

From Foundations to Current Work in a One Quarter Course on Artificial Intelligence

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Preamble

- This presentation is about two issues:
 - What is an effective way to teach AI, given a limited amount of time?
 - In particular, what materials should one cover?

Overview

- Constraints
- Justification of Course Contents
- Course Contents
- Major Assignments
- Conclusions

Constraints

- 40 sessions at 50 min/session
- Students are academically very well-prepared
- An elective course, taken by about 80% of our CSSE students
- Two sections with about 20 students each

Constraints

- Pre-requisite: a CS-2 course
- Has since been changed to Data Structures
- TA support has been mixed as a good amount of students take this course in the senior year.

Justification of Course Contents

- Search is at the heart of AI applications
 - ➔ We cover basic and heuristic search
- Logic, while not necessarily used by many AI applications is at the foundation of many AI techniques
 - ➔ We cover propositional and predicate logic
- Students want to understand that what they study is relevant
 - ➔ We study current work in AI

Justification of Course Contents

Search, Logic

Current Work



Justification of Course Contents

- We bridge the gap with:
 - KR (make logic more efficient)
 - XPS/Bayesian Reasoning (capture uncertainty)
 - Planning (important application of AI)
 - Game playing (fun and lucrative application)
 - Various forms of Machine Learning (significant tool)
- Major research areas through the history of AI

Course Objectives

- I would like my students to be able to:
 - Give a working definition of AI
 - Recognize AI when they see it
 - Give examples of representative AI applications
 - Explain the power and limitations of AI and
 - Apply significant AI techniques

Major Work

- Programming assignments: 60%
- Reviews of papers: 12%
- Class participation: 5%
- Presentation of Current Work: 15%
- Homework problems: 8%

Course Contents

- Search and logic: 12 sessions
- Major AI tools: 22 sessions
 - KR: 3 sessions
 - Planning: 2 sessions
 - XPS: 2 sessions
 - Game playing: 2 sessions
 - ML: 12 sessions
 - Inductive Learning, Learning by discovery
 - CBR
 - NN
 - Evolutionary Computing
- Current work: 4-5 sessions

Course Contents

- Guest lectures by fellow faculty: 2 sessions
 - Introduction to some of the research done in our department
 - Advertisement of special topic courses in AI
 - Attract potential senior thesis students.

Overview of Programming Assignments

- Eliza
- Heuristic Search
- Theorem Prover
- Game Competition
- Neural Networks

Programming Assignments in Detail

ELIZA

- Warm-up exercise
- A fun way to exemplify some of the early goals and concerns of AI
- Random response
- Keyword response
- Very limited NLP

Programming Assignments in Detail

Heuristic Search

- Forest Fire Rescue Problem
- Adapted from an assignment given by Andrew Moore at CMU
- Trucks need to rescue people
- Trucks move, people don't and fires are stationary
- After all people have been picked up, trucks must exit to left
- Interesting two-stage heuristic

Programming Assignments in Detail

THEOREM PROVER

- Implementation of a resolution refutation theorem prover
- Unification
- Resolution
- Resolution heuristic
- Exemplifies the role of logic in AI

Programming Assignments in Detail

Game Competition

- Students are asked to implement some game
- Changes every year
- They thrive on competition
- Past games:
 - capture the flag
 - checkers
- Programs compete against each other in a tournament
- Excellent way to introduce the amount of work it takes to build AI applications

Programming Assignments in Detail

NEURAL NETWORKS

- First time assignment during last offering
- Use simulation software to train a network
 - XOR
 - Character recognition
- Beef-up next time

Reviews

- Use guidelines from [reviews.com](https://www.reviews.com)
- Prepare students for graduate school
- Discuss important underpinnings of AI

Reviews

- Papers:
 - “Computing Machinery and Intelligence”
 - “Minds, Brains, and Programs”
 - “Stanley, the Robot that Won the DARPA Grand Challenge”
 - “Revisiting the Dynamical Hypothesis”, a paper suggesting a view of cognition that is an alternative to the Turing Machine based explanation.

Integration of Reviews

Paper	Programming	Lectures	Learning
Turing Test	Eliza	Early history of AI	Reasonable goals of AI
Chinese Room	Theorem prover	Logic, KR	Connection between AI and Cognition
Stanley		Planning	Successful AI application
Dynamical Hypothesis	NN	NN	Non-Turing Machine models of cognition

Presentation of Current Work

- Students pair up to study an active research project or their choosing
- Give a 20 minute oral presentation (using typical conference presentation guidelines)
- Presentations summarize the work and need to address why the chose project is an AI project
- Submit a write-up of their work (boosts the quality of the presentation)

Presentation of Current Work

- Students are encouraged to
 - research an area which they may wish to pursue for a senior thesis
 - contact authors so as to identify potential schools for graduate studies
- Enjoyable for students and instructor

Relevant Student Feedback

- Students liked the projects, their level of difficulty, the topics of the projects, and the fact that they reinforced the materials covered in class and the number of them.
- Some students suggested to split up the projects into smaller parts or to assign milestones so as to prevent procrastination.
- Some students suggested small in-class quizzes (rather than three or four long quizzes.)

Conclusions

- Tight integration of lectures, reviews, and programming assignments works well
- Students meet the learning objectives