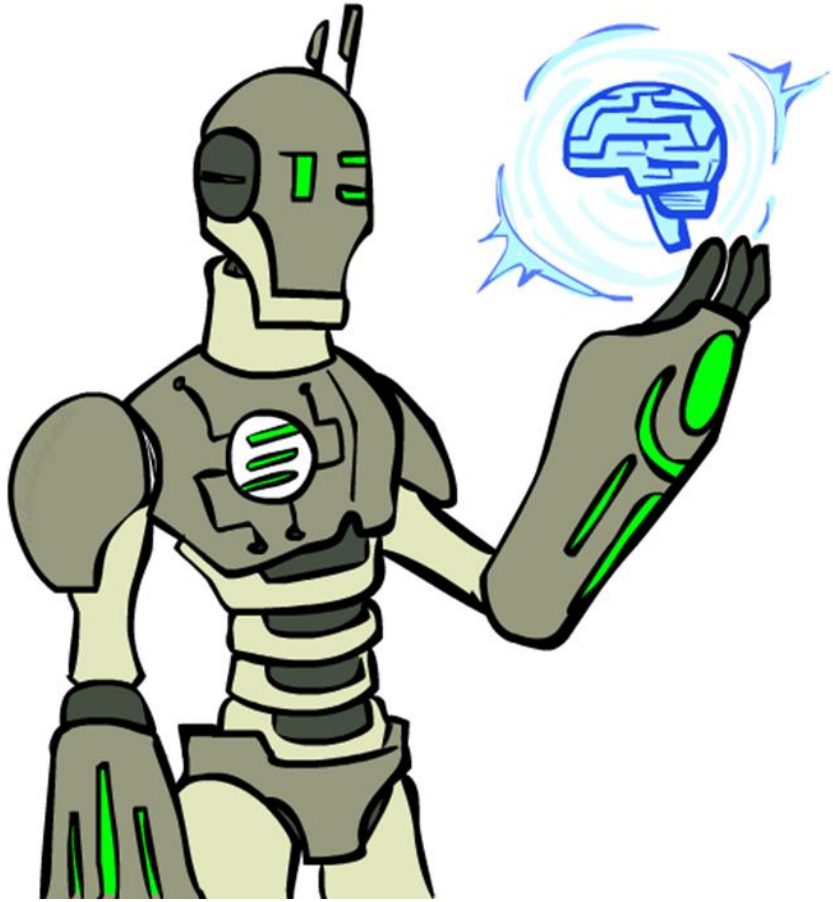
CISC440: Artificial Intelligence and Robotics

Chapter 1: Introduction

Outline

- What is Artificial Intelligence (AI)?
- The foundation of AI
- The history of AI
- The state of Art
- Risks and Benefits

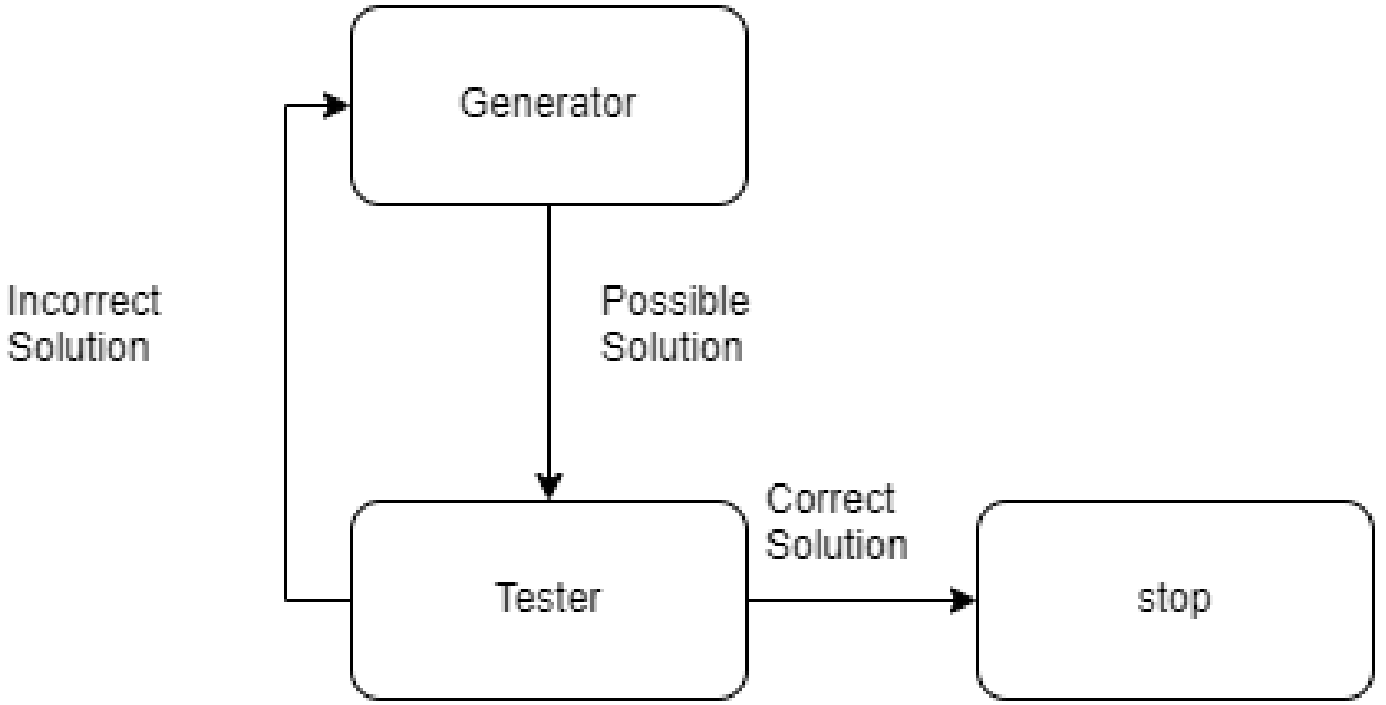


What is AI?

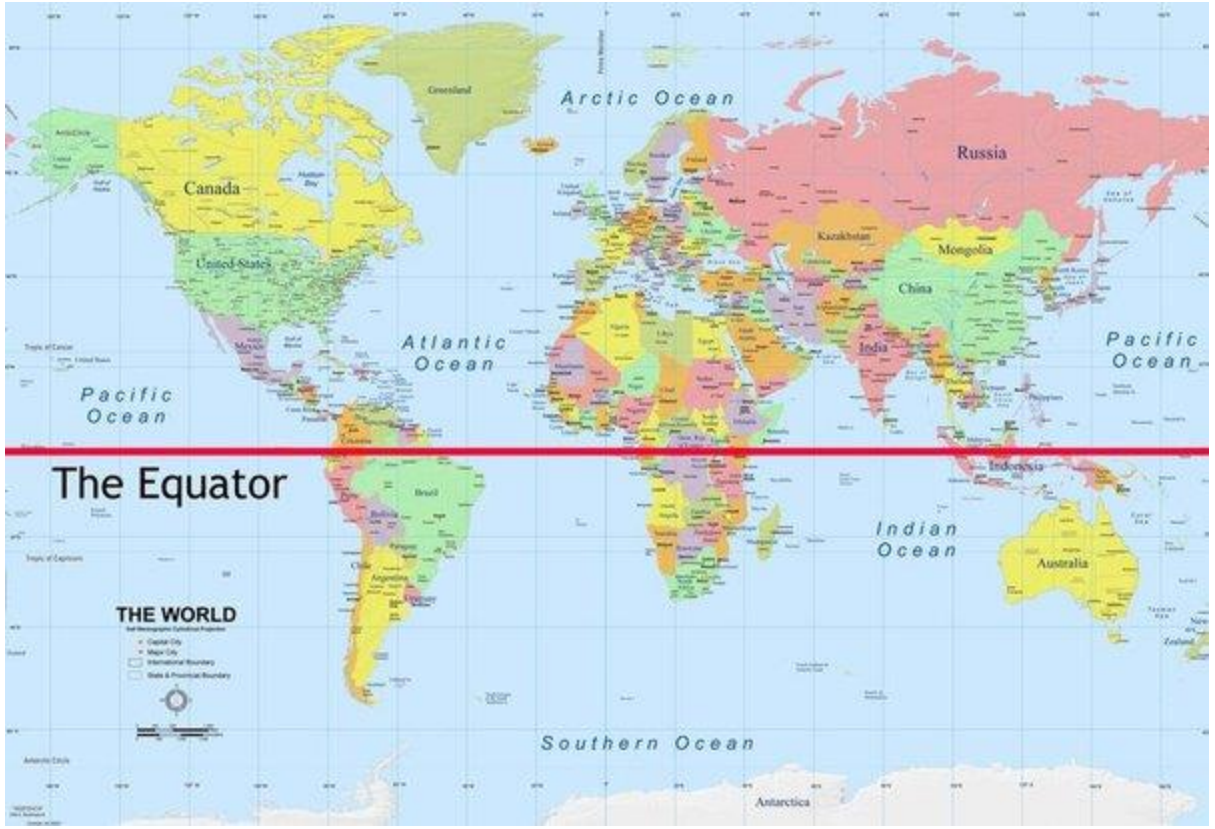
- Thinking + Perception + Action
- Philosophy class -> Fine
- Computer Science class ->
  - Models targeted at thinking, perception and action
  - Representation
  - Constraints exposed
  - Algorithm
- Example

Algorithms enabled by constraint exposed by representation that support models targeted at thinking, perception and action

Generate and Test



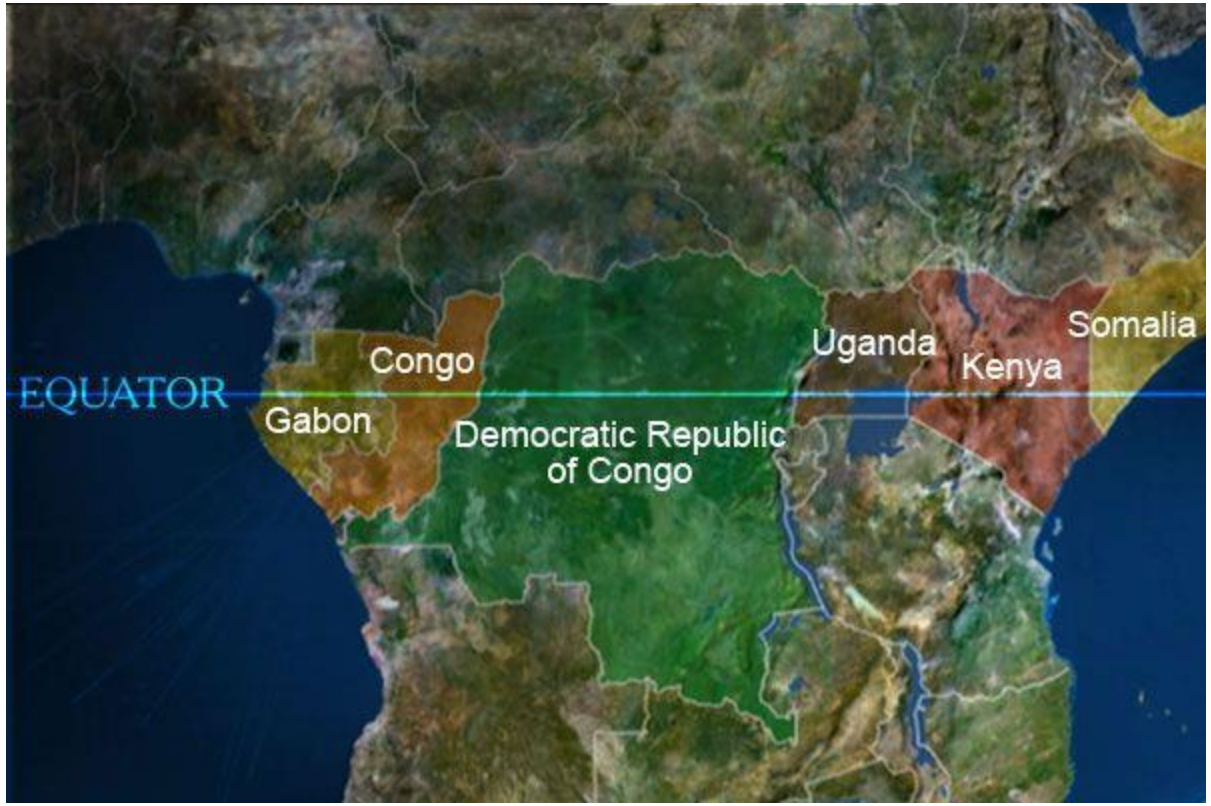
How many continents cross the equator?



- The equator passes through the continents of South America, Africa and Asia.

How many countries of Africa cross the equator?

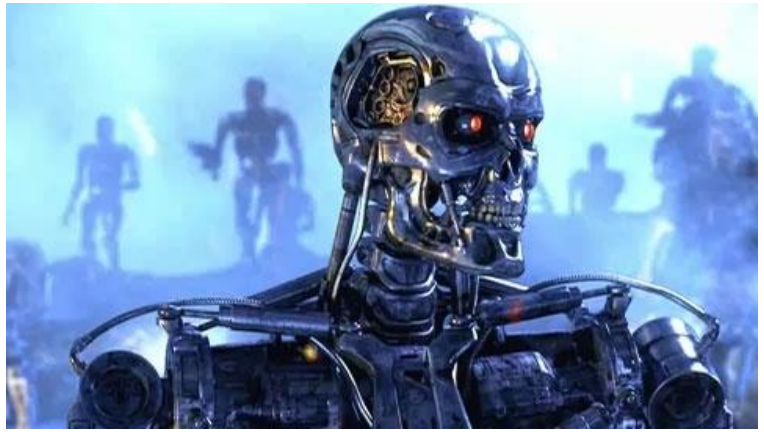
- Scan
- Interpret
- Answer



Sci-Fi AI?

Hope (70's)

80's Hardware could be scary



90's Software could be scary

2000's can we be able to tell a difference

Now: Reality Check

AI in News

Watson in Jeopard

[ChatGPT]

AlphaGo

Chatbots

Autonomous Driving

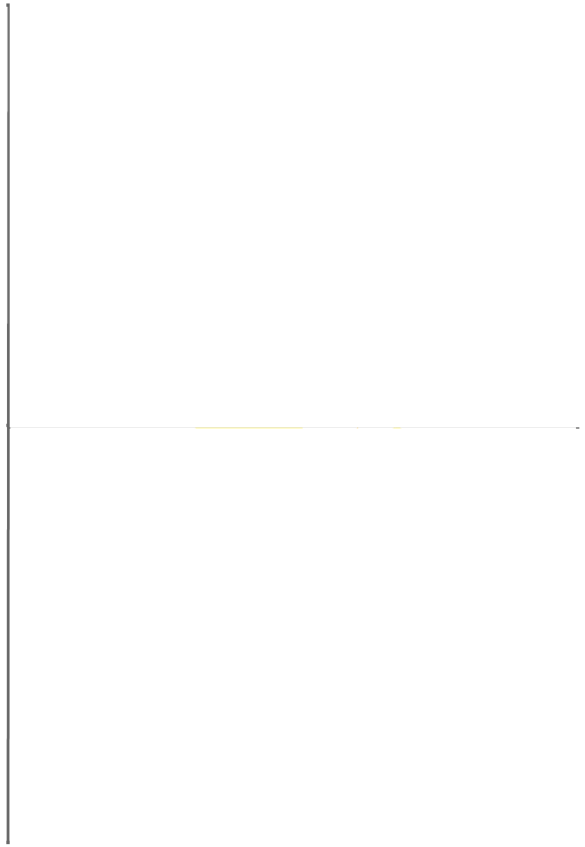
AI at the Fun End

- Funny AI

Color Names

What is AI?

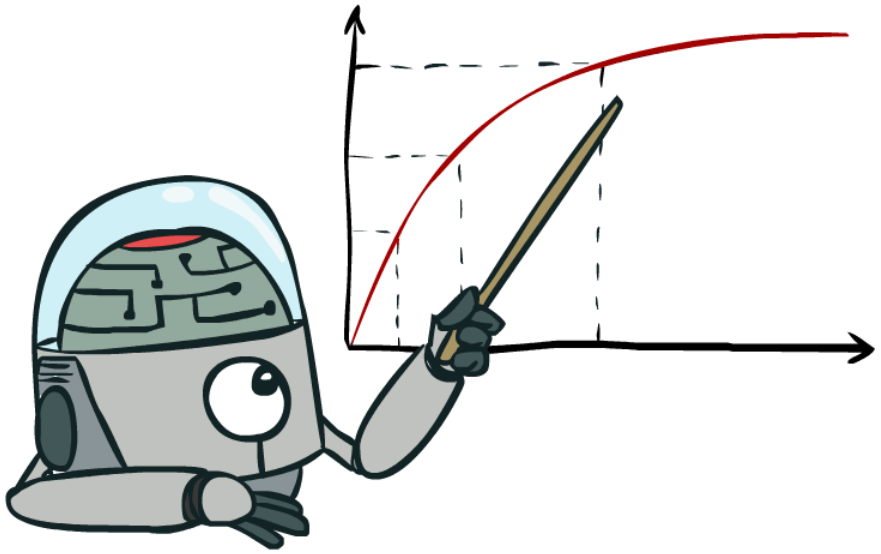
The science of making machines that:



Rational Decisions

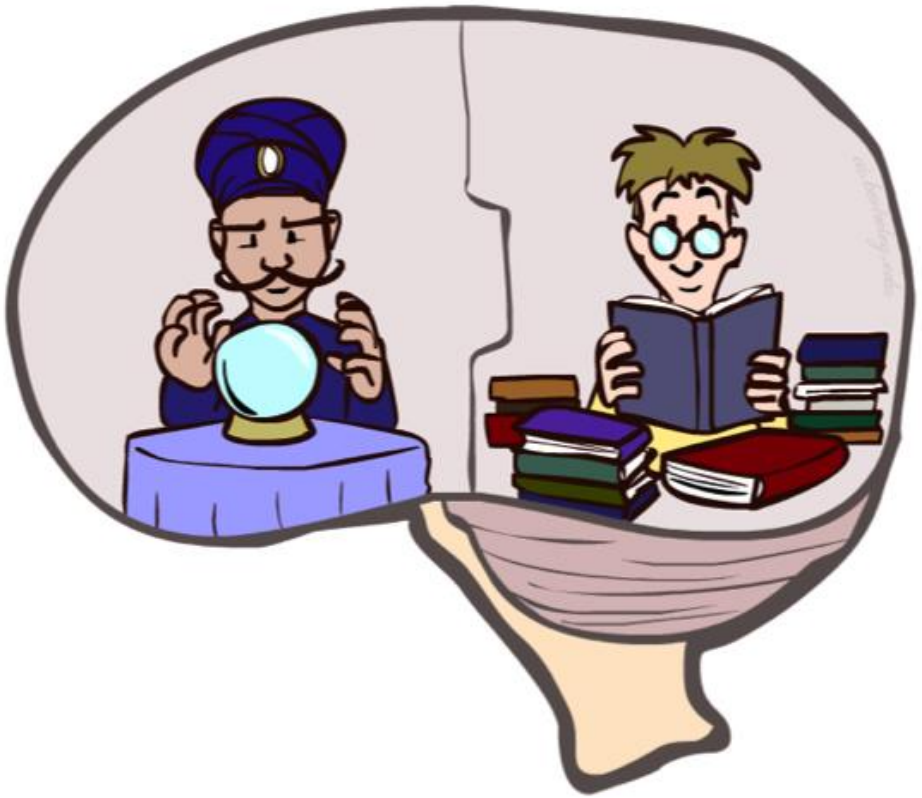
- We'll use the term **rational** in a very specific, technical way:
  - Rational: maximally achieving **pre-defined goals**
  - Rationality only concerns what decisions are made (not the thought process behind them)
  - Goals are expressed in terms of the **utility** of outcomes
  - **Being rational means maximizing your expected utility**

Maximize Your Expected Utility



What About the Brain?

- Brains (human minds) are very good at making rational decisions, but not perfect
- Brains aren't as modular as software, so hard to reverse engineer!
- "Brains are to intelligence as wings are to flight"
- Lessons learned from the brain: **memory and simulation** are key to decision making



Course Distribution

Part 1: Intelligence from Computation
- Fast Search
- Constraint Satisfaction
- Uninformed Search

Part 2: Intelligence from Data
- Bayes' Net
- Decision Theory
- Machine Learning

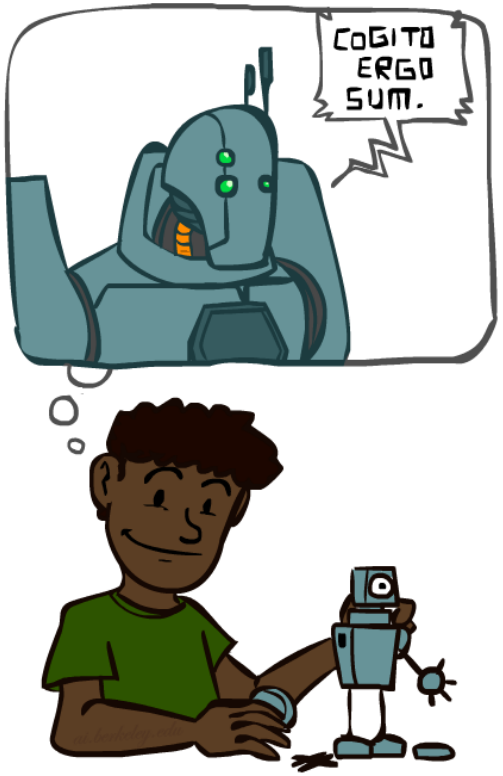
LISP

Part 3: Introduction of the Robotics
- Connection
- Motors
- Intelligent Bricks
- Sensors

Python

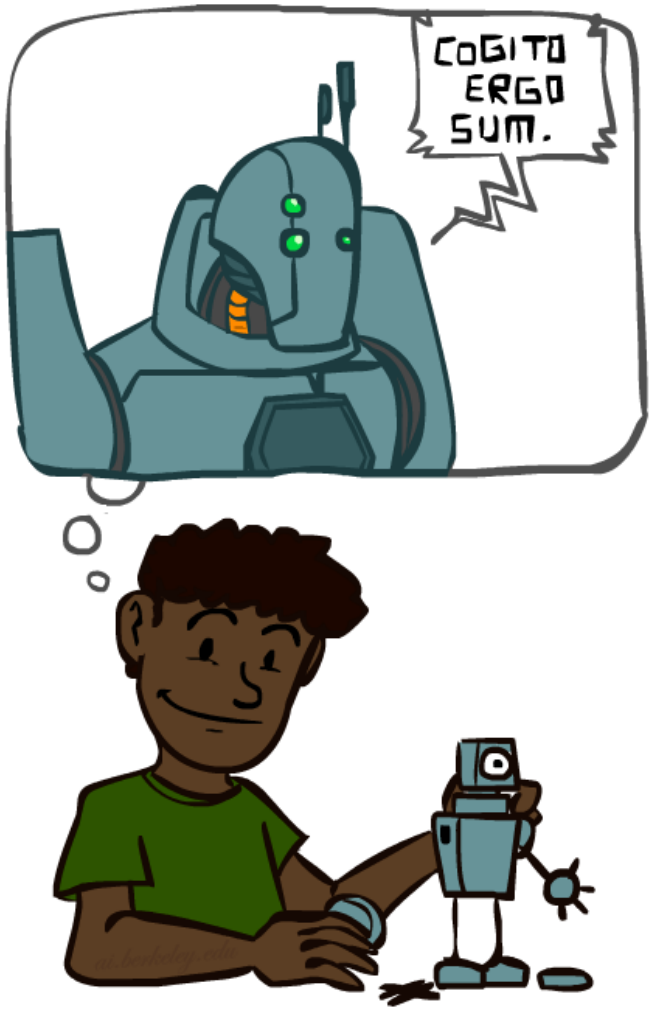
History of AI

Interesting interview from back in 1960's



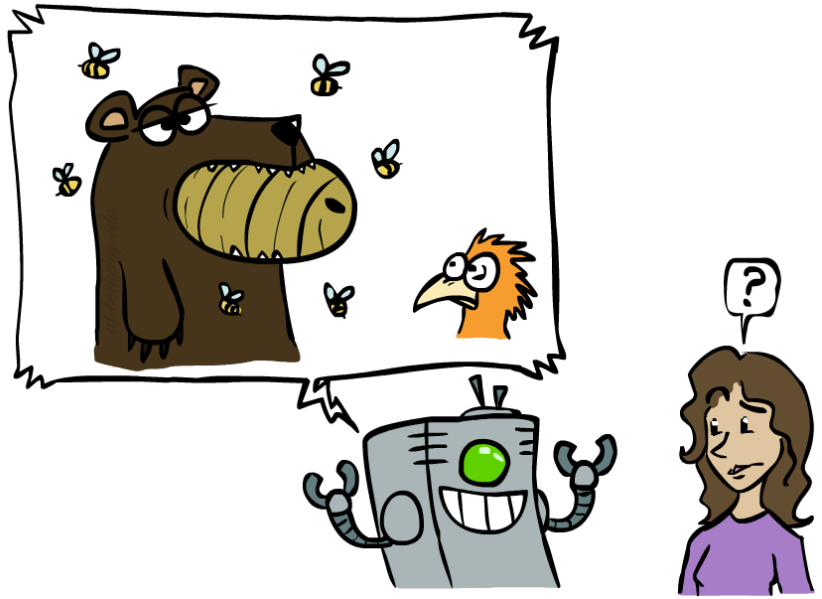
History of AI

- !842 Lady Lovelace:
  - "The analytical engine has no presentation to originate anything. It can do whatever we know how to order it to perform"
- 1940-1950: Early days
  - 1943: McCulloch & Pitts: Boolean circuit model of brain
  - 1950: Turing's "Computing Machinery and Intelligence"
- 1950—70: Excitement- (a honeymoon period)
  - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
  - 1956: Dartmouth meeting: "Artificial Intelligence" adopted
  - 1965: Robinson's complete algorithm for logical reasoning
- 1970—90: Knowledge-based approaches (AI Winter)
  - 1969—79: Early development of knowledge-based systems
  - 1980—88: Expert systems industry booms
  - 1988—93: Expert systems industry busts: "AI Winter"
- 1990—2000: Statistical approaches (AI Spring)
  - Resurgence of probability, focus on uncertainty
  - General increase in technical depth
  - Agents and learning systems… "AI Spring"?
- 2000—: Where are we now?



Unintentionally Funny Stories

- One day Joe Bear was hungry. He asked his friend Irving Bird where some hon im there was a beehive in the to the oak tree. He ate the be



- Henry Squirrel was thirsty. he riverbank where his good fr ing. Henry slipped and fell in the ned. The End.

- Once upon a time there wa d a vain crow. One day the crow was sitting in his tree, holdi in his mouth. He noticed that he was holding the piece of hungry, and swallowed the cheese. The fox walked ove to the crow. The End.

[Shank, Tale-Spin System, 1984]

ChatGPT

> How does people think that Jan 1649 is an imaginary date?
>
> Because they're buying stuff.

> What were the skeletons in the closet.
>
> They were bugs, mysterious.

> Who is going to get the cookie?
>
> Tiny one.
>
> The most terrible of bears.

Once upon a time, there was a lazy dog named Bingo who lived in a small village. Bingo was so lazy that he wouldn't even bother to chase after his own tail.

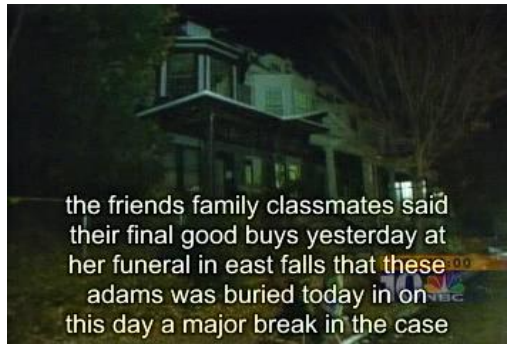
One day, the village was having a big race and all the animals were excited to participate. Bingo, however, wasn't interested. He told his friends, "Why bother running when I can just sleep through the race?"

But when the race began, Bingo suddenly woke up from his nap and joined in. He was so fast that he zoomed past all the other animals, leaving them in the dust. When he crossed the finish line, he barked, "I didn't even know I was in a race!"

Bingo was declared the winner and everyone was shocked. From that day on, Bingo was known as the fastest dog in the village, but he still remained lazy and only ran when he was well rested.

Natural Language

- Speech technologies (e.g. Siri)
  - Automatic speech recognition (ASR)
  - Text-to-speech synthesis (TTS)
  - Dialog systems



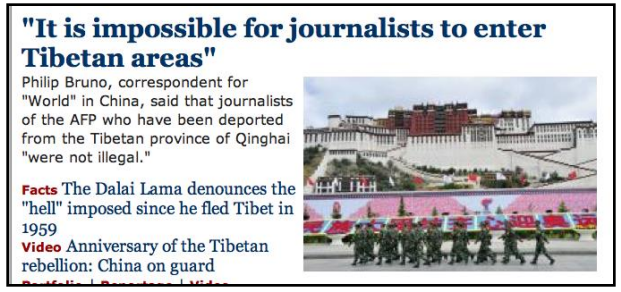
- Language processing technologies
  - Question answering
  - Machine translation


"Il est impossible aux journalistes de rentrer dans les régions tibétaines"

Bruno Philip, correspondant du "Monde" en Chine, estime que les journalistes de l'AFP qui ont été expulsés de la province tibétaine du Qinghai "n'étaient pas dans l'illégalité".

Les faits Le dalaï-lama dénonce l'"enfer" imposé au Tibet depuis sa fuite, en 1959

Vidéo Anniversaire de la rébellion


"It is impossible for journalists to enter Tibetan areas"

Philip Bruno, correspondent for "World" in China, said that journalists of the AFP who have been deported from the Tibetan province of Qinghai "were not illegal."

Facts The Dalai Lama denounces the "hell" imposed since he fled Tibet in 1959

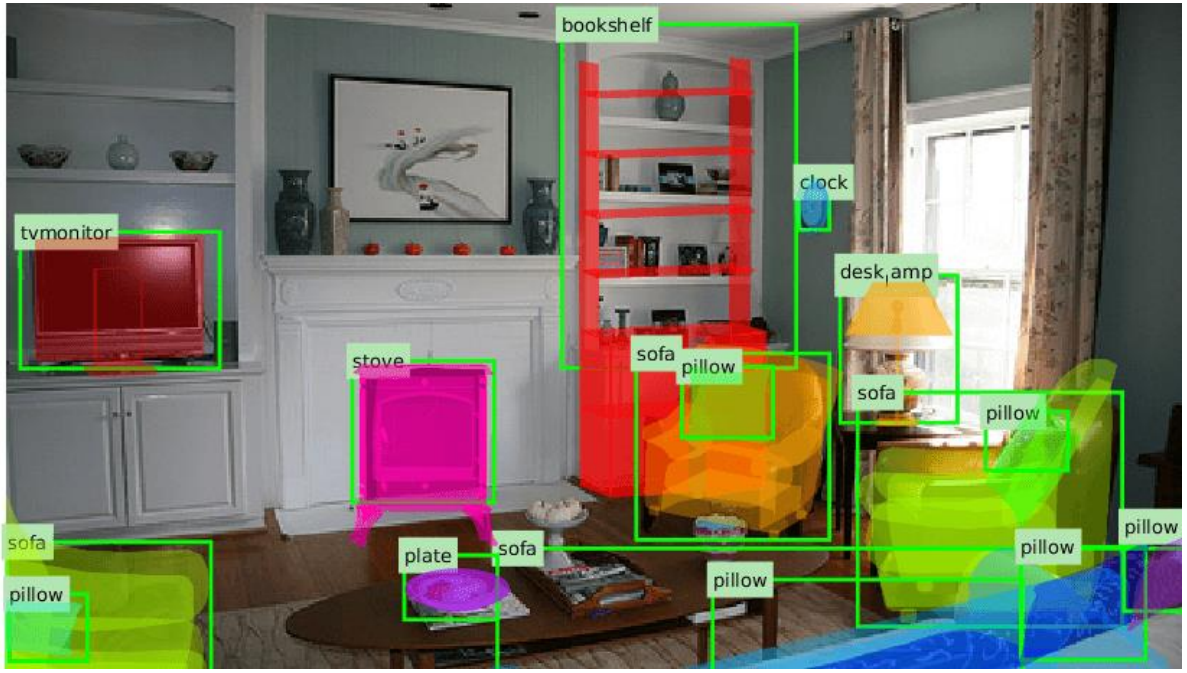
Video Anniversary of the Tibetan rebellion: China on guard

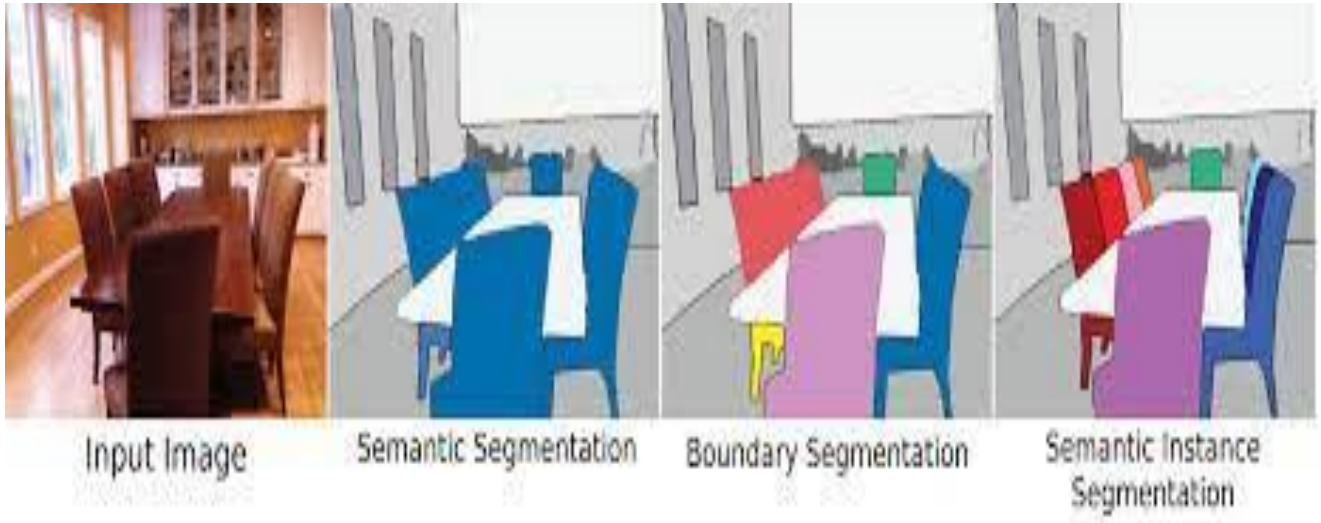
  - Web search
  - Text classification, spam filtering, etc…

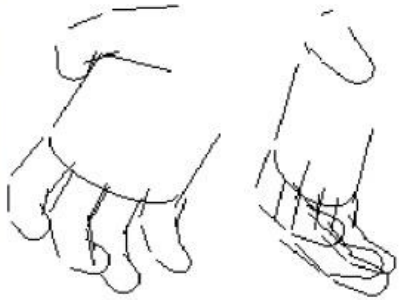
Vision (Perception)

Pixel Value -> Info /decision

- Object and face recognition
- Scene segmentation
- Image classification







Computer Vision

"man in black shirt is playing guitar."

"construction worker in orange safety vest is working on road."

"two young girls are playing with lego toy."

"boy is doing backflip on wakeboard."

"girl in pink dress is jumping in air."

"black and white dog jumps over bar."

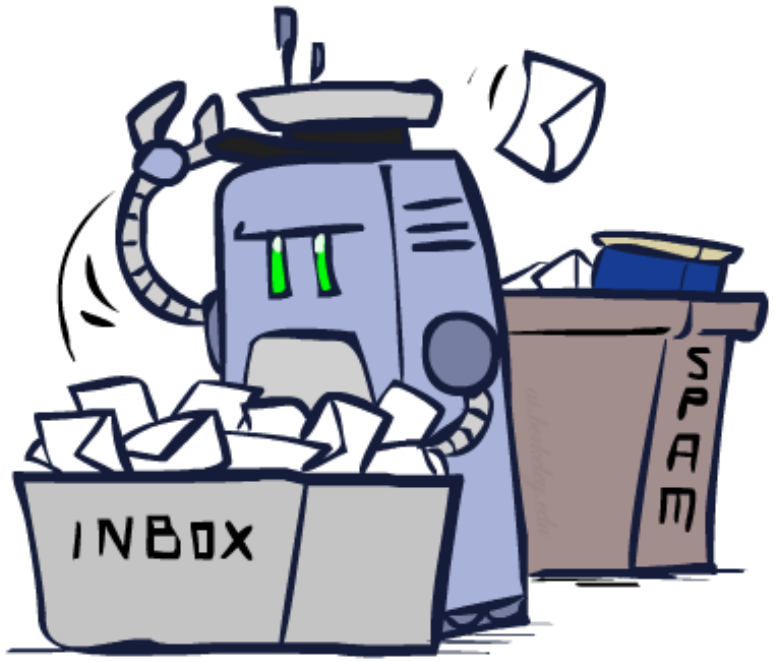
"young girl in pink shirt is swinging on swing."

"man in blue wetsuit is surfing on wave."

Karpathy & FeiFei, 2015; Donahue et al., 2015; Xu et al, 2015; many more

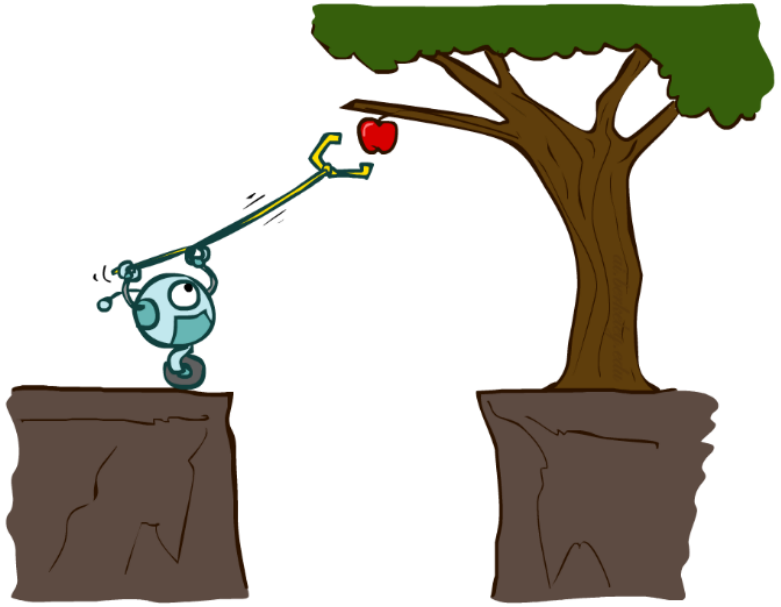
Decision Making

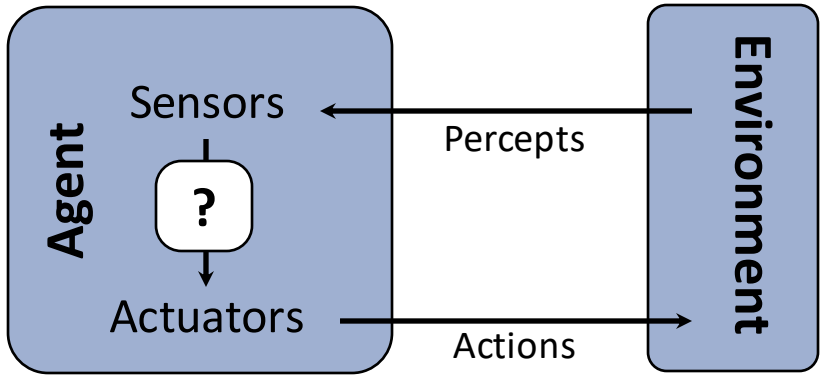
- Applied AI involves many kinds of automation
  - Scheduling, e.g., airline routing, military
  - Route planning, e.g., Google maps
  - Medical diagnosis
  - Web search engines
  - Spam classifiers
  - Automated help desks
  - Fraud detection
  - Product recommendations
  - … Lots more!



Designing Rational Agents

- An **agent** is an entity that *perceives* and *acts*.
- A **rational agent** selects actions that maximize its (expected) **utility**.
- Characteristics of the **percepts, environment,** and **action space** dictate techniques for selecting rational actions
- **This course** is about:
  - General AI techniques for a variety of problem types
  - Learning to recognize when and how a new problem can be solved with an existing technique





Summary

- Introduction
- History
- AI today

- Next time LISP Programming and more

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