

CS 416 Artificial Intelligence

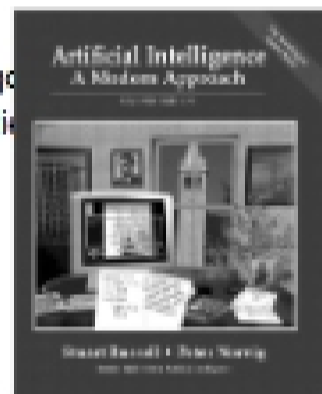
Lecture 1
Introduction

I Cannot Add Students to Course

- Unfortunately, this class is oversubscribed
- I cannot add new students to the course
 - Potential exception for 4th-year CS Majors
- Feel free to stay through end of course today

Textbook

- This is a great book
 - 2nd edition released one month ago
 - Most widely used in U.S. universities
 - It's so good....
 - I'm going to make you read it!
- Homework
 - Read chapters 1 and 2



Syllabus

- Instructor
 - David Brogan
Olsson 217
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 - Office hours: Wednesday 1:30 – 3:00
- TA
 - Ben Hocking
 - Office hours: TBA

Syllabus

- Class web page:
 - Soon to be at: <http://www.cs.virginia.edu/~cs416>
- Grading
 - 3 (perhaps 4) programming assignments (40%)
 - A couple homework assignments (10%)
 - Midterm and Final (25% for each)

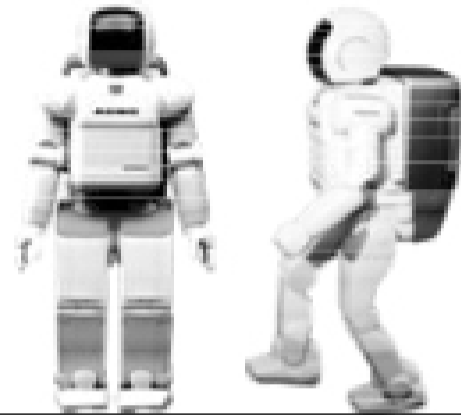
What is AI?

- Discussion exercise for class
 - Think of example AI systems (applications that are intelligent)
 - Think of example AI Techniques

AI Systems

- Thermostat
- Tic-Tac-Toe
- Your car
- Chess
- Google
- Babblefish

- This thing
 - Asimo



AI Techniques

- Rule-based
- Fuzzy Logic
- Neural Networks
- Genetic Algorithms

How to Categorize These Systems

- Systems that think like humans
- Systems that act like humans

- Systems that think rationally
- Systems that act rationally

Distinctions

- How one thinks vs. How one acts
 - How can I know how you think?
 - For the most part, you are a "black box"
 - Cognitive Science
 - How can I know how you act?
 - Observation
 - Turing Test

Alan Turing – "Building a Brain"

- World War II motivated computer advances
 - Code breaking (Colossus)
 - Computing missile trajectories (Mark I)
 - Electronic Numerical Integrator and Computer (ENIAC)
- Turing greatly involved with British efforts to build computers and crack codes (Bletchley Park)
 - Arrested for being a homosexual in 1952 and denied security clearance
 - Committed suicide in 1954

Rational vs. Human

- Thinking/acting rationally vs. Thinking/acting like a human
 - Rely on logic rather than human to measure correctness
 - Thinking rationally (logically)
 - Socrates is a human; All humans are mortal; Socrates is mortal
 - Logic formulas for synthesizing outcomes
 - Acting rationally (logically)
 - Even if method is illogical, the observed behavior must be rational

Perspective of this Course

- We will investigate the general principles of rational agents
 - Not restricted to human actions and human environments
 - Not restricted to human thought
 - Not confined to only using laws of logic
- Anything goes so long as it produces rational behavior

What is AI?

- *The use of computers to solve problems that previously could only be solved by applying human intelligence.... thus something can fit this definition today, but, once we see how the program works and understand the problem, we will not think of it as AI anymore* (David Parnas)

Foundations - Philosophy

- Aristotle (384 B.C.E.) – Author of logical syllogisms
- da Vinci (1452) – designed, but didn't build, first mechanical calculator
- Descartes (1596) – can human free will be captured by a machine? Is animal behavior more mechanistic?
- Necessary connection between logic and action is discovered

Foundations - Mathematics

- More formal logical methods
 - Boolean logic (Boole, 1847)
- Analysis of limits to what can be computed
 - Intractability (1965) – time required to solve problem scales exponentially with the size of problem instance
 - NP-complete (1971) – Formal classification of problems as intractable
- Uncertainty (Cardano 1501)
 - The basis for most modern approaches to AI
 - Uncertainty can still be used in logical analyses

Foundations - Economics

- Humans are peculiar so define generic happiness term: utility
- Game Theory – study of rational behavior in small games
- Operations Research – study of rational behavior in complex systems
- Herbert Simon (1916 – 2001) – AI researcher who received Nobel Prize in Economics for showing people accomplish satisficing solutions, those that are good enough

Foundations - Neuroscience

- How do brains work?
 - Early studies (1824) relied on injured and abnormal people to understand what parts of brain do
 - More recent studies use accurate sensors to correlate brain activity to human thought
 - By monitoring individual neurons, monkeys can now control a computer mouse using thought alone
 - Moore's law states computers will have as many gates as humans have neurons in 2020
 - How close are we to having a mechanical brain?
 - Parallel computation, remapping, interconnections, binary vs. gradient...