Content goal of the course is to learn techniques and theory underlying major areas of AI.

Secondary goal is to practice skills needed for research and development in AI: programming, reading literature, giving oral presentations, writing papers.

Course is designed to complement other courses in dept: CS440 (search & logic), CS545 (statistical machine learning), CS510 (computer vision), CS548 (bioinformatics)

Prerequisites
- CS440 Intro to AI, which requires
  - CS320 (Algorithms: Theory & Practice)
  - 4 programming courses
    - CS160 Foundations in Programming
    - CS161 Object-Oriented Problem Solving
    - CS200 Algorithms and Data Structures
    - CS253 Problem Solving with C++

Expected Background
- Representation/problem formulation
  - What is a state space?
  - How do we go from abstract problem to bits in a computer?
- Search
  - Under what conditions will A* find the optimal solution?
  - Name a stochastic search algorithm.
  - When is backtracking done?
  - What is TSP?
- Logic
  - How do predicate and propositional differ?
  - What is the frame problem?
  - What is an automated theorem proving technique?
  - How does search relate to logic?
Course Requirements

Text:
- suggested readings from textbooks and research papers available via online library reserve

Deliverables:
- ~5 programming/written assignments
  - 4 full and 2½ assignments which build on each other
  - some latitude on programming language
  - 10% of grade is competitive
- 1 project (written and oral parts) related to topics covered in class

Categories of Intelligent Behaviors

- Learning
- Reasoning
- Understanding
  - Vision
  - Language
- Interacting with the environment
  - Motor skills
  - Communication

Topics in CS540

- Reasoning
  - Advanced Search:
    - construct better solutions by perturbing current solutions and encouraging more useful exploration
    - Optimization, TSP, SAT
  - Evolutionary Computation:
    - Optimize evaluation through a combination of parameters
    - Exploit a natural model, genetics and evolution, of problem solving and learning.
    - Scheduling orders at a manufacturing plant, interpreting layers in geophysical data.

Topics (cont.)

- Reasoning (cont.)
  - Planning:
    - satisfy a set of goals by determining, executing and monitoring ordered actions
    - How can we coordinate the activities on the space station? What action can be taken to mitigate a computer security vulnerability?
  - Scheduling:
    - Find best allocation of tasks to resources (including time)
    - How can we fit all requests to access a satellite? What processors should be used in grid tasks?
Topics (cont.)

- Agents: combining together capabilities
  - Software
    - Assist humans and other programs in accomplishing tasks requiring access to varied knowledge
    - WWW search agents, shopping assistants
  - Robotics
    - Develop physical agents capable of acting autonomously to accomplish tasks
    - Exploring other planets or dangerous environments, assembling parts on manufacturing line, lawn mowing

Topics (cont.)

- Learning (but not 545 or 548 material)
  - Data Mining
    - Create knowledge from data, find patterns in large datasets
    - Wide range of techniques producing different types of models (e.g., clusters, sequences, collaborative filtering)
    - Recommending additional purchases at Amazon, deciding if a credit card purchase might be fraudulent.
  - Inductive Learning and Decision Trees
    - To induce general characteristics from examples
    - What symptoms best characterize a disease? Can we distinguish normal network accesses from hackers?
  - Text/Web Mining
    - Basic techniques for information search and retrieval

Topics (cont.)

- Evaluation & Experimentation in AI
  - “Every system is an experiment.” Simon & Newell
  - much AI is empirical rather than theoretical.
  - thus, to draw conclusions from our projects, we need to know how to design experiments.

Background in AI

- Read Russell & Norvig, Artificial Intelligence: A Modern Approach chapters on search (3, 4 and 5 in 3rd edition) and logic (8 and 9)
- Review on-line sites such as CS440 website: www.cs.colostate.edu/~cs440
CS540 Projects

- In-depth exploration of topic in AI not covered in lectures & assignments, but germane to topics
- Opportunity to focus on your interests
- Can be done individually or in a team of 2
- Graded Parts:
  - Proposal
  - Oral presentation (yes, even for distance students)
  - Written report
- Ungraded Parts:
  - milestones

CS540 Projects must include

- Research review must
  - Demonstrate that you have read scholarly papers in the subfield that you have selected
  - Understand state of the art and can identify both strengths and weaknesses
  - Primarily consist of peer reviewed papers (conferences, workshops, journals)
- Hands-on can be
  - Programming a new algorithm or variant on existing algorithm
  - Implementing algorithm from the literature and not covered in class
  - Obtaining code from existing research and running it on new problems or to pose new questions

CS540 Proposal

- Proposal
  - 1-2 page description of what and why
  - See project description reached through assignments page on course website for details
  - due 2/10 at noon MST