# CS 331: Artificial Intelligence

## Introduction

### What is AI? (4 categories of defns)

<table>
<thead>
<tr>
<th>Thought process</th>
<th>Human performance</th>
<th>Rationality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavior</td>
<td>Systems that think like humans</td>
<td>Systems that think rationally</td>
</tr>
<tr>
<td></td>
<td>Systems that act like humans</td>
<td>Systems that act rationally</td>
</tr>
</tbody>
</table>
Acting like humans (Turing Test)

Can a human interrogator, after posing some written questions, tell if the responses come from a human being or a computer?

Requirements for computer: natural language processing, knowledge representation, automated reasoning, machine learning, vision and robotics (the last two are for the "total Turing Test")

Problems with the Turing Test

- Not reproducible
- Can’t be analyzed mathematically
- Tends to focus on human-like errors, linguistic tricks, etc.
- Does not produce useful computer programs

AI researchers believe it’s more important to study the underlying principles of intelligence than duplicating how humans act
Thinking Humanly (Cognitive Modeling)

- Models of the internal workings of the human mind
- Validation:
  - Compare models with actual behavior of human subjects (cognitive science)
  - Compare models with neurological activity in the brain (cognitive neuroscience)
- AI is now distinct from both cognitive science and cognitive neuroscience

Thinking rationally (Laws of Thought)

- Rational = conclusions are provable from inputs and prior knowledge
- Ensure all actions by a computer are justifiable (i.e. “rational”)

Problems:
- Hard to represent informal knowledge formally, especially when not 100% certain
- Computationally expensive
Acting Rationally (Rational Agents)

- “Agent”: something that acts
- “Rational” means more than just logically justified. It also means “doing the right thing”
- “Rational agent”: an agent that acts to achieve the best outcome given its resources

Rational Agents

<table>
<thead>
<tr>
<th>very few resources</th>
<th>lots of resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>no thought</td>
<td>Careful, deliberate reasoning</td>
</tr>
<tr>
<td>“reflexes”</td>
<td>limited, approximate reasoning</td>
</tr>
</tbody>
</table>

- Adjust amount of reasoning according to available resources and importance of the result
- This is one thing that makes AI hard
**AI Timeline**

<table>
<thead>
<tr>
<th>Year Range</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1943-1956</td>
<td>The gestation of AI</td>
</tr>
<tr>
<td>1956</td>
<td>The birth of AI</td>
</tr>
<tr>
<td>1952-1969</td>
<td>Early enthusiasm, great expectations</td>
</tr>
<tr>
<td>1966-1973</td>
<td>A dose of reality</td>
</tr>
<tr>
<td>1969-1979</td>
<td>Knowledge-based systems</td>
</tr>
<tr>
<td>1980-present</td>
<td>AI becomes a successful industry</td>
</tr>
<tr>
<td>1986-present</td>
<td>The return of neural networks</td>
</tr>
<tr>
<td>1987-present</td>
<td>AI adopts the scientific method</td>
</tr>
<tr>
<td>1995-present</td>
<td>The emergence of intelligent agents</td>
</tr>
<tr>
<td>2001</td>
<td>Big Data</td>
</tr>
</tbody>
</table>

**AI Today**

- Deep Blue: first computer program to defeat the world champion in chess (1996)
- AlphaGo: master-level performance at Go (2016)
- NavLab: minivan drove itself across the US on its own 98% of the time (1995)
- Google’s self-driving cars
- Proverb: crossword puzzle solver (1998)
Other AI applications in the real world

- Credit card fraud detection
- Medical diagnosis programs
- Computer-assisted surgery
- Search engines
- Personalized news sites
- Collaborative filtering
- Spam filtering
- Disease outbreak detection
- Opponents in video games

Surprises in AI Research

- Tasks difficult for humans have turned out to be “easy”
  - Chess
  - Checkers, Othello, Backgammon
  - Logistics planning
  - Airline scheduling
  - Fraud detection
  - Sorting mail
  - Proving theorems
  - Crossword puzzles
Surprises in AI Research

- Tasks easy for humans have turned out to be hard.
  - Speech recognition
  - Face recognition
  - Composing music/art
  - Autonomous navigation
  - Motor activities (walking)
  - Language understanding
  - Common sense reasoning (example: how many legs does a fish have?)

AI Courses at OSU

1. CS331: Introduction to AI (Spring quarter)
   - Search
   - Games
   - Knowledge Representation
   - Bayesian Networks

2. CS434: Machine Learning and Data Mining (Spring quarter)
   - Supervised Learning
   - Unsupervised Learning
   - Reinforcement Learning
1. Search

8-puzzle: Beginning with the start state, slide tiles horizontally or vertically until you get to the goal state.

Start State

Goal State

We will discuss:
- Uninformed search
- Informed search
- Local search
2. Games (Fully observable)

• How do you create a program to play tic-tac-toe intelligently?

• What about chess?

3. Knowledge Representation

Knowledge Base

From this knowledge base, can we derive the following?

• Your professor is a Packer fan
• You will have a difficult midterm
• Your professor does not like cheese
Private And Confidential

Dear Friend,

It is with heart of hope that I write to seek your help in the context below. I am Mrs. Jumai Asfatu Abacha, the second wife of the former Nigeria head of state who died on the 8th of June, 1998.

Having gotten your address through the internet, I have no doubt on your goodwill to assist us in receiving into your custody (For Safety) the sum of Forty-Eight Million, Five Hundred Thousand United States Dollars (US$48.5M) willed and deposited in my favour by my Late husband…

P(Spam) = 0.88

Professor Hutchinson,

I tried to hand in homework 1 electronically but the handin script was broken. I’ve attached my homework in this email…

P(Spam) = 0.28

Example: Learning to classify emails as spam or not spam

4. Bayesian Networks