

Introduction to Artificial Intelligence

COMP 30030

Dr. Robin Burke



Who am I?

- Associate Professor at DePaul University, Chicago, Illinois
- Fulbright Scholar at UCD for 2008-2009 Academic Year
- PhD from Northwestern University, Evanston, Illinois, 1993
 - Artificial Intelligence
- Research
 - Case-based reasoning
 - Recommender systems
 - User modeling
- Teaching
 - Mostly computer game development, including game AI



About this class

- Marking

- Exam 50%

- Mid-term 15%

- Practicals 35%

- Project 20%

- Homework 15%

- Lectures

- Tuesday / Thursday 9-10

- Computer Science Theatre



Bear with me!

- First time teaching here
- Many things I don't know
 - we will rely a great deal on our teaching assistant
- Contact information
 - rburke@cs.depaul.edu
 - most reliable
 - Office phone
 - 716-2858
- TA contact info
 - Not assigned yet
- Moodle forum will also be important

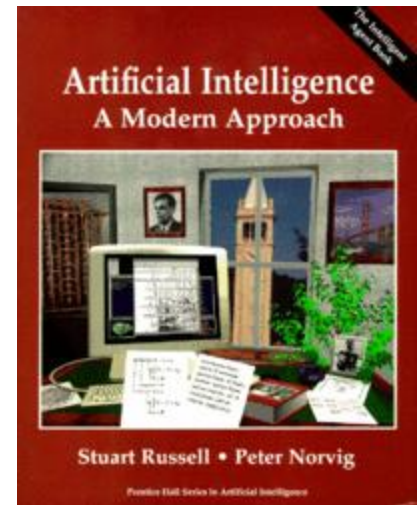
Book

- Russell & Norvig,
Artificial Intelligence: A
Modern Approach

- cover chapters 1-6

- skipping some bits

- Other books probably cover the
core topics as well





What is AI?

- problematic concept
- conjunction of two difficult terms
 - artificial
 - “not natural”
 - intelligence
 - ?
- Typical definition
 - Minsky: “The science of making machines do things that would require intelligence if done by people.”



Problems with the definition

- Cube roots
 - if you can do cube roots in your head, most people would say that requires intelligence
 - no one would call numeric algorithms AI
- Vision
 - chickens can recognize complex objects in visual scenes
 - duplicating such abilities is a (not so easy) AI problem
 - we don't think chickens are intelligent
- Optical character recognition
 - used to be considered an AI problem
 - then it was (mostly) solved
 - now we don't consider it AI



My favorite definition

- (courtesy Chris Riesbeck)
- “Artificial Intelligence is the search for the answer to the fundamental question: Why are computers so stupid?”

Computer stupidity



- Examples?

- crash

- performance problems

- anomalies not noticed



Some AI topics

- Learning
 - how to get computers to do better over time and experience
 - how to get them to take correction / instruction
- Common sense
 - how to get computers to know basic facts about the world
 - can a ping-pong ball be used as a football?
 - can you drive from Dublin to Chicago?
- Language
 - how to get computers to make use of human language
 - “The man with the white dog with the white gloves.”
 - “The man with the white dog with the white tail.”
 - “Mike thinks chocolate.”
- Planning
 - how to get computers to act in the world
 - starting from Celbridge, get to UCD in time for class.



AI philosophies

- Hard / Strong AI

- The result being sought is a computer program that exhibits intelligent behavior and the program constitutes an explanation of how humans achieve the same behavior.
- Example: a computer vision algorithm might claim to reproduce certain functions in the human visual system.

- Weak AI

- We're interested in solving the problem but we don't care how people do it.

How could a program explain human intelligence?

- Obviously, people and computers are very different
 - neurons vs transistors
 - sugars vs electric current
 - neurotransmitter diffusion vs voltage pulses
- AI programs will not be the same as brains
 - so is hard AI doomed?
- Not necessarily
 - (some would disagree)
 - birds fly and so do airplanes
 - they don't fly the same way
 - on the other hand,
 - airplanes solve the problem of moving people through the air and
 - have taught us about the fundamental principles that help us understand bird flight
 - functional equivalence

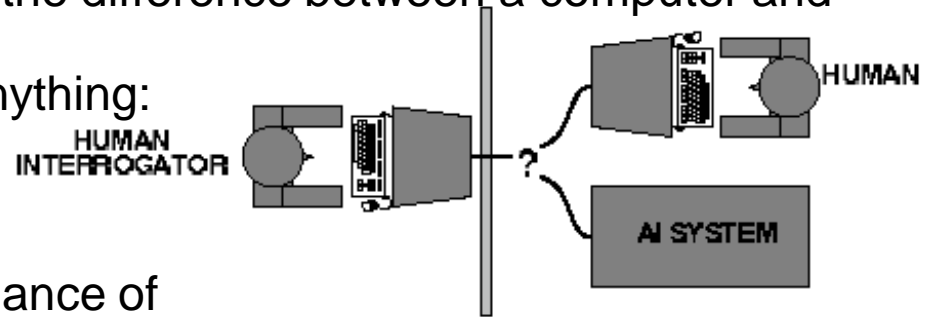


Some related fields

- Cognitive science
 - branch of psychology interested in modeling intelligence
 - controlled experiments focused on basic features of thought
 - example: 7 ± 2
 - Names: Pinker, Tversky
- Linguistics
 - study of language
 - commonalities across languages suggest relationships between language and thought
 - example: shape words are learned earlier than color words
 - Names: Chomsky, Lakoff
- Philosophy
 - What is knowledge? How do we know? How do we know that we know?
 - What is thought / intelligence?
 - Names: Dennett, Dreyfus

The Turing Test

- Proposed in 1950 by Alan Turing
 - Given only a textual interface
 - Can a experimental subject tell the difference between a computer and a person?
 - Conversation could be about anything:
 - What are you wearing today?
 - Is Ronaldinho over the hill?
 - Estimated that by 2000 a computer would have 30% chance of fooling a lay person for 5 minutes
 - not quite there
- Raises many research issues that are still open questions
- Some dislike it
 - the computer has to lie
 - computer has to match human cognitive limitations





ELIZA

- Written in the 1960's by Joseph Weizenbaum
- Engages in ``conversations'' with a user
 - [example](#)
- Eliza's responses are generated through **pattern-matching**
 - Eliza's memory contains a set of patterns and responses
 - ``Transformed'' input is matched against the patterns; whichever pattern matches determines the response
- Occasionally, inputs are stored so that they can be responded to later
- The experience made Weizenbaum a skeptic of the Turing test
 - it obviously wasn't intelligent
 - but some people did respond to it as if it were human



Loebner Prize

- Annual competition similar to the Turing test
- Limitations placed on questioners make the results somewhat suspect
- 2007 winner
 - [UltraHal](#)



AI Research

- No one works on general-purpose Turing intelligence
 - a Turing-capable system would need to integrate all of the AI capabilities
 - learning, language, planning, etc.
 - all still open problems
 - Cyc comes closest
- AI research is specialized
 - focused on specific problems
 - focused on adding specific capabilities to systems
 - often the AI component is a small but crucial subpart
 - planning on NASA missions
 - Many AI successes

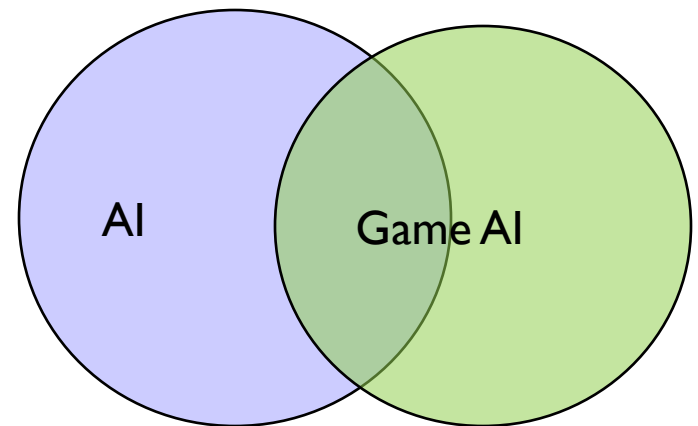


Everyday AI

- Spell/grammar checkers
- Medical diagnosis systems
- Regulating/Controlling hardware devices and processes (e.g, in automobiles)
- Voice/image recognition (more generally, pattern recognition)
- Scheduling systems (airlines, hotels, manufacturing)
- Program verification / compiler and programming language design
- Web search engines / Web spiders
- Web personalization
- Recommender systems (collaborative/content filtering)
- Credit card verification in e-commerce / fraud detection
- Data mining and knowledge discovery in databases
- Computer games

Computer Games

- In games, the non-player characters are often referred to as “AI”
 - “The AIs will retreat if you throw grenades.”
- Game AI is quite different from “real” AI
- Game AI
 - often covers techniques that are not considered “AI-like”
- AI
 - uses techniques impractical in a game context





Differences

- Analogy

- game AI is to "real" AI as
- stage design is to architecture

- The goal of game AI is to give the impression of intelligence

- to avoid the impression of stupidity
- to provide a reasonable challenge for the player



Challenge

- It is very possible to make the computer too smart
 - think: driving game
 - precise calculations = perfect driving for conditions
 - faster response time = quicker response
 - player left in the dust
- The task of AI is to support the experience
 - many compromises from “optimal” required



Not dumb

- It is surprisingly hard to make the computer not dumb
 - especially with (very) limited computational resources
- Example
 - Humans are good at navigating complex 3-D environments
 - This is a basic requirement for a lot of games
 - First-person shooter games like Call of Duty, for example
 - Doing this efficiently is (still) an unsolved problem in AI



But

- Game AI is the future of games
 - More AI techniques will make it into games in the next 5 years
- Many designers see AI as a key limitation
 - the inability to model and use emotion
 - the inability of games to adapt to user's abilities
 - the need for level designers to supply detailed guidance to game characters
- Computational resources are more available
 - Console games are not as compute-bound as they used to be
 - PS3 / XBox 360



Other emerging applications

- Assistive robotics for elderly / handicapped
- Autonomous vehicles
- Intelligent user interfaces
- Smart rooms / houses



Overview of the course

- **Search**
 - Blind, Heuristic, Optimal, Stochastic
 - Game Playing & Adversarial Search
- **Logic & Deduction**
 - Proposition logic
 - Predicate logic
 - Deduction
- **Planning**
 - Standard, Partial-Order, Hierarchical
- **Probability and Uncertainty**
 - Probabilistic models
 - Network models
- **Learning & Classification**
 - Inductive Learning – Decision Trees, ID3
 - Genetic Algorithms
 - Neural Networks
- **AI Case Studies**
 - Applications and Research



Problem Solving

- Specific subarea of AI
 - solving well-defined puzzle-like problems
- Classic example
 - Three missionaries and three cannibals must cross a river using a boat which can carry at most two people, under the constraint that, for both banks, if there are missionaries present on the bank, they cannot be outnumbered by cannibals (if they were, the cannibals would eat the missionaries.) The boat cannot cross the river by itself with no people on board.
 - (originally, the “jealous husbands problem” from medieval times)
- Solution = the sequence of boat trips that will get the groups across

Sudoku solved

5	3	4	6	7	8	9	1	2
6	7	2	1	9	5	3	4	8
1	9	8	3	4	2	5	6	7
8	5	9	7	6	1	4	2	3
4	2	6	8	5	3	7	9	1
7	1	3	9	2	4	8	5	6
9	6	1	5	3	7	2	8	4
2	8	7	4	1	9	6	3	5
3	4	5	2	8	6	1	7	9



An AI solution

- We need a representation
 - a formal description of the problem
 - the starting state of the puzzle
 - the termination condition
 - the constraints
 - the possible moves
- We need an algorithm
 - how do we go about constructing a solution?

Thursday



- Meet in the regular room
 - CS Theatre
- Read Ch. 1 and 2, Ch. 3.1-3.3