# Syllabus

## Course Information

**Course title:** Artificial Intelligence

**Course number:** CSCI 446

**Course description:** This course examines the concepts, techniques, applications, and theories of Artificial Intelligence. Given the broad range of topics addressed by the AI field, topics for discussion must, necessarily, be limited. The course is organized around two main themes–symbolic AI and numerical AI–and these are covered in the first and second halves of the course, respectively. The topics in symbolic AI will emphasize logic and search. The topics in numerical AI will emphasize probabilistic methods, graphical models, and statistical learning.

**Course date (Fall even years):** Monday, August 25, 2014 through Friday, December 5, 2014 (not counting final)

**Location:** EPS 108

**Meeting days:** Monday, Wednesday, Friday

**Meeting time:** 2:10–3:00 pm

**Prerequisites:** CSCI 232 Data Structures and Algorithms

## Professor Information

**Name:** Dr. John W. Sheppard

**Email:** john.sheppard@cs.montana.edu

**Office location:** EPS 363

**Office hours:** MWF 10:00–11:00 am

**Phone:** (406) 994-4835

**Biography:** Dr. Sheppard is a Professor of Computer Science, the RightNow Technologies Fellow, and the Director of the Numerical Intelligent Systems Laboratory at MSU. Dr. Sheppard received his BS in computer science from Southern Methodist University in 1983. Later, while a full-time member of industry, he received an MS in computer science in the Johns Hopkins Part Time Engineering program (1989). He then continued his studies and received his Ph.D. in computer science from Johns Hopkins in the day school (1996). His research interests include model-based and Bayesian reasoning, reinforcement learning and games, and fault diagnosis/prognosis of complex systems. He has been recognized for his research as a Fellow of the IEEE "for contributions to system-level diagnosis and prognosis." Prior to joining the faculty at Hopkins, Dr. Sheppard was a member of industry for 20 years. His prior position was as a research fellow at ARINC. Currently, he also holds a position as an Adjunct Professor at Johns Hopkins where is he advising two PhD students.

## Learning Outcomes

At the end of this course, the student will be able to:

- Formulate and assess problems in artificial intelligence.
- Assess the strengths and weaknesses of methods for representing knowledge.
- Assess the strengths and weaknesses of several AI algorithms in areas such as heuristic search, constraint satisfaction, game search, logical inference, statistical inference, decision theory, planning, machine learning, and neural networks.
- Critically analyze and predict the behaviors of alternative approaches to solving problems in heuristic search, constraint satisfaction, game search, logical inference, statistical inference, decision theory, planning, machine learning, and neural networks.
- Implement and evaluate the performance of software solutions to problems in game search, constraint satisfaction, probabilistic inference, and machine learning.

## Readings

*Artificial Intelligence: A Modern Approach*, Stuart Russell & Peter Norvig, Prentice-Hall, 3rd Edition, 978-0-13-604259-4

Note that iClickers are required for this course.

## Course Evaluation

Grading will be based on seven homework assignments, a semester-long programming project, a midterm examination, and a comprehensive final examination. The homework assignments will focus on clarifying and implementing ideas presented in class or in the readings. Based on timing of topics, a homework assignment may be deleted (with weighting adjusted accordingly); however, no homework assignments will be added. The programming project will be split into three parts. The first part will focus on design, the second on implementation, and the third part will focus on writing up experimental results. The student may use any language and machine for satisfying the programming requirements. The project will be completed with teams of two or three people.

*All assignments are due at the beginning of class on the assigned date.*

The lowest homework score of assignments that have been submitted will be dropped. All problems must receive legitimate attempts at completion; otherwise, the submission will not be eligible for consideration to be dropped. Failure to submit an assignment will result in a zero being counted in the grade.

**Grading:**

- Homework (30%):
- Semester Project (25%)
  - Design Document (5%)
  - Programming (10%)
  - Paper (10%)
- Midterm examination (15%) — Monday, October 20, 2014
- Final examination (20%) — Wednesday, December 10, 2014, 12:00–1:50.
- Class attendance and participation (10%)

**Group Work:** The semester-long project will be completed in groups of two or three people. Individual projects are not permitted. All homework assignments have the option of being completed individually or in groups of no more than three people. For projects or assignments completed by groups, it is up to the individual groups to ensure fair distribution of labor. All members of the group will receive the same grade.

**iClickers:** Attendance will be taken using iClickers on random days. Active learning exercises will also be held using iClickers. Participation is required to receive attendance credit.

**Appeals:** With respect to grading appeals, ideally, assignments will be returned within one week of being handed in. Questions on grading should be directed to the instructor within one week of receiving your graded assignment. After that, appeals will not be considered. The instructor's decision is final.

## Topics

We will cover topics using whatever amount of time is necessary. Therefore, the following is a desired list of topics to be covered.

**Topic 1: Search and Constraint Satisfaction**

- Readings: Chapters 1,2, 3, 4, 6

**Topic 2: Game Playing**

- Readings: Chapter 5, 17.5

**Topic 3: Logic and Inference**

- Readings: Chapter 7, 8, 9

**Topic 4: Planning**

- Readings: Chapter 10

**Topic 5: Machine Learning**

- Readings: Chapter 18, 19, 20

**Topic 6: Reinforcement Learning**

- Readings: Chapter 16.1-4, 17, 21

**Topic 7: Probabilistic Reasoning**

- Readings: Chapter 13, 14, 16.5-7

Depending on rate of coverage, some topics may be deleted. Alternatively, if the rate of progress is faster than expected, topics may be added. The following provides a best guess at when and what topics will be covered.

| Week of | Monday | Wednesday | Friday |
|---|---|---|---|
| 8/25/14 | What is AI? | History/Agents | State Space Search |
| 9/1/14 | No Class | Informed Search | Local Search |
| 9/8/14 | Constraints | CSP Search | CSP Heuristics |
| 9/15/14 | Game Theory | Normal Forms | Alpha-Beta Search |
| 9/22/14 | Propositional Logic | Propositional Logic | First Order Logic |
| 9/29/14 | First Order Logic | Inference | Resolution |
| 10/6/14 | Situation Calculus | Prog/Reg Planning | STRIPS |
| 10/13/14 | Total Order Plans | Partial Order Plans | Review for Midterm |
| 10/20/14 | Midterm Exam | Experiments | Decision Trees |
| 10/27/14 | Instance-Based Learning | Neural Networks | Neural Networks |
| 11/3/14 | Decision/Utility Theory | Naive Bayes | Markov Decision Processes |
| 11/10/14 | Value/Policy Iteration | Q-Learning/SARSA | Temporal Difference Learning |
| 11/17/14 | Probability Review | Bayesian Networks | Bayesian Networks |
| 11/24/14 | Bayesian Networks | No Class | No Class |
| 12/1/14 | Decision Networks | Decision Networks | Review for Final |
| 12/8/14 | Final: Wednesday, December 10, 12:00–1:50 | | |

## Policies

### Academic Integrity

All students are expected to conduct themselves in a professional, honorable, and courteous way. Plagiarism and other forms of academic misconduct (see below), including seeking out solutions to homework assignments or unauthorized collaboration, will have severe consequences. Example: Googling the solution to a homework problem and submitting what you find as your own work. Students who engage in any form of academic misconduct will be reported to the Dean of Students and will receive an F for the course. *Dropping the course to avoid an F resulting from academic misconduct will not be permitted under any circumstances.*

### Policy on Academic Misconduct

Academic misconduct by students is unacceptable. It is the responsibility of all full-time, part-time or non-degree (special) students to adhere to strict standards of integrity in their professional and scholarly activities, as well as to high standards of conduct in their non-academic activities. Misconduct will be treated swiftly and harshly. Examples of academic misconduct:

- Cheating on Examinations
  - Use of unauthorized materials during examinations and in completing assignments.
  - Consultation of unauthorized materials while being excused from an examination room.
  - Discussion of an exam's contents during its administration.
  - Copying answers from another student on an examination.
  - Obtaining an examination or answers to an examination prior to its administration
  - Studying from an old exam whose circulation was prohibited by the instructor.
- Plagiarism
  - Submission of the same or substantially similar work of another person, even if re-worded
  - Use of another person's work while representing it as your own
  - Improper documentation of quotations, ideas, or paraphrased passages taken from published or unpublished works
- Reuse of Assignments

  - Submission of the same or substantially similar assignment to fulfill the requirements of more than one course.

- Improper Use of the Internet
  - Plagiarism from a published or unpublished Internet source.
  - Improper documentation of an Internet source.
  - Use of paper writing services of paper databases on the Internet.

- Improper Use of Electronic Devices
  - Consultation of unauthorized electronic devices during an examination.
  - Use of electronic devices to communicate within or outside of an examination room.
  - Storage of test answers, class notes, and other references in electronic devices during examinations.

- Unauthorized Collaboration
  - Collaboration when solving homework problems or writing lab reports, computer programs, or papers, unless explicitly approved by the professor.

- Alteration of Graded Assignments
  - Submission of an examination or assignment for a re-grade after making changes to the original answers or text.

- Forgery or Falsification
  - Falsification or invention of data in a laboratory experiment.
  - Citation of nonexistent sources or creation of false information in a written assignment.
  - Attributing to a source ideas or information that is not included in the source.
  - Forgery of university documents.
  - Impersonating a faculty member.

- Lying
  - Request for special consideration from professors or university officials based upon false information or deception.
  - Fabrication of a medical or emergency excuse.
  - Claiming falsely to have completed and/or turned in an assignment.
  - Falsely reporting an ethics violation by another student.

- Facilitating Academic Dishonesty
  - Intentionally or knowingly aiding another student to commit a violation of academic conduct.
  - Allowing another student to copy from one's own examination during its administration.
  - Providing copies of course materials whose circulation was prohibited to students enrolled in or planning to take that course.
  - Taking an examination or completing an assignment for another student, or permitting another student to do so on one's behalf.

- Unfair Competition
  - Willfully damaging the academic efforts of other students.
  - Stealing another student's academic materials.
  - Denying another student needed resources.

**Policy on Assignments**

This course has several assignments requiring outside work of the students. The assignments are critical for gaining understanding and experience using the materials presented in class. Due to the importance of these assignments, the following policy is set forth.

1. All assignments will be completed by the individual student or collaborative group and will be the original work of that student or group.
2. All assignments are due at the beginning of class on the dates indicated in the syllabus. No assignments will be accepted late without prior approval of the instructor (other than exceptions noted below). Note that this approval will not be easy to obtain, so don't try unless absolutely necessary. Extensions will not be granted based on personal time-management issues.
3. Unapproved late assignments will receive no credit. Approved late assignments may still receive a penalty, depending on the circumstances. It is the responsibility of the student to ensure that the instructor is kept informed of any problems related to turning in assignments on time. Only serious, uncontrollable circumstances (such as serious illness or family tragedy) will result in accepting late assignments without prior notification. In such cases, documentation of these circumstances must be provided.
4. Attending class sessions is critical to a successful course. If an absence is anticipated, please notify the instructor beforehand by email so it is documented. Unexplained absences may adversely affect the final grade.
5. All written assignments are expected to be typed. Avoid hand drawn figures if at all possible. If the assignments are not legible, they will be returned to the student with a grade of zero. Be sure each assignment includes name, daytime phone number, and email address.
6. Any language and any computer system may be used to complete the programming assignments unless otherwise specified in the assignment itself. That said, it is expected that all programs can be run on departmental computers, and students may be requested to demonstrate this.
7. All programming assignments must include fully commented code and several sample runs to demonstrate proper functioning of the assigned program. It is the responsibility of the student to ensure that the code is readable and understandable. It is also the responsibility of the student to ensure that the output is understandable and accurately reflects the functioning of the program.
8. The world-wide web provides a tremendous resource to both students and instructors, and students may be tempted to look for problem solutions on the web. Any student turning in an assignment with a solution obtained from the web must give full attribution to the source of that solution. Failure to do so is plagiarism and is grounds for failing the course. Even with proper attribution, credit received for the assignment will depend on the nature of the web information used and on the problem assigned. (See policy on web usage.)

**Policy on Web Usage**

The world-wide web provides a resource for finding and using a tremendous amount of information in the computer science and engineering fields. As computer scientists, we are able to use the web to maximize our productivity in all aspects of our life, including home, work, and school. In this class, all students are encouraged to use the web as an educational resource. Unfortunately, as with any resource, use of the web can be abused to the point where the educational experience is diminished. As an attempt to limit such abuse, the following policy on using the web in this class is set forth.

1. Students are free to explore the web to visit sites related to topics discussed in this course insofar as such exploration identifies material that elucidates and expands on material related to or discussed in class.
2. Students are not permitted to seek out solutions to any of the problems assigned unless the assignment specifically states that web use is permitted.

3. On programming assignments, students may not download solutions from a web site implementing similar or equivalent programs. Further, students are discouraged from even examining such solutions. Turning in a program obtained from the web will result in no credit for that program. Further, turning in a program obtained from the web without attribution to the web source constitutes plagiarism and will result in failure of the course.

4. On problem assignments, students may not download or examine solutions from a web site focusing on similar or equivalent problems. Turning in a solution from the web will result in no credit for that problem. Further, turning in a solution obtained from the web without attribution to the web source constitutes plagiarism and will result in failure of the course.

5. If there are any questions or even a hint of doubt concerning appropriate use of the web for completing class assignments, the student should consult the instructor for guidance.

**Policy on Class Attendance**

A large amount of material will be covered in a relatively limited amount of time. In addition, a fairly large amount of work will be done by the student. Consequently, class attendance is required. If a student must miss class for any reason, he or she should notify the instructor as soon as the absence is known. In the event of emergency absences, the instructor reserves the right to request an excuse from some cognizant authority such as a supervisor or physician. Note that class attendance accounts for 10% of the student's final grade.

**Policy on Personal Communications Devices**

It is unfortunate, but the advances in personal communications technologies has also resulted in the need for a policy concerning the use of these devices. Since students receiving and/or responding to pages, texts, or cell phone calls creates a distraction to other students, no personal, hand-held electronic devices will be permitted to be brought into the classroom without prior authorization of the instructor. This includes cell phones, smart phones, and tablets. Laptops are permitted for note taking only. If a student is caught using a laptop for purposes unrelated to the course, that student will no longer be permitted to bring laptops to class. Absolutely no electronic devices of any kind will be permitted during examinations.