CS3331 (4-0): Basics of Applied Artificial Intelligence, Summer 2025

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. Students will be presented with a series of examples 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 research publications referred to in class is http://faculty.nps.edu/ncrowe.

Lectures and resources

You should have an account already in Sakai if you are on the class list. If not, or you need additional help for Sakai, email to clehelp@nps.edu.

Lectures are 1700-1900 PST (2000-2200 EST) Tuesdays and Thursdays on Zoom starting 7/8; we will send you the link for Zoom. Lecture hours will be recorded for those who miss them, but we prefer you attend live for the benefits of interaction. If you cannot attend class, it is important to watch the videos within a few days so you can still do the homework by the due date and take the quizzes on time.

Course materials will be stored on our Sakai site at cle.nps.edu under the "Resources" tab including copies of the slides used in class, homework assignments, and reading materials; to download them, click on the file to open a copy, and save the copy to your computer, or else right-click on it and do "Save link as". Quizzes will be run on Sakai under the "Tests and Quizzes" tab. We do not have a textbook since the slides are rather thorough; but we have copied some readings on harder topics to the "Readings" link under "Resources".

Grading

There are three homework assignments (approximately 40% of the final grade), three quizzes (approximately 40% of the final grade), and a final project (approximately 20% of the final grade. The median course grade is usually somewhere between an A- and a B+; we rarely give grades below a B.

Mail homework assignments to Prof. Rowe. 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, and homework answers cannot be copied from online or printed resources including output of large language models like ChatGPT. Homework will include some mathematical calculations including problems described in English.

Quizzes will be delivered through Sakai. They are open-book and open-notes, meaning you can use any previously printed or previously downloaded materials you want, but you cannot talk to anyone or use the Internet during the quiz except for administration of the quiz. The median score is typically 70%, so the questions will be challenging. This course is different from training courses where perfect performance is desired. Since the quizzes are open-book, questions will not focus on memorization but ability to apply concepts to new problems, but some memorization will save time.

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 at least involve project planning, design, and documentation. Projects can involve some implementation, and those earn a few more points, but that is not required for everyone. The student or students will submit an original project report at the end of the course of at least 1500 words. The project should involve at least 15 hours of work per student. Students will give a presentation of no more than 7 minutes for single-student projects, 12 minutes for 2-student projects, and 17 minutes for 3-student projects. Each project must also submit a project report (see document giving instructions) that must be original work and which specifies what each student did.

Software

We ask you download and install this open-source product:

- Weka (https://waikato.github.io/weka-wiki/downloading_weka/)

We will also refer to two other programming environments which you may optionally install:

- Python (https://www.python.org/downloads/)
- Gnu Prolog (http://gprolog.org)

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

Schedule

On 7/8: First day of class, 1700-1900 PST
By 7/15: Read "mani_ai_progress_20_years.pdf" and "witten_data_mining_book_chap1.pdf" (readings are in the "cs3331_readings" directory in Sakai under Resources)
By 7/22: Read "Libratus poker…..pdf" and "witten_data_mining_book_chap2.pdf"
On 7/29: Homework 1 due 1700 PST
On 7/31: Quiz 1 (sections 1-3 of the slides) at 1800 PST
By 8/7: Read "ai_algorithms_MC169360.pdf" and "witten_data_mining_book_chap3.pdf", "bayes_theorem_reading.pdf", "Bayesian_networks_reading.pdf", and "linear_models.reading.pdf"
On 8/14: Homework 2 due 1700 PST
On 8/21: Quiz 2 (sections 4-6 of the slides) at 1800 PST
By 8/26: 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 9/4, 9/9, 9/11, and 9/16: Student presentations of projects
On 9/11: Homework 3 due 1700 PST

On 9/16: Last class meeting, Quiz 3 (sections 7-9 of the slides) at 1800 PST
On 9/19: Project writeup due by 1700 PST

Course outline

- AI in general
  - Defining AI
  - AI algorithms
  - Measuring AI and trusting AI
- Reasoning about facts
  - Fact representation
  - Logical reasoning
  - Logic programming
  - Large language models
- 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.