Introduction

CS 486/686: Introduction to Artificial Intelligence
Winter 2016

Outline

- Course administration
- What is AI? (Chapter 1)
  - Definitions
  - History
  - What we will cover
- Rational Agents (Chapter 2)

Course Administration

- CS 486/686: Introduction to Artificial Intelligence
  - Section 1: MC 2035 Wed/Fri 2:30-3:50
  - Section 2: MC 2035 Wed/Fri 4:00-5:20
- Course Personnel:
  - Kate Larson (klarson@uwaterloo.ca)
    - Office Hours: Wednesdays 10:30-11:30 in DC 2518
  - TAs: John Doucette, Sajin Sasy, Luyu Wang, Rong Wang, Chi Zhang

Course Administration

- Website:
  - http://www.cs.uwaterloo.ca/~klarson/teaching/W16-486
  - Learn
- Newsgroup:
  - We will be using Piazza for the newsgroup. Details on how to sign up are in the syllabus.
- Texts:
  - Artificial Intelligence: A Modern Approach by S. Russell and P. Norvig (3rd Edition)
  - Artificial Intelligence: Foundations of Computational Agents, D. Poole and A. Mackworth (available online)

Evaluation

CS 486

- 5 Assignments: 40%
- Blog Task: 5%
- Midterm: 15%
- Final: 40%
- Project (Optional): up to 5 bonus marks

CS 686

- 5 Assignments: 30%
- Blog Task: 5%
- Midterm: 10%
- Final: 35%
- Project: 20%

Assignment Late Policy

- Assignments are due as announced
  - For each assignment, you can pass it in up to 48 hours late
    - No doctor's note required, etc
- **<u>BUT</u>**
  - No assignment will be accepted after the 48 hour grace period
  - No questions about the assignment will be answered during the 48 hour period

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What is AI?

- According to media/ popular perception
  - Something that is changing the world somehow??
  - What socially-inept hackers do
  - “When Robots Attack”
  - ...

What is AI?

- Definition of AI differ along two dimensions
  - Reasoning vs behaviour
  - Fidelity to human behaviour vs rationality

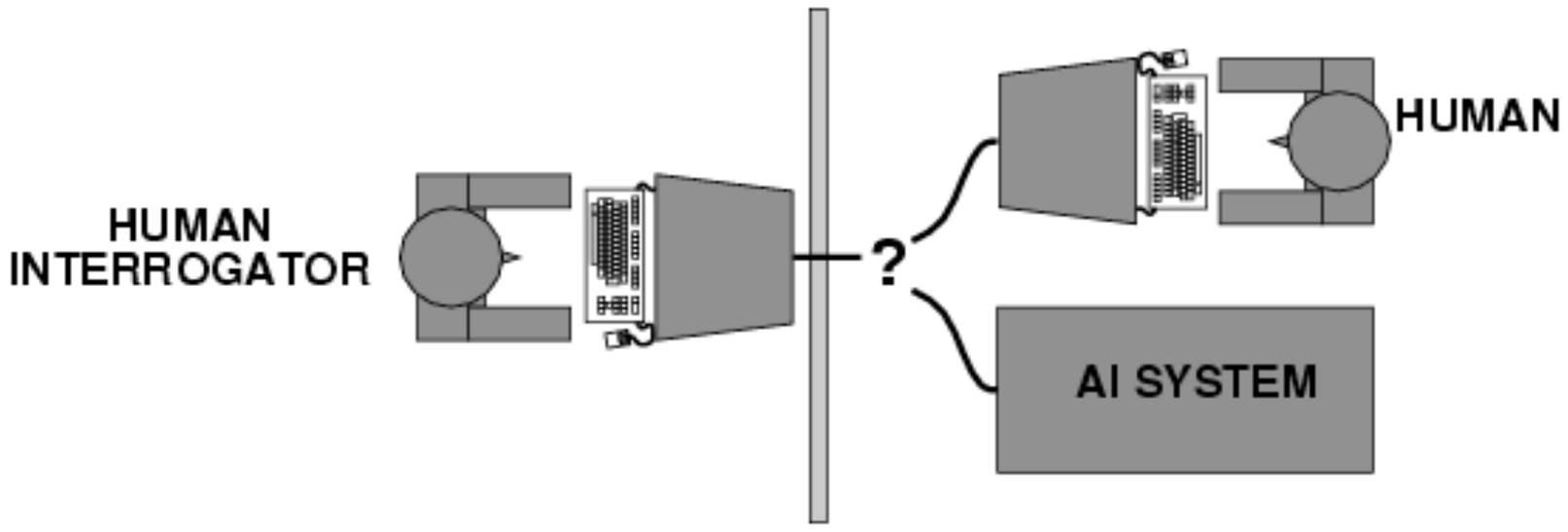
Systems that think like humans	Systems that think rationally
Systems that act like humans	Systems that act rationally

What are the Goals of AI?

- AI is about duplicating what the (human) brain **DOES**
  - Turing Test
- AI is about duplicating what the human brain **SHOULD DO**
  - Rationality

Behaving Like a Human

- Alan Turing (1950) “Computing machinery and intelligence”



Computing Machinery and Intelligence

- Predicted that by 2000 a computer would have a 30% chance of fooling a lay person for 5 minutes
- Anticipated all major arguments against AI
- Suggested major components of AI:
  - Knowledge, Reasoning, Language Understanding, Learning

The Turing Test

- The test is still relevant today
  - The Loebner Prize
  - “Eugene Goostman”

- However,
  - It is not reproducible or amenable to mathematical analysis
  - More important to understand underlying principles of intelligence than copy them?

What are the Goals of AI?

- AI is about duplicating what the (human) brain **DOES**
  - Turing Test

- AI is about duplicating what the human brain **SHOULD DO**
  - **Rationality**

Rational Behaviour

Doing the Right Thing

- Doing what is expected to maximize goal achievement, given available information
  - Does not necessarily require thinking
    - But often thinking serves rational behaviour

Abridged History of AI

- 1943: McCulloch & Pitts: Boolean circuit of the brain
- 1950: Turing's "Computing machinery and intelligence"
- 1950s: Early AI Programs including Samuel's checkers, Newell and Simon's Logic Theorist
- **1956: Dartmouth meeting: "Artificial Intelligence"**
- 1966-1973: Problems with scaleability, Perceptron paper
- 1970s: Knowledge-based systems
- 1980's: Expert-systems industry
- 1988-now: Probabilistic and decision theoretic methods
- Now- : Significant progress in machine learning and industry interest

"The AI Winter"

Classical AI

- Reasoning was seen as THE AI problem
  - Chess was considered pivotal to understanding intelligence

- **Goal**: General Problem Solver

Recent AI

- Focus on solving specific problems
- Heavy use of probability theory, decision theory, statistics,...
- Collection of subfields
  - Perception (including vision) is usually separate
  - Robotics is mostly separate
  - Deliberative reasoning is “AI”
    - But lots of different approaches

Course Contents

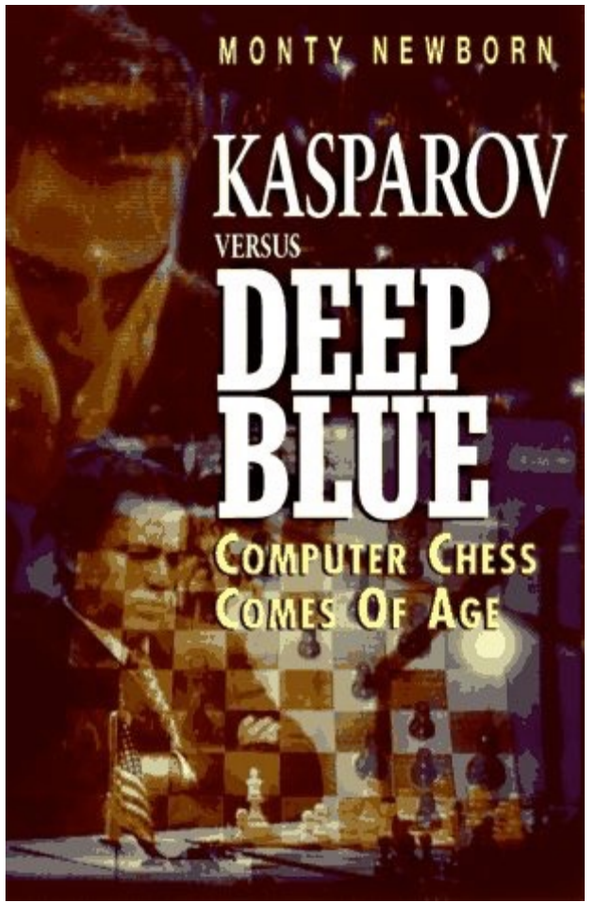
- Search
- Knowledge Representation and Reasoning
- Planning
- Reasoning Under Uncertainty
- Learning

State of the Art

- Chess was **THE** AI challenge for decades

"I could feel – I could smell – a new kind of intelligence across the table"

-Gary Kasparov



"Saying Deep Blue doesn't really think about chess is like saying an airplane doesn't really fly because it doesn't flap its wings."

– Drew McDermott

State of the Art

- Play soccer?
- Play a decent game of Jeopardy?
- Play poker?
- Drive along a curving mountain road?
- Drive safely along King St in Waterloo?
- Buy a weeks' worth of groceries on the Internet?
- Buy a week's worth of groceries at the grocery store?
- Discover and prove a new mathematical theorem?
- Converse successfully with another person for one hour?
- Perform a surgical operation?
- Put away the dishes and fold the laundry?
- Translate spoken Chinese into spoken English in real time?
- Write a news story?
- Write an intentionally funny story?

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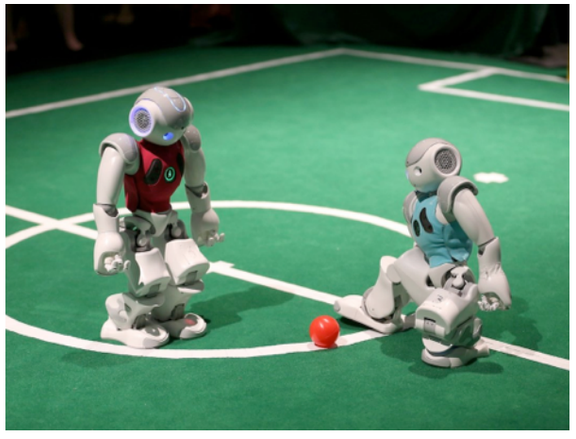
State of the Art

[House-hold chores]



State of the Art

Toronto-Dominion Bank posts fourth-quarter profit of $1.38 billion

BY THE ASSOCIATED PRESS DECEMBER 3, 2015

TORONTO - TORONTO (AP) _ The Toronto-Dominion Bank (TD) on Thursday reported fiscal fourth-quarter profit of $1.38 billion.

The bank, based in Toronto, said it had earnings of 73 cents per share. Earnings, adjusted for one-time gains and costs, came to 87 cents per share.

The results surpassed Wall Street expectations. The average estimate of four analysts surveyed by Zacks Investment Research was for earnings of 85 cents per share.

The retail and wholesale bank posted revenue of $6.12 billion in the period.

For the year, the company reported profit of $6.38 billion, or $3.40 per share. Revenue was reported as $25.32 billion.

Toronto-Dominion shares have dropped 14 per cent since the beginning of the year. The stock has decreased 17 per cent in the last 12 months.

———

This story was generated by Automated Insights (http://automatedinsights.com/ap) using data from Zacks Investment Research. Access a Zacks stock report on TD at http://www.zacks.com /ap/TD

State of the Art

ARTIFICIAL INTELLIGENCE | **Nature** | *1 day ago*

AI called in to tackle Large Hadron Collider data deluge

Leading particle physicists and AI researchers discuss how advanced AI techniques could revolutionize data analysis at the Large Hadron Collider. Many physicists are hesitant to hand over such a level of control to an algorithm.

- Large Hadron Collider
- LHC graphical guide

APPLIED COMPUTING | **The Guardian** | *1 day ago*

World's first computer-generated musical to debut in London

From musical theater data analysis from Cambridge University to character development from University of London's What-If Machine and music by algorave, a collaboration of computer science research hits the London stage in February:

- The What-If Machine
- Algorave
- Watch the video
- Book tickets

ARTIFICIAL INTELLIGENCE | **Engadget** | *5 hrs ago*

I taught a computer to write like Engadget

A writer uses Andrej Karpathy's Char-RNN to write like Engadget and concludes that a single neural network is never going to be able to write news articles with actual sense or meaning.

- Read the paper
- Char-RNN
- Andrej Karpathy on RNN
- More news on Char-RNN

ARTIFICIAL INTELLIGENCE | **Wired** | *5 hrs ago*

Teaching AI to play Atari will help robots make sense of our world

Google is teaching machines to play Atari games like Space Invaders, Video Pinball, and Breakout. At DeepMind, researchers have built artificial intelligence software that can sometimes beat human players at these classic games.

- DeepMind
- Skymind
- Osaro

ARTIFICIAL INTELLIGENCE | **Cambridge University** | *5 hrs ago*

Cambridge University launches £10 million AI research center

It used to be a question purely for science fiction writers, but with experts predicting human-level AI could become a reality within this century. Cambridge University has been at the forefront of the issue.

- Huw Price
- Zoubin Ghahramani

ARTIFICIAL INTELLIGENCE | **FastCompany** | *5 hrs ago*

Inside the hack rod, the world's first AI-designed car

The brainchild of the Primordial Research Project, this car is based on billions of data points plugged into generative-design software.

- Mickey McManus
- Mouse McCoy

ARTIFICIAL INTELLIGENCE | **The Washington Post** | *5 hrs ago*

The computer that can rate your therapist

Researchers have shown that an automated computer system using only audio recordings of sessions can effectively evaluate the level of empathy shown by a psychotherapist.

- Read the paper
- Read another article

HUMAN-CENTERED INTERACTION | **Medical Xpress** | *5 hrs ago*

Robotic therapy more effective when patients' brains stimulated by electricity

Motor imagery and brain-computer interface (BCI) feedback can help the brain rebuild damaged neural pathways in stroke victims. Patients who received an electric current to the skull demonstrated significantly more accurate BCI use.

- Read the paper
- Kai Keng Ang

ARTIFICIAL INTELLIGENCE | **Wall Street Journal** | *1 day ago*

Japan seeks tech revival in artificial intelligence

Japanese startup taps machine learning in bid to restore luster to Japan's long history of technical innovation.

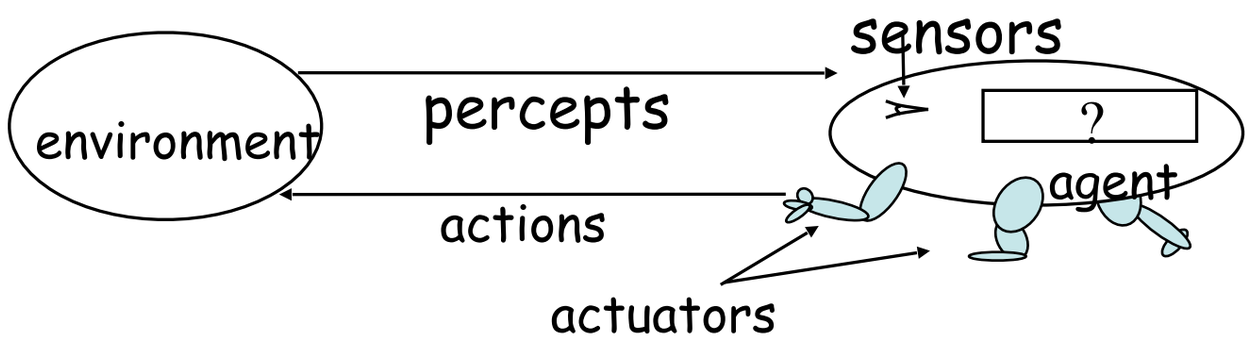
- Preferred Networks

State of the Art

They can even question our commands!

Rational Agents

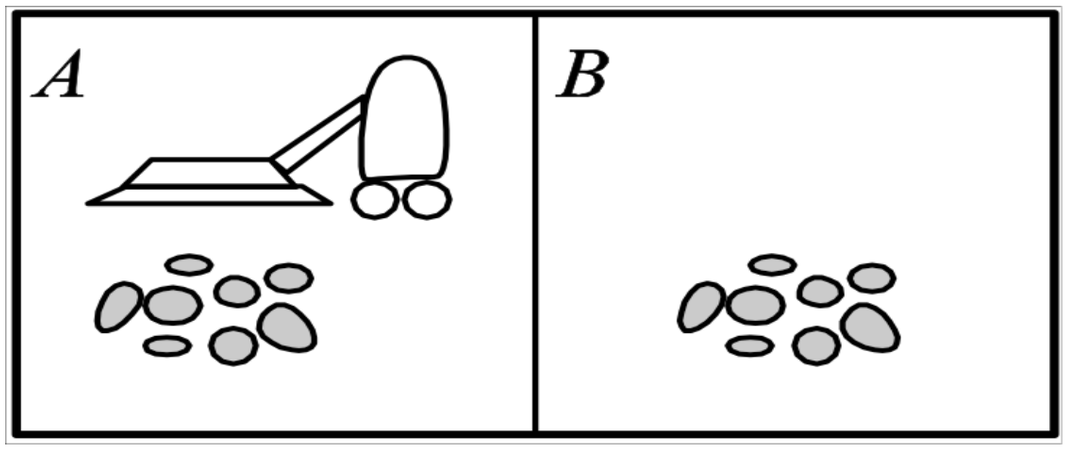
- An entity that perceives and acts
  - Function from percept to actions f:P→A
- Performance measures
  - Goal achievement, resource consumption,...
- **Caveat**: Computational limitations and environmental constraints mean we do not have perfect rationality



Task Environment

- To design a rational agent, the **task environment** must be specified
  - Performance measure
  - Environment
  - Actuators
  - Sensors

Performance Measures



- **Percepts:** [Location, Dirty or Clean]
- **Actions:** Right, Left, Vacuum, NoOp, Dump
- **Function**: ([A,Clean],Right), ([A, Dirty], Vacuum), ([B, Dirty], Vacuum), ([B, Clean], Left)...

Properties of Task Environment

- Fully Observable vs Partially Observable
- Deterministic vs Stochastic
- Episodic vs Dynamic
- Discrete vs Continuous
- Single agent vs Multi agent

Questions?

- Next lecture: Problem Solving Agents (Chapter 3)