COL864: Special Topics in AI

Semester II, 2021-22

Course Organization

Rohan Paul

Course Information

- Name
  - Couse Name: COL864 (Special Topics in AI)
  - Course Theme: Planning and Estimation for Autonomous Systems
  - Credits: 3
  - LTP: 3-0-0
- Timing
  - Slot AD
  - Class Days: Tuesday and Friday
  - Class Times: 3:30pm – 5:00pm.

Course Information

- Instructor
  - Rohan Paul
  - Email: rohan@cse.iitd.ac.in
  - Course webpage: https://www.cse.iitd.ac.in/~rohanpaul/teaching

- Teaching Assistants
  - Vikas Upadhyay (vikas.upadhyay@cse.iitd.ac.in)
  - Aadish Jain (mcs202443@cse.iitd.ac.in)
  - Satyam Jay (mcs202468@cse.iitd.ac.in)

Teaching Mode

- Lectures
  - Microsoft Teams account created by the institute as per registration.
  - Combination of live sessions and asynchronous recorded material.
  - Class recordings will be made available on Impartus.
  - Any slide material will be made available.
  - Extra teaching days may be utilized (discretionary and with prior notification).

- Communication
  - Class mailing lists: col864@cse.iitd.ac.in.

Who should take this course?

- Some Relevant Background
  - Introduction to Artificial Intelligence (COL333-COL671) or Introduction to Machine Learning (COL774 or equivalent).
  - Programming proficiency (Python and ability to install/work with external libraries on your own).
  - Knowledge of probabilistic models, basic deep learning, basic search algorithms, Markov Processes is an advantage.

Evaluation Criteria (tentative)

- Examination component: 60%
  - Minor and Major Examination
- Practical Component: 40%
  - Assignments (Typically 2 nos.)
- Margin: ~15% (discretionary)

Other Guidelines

- Pass Criteria for Credit
  - 30% of the total score in the course
- Criteria for Audit Pass (NP)
  - 40% of the total score in the course with 30% in the examination component and 30% in the practical component
- Class Attendance
  - . Class attendance is encouraged but not included in the evaluation.
  - Clarifications on technical material will be provided only in class. The student is requested to track announcements and clarifications given in class
- Institute guidelines will apply if announced by the Dean.

Exams

- Online mode as per institute guidelines.
- Information regarding exam logistics will be provided before the exam.
- Ensure familiarity with Moodle and Gradescope.

Assignments

- Detailed instructions will be provided for each assignment.
- Please ensure access to Moodle.
- Basic proficiency in Python/C++ and ability to install/work with external libraries if required for an assignment on your own.
- The submission time will be 5pm. No deadline extensions please.
- Any delays beyond the submission time will result in late penalty of X% per day (from the submission day and time). Typically, X is 10%
- Any changes to the code or replacement of files after deadline are not permitted.

Other Emergencies

- Requests for late submissions or re-appearing in an exam on the grounds of medical emergencies must be accompanied with a medical certificate from a qualified doctor indicating that you were unwell in the period of submission and a proof of prescription.
- Provided to the TA before the submission deadline not afterwards.
- Any other requests on other grounds such as law and order, basic infrastructure must be accompanied with written proof.
  - Formal proof and verification is necessary for consideration of any such requests.
  - Any decision will be taken on those as per institute guidelines and consideration of the documents. The documents may be submitted in the Department as per institute guidelines.
- Any request to appear in the re-minor will require formal proof that you were unwell or exceptional circumstances prevailed during the minor due to which you could not appear. The proof will be used by the Department and the Dean to decide if a re-minor will be permitted on not.

Academic Integrity

- Please listen to your conscience. Please do not cheat.
  - Please write code or other written submissions from scratch independently. Sharing of code or parts of it or posting it online will constitute a violation of the honor code.
  - Only submit work from your own efforts. Do not look at or refer to code written by anyone else. You may discuss the problem, however the code implementation must be original. Discussion will not be grounds to justify software plagiarism.
  - Code similarity s/w e.g., MOSS may be used check plagiarism in code and results may be released. The assessment and handling of plagiarism is the Department's prerogative.
  - Submission of code written by some one else or form internet sources will be excluded from any evaluation.

Honor Code Violations

- We are duty bound to follow the disciplinary procedures of the Department and the Institute in this regard.
- Plagiarism in assignment/exam will result in zero in the assignment/exam and an additional penalty on an absolute scale (at least -10 absolute). Department and institute procedures such as DISCO and an F-grade will follow.
- Copying or cheating in even a sub-part of an assignment or an exam will be counted as plagiarism in the whole assignment/exam. The whole assignment and exam will be made void with additional penalties and Dept. procedures.
- In case an assignment allows working in pairs, both students will receive penalty even if only one student may be involved.
- Names will be released/forwarded to the Dept. and the institute as per guidelines. Information will be shared with other faculty members for future courses and projects.

What is this course about?

- Autonomous Systems or Embodied AI Systems
  - A class of AI systems/applications
  - Capacity of
    - Sensing, decision making and interacting with the physical world.
    - Physical interaction, exchange of energy with the physical environment.
  - Names: Intelligent Robotic Systems or Embodied AI (EAI).
  - Why now?
    - Advances in computing and sensing is making computing + AI systems pervasive.
    - We can start imagining a future where we can interact with such systems as we can now interact with other hardware.

- An Algorithmic Toolkit
  - Estimation
  - Planning
  - Decision-making under uncertainty. Learning.
  - Overlap with Learning/AI. Connections will be strengthened and in other cases new concepts will be introduced.

Topics

- Introduction
- State Estimation
- Classical State-space Planning
- Task Planning
- Decision-making under Uncertainty
- Reinforcement learning (relevant applications)
- POMDPs
- Information Gathering, Human-robot interaction, applications of neural models, scene understanding etc. (if time permits).
- The topic list is tentative and will be updated as the lectures are presented.

Books and References

- Primary resource is the **lecture material**.
- Books
  - Material is derived from various sources. The relevant sections will be indicated on the course webpage.
    - Artificial Intelligence: A Modern Approach (3rd Edition). Russell, Stuart J., and Peter Norvig. Link.
    - Sebastian Thrun, Wolfram Burgard and Dieter Fox. Probabilistic Robotics. MIT Press, 2005.
    - Reinforcement Learning (Second Edition). Richard Sutton and Andrew Barto. MIT Press. 2018. Online.
    - Deep Learning. Ian Goodfellow, Yoshua Bengio and Aaron Courville. Online.
    - Mykel Kochenderfer, Decision Making Under Uncertainty
    - Steven LaValle. Planning Algorithms. Cambridge University Press, 2006.
- Paper references
  - Any paper references mentioned will be provided on the course webpage.

Learning Objectives

- At the end of the course students will model a robotic system (e.g., a ground robot or manipulator) as a decision-making AI and Learning agent.
- Students will be able to formulate/solve relevant planning and estimation problems in this domain.
- Understand how to incorporate recent learning-based methods decision-making algorithms.
- Undertake independent project work in this area.

Other Information

- This course will focus on AI aspects of autonomous systems.
- A robotic system (ground/air vehicle or manipulator) will be modeled as an AI agent capable of sensing and taking simple actions in the environment.
- The detail control and physical aspects of the system will be abstracted to a certain degree for the models discussed in the course.
- In future offerings experimental component with a real system is likely to be added but is beyond scope in the current offering.

Next Time

- This Class
  - Course Organization
- Next Class
  - Introduction