Artificial Intelligence

Goal:
- Understand how intelligent behavior is possible
- i.e. Come up with a theory that explains intelligent behavior

Methodology:
- Design, build and experiment with computation systems that perform tasks commonly viewed as intelligent

Flying Analogy:
- First approach:
  + Dissect known flying animals
  + Figure out what they have in common
  + Flapping of wings made of some structure covered with feathers
- A better approach:
  + Understand principles of flight
  + Don't restrict to just natural occurrences of flight
  + Construct objects that embody hypothesized principles

Overview

- Bookscapes
- Example Problems
- Symbolic Reasoning

Textbook:
Computational Intelligence: A Logical Approach
David Poole, Alan Mackworth and Randy Goebel
Oxford University Press. 1998

Optional Resource:
Knowledge Representation and Reasoning
Michael stance, Hector J. Levesque
Morgan Kaufmann. 2004

Help:/cse560/textbooks/heemann/cse560
Limitation of Mapping Approach

- Not enough training data
- Might be interested in the internals of the model
- Might need to incorporate well-known knowledge
- Making the reasoning understandable to a person
- Not enough training data

Overview

- Agent Approach
  - Symbolic Reasoning

Mapping Inputs to Outputs

- Many intelligent tasks involve mapping

Books are physical things
- Books are physical things, and physical things have a weight
- Books are physical things, and physical things have a weight

- Trump's wives are Ivana, Marla, and Melania

Mapping can be done by a neural network, SVM, decision tree, etc.

- Image matching
- Text matching
- Numerical matching

- Many intelligent tasks involve mapping

Mapping Inputs to Outputs
Declarative Approach: Reasoning Algorithm

- Rules encode how new symbols are created from existing ones
- From rules and facts, we should be able to make conclusions that follow from internal state
  - Facts that are not explicitly represented
  - Assumptions that seem reasonable
  - Plans of action
  - Action to perform right now

Declarative Approach: Rules

- Not only can facts be represented with symbols
- But also more general knowledge can be represented

Declarative Approach: Symbols

- Model knowledge with symbols
  - Symbols will have meaning to us (us = the designer)
  - Meaning of symbols should be unambiguous, unlike English
- Need to express complex relations with minimum of symbols
  - Need to express complex relations with minimum of symbols
- Model knowledge with symbols
Overview

Agent Approach

Symbolic Reasoning

Example Problems

Bookkeeping

Fundamental Issues

What are good languages for representing the facts of an agent's internal state?
- What do we mean by a 'good' language?

What are good languages for defining the rules that define the agent's reasoning?
- What good algorithms that can produce the conclusions that correspond to reasoning?
- The rules that define the agent's reasoning?
- The rules of an agent's internal state?

What are good languages for representing constraints on the environment?
- Constraints that can express assertions of facts and rules to make conclusions.

Declarative Approach
Overview

Agent Approach

Symbolic Reasoning

Example Problems

Wiring

- Needs to know
  - What each device is
  - What is connected to what
  - Whether each switch is on
  - Whether each circuit breaker is on
  - Whether each light is on

- Needs to reason about
  - How to turn on a light
  - Whether there is a fault in the system
  - Where it is likely to be

- What is a good way of representing that knowledge?
- How do we specify what we want to reason about?
- How do we reason about what?

Delivery Robot

- Needs to know
  - layout of space
  - where things are
  - which doors are open

- Needs to reason about
  - How to get from one point to another
  - Which packages are available
  - Which deliveries are in the system
  - Which devices are open

- What is a good way of representing that knowledge?
- How do we specify what we want to reason about?
Tcl versus Python

• I've used Tcl in the past for homeworks - Tcl is not as commercially used as Python

• Very picky about tokening - Difficult to differentiate between a token and a list with one token

• Tcl has more weird inconsistencies - Tk is not as concretely used as Python

• I've used Tcl in the past for homeworks

Grading

Assignments 50%
Midterm 25%
Final 25%

• Course website: cslu.ohsu.edu/~heeman/cs560
• Slack channel

Course Outline

Building Agents
Knowledge and Reasoning
Richer formalisms
Representing knowledge
Reasoning about equality
Integrity constraints
Disjunctive knowledge
Quantification
First order predicate logic
Reasoning about actions
Planning
Actions and Planning
Negation as Planning
Non-monotonic reasoning

Knowledge and Reasoning

Two versions of each homework: Tcl and Python versions

If you already know Python, use Python
If you want to minimize the time on homeworks, use Python
If you want to minimize the error on homeworks, use Python
If you don't have a lot of programming experience, use Python

I've done the previous use Tcl
Academic Integrity

You can do the homeworks with your colleagues.
- But, you cannot bring any part of your homework into the meeting.
- You cannot bring anything written out of your meeting.
- You can do the homeworks with your colleagues.

Corollary
- Unless both people have photographic memories, homework assignments should look different.

Critique
- Answer key given out via Sakai when you submit your answers.
- On honor system, not to share it, nor post questions about the answers.
- Have until Sunday at 11:55pm to submit a critique.
- Explain what you did wrong, and why you made that mistake.
- Worth up to half the marks that you lost.
- Really good explanations might even get more.
- Should show that you reviewed and understood the answer key and understood whether your answer was correct.

Homework
- Homework usually given out Monday by 11:55pm.
- Homework must be submitted through Sakai.
- Homework is due a day after the class meeting.
- You can distrubute the solutions on the web.
- Sample homework on the website.
- Homework should be typeset.
- You need to typeset it so that it fits horizontally and vertically.
- If your solution does not work, you need to say so.
- If your solution does not work, you need to say so.
- If you submit incorrect answers, give the answer key and explain why you made that mistake.

Submission
- Submit your code as a single Python file, the under program file.
- If the code does not work, you need to say so.
- You need to explain it in the program file.
- If you submit incorrect answers, give the answer key, and explain why you made that mistake.
- Sample homework on the website.
- If you have questions, email me at heemanp@ohsu.edu.
- Sample homework on the website.
- Homework should be typeset.
- You need to typeset it so that it fits horizontally and vertically.
- If your solution does not work, you need to say so.
- Sample homework on the website.
- Homeowrk must be submitted through Sakai.
- Homework is due a day after the class meeting.
- You can distrubute the solutions on the web.
- Sample homework on the website.
- Homework should be typeset.
We will be following the textbook closely.

Reading assignments are posted on the course website.

- Read chapter 1, 2.1-2.5 for next class.

You are responsible for material in the textbook.