15-780: Graduate Artificial Intelligence
Course Syllabus

January 13, 2014

1 Course Information

- **Course number**: 15-780
- **Instructors**: Zico Kolter (`zkolter@cs.cmu.edu`), Zack Rubinstein (`zbr@cs.cmu.edu`)
- **TA**: Vittorio Perera (`vdperera@cs.cmu.edu`)
- **Lecture**: MW 1:30-2:50, GHC 4211
- **Units**: 12
- **Course website**: `http://www.cs.cmu.edu/~zkolter/course/15-780-s14`
- **Piazza website**: `http://piazza.com/cmu/spring2014/15780/`
- **Office hours**:

Time	Location	Instructor
M 3-4	GHC 7115	(Kolter)
W 3-4	NSH 1517	(Rubinstein)
TR 1:30-3	Room TBA	(Perera)

1.1 Course description

Artificial Intelligence spans a wide variety of topics at the forefront of computer science research, including areas like machine learning, robotics, planning, computer vision, natural language processing, an many others. This course serves as a broad introduction to many of these topics, but taught at the graduate level, where students will delve into specific algorithms and applications in significant detail. The course covers is ideal for students who would like some exposure to these topics without devoting an entire semester to each one (many of the topics have entire classes devoted to them).

1.2 Recommended background

There are no formal pre-requisites for this course, but students are expected to have substantial experience with programming. Each problem set will include a programming assignment to be completed in Python. Students who have a programming background but who have not used Python in particular are encouraged to talk to the instructors to make sure they can complete all the required work. Some background in linear algebra, data structures and algorithms, and probability will all be helpful, but are not required for the course.

1.3 Piazza

This course will use Piazza for all discussion with the instructors and TAs, and for in-class polls. All students attending the course must register on the Piazza site above as soon as possible, and anyone enrolled in the course who has not registered on Piazza by the second week of class will be dropped from the course to make room for those on the waitlist.

Questions posted to the Piazza form should be answered by the instructors or TA within 24 hours. If a question is not answered within this time frame, please email the instructors or TA as soon as possible. Students are also welcome and encouraged to post answers to other student questions, and doing so will count toward the class participation portion of their grade. In addition to the forums, Piazza will be used for in-class questions during many of the lectures. Because of this, it is important that all students both sign up for the Piazza and and bring either a laptop or smartphone (with the Piazza app installed), so that they are able to answer in-class questions. These questions are mandatory, and will count toward the class participation grade (50% of the credit will be given for just answering the questions, and the rest for answering correctly).

1.4 Textbook

The textbook for this course will be "Artificial Intelligence, A Modern Approach, 3rd Edition," by Stuart Russell and Peter Norvig; the book is available in the bookstore, and more information is available at `http://aima.cs.berkeley.edu`. However, there is also substantial material in the course that will not be covered directly in the textbook. In all these cases, all required material, including class slides or supplemental notes, will be posted on the course web page.

2 Coursework and grading

Final grades for the course will be determined by 4 elements:

Problem Sets	45%
Mid-term exam	20%
Course project	25%
Class participation	10%

2.1 Problem sets

There will be four problem sets released during the class, tentatively scheduled for the dates mentioned in the schedule below. The goal of the problem sets is to expand and build upon the material from class. Each problem set will contain a number of written questions, which may involves explanations, short proofs, or mathematical derivations, as well as one or two programming assignments. Written assignments should be turned in on paper at the beginning of class. Programming assignments will be turned in using the Autolab tool for automated grading (details will follow in the first assignment).

Working together on homework problems in a group can be one of the most effective ways to learn class material. Thus, students are allowed and encouraged to discuss and work through homework problems with each other in groups. However, after you have worked through the problems as a group, **you must complete the final write-up of the problem sets yourself**. This includes programming assignments: you may discuss in a group the algorithms you will implement for solving the problems, but the actual code you submit must be written independently. You may consult outside material for the problem sets, but, if you do so, you must indicate explicitly

on your turned-in solutions which sources you consulted, and make clear which portions of your solutions reference any outside material.

2.2 Midterm exam

There will be an in-class midterm scheduled for the normal class time on 3/24/14. The midterm will include a number of derivations and short answer questions, but will not include any programming and will be designed to ideally take one hour to complete (thought students will have the entire class).

2.3 Course project

A major component of this class is a course project on a topic in Artificial Intelligence. The project is an opportunity to delve much deeper into a particular problem or algorithmic method related to AI, and can certainly involve your research outside of this class (this is encouraged). The project may be completed alone or in groups of two, but each member of a group will also give a written description of which portions each member worked on. We will release a separate document describing the elements of the course project in more detail by the second week of class.

2.4 Class participation

Ten percent of each students final grade will involve class participation. The majority of this grade will consist of participating in the in-class Piazza polls, though this portion can also be further boosted for students who are particularly active in participating in the Piazza forums. Half of the class participation grade will simply involve whether students answer all the in-class poll questions (regardless of whether these answers are correct or not), while the other half will depend on whether the answers are correct or not, and can additionally be boosted by participation in the forums.

2.5 Late days

Homeworks are due at the *beginning* of class on the due date. However, there are times in the semester when many deadlines coincide and it is difficult to hand in an assignment on the original due date. For this reason **each student has total of five free "late days" that they may use throughout the semester.** These late days extend the deadline for 24 hours (so homeworks are due at 1:30pm on the corresponding day), and can be distributed amongst the 4 problem sets any way desired, though you cannot use more than 3 late days for any single assignment. After you spend your five late days, you will receive 20% off per day on any assignment handed in late. **Late days may only be used on the problem sets and project proposal/milestone, cannot be used on the final written project** (to allow sufficient time for grading at the end of the course).

Schedule

The following is a tentative schedule for the course lectures as well as the problem sets and project milestones.

Date	Lecture	Lecturer	Deadline
1/13/2014	Introduction + History	Kolter	
1/15/2014	Intelligent Agents + Other AI frameworks	Kolter	
1/20/2014	*No class - MLK Day*		
1/22/2014	Search 1 - Uniformed, Informed	Rubinstein	
1/27/2014	Search 2 - Informed, Adversarial	Rubinstein	
1/29/2014	Numerical Optimization 1	Kolter	
2/3/2014	Numerical Optimization 2	Kolter	
2/5/2014	Search 3 - Local Search, Genetic Algorithms	Rubinstein	PS1 Out
2/10/2014	Constraint Satisfaction Search	Rubinstein	
2/12/2014	Classical Planning 1	Rubinstein	
2/17/2014	Classical Planning 2	Rubinstein	
2/19/2014	Integer Programming	Kolter	PS1 Due / PS2 Out
2/24/2014	Machine Learning 1	Kolter	
2/26/2014	Machine Learning 2	Kolter	Project Proposal Due
3/3/2014	Probabilistic Modeling, Bayesian Networks	Rubinstein	
3/5/2014	Probabilistic Inference	Kolter	PS 2 Due
3/10/2014	*No class - Spring Break*		
3/12/2014	*No class - Spring Break*		
3/17/2014	Probabilistic Planning, MDPs	Rubinstein	
3/19/2014	Reinforcement Learning	Kolter	
3/24/2014	Mid-term		
3/26/2014	Computer Vision 1	Kolter	PS 3 Out
3/31/2014	Computer Vision 2	Kolter	
4/2/2014	Scheduling 1	Rubinstein	Project Milestone Due
4/7/2014	Scheduling 2	Rubinstein	
4/9/2014	Robotics 1, Robot Motion Planning	Kolter	PS 3 Due / PS 4 Out
4/14/2014	Robotics 2, Dynamics and Control	Kolter	
4/16/2014	Natural Language Processing 1	Rubinstein	
4/21/2014	Natural Language Processing 2	Rubinstein	
4/23/2014	Computational Game Theory	Kolter	PS 4 Due
4/28/2014	Current Directions in AI Research	Both	
4/30/2014	Student Presentations		