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 hart 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
• 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

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