:

- Conducting a research survey that provides a detailed and comprehensive explanation and evaluation of the state of knowledge or art on some topic. The works selected might represent

a question of interest to the student, or perhaps works extending those presented in class by the student. The topic should likely be a narrow one to permit completion as a term project rather than as a thesis or research career.

- Investigating an open research question of interest to the student. This might involve work to identify specific open questions at the foundations or frontier of some area, and formulating problems and algorithms carefully in precise formal (mathematical or logical) terms.
- Implementing and carefully describing a novel application of concepts and techniques under discussion to a practical problem.

The instructor would be happy to discuss any other ideas for projects that students might have in mind.

Term project proposal

Topics for projects require the approval of the instructor. The student should be able to describe the intended topic clearly in a short proposal of no more than two pages.

Term project report

Each term project must be described in a written term project report. One should expect project reports to run about the length of conference papers, that is, 5-10 pages in double column format or 10-20 single spaced pages in single-column format. Each term paper should represent an individual effort, not a collaboration. The nature of the report will vary with the type of the project. For example, reports on implementational projects should clearly describe the problem addressed and its motivations, as well as the structure, specifications, and properties of the implementation.

Term project presentation

Each student will make a brief oral presentation of his or her project to the class during the time set aside for the final exam, or during the last week of classes if necessary. As with class presentations of assigned papers, the aim should be to present the central ideas and essential details briefly and clearly. The presentations should be aimed at all class members, not just the instructor, and should not presume the audience has read the associated term project report.

Computation

The course does not require a programming project, but implementation efforts are welcomed either as a part or as the centerpiece of the work in a term paper. Choice of implementation language is up to the student. Implementations may make use of standard libraries unrelated to the primary aims of the project. Thus if the primary purpose of the implementation is to illustrate ideas developed in the report rather than to develop new implementation capabilities, the implementation can reuse substantial portions of existing AI programs. If the primary purpose of the implementation is to develop new algorithms from scratch or to extend existing implementations with substantial new capabilities, there should be a clear distinction between the new portions and the old. In such

cases the student should first obtain the instructor's approval and then credit the reuse explicitly in the report.

Privacy

Do *not* include student ID numbers on papers or tests unless specifically instructed to do so by the instructor.

Grading

Clarity of writing and organization forms an important factor in grading of written and oral presentations. Unclear writing can suggest a lack of understanding of the material. Examples, figures, tables, and analytical results should be accompanied by clear explanations of what lessons the reader should take away from them. Students should avoid writing in terms of bullet lists, which usually reflect a lack of thought about how to express the material. Make sure the paragraphs of the writing clearly express the main points, supporting arguments, and connections between the main points.

Assignments must be submitted via Moodle prior to the due date and time announced in advance. Late submissions will not be accepted apart from absences excused according to the University attendance policy. Incomplete grades will not be assigned except in cases of absences excused according to the University attendance policy.

Students should expect to contribute to class discussion with questions, observations, and responses to questions posed by the instructor or other students. One need not speak up in every discussion, but students should not leave the instructor or other students thinking that they never have anything to say.

Overall grades will be assigned based on a weighted combination of performance on different course activities, according to the scheme

A+	=	97 - 100	C+	=	77 - 79.9
A	=	93 - 96.9	C	=	73 - 76.9
A-	=	90 - 92.9	C-	=	70 - 72.9
B+	=	87 - 89.9	D+	=	67 - 69.9
B	=	83 - 86.9	D	=	63 - 66.9
B-	=	80 - 82.9	D-	=	60 - 62.9
			F	=	59 and below

with the weighting given by

In-class presentation	30%	Project proposal	5%
Analytical summary	10%	Project report	40%
Reading assignments	5%	Project presentation	5%
Class participation	5%		

Attendance

This course follows the University Attendance Regulation (REG02.20.03) available at
http://policies.ncsu.edu/regulation/reg-02-20-03.

Attendance is mandatory during class sessions in which students are presenting papers.

The instructor imposes no formal limits on absences from lecture, but attendance in lecture is strongly encouraged because the discussions will involve material not in any textbook. Students are responsible for all material presented or discussed in lecture.

Academic integrity

This course follows the University policy on academic integrity found in the Code of Student Conduct (POL11.35.01), available at
http://policies.ncsu.edu/policy/pol-11-35-01 and the Honor Pledge.

A student shall be guilty of a violation of academic integrity if he or she:

- Represents the work of others as his or her own;
- Obtains assistance in any academic work from another individual in a situation in which the student is expected to perform independently;
- Gives assistance to another individual in a situation in which that individual is expected to perform independently;
- Offers false data in support of laboratory or field work.

Violations will be reported to the Office of Student Conduct, which may impose penalties beyond those recommended by the instructor.

Students with disabilities

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with Disability Services for Students at 1900 Student Health Center, Campus Box 7509, 919-515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation (REG 02.20.01) available at http://policies.ncsu.edu/regulation/reg-02-20-01.

Class evaluations

Online class evaluations will be available for students to complete during the last two weeks of the semester. Students will receive an email message directing them to a website (classeval.ncsu.edu) where they can login using their Unity ID and complete evaluations. All evaluations are confidential; instructors will never know how any one student responded to any question, and students will never know the ratings for any particular instructors. The student

help desk can be reached at classeval@ncsu.edu. More information about evaluations is available at http://www.ncsu.edu/UPA/classeval/.

Schedule

This syllabus assumes a 15-week schedule with two 75 minute meetings per week. The final presentation period follows the University final exam schedule. The order and content of lectures is subject to change.

Week	Dates	Topic	Reading sets and other assignments
INTRODUCTION AND BACKGROUND			
1	Jan 7	Course introduction and the big problems	RS 1, read syllabus
RATIONALITY			
2	Jan 12–14	Logical rationality	RS 2
	Jan 19	Martin King Day, no class	
3	Jan 21	Economic rationality	RS 3
4	Jan 26–28	Psychological rationality	RS 4
KNOWLEDGE			
5	Feb 2–4	Representing knowledge	RS 5, proposal due 2/4
6	Feb 9–11	Representing knowledge	RS 6
SELF-GOVERNMENT			
7	Feb 16–18	Consciousness and personhood	RS 7
8	Feb 23–25	Deliberation and argumentation	RS 8
9	Mar 2–4	Decision-model construction	RS 9
	Mar 9–11	Spring break, no classes ☺	
10	Mar 16-18	Planning	RS 10
11	Mar 23–25	Planning	RS 11
LEARNING			
12	Mar 30–Apr 1	Knowledge acquisition	RS 12
13	Apr 6–8	Learning	RS 13
14	Apr 13-15	Learning	RS 14
15	Apr 20–22	Mind, matter, and computation	Report due 4/22
	May 1	*Report presentations*, 1–4 PM	

