CPS 271
Introduction
Ron Parr

Requirements

• Prior AI experience useful but not required
• Reasonable programming skills:
  – C, matlab, or lisp
• Some mathematical sophistication
  – Short proofs
  – Basic probability concepts
  – Basic algorithmic concepts
    • Complexity
    • Analysis of algorithms

Details

• Professor
  – Ron Parr
  – D209 LSRC, parr@cs, 660-6537
  – Office hours: TBD
• TA
  – Michail Lagoudakis
  – D239 LSRC, mgl@cs, 660-6598
  – Office hours: Almost anytime
• Meetings: T,TH 9:15-10:25 LSRC

About Me

• My first year at Duke
• Bachelor’s degree in philosophy
  – Philosophy of mind
• Ph.D. in computer science
  – Hierarchical planning under uncertainty
• Current interests:
  – Planning under uncertainty
  – Probabilistic reasoning
  – Tracking and diagnosis
  – Reinforcement learning

Major Topics Covered

• Search
  – A*, Games, SAT, CSPs
• Planning
  – Classical, stochastic
• Reasoning uncertainty
  – Bayes nets, decision theory, HMMs, tracking
• Learning
  – Decision trees, Neural nets, Reinforcement learning

Major Topics Not Covered

• Logic
• Knowledge Representation
• Natural Language
• Vision
Why Study AI?

• Many important innovations have grown out of AI
  – Linked list manipulation (Lisp)
  – Timesharing
  – X
  – Formalization of search techniques
  – Heuristics for intractable (NP hard) problems
  – Pattern recognition methods
• Cool tools
• Cool applications

Turing Test

• Computer must be indistinguishable from a human based upon written exchanges
  – Does this imply intelligence?
  – How could the computer cheat?
  – Does intelligence imply a certain type of computation?
  – Could an intelligent machine still fail the test?
• Does our notion of intelligence transcend our concept of humanity?

Cool AI Applications

• AI is lurking in more places than you think:
  – My PDA
  – This Program
  – E-commerce
  – Dragon Naturally Speaking
  – Deep Blue
  – Mobile robotics
  – Space exploration
  – Logistics planning

Ideal Intelligence

• Intelligence means making optimal choices
• Is anything truly intelligent?
• How do we define optimality?
• Is there a more modest goal?

So, what is this AI stuff?

• Make machines think like humans
  – Is this enough?
  – Is this too much?
• Make machines act like humans
  – Is this sufficient?
  – Is this desirable?

Ron’s Compromise Definition

Artificial Intelligence is the task of developing general purpose algorithms with which machines can accomplish tasks which, if performed by a human, would be considered indicative of intelligence.
The Moving Target

• What is human intelligence?
  – At one time, calculating ability was prized
    • Now it is deprecated
    • Calculators permitted earlier and earlier in school
  – Chess was once viewed as an intelligent task
    • Now, massively parallel computers use not very
      intelligent search procedures to beat grand masters
    • Some say Deep Blue wasn’t AI
  – Learning once thought uniquely human
    • Now it’s a well-developed theory
    • Best backgammon is a learning program

Early Efforts: General

• Good news:
  – Many problems can be formalized as problems of logical deduction
  – The space of all proofs is a searchable space
  – A theorem proving engine + a knowledge base provide a satisfying picture or reasoning, knowledge and learning
    • Tell PC:
      – All men are mortal
      – Socrates is a man
    • Ask:
      – Is Socrates mortal?

Artificial Flight

• Even seemingly unambiguous terms such as “flight” were subject to biological chauvinism.

• Demonstrable, unambiguous success ended chauvinism

Intelligence: A web of abilities

• Intelligence is hard to define in isolation
• We are an odd mixture of special purpose and general purpose hardware
  – Special purpose
    • Recognizing visual patterns
    • Learning and reproducing language
  – General Purpose
    • Theorem proving
    • Learning and excelling at new tasks
• Seamless integration

Early Efforts: Special Purpose Methods

• Neural networks attempted to reproduce the function of human neurons
• Is this the proverbial wing-flapping mechanical flying machine?
• Success at reproducing low-level tasks
  – Pattern recognition, associative memory
• Huge gap between low and high level
• Nearly became a religion
Middle of the Road (This Class)

- Study broad classes of problems
- Restrict problem somewhat:
  - Develop a crisp input specification
  - Develop a well-defined success criterion
- Develop results with provable properties and broad applicability
- Extract and study underlying principles behind successful methods

Conclusion

- We want to solve hard problems that would traditionally require human-level intelligence. (Most we consider are at least NP-hard.)
- We want to be good computer scientists, so we force ourselves to use well-defined input/output specifications
- We aim high, but we let ourselves simplify things if it allows us to produce a general-purpose tool with well-understood properties.

Modern AI: The worst case

- We fail to solve the general AI problem, but solve a bunch of less general problems
- We leave behind a many interesting and powerful tools for solving these problems (This is already happening.)
- Nobody gets upset with us for promising too much

Modern AI: The best case

- We achieve the seamless integration that humans have achieved
- We use pattern recognition and learning to shape and guide more general reasoning processes
- The amount of work required to engineer each new success goes down
- We can no longer explain away the intelligence we have created by calling it “artificial”.

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