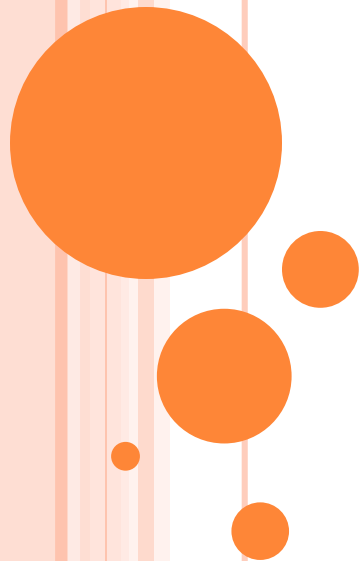


CS480 – ARTIFICIAL INTELLIGENCE

FALL 2015

TOPIC: INTRODUCTION
CHAPTER: 1
DATE: 8/26



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READING

- Chapter 1
- Turing, A. (1950). Computing machinery and intelligence. *Mind*, 59, 433-460.
- Tversky, A. and Kahneman, D. (1974). Judgment under uncertainty: heuristics and biases. *Science*, 185:4157, 1124-1131

OUTLINE

- Fallacies in human reasoning
- Arguments against true AI
- Define artificial intelligence
- The foundations of AI
- The history of AI
- The state of the art
- Outline for the rest of the semester

FALLACIES IN HUMAN REASONING

- Mostly from Tversky, A. and Kahneman, D. (1974).
Judgment under uncertainty: heuristics and biases.
Science, 185:4157, 1124-1131
- Tuberculosis test
- Coin flips
- Sampling a word
- Computation

TUBERCULOSIS TEST

- Tuberculosis test
 - The test is 90% accurate
 - If one has TB, the test is positive with 90% probability
 - If one doesn't have TB, the test is negative with 90% probability
 - John takes the test and the result is positive
 - What is the probability that John has TB?
- <http://www.cdc.gov/tb/publications/factsheets/statistics/TBTrends.htm>

COIN FLIPS

- Imagine a fair coin
- We flip it 6 times
- Which one is a more likely sequence
 - H,T,H,T,T,H
 - H,H,H,T,T,T

SAMPLING A WORD

- Sample a word from the English dictionary that has at least three letters
- Is it more likely
 - That the word starts with an r, or
 - That r is the third letter?

COMPUTATION

- First group of people were asked to estimate

$$1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8$$

- The second group was asked to estimate

$$8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$$

- First group: 512
- Second group: 2,250
- Correct answer: 40,320

ARGUMENTS AGAINST TRUE AI - I

- The theological objection
 - Thinking is a function of man's immortal soul.
- The “Heads in the Sand” objection
 - The consequences of machines thinking would be too dreadful. Let us hope and believe they cannot do so.
- The mathematical objection
 - There are limitations to the power of discrete-state machines
- The argument from consciousness
 - “Not until a machine can write a sonnet or compose a concerto because of thoughts and emotions felt, and not by the chance of fall of symbols, could we agree that machine equals brain – that is, not only write it but know that it had written it.”

ARGUMENTS AGAINST TRUE AI - II

- Arguments about cannot do's
 - I grant you that you can make machines do all the things you have mentioned but you will never be able to make on do X.
 - Be kind, resourceful, beautiful, and friendly
 - Have initiative
 - Have a sense of humor
 - Fall in love
 - Enjoy strawberries and cream
 - Do something really new

OUTLINE

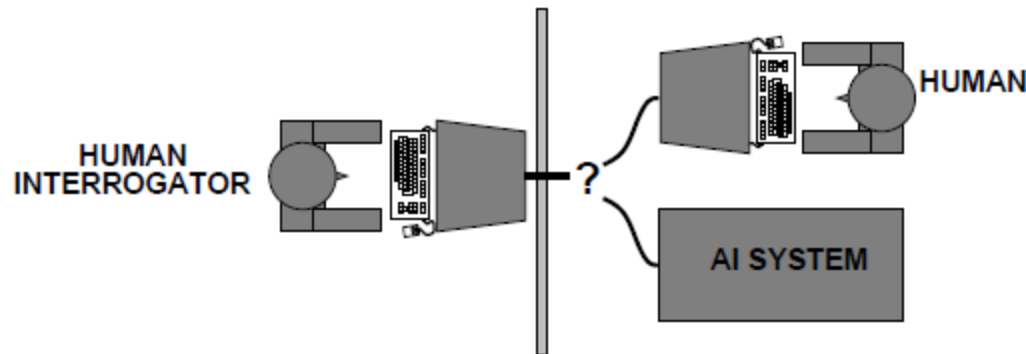
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HUMANLY VS. RATIONALLY & THINKING VS. ACTING

	Humanly	Rationally
Think	Thinking humanly	Thinking rationally
Act	Acting humanly	Acting rationally

ACTING HUMANLY – THE TURING TEST

- The imitation game
 - An operational test



- The AI system needs to have:
 - Natural language processing
 - Knowledge representation
 - Automated reasoning
 - Machine learning

THINKING HUMANLY — COGNITIVE MODELING

- Need to know how humans think
 - Introspection
 - Psychological experiments
 - Brain imaging
- Cognitive science
 - Based on experimental investigation of humans and animals

THINKING RATIONALLY – LAWS OF THOUGHT

- Codify “right thinking”
 - Aristotle
- Logic
 - “Socrates is a man; all men are mortal; therefore, Socrates is mortal”
- Two main challenges
 - It is hard to encode esp. uncertain knowledge in formal logic
 - Can be computationally very demanding, unless it is provided some guidance

ACTING RATIONALLY

- A **rational agent** is an agent that acts so as to achieve the best outcome, or when there is uncertainty, the best expected outcome.
- Two advantages
 - More general than thinking rationally, because acting rationally requires thinking rationally
 - More amenable to scientific development than the approaches based on human

IN THIS CLASS

ACTING RATIONALLY

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THE FOUNDATIONS - I

- Philosophy

- Logic, induction, rationalism, empiricism

- Mathematics

- Algorithms, computability, tractability, np-completeness, probability

- Economics

- Utility, decision theory, game theory

THE FOUNDATIONS - II

- Neuroscience
 - The study of the brain
- Psychology
 - Behaviorism, cognitive psychology, how humans and animals think and act
- Computer engineering
 - Making small, efficient, fast, programmable devices
- Linguistics
 - Grammar, syntax, how language relates to thinking

HISTORY - I

○ Gestation: 1943 – 1955

- Based on:
 - Physiology and function of the neurons in the brain
 - Formal analysis of propositional logic
 - Theory of computation
- First neural network computer – 1950
- Turing test – 1950

○ Birth: 1956

- Dartmouth workshop: the term AI was coined
- Logic Theorist – was able to prove most theorems in the book *Principia Mathematica*

HISTORY - II

- Early enthusiasm: 1952 – 1969
 - General Problem Solver (GPS) – imitate human problem-solving protocols – thinking humanly approach
 - Geometry Theorem Prover – was able to prove theorems that many math students found to be tricky
 - Checkers – the program that learned to play checkers – disproved the idea that the computers can do only what they are told to do
 - Lisp – the dominant AI programming language for about 30 years
 - Many microworlds – limited domains
 - SAINT – solved closed-form calculus integration problems
 - ANALOGY – solved geometric analogy problems that appear in IQ tests
 - STUDENT – solved algebra story problems
 - Perceptrons

HISTORY - III

- A dose of reality: 1966 – 1973
 - Merely syntactic manipulations
 - “The spirit is willing but the flesh is weak” => “The vodka is good but the meat is rotten”
 - Intractability
 - Tried many possible combinations till worked
 - Worked initially because microworlds contained very few objects and actions
 - Representation limitations of perceptrons
 - Almost killed the neural net research until 80s

HISTORY - IV

- Knowledge-based systems: 1969 – 1979
 - Narrow areas of expertise with domain knowledge integration
 - DENDRAL – inferred molecular structure
 - Integrated domain knowledge to guide and limit the search
 - MYCIN – diagnosed blood infections
 - Was better than junior doctors
 - Was able to handle uncertain knowledge
 - Developments in knowledge representation

HISTORY - V

- AI becomes industry: 1983 – present
 - R1 – the first successful commercial application – 1982
 - Helped configure orders for new computer systems
 - By 1986, it saved an estimated of \$40 million a year
 - AI industry
 - 1980 – a few million dollars
 - 1988 – billions of dollars

HISTORY - VI

- Return of neural networks: 1986 – present
- AI adopts scientific method: 1987 – present
- Emergence of intelligent agents: 1995 – present
- Very large datasets: 2001 – present

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THE STATE OF THE ART

- Robotic vehicles
 - Driverless cars
- Speech recognition
 - Speech-to-text
 - Automated dialog management systems
- Autonomous planning and scheduling
 - NASA's mission robots
- Game playing
 - Deep blue
- Spam filtering
- Machine translation

THE STATE OF THE ART – NOT MENTIONED IN THE BOOK

- Personal agents
 - Siri, Google now, Cortana
- Recommendations
 - Netflix, Amazon
- Face detection and recognition
 - Even personal cameras can do face detection now
- Near real-time speech recognition, translation, and voice
 - Skype translator
- IBM Watson
 - Jeopardy

SOME USEFUL LINKS

- The AI Effect
 - http://en.wikipedia.org/wiki/AI_effect
- Applications of AI
 - http://en.wikipedia.org/wiki/Applications_of_artificial_intelligence
- AI Competitions
 - http://en.wikipedia.org/wiki/Competitions_and_prizes_in_artificial_intelligence
- AAAI
 - <http://www.aaai.org/home.html>
 - <http://aitopics.org/>
- Shameless self-promotion ☺
 - <https://twitter.com/bilgicm>

IBM WATSON PLAYING JEOPARDY

- If you have not seen IBM Watson play the jeopardy game, I strongly suggest you to do so

REST OF THE SEMESTER - I

- Intelligent agents – Chapter 2
 - Environment, performance, agent programs
- Search – Chapter 3, 5, & 6
 - Problem solving through uninformed and informed search
 - Game playing
 - Constraint satisfaction

REST OF THE SEMESTER - II

- Knowledge representation and reasoning –

Chapters 7, 8, & 9

- Propositional logic
- First-order logic
- Resolution algorithm

REST OF THE SEMESTER - III

- Uncertainty and Probabilistic Reasoning – Chapters 13, 14, & 15
 - Probability theory
 - Bayesian networks
- Decision making – Chapter 16
 - Utility theory
 - Value of information

REST OF THE SEMESTER - IV

- Learning – Chapters 18, 19, & 20
 - Supervised learning
 - Decision trees
 - Statistical learning

NEXT

- Chapter 2