CS3331 (4-0): Basics of Applied Artificial Intelligence, Summer 2022

Catalog description

Basics of artificial-intelligence concepts illustrated with military examples. Topics include knowledge representation, logical reasoning, probabilistic reasoning, heuristic search, agent-based systems, and social artificial intelligence. The course is intended for students who are not computer-science majors. Prerequisite: CS4000 (may be concurrent).

Course Objectives

Students will gain an understanding of core artificial intelligence concepts underlying a variety of systems including automated reasoning and expert systems, natural language processing, wargame simulations, robot mission planning. With a focus on applications, students will be presented with a series of hands-on and practical scenarios to motivate the development of the fundamental algorithms and methods of problem solving in artificial intelligence. By the end of the course, students should be able to decide when the use of artificial intelligence techniques is appropriate, formulate an approach to solving specific problems, and simulate simple methods with paper and pencil.

Instructor

Prof. Neil Rowe, ncrowe@nps.edu, (831) 656-2462. Prof. Rowe's home page with publications is http://faculty.nps.edu/ncrowe.

Lectures and resources

There are four hours a week of lectures on Zoom; we will send you the link. Lecture hours will be recorded for those who miss them, but we prefer you attend live for the benefits of interaction. Course materials will be stored on our Sakai site under "Resources" including copies of the slides used in class, homework assignments, and reading materials; quizzes will also be run there under the "Tests and Quizzes" tab. You should have an account already in Sakai if you are on the class list. Additional help for Sakai is at clehelp@nps.edu.

Grading

Homework assignments: approximately 40%
Quizzes: approximately 40%
Term project: approximately 20%

The median course grade is usually somewhere between an A- and a B+; we rarely give grades lower than a B.

Homework assignments will reinforce concepts covered during lectures. These include thought experiments, essay questions, and algorithm tracing. The penalty is 15% off for homework assignments submitted after the due date and time, but before solutions are released; homework cannot be accepted after solutions are released. Homework must be done individually without discussing it with anyone else besides the instructor.

Quizzes will be delivered through Sakai. They are open-book and open-notes, meaning you can use any previous printed or previously downloaded materials you want, but you cannot use the Internet during the quiz except for administration of the quiz. The median score is typically 70%, so the questions will be challenging. Since the quizzes are open-book, questions will not test memorization but ability to apply concepts to new problems.

The term project can be done individually or in teams of 2 or 3 students. It should study an AI capability that could be used by some customer, and should involve project planning, design, and documentation. It can also involve some implementation, but that is not required. The student or students will submit a project report at the end of the course of at least 1500 words. The project should involve around 15 hours of work per student. Students will give a presentation of 15 minutes for single-student projects, 22 minutes for 2-person projects, and 30 minutes for 3-person projects.

Software

We will refer to three programming environments in the course that we will use for software examples. They are all free open-source products that you should install on a computer. The first is the most important.

- Weka (https://waikato.github.io/weka-wiki/downloading_weka/)
- Python (https://www.python.org/downloads/)
- Gnu Prolog (http://gprolog.org)

We won't be doing much programming but you can run programs in them. It is best to download them on a home computer since organization-owned computers tend to have more restrictions on software. If you have problems installing them, talk to the instructor.

Schedule

By 7/18: Read "mani_ai_progress_20_years.pdf" and "witten_data_mining_book_chap1.pdf" (readings are in the "Readings" directory in Sakai)
By 7/25: Read "Libratus poker…..pdf" and "witten_data_mining_book_chap2.pdf"
On 7/25: Homework 1 due 1700 PST
On 7/27: Quiz 1 (sections 1-3 of the notes)
By 8/11: Read "MC169360_edited.pdf" and "witten_data_mining_book_chap3.pdf", "bayes_theorem_reading.pdf", "Bayesian_networks_reading.pdf", and "linear_models.reading.pdf"
On 8/18: Homework 2 due 1700 PST
On 8/24: Quiz 2 (sections 4-6)
By 9/5: Read "The Military Wants to Replace Human …..txt", "planning_reading.pdf", "Markov_models.pdf", "case_based_reasoning_reading.pdf", and "genetic_evolutionary_algorithms_reading.pdf"
On 9/12: Homework 3 due 1700 PST
On 9/14: Quiz 3 (sections 7-9)
On 9/16: Project writeup due by 1700 PST

Course outline

- AI algorithms in general
- Reasoning about facts
    - Fact representation
    - Logical reasoning

    - Logic programming
- Data setup
    - Data formats
    - Managing data
    - Usability problems with data
    - Data transformations
- Numeric AI
    - Case-based reasoning
    - Probabilities in rules
    - Bayesian reasoning
    - Linear models
    - Artificial neural networks
- Control structures for AI
    - Backward and forward chaining
    - Inference networks
    - Decision graphs
    - Distributed processing and agents
- Search and planning
    - Heuristic search
    - Hierarchical planning
    - Other planning methods
- Specialized sensory AI methods
    - Natural-language processing
    - Sensors
    - Computer vision
- Conclusions

Learning objectives

- Students can define and recognize key artificial-intelligence concepts in knowledge representation, logical reasoning, probabilistic reasoning, heuristic search, and agent-based systems.
- Students can recommend appropriate artificial-intelligence techniques for key applications including advisory systems, planning systems, natural-language understanding, computer vision, and sensor systems.