CSC261 Artificial Intelligence

Synopsis: This class introduces the fundamentals of automated intelligence. Through the “eyes” of an intelligent agent, we will learn about searching for problem solutions, exhibiting rational behavior, handling uncertainty, and learning from experience.

MTWF 11:00-11:50 am Science 3819

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| E-mail:     | [weinman]    |

Office hours:
- Monday 2:00-3:30 PM
- Tuesday 1:30-3:00 PM
- Wednesday 3:30-5:00 PM
- Friday 1:30-3:00 PM
or by appointment.


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1 Overview

What is intelligence? Can it be automated? These are deep questions whose algorithm roots go back thousands of years. In this course, we will examine computational approaches to problem solving, rational behavior, and learning. The field of artificial intelligence (AI) has gone through many ups and downs. AI has branched into many sub-areas that are beginning to be reunified with great success for many practical applications. We will study the foundations and theories behind the “big ideas” in AI, and spend some time exploring and implementing some real models for real problems.

Our major objectives for this course include:

- Understanding the fundamental problems in AI
- Learning about both new and classical approaches to AI
- Sharpening functional programming skills by implementing AI algorithms
- Understanding how to evaluate AI solutions

Why take it? Rational, learning, computer-based agents are being used to solve more, bigger, and often very important problems. If you have any interest in how this increasingly visible sub-field of computer science operates, this course is for you. Even if your occupation is not typically thought of as “AI work,” exposure to these ideas may influence how you approach problem-solving and will definitely influence how you interpret future developments in the field of AI that you may learn about.

What do I need to know? This course assumes you have experience with functional programming in Scheme and imperative programming in C. You should also be fluent in some basic computational ideas like encapsulation and code re-use with procedures and recursion. Familiarity with some basic data organization principles (i.e., linear and recursive data structures) are also necessary. Some mathematical maturity (e.g., familiarity with multivariable calculus, linear algebra, or combinatorics) will be helpful, but is not absolutely necessary.

2 Accommodations

If you have any disability that requires accommodations, please meet with me right away so that we can work together to find accommodations that meet your learning needs. You will also need to provide documentation of your disability to the Dean for Student Academic Support and Advising, Joyce Stern, located on the 3rd floor of the Rosenfield Center (x3702).

Please also note that I require your accommodations. The synthetic fragrances found in deodorants, lotions, after shave, body sprays, laundry products, perfume, cologne, etc. make many people who suffer with asthma, allergies, environmental sensitivities, cancer, and migraines much sicker. I am sensitive to many such chemicals you may not even notice, so please try to avoid using such scented products before coming to class and especially if you visit my office.

3 Textbook

Our course will be based on the following text:


The authors have updated this text on average only every 6.5 years. Thus, you should expect meaningful differences that represent significant improvements between editions. While you might be able to succeed with a second edition,
I do not recommend it and cannot guarantee it. This is a quality textbook that is worth owning and keeping. Buying the third edition is an investment.

Our programming exercises will be (mostly) done in Scheme. An excellent Scheme reference/textbook is available free online, but a print edition is also available (you may also find an older copy in the CS Learning Center/MathLAN Library). We’ll be using R5RS for this course.


Some additional programming exercises will be conducted in C. You may wish to refer to the following free online (first) or print (second) reference manuals.


### 4 Class attendance

Class meetings will involve a mix of discussions, collaborative activities, labs, and the occasional mini-lecture. In short: *You are expected to attend and actively participate in class. I am expected to make class worth attending.*

Because is a collaborative, discussion-based course, your presence is integral to your learning. Thus, 1.5% (0.06 grade points) will be deducted from your *overall* grade for each absence. I know that sometimes “things happen.” Therefore, you will be granted one unexcused absence from class without penalty. However, this rebate is cancelled upon a second absence.

If you are absent, you must send a written explanation (email is appropriate) before class except in case of dire emergency. If you know in advance that you will be absent for any reason, you must notify me in writing (again, email is fine) at least 7 days in advance to make arrangements for considering your absence excused.

*Because I do not wish you to risk harm to yourself or others, I am likely to moderate penalties in case of illness.*

Our discussions benefit from your contributions. If you do miss a class, you must first talk to a classmate about any material that you may have missed. After that, you may follow up with the instructor about any further questions or concerns.

### 5 Schedule of topics

The following is an approximate schedule of topics to be discussed during the course. See the web page schedule for daily details.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Week</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Intelligent Agents</td>
<td>8</td>
<td>Bayesian Networks</td>
</tr>
<tr>
<td>2</td>
<td>Search</td>
<td>9</td>
<td>Learning</td>
</tr>
<tr>
<td>3</td>
<td>Heuristic Search</td>
<td>10</td>
<td>Classification</td>
</tr>
<tr>
<td>4</td>
<td>Adversarial Search</td>
<td>11</td>
<td>Parametric Models</td>
</tr>
<tr>
<td>5</td>
<td>Propositional Logic</td>
<td>12</td>
<td>Decision Theory</td>
</tr>
<tr>
<td>6</td>
<td>First-Order Logic</td>
<td>13</td>
<td>Reinforcement Learning</td>
</tr>
<tr>
<td>7</td>
<td>Probability</td>
<td>14</td>
<td>Philosophy of AI</td>
</tr>
</tbody>
</table>
6 Assignments and activities

Under a normal 16 credit load, I expect that you will spend at least 40 hours per week on your studies (class time, homework, and studying). Thus, you should plan to spend a minimum of 10 hours/week on work for this course:

6.1 Reading

Our class meetings will be heavily discussion-based, and this will require a significant amount of preparation on your part. Most of this will consist of careful reading and reflection on the material through the use of a reading journal.

6.1.1 Preparation

You should check the class schedule for updates and read any material that has been assigned before coming to class. Reading the textbook entails the following:

Overview You should quickly skim through the reading once to get an overview of the material to be covered, paying particular attention to subject headings and topic introductions. This first “reading” can (and should) be very quick. (Expected time: 5 to 10 minutes.)

In-Depth Next, read the material closely. Try to understand what individual steps of algorithms or mathematical proofs are accomplishing. Not everything will make sense at this point, but hopefully many things will. (Expected time: 40 to 50 minutes.)

Final Notes After carefully reading the material, mentally review and try making a few notes to yourself about what you think are the most important concepts being covered, as well as any questions you have. (Expected time: 5 to 10 minutes.)

Many of the readings are fairly short (about 13 ± 6 pages, or roughly 30-40 pages per week), but can contain mathematics or algorithms that require a moderate amount of study. While I realize not everyone learns best by reading, you are asked to make your best effort and come to class with any questions you may have. Then we can proceed with discussion, examples, and exercises that enhance and clarify the material in class.

6.1.2 Reading journal

To help focus your efforts and give us a basis for discussion, you will be provided short a list of questions to answer for each day’s reading. Reflecting upon your responses to the questions will help to give you a deeper understanding of the most important concepts surrounding each topic. See the accompanying “Reading Journal” document on the course web page.

Your responses are due by 11:59 p.m. the night before class. No late responses will be accepted. You will submit your responses electronically to a private journal via our PioneerWeb course page, where I will be able to give you feedback on your writing.

While these low-stakes writing assignments are technically “informal,” they must reflect a certain level of engagement and evidence of thinking seriously about the material.

Responses will be graded using the following ternary scale:

PLUS Exhibits exceptional clarity, insight and/or creativity.
CHECK Exhibits evidence of processing and studying concepts.
MINUS Superficial response or insufficient evidence of engagement.

Because I expect most entries will receive a check, I will comment on your journal to report a plus or minus. You should expect to discuss the issues raised in your reading journal entries during class.

1 This is a minimum recommendation for achieving “satisfactory” (i.e., C-level) results. “Good” or “excellent” results may require a greater investment.
6.2 Participation

Because much of our work in this course involves collaboration and discussion, you will be evaluated on your participation.

Participating in class involves:

- being present in class (physically and mentally)
- coming to class on time
- coming to class prepared
- asking questions when appropriate
- making positive contributions to class discussion by volunteering and when called upon
- staying on task during collaborative exercises, and
- working effectively with your group.

Students who regularly meet these criteria can expect to earn a 3.67 (i.e., an A−) for their participation grade. I will reward students who regularly provide significant insights or guide discussion in productive ways with a higher participation score. Students who fail to participate regularly or who participate in counterproductive ways (e.g., by dominating the conversation or making inappropriate comments) can expect to earn a lower score.

6.3 Lab assignments

Weekly lab-based programming assignments use algorithms from our reading to address interesting problems. These will be due Monday night at midnight throughout the semester.

Your reading for Tuesday’s lab is the lab assignment itself. It is imperative that you come to lab prepared, having read the assignment and readied any questions you may have. **Bring a hard copy of the lab assignment with you.**

We will launch our lab assignments with in-class warm-up lab exercises each Tuesday. If you do not complete these exercises in class, you are strongly encouraged to finish them before beginning the assignment itself.

Instructions regarding collaboration will be given with each assignment. While you are welcome to discuss course concepts with others, solutions and any work you do and submit should be that of you and your group alone. (See Academic honesty, section 8 below.)

Most work is required to be done with partners, which will often be assigned. Working with a partner will help ensure you can take some advantage of the principle that “Given enough eyeballs, all bugs are shallow.” Working with an assigned partner will increase the chances of being exposed to different ways of thinking and problem-solving as well as help you practice the skills you’ll need in the real world, where you typically do not get to choose your coworkers.

Working collaboratively means everyone whose name appears on a submission has contributed to and understands all parts of the work. I reserve the right to briefly interview you to ask questions about your work. The kinds of questions I would ask will be easy for anyone who contributed to and understands their submission.

All group members are jointly responsible for ensuring a submission is made. (For example, if your partner told you he would submit a lab but he forgets to, you will both receive late penalties.) For this reason, I recommend submitting collaborative labs while you are sitting together.

You are highly encouraged to use the PioneerWeb Discussion Board for questions related to the course. If a post is related to an assignment, it must adhere to the standards of collaboration for that particular assignment.

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6.4 Exams

As opportunities for you to demonstrate your agent design prowess and grasp of artificial intelligence principles, there will be three hour exams and a cumulative final exam.

<table>
<thead>
<tr>
<th>Exam Type</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hour Exam 1</td>
<td>Monday 23 September</td>
</tr>
<tr>
<td>Hour Exam 2</td>
<td>Friday 18 October</td>
</tr>
<tr>
<td>Hour Exam 3</td>
<td>Friday 22 November</td>
</tr>
<tr>
<td>Final Exam</td>
<td>Friday 20 December (9 a.m.)</td>
</tr>
</tbody>
</table>

Do not make airline reservations that will conflict with your final exam schedule.

7 Grading

My goal is for everyone taking this course to be able to demonstrate familiarity and fluency with the course concepts. I would be very happy if you all met the goals above and received “A”s. The following weighting will provide a basis for evaluation:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming Assignments</td>
<td>40%</td>
</tr>
<tr>
<td>Participation</td>
<td>10%</td>
</tr>
<tr>
<td>Reading Journal</td>
<td>15%</td>
</tr>
<tr>
<td>Exams</td>
<td>25%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>10%</td>
</tr>
</tbody>
</table>

with the caveat that you must pass the final exam to pass the course.

Grading will be based on the College’s Grading System with the following brackets:

<table>
<thead>
<tr>
<th>Average at least</th>
<th>Receives</th>
<th>Grade Points</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.75</td>
<td>A</td>
<td>4.00</td>
<td>Excellent</td>
</tr>
<tr>
<td>3.50</td>
<td>A-</td>
<td>3.67</td>
<td>Excellent</td>
</tr>
<tr>
<td>3.16</td>
<td>B+</td>
<td>3.33</td>
<td>Good</td>
</tr>
<tr>
<td>2.83</td>
<td>B</td>
<td>3.00</td>
<td>Good</td>
</tr>
<tr>
<td>2.50</td>
<td>B-</td>
<td>2.67</td>
<td>Good</td>
</tr>
<tr>
<td>2.16</td>
<td>C+</td>
<td>2.33</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>1.50</td>
<td>C</td>
<td>2.00</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>0.50</td>
<td>D</td>
<td>1.00</td>
<td>Passing</td>
</tr>
<tr>
<td>0.00</td>
<td>F</td>
<td>0.00</td>
<td>Failing</td>
</tr>
</tbody>
</table>

To compensate for the unpredictability of learning exercises’ outcomes, the brackets (left column) may be adjusted downward (but not upward).

8 Academic honesty

You, as students, are members of the academic community. Both the College and I expect the highest standards of academic honesty. (See the Grinnell College Student Handbook, e.g., [http://catalog.grinnell.edu/content.php?catoid=4&navoid=89#Honesty_in_Academic_Work](http://catalog.grinnell.edu/content.php?catoid=4&navoid=89#Honesty_in_Academic_Work)). Among other things, this means clearly distinguishing between work and ideas that are your own, and those that should be attributed to others. It is expected that the collaboration policies given in this syllabus and on particular assignments will be followed. In particular:
• When you explicitly work as part of a group or team, you need not identify the work of each individual.
• You may discuss concepts (algorithms, ideas, approaches, etc.) described in the readings, lab exercises, during class, or explained in the lab assignments with anyone.
• You may only discuss collaborative homework assignments (algorithms, solutions, write-ups, code, debugging, etc.) with your partner/group members or the instructor.
• All the work submitted (code, experimental data, write-ups, etc.) must be your own. Important: Code or documentation provided by the instructor must be attributed, but no other code or written work (from any source) may be shared with others or copied for your own use.
• All non-syntax consultations (including the textbook and language references) require formal citation within the related program or write-up.
• Any conceptual contributions by others (not in your group) must be acknowledged and attributed in your report. That is you must give specific attribution for any assistance you receive. The suggested acknowledgment format is

  “[Person X] helped me to do [thing Y] by [explaining Z].”

• Any program results or output must be faithfully recorded, not forged. (A thoughtful explanation of unexpected behavior can often be a worthwhile submission and is much better than the alternative.)
• You are responsible for safeguarding your work from being copied by others. This requires you to take reasonable precautions with hard copy printouts as well as file system permissions.

As an instructor, I will meet my obligation to bring any work suspected to be in violation of the College’s Academic Honesty Policy to the attention of the Committee on Academic Standing, after which there is no recourse with me.

9 Deadlines

Assignments are due at the specified time and date. Assignments due on days for which you have a prior excused absence must still be submitted by the deadline.

A late penalty of one letter grade (one grade point) will be deducted in each subsequent twenty-four hour period after the deadline.

Exception: Deadlines for MathLAN computer-based assignments will automatically be extended by at least one twenty-four hour period if MathLAN is down for an unscheduled period of three or more hours during the week preceding the assignment due date.

10 Contacting Me

Please come by during my office hours to discuss the course content, get any extra assistance, or just talk about how the course is going. Note that if multiple students have similar questions or issues, we may work together as a group. If you cannot attend a scheduled office hour, you may also email me to schedule an appointment; please include 3-4 possible meeting times so that I can find one that works for both of us.

I enjoy getting to know my students, but I prefer to reserve office hours for academic matters. If you would like to have a more informal conversation, I would be delighted to accept an invitation to eat lunch with you at the Marketplace.

Email is also a reliable way to contact me, but please allow 24 hours for a response (except on weekends, when I do not regularly read email). You may also call me in my office (x9812).

With thanks to Janet Davis for the “Reading Suggestions” and other key policies.