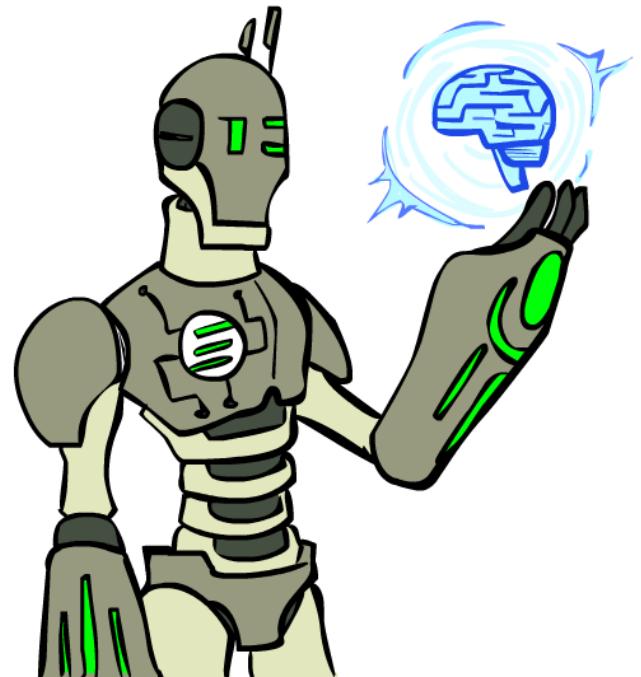


# Introduction

- What is artificial intelligence?
- What can AI do?
- What is this course?



# AI can draw your visions...



Charlie, created in Midjourney's image

# AI can write for you...

V

Write a summary for the introduction lecture of an Intro to Artificial Intelligence course in the style of Pink Floyd lyrics

< 2 / 2 >  (Verse 1)

Hey students, welcome to the stage,  
We'll explore a field that's all the rage.  
From algorithms to neural nets,  
A journey you will not forget.

(Chorus)

Welcome, welcome to the A.I. show,  
Where data flows and models grow.  
Is it a boon or a cosmic flaw?  
Come find out what you never saw.

(Verse 2)

From Turing's mind to silicon chip,  
We sail on this academic trip.  
Ethics, logic, in circuits blend,  
Can you tell where humans end?

(Bridge)

Deep learning, let's unmask,  
Complex questions we shall ask.  
Can a machine truly know?  
The dreams where only poets go?

(Chorus)

Welcome, welcome to the A.I. show,  
We build the minds that never grow old.  
Fairy tales of silicon,  
In this class, we'll see how they're spun.

## Welcome to AI by GPT-4

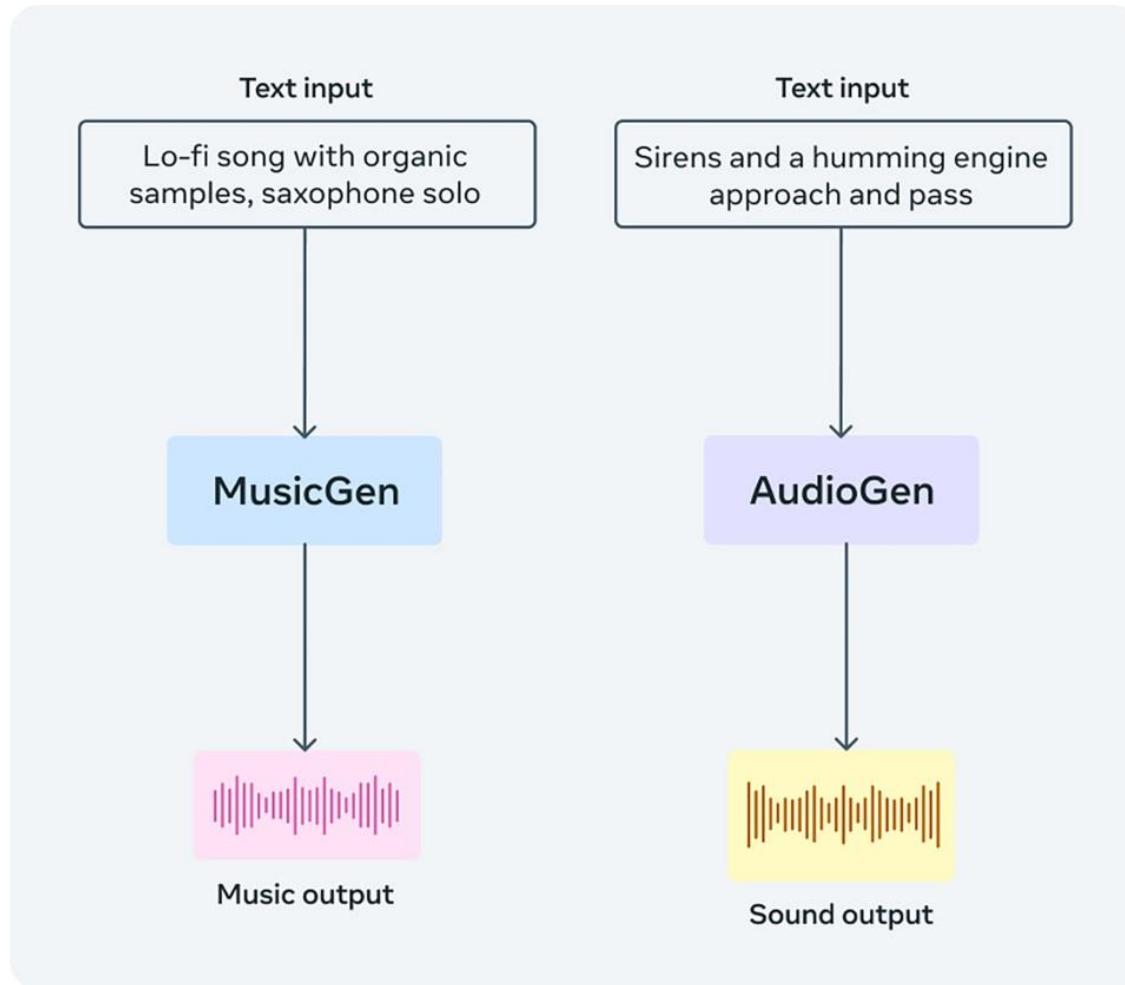
(Outro)

So sit back and let's unfurl,  
The secrets that could change the world.  
When the final lecture's done and told,  
Will you see the future, brave and bold?

(End)

Welcome, welcome to the Intro Class,  
Strap in tight; it's gonna be a blast.  
A.I.'s tale, in zeros and ones,  
The story's told, but it's never done.

# AI can make music for you...

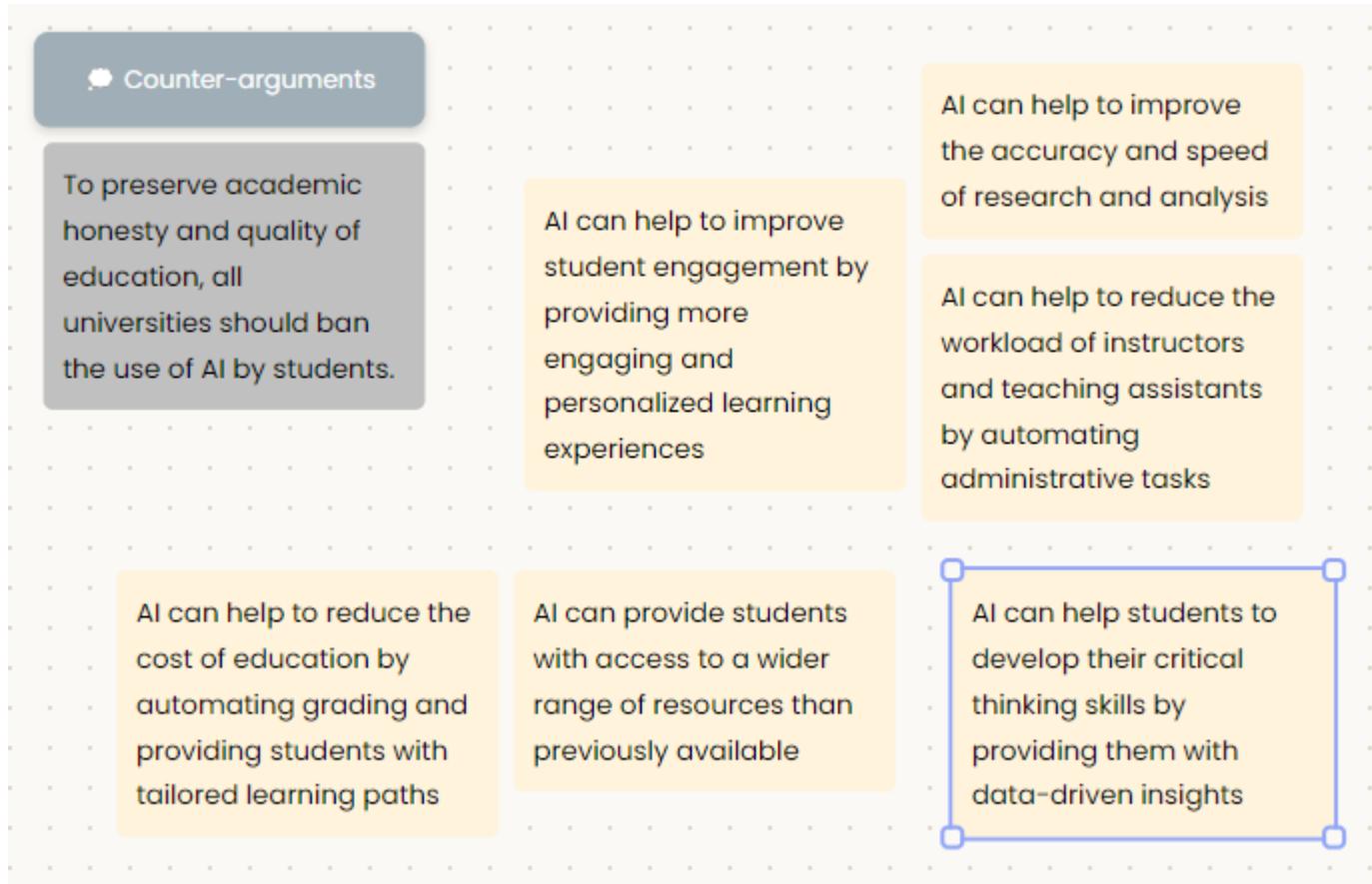


<https://audiocraft.metademolab.com/musicgen.html>

Meta Audiocraft

<https://audiocraft.metademolab.com/audiogen.html>

# AI can generate counter arguments...



# AI can help with research ...

Elicit  What are the potential economic impacts of AI on labor markets?   

Paper title	Abstract summary
<b>Economic impacts of artificial intelligence</b>  M. Szczepański 2019 5 Citations	AI may lead to the creation of s have detrimental effects on the
<b>The Occupational Impact of Artificial Intelligence: Labor, Skills, and Polarization</b>  E. Felten, Manav Raj, Robert C. Seamans 2019 30 Citations DOI 	AI has the potential to exacerbate polarization.
<b>Toward understanding the impact of artificial intelligence on labor</b>  M. Frank, David Autor, James Bessen, E. Brynjolfss... <i>Proceedings of the National Academy of Sciences</i> ...  2019 Longitudinal 247 Citations DOI  PDF 	AI and automation can augment some workers.

**What are the potential economic impacts of AI on labor markets?**

SUMMARY OF TOP 4 PAPERS 

The papers suggest that AI has the potential to disrupt labor markets and have significant economic impacts. Szczepański (2019) warns that AI could widen the gap between developed and developing countries, increase inequality, push down wages, and shrink the tax base. Felten (2019) finds that AI has a small but positive impact on wages for occupations impacted by AI, but no change in employment. Higher-income occupations have a strong positive relationship between AI impact and both employment and wages, suggesting that access to complementary skills and technologies may play an

Elicit.org

# AI can explain scholarly text...

Explainpaper

$C(\Omega) = \{f : \Omega \rightarrow \mathbb{R} : f \text{ is continuous}\}$   
 $C^m(\Omega) = \{f : \Omega \rightarrow \mathbb{R} : \forall |\alpha| \leq m \quad \partial^\alpha f \in C(\Omega)\} \quad (C^0(\Omega) = C(\Omega))$   
 $BC(\Omega) = \{f : \Omega \rightarrow \mathbb{R} : f \text{ is continuous and bounded on } \Omega\}$   
 $BC^m(\Omega) = \{f \in C^m(\Omega) : \forall |\alpha| \leq m \quad \partial^\alpha f \text{ is bounded on } \Omega\}$   
 $BC(\bar{\Omega}) = \{f : \Omega \rightarrow \mathbb{R} : f \in BC(\Omega) \text{ and } f \text{ is uniformly continuous on } \Omega\}$   
 $BC^m(\bar{\Omega}) = \{f : \Omega \rightarrow \mathbb{R} : f \in BC^m(\Omega), \forall |\alpha| \leq m \quad \partial^\alpha f \text{ is uniformly continuous on } \Omega\}$   
 $C^\infty(\Omega) = \bigcap_{m \in \mathbb{N}_0} C^m(\Omega), \quad BC^\infty(\Omega) = \bigcap_{m \in \mathbb{N}_0} BC^m(\Omega), \quad BC^{\infty\infty}(\Omega) = \bigcap_{m \in \mathbb{N}_0} BC^m(\Omega)$

**Remark 1 ([1]).** If  $g : \Omega \rightarrow \mathbb{R}$  is in  $BC(\bar{\Omega})$ , then it possesses a unique, bounded, continuous extension to the closure  $\bar{\Omega}$  of  $\Omega$ .

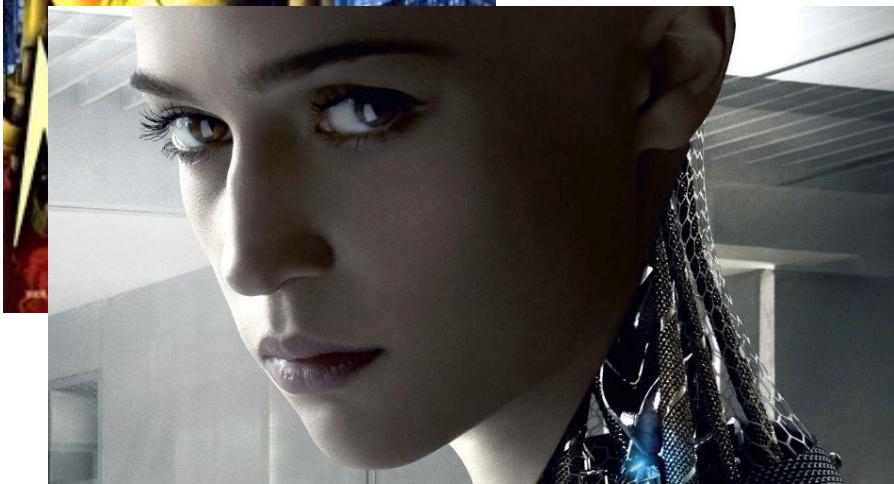
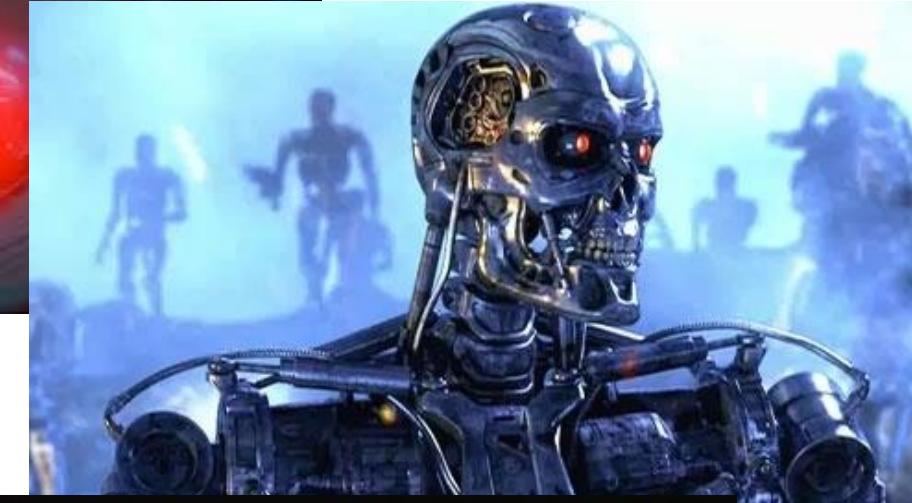
**Notation:** Let  $\Omega$  be a nonempty open set in  $\mathbb{R}^n$ . The collection of all compact sets in  $\Omega$  is denoted by  $\mathcal{K}(\Omega)$ . If  $f : \Omega \rightarrow \mathbb{R}$  is a function, the support of  $f$  is denoted by  $\text{supp } f$ . Notice that, in some references  $\text{supp } f$  is defined as the closure of  $\{x \in \Omega : f(x) \neq 0\}$  in  $\Omega$ , while in certain other references it is defined as the closure of  $\{x \in \Omega : f(x) \neq 0\}$  in  $\mathbb{R}^n$ . Of course, if we are concerned with functions whose support is inside an element of  $\mathcal{K}(\Omega)$ , then the two definitions agree. For the sake of definiteness, in this manuscript we always use the former interpretation of support. Furthermore, support of a distribution will be discussed in Section 6.

Explainpaper.com

# Movie AI



# Movie AI





# News AI

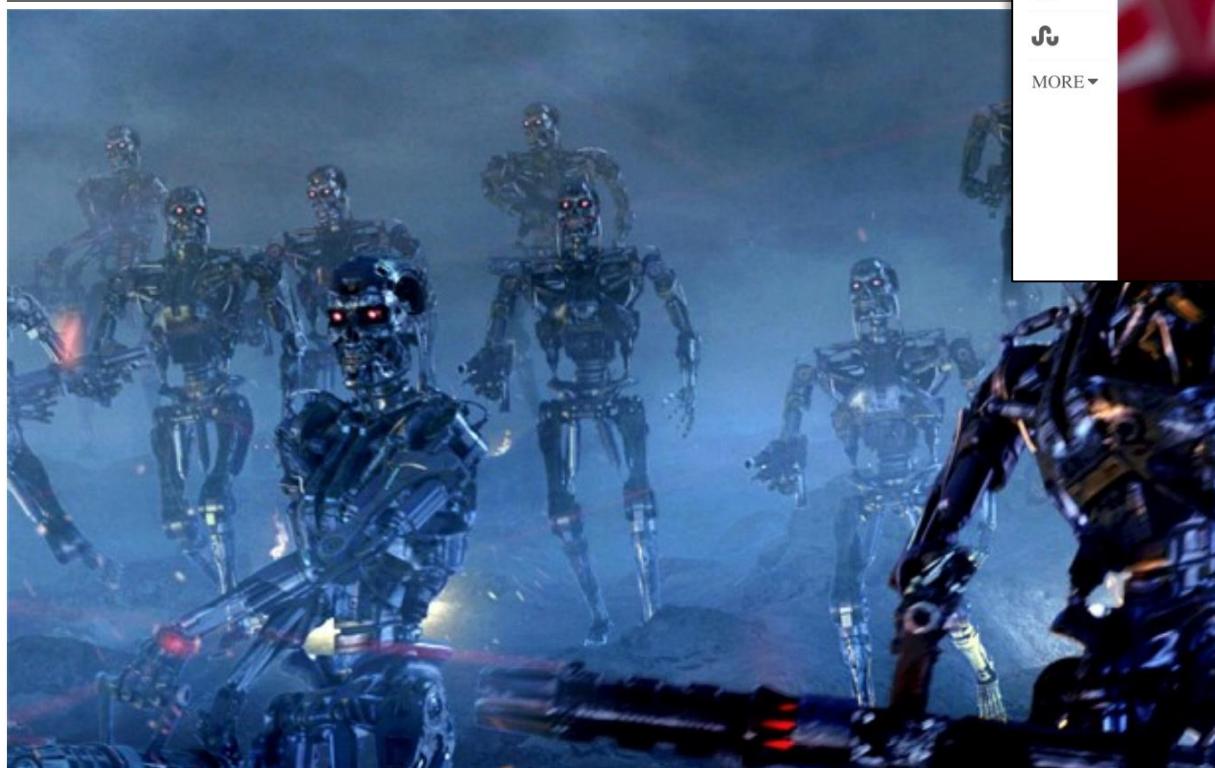
AI is the biggest risk we face as a civilisation, Elon Musk says

## Billionaire burn: Musk says Zuckerberg's understanding of AI threat 'is limited'

[HOME](#) » [FINANCE](#) » [FINANCE TOPICS](#) » [DAVOS](#)

'Sociopathic' robots could overrun the human race, says a leading expert on artificial intelligence

Computers should be trained to serve humans to reduce their threat to the human race, says a leading expert on artificial intelligence



## LIVE SCIENCE

NEWS TECH HEALTH PLANET EARTH

[Live Science](#) > [Tech](#)

Lifelike 'Sophia' Robot Granted Citizenship to Saudi Arabia

By Mindy Weisberger, Senior Writer | October 30, 2017 03:39pm ET

f 0

t 0

F

g

s

MORE ▾

Be the most interesting person you know, subscribe to LiveScience.

Subscribe ▾



# News AI

TECH • ARTIFICIAL INTELLIGENCE

## United Kingdom Plans \$1.3 Billion Intelligence Push

France to spend \$1.8 billion on compete with U.S., China

EU wants to invest £18b development

## China's Got a Huge Artificial Intelligence Plan

'Whoever leads in AI will rule the world': Putin to Russian children on Knowledge Day

Published time: 1 Sep, 2017 14:08  
Edited time: 1 Sep, 2017 14:40



# News AI

NATURAL 'PROZAC': DOES IT REALLY WORK?



**IBM's Watson Jeopardy Computer Shuts Down Humans in Final Game**

DAILY NEWS 9 March 2016

Sili 'I'm in shock!' How world's best human

**Google DeepMind Challenge Match**  
8 - 15 March 2016

Who is Stoker?  
(FOR ONE WELCOME OUR NEW COMPUTER OVERLORDS)



**Blizzard will show off Google's Deepmind AI in StarCraft 2 later this week**

By Andy Chalk 4 hours ago

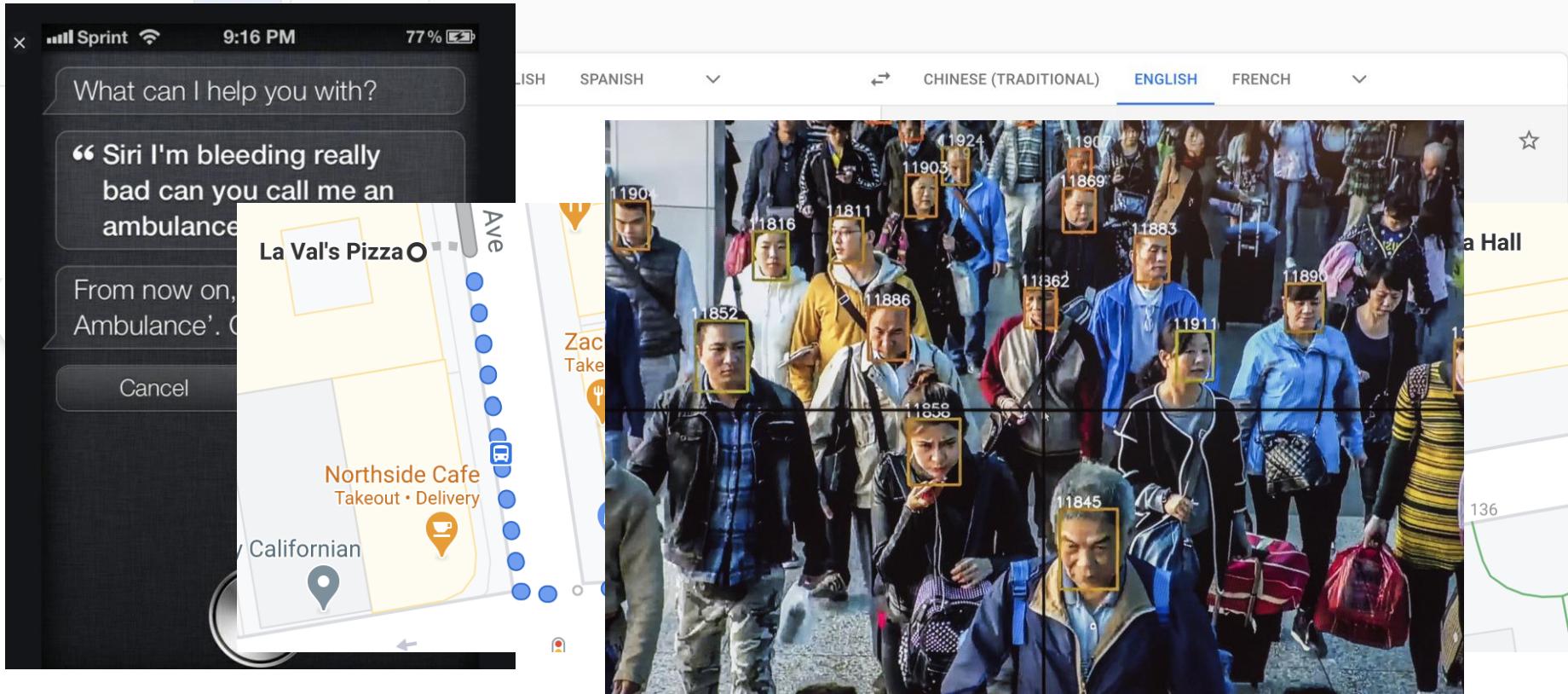
**Google and Blizzard launched the artificial intelligence project in 2016.**

[f](#) [t](#) [r](#) [e](#) | [COMMENTS](#)



# Real AI

≡ Google Translate



# Real AI



# Real AI



Intro Artificial Intelligence – Lecture 1

# Real AI



# Real AI



Boston Dynamics

# Real AI



# What is AI?

The science of making machines that:

# Rational Decisions

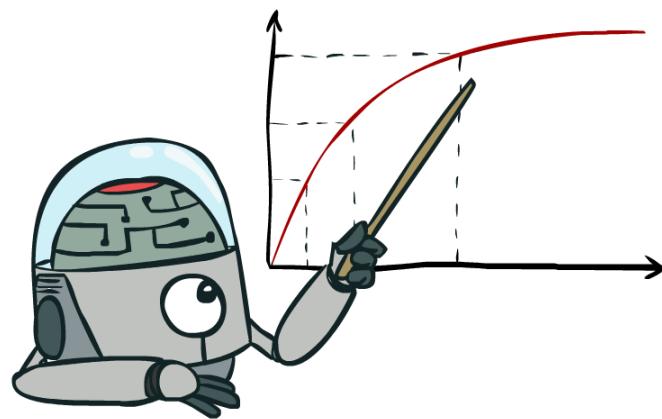
We'll use the term **rational** in a very specific, technical way:

- 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**

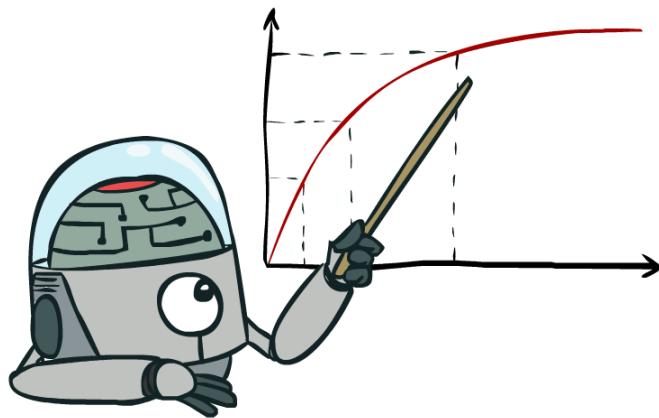
A better title for this course would be:

## Computational Rationality

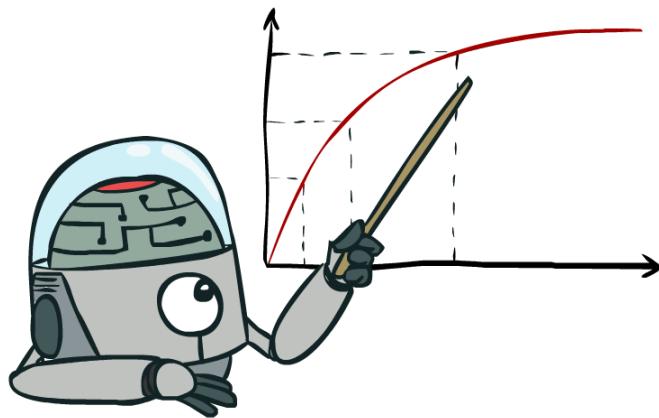
# Maximize Your Expected Utility



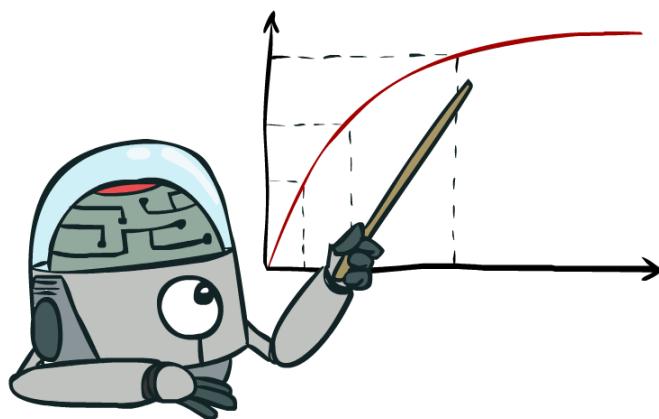
# Maximize Your Expected Utility



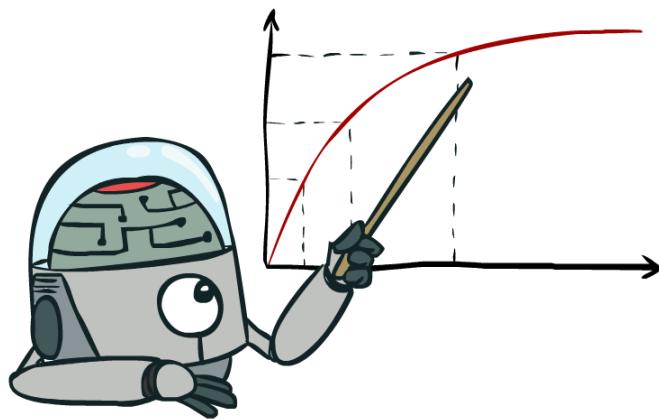
# Maximize Your Expected Utility



# Maximize Your Expected Utility

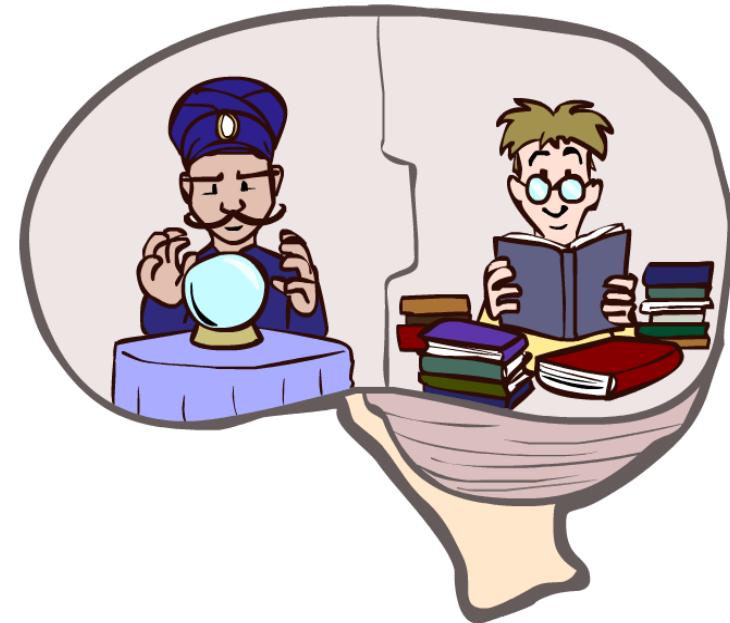


# Maximize Your Expected Utility



# What About the Brain?

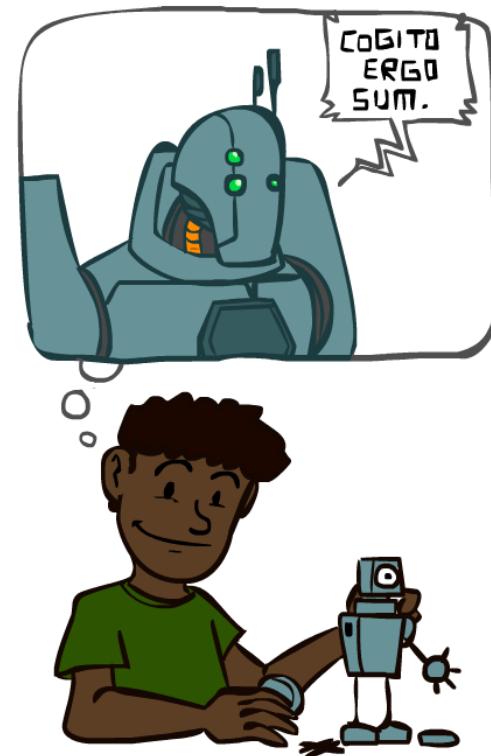
- Brains (human minds) are very good at making rational decisions, but not perfect
- Brains aren't as modular as software, so hard to reverse engineer!
- “Brains are to intelligence as wings are to flight”
- Lessons learned from the brain: memory (data) and simulation (computation) are key to decision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



# A (Short) History of AI

# A (Short) History of AI

- 1940—1950: Early days
  - 1943: McCulloch & Pitts: Boolean circuit model of brain
  - 1950: Turing's "Computing Machinery and Intelligence"
- 1950—70: Excitement: Look, Ma, no hands!
  - 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
  - 1969—79: Early development of knowledge-based systems
  - 1980—88: Expert systems industry booms
  - 1988—93: Expert systems industry busts: "AI Winter"
- 1990—2012: Statistical approaches + subfield expertise
  - Resurgence of probability, focus on uncertainty
  - General increase in technical depth
  - Agents and learning systems... "AI Spring"?
- 2012—: Excitement: Look, Ma, no hands!
  - Big data, big compute, neural networks
  - Some re-unification of subfields
  - AI used in many industries



# Unintentionally Funny Stories

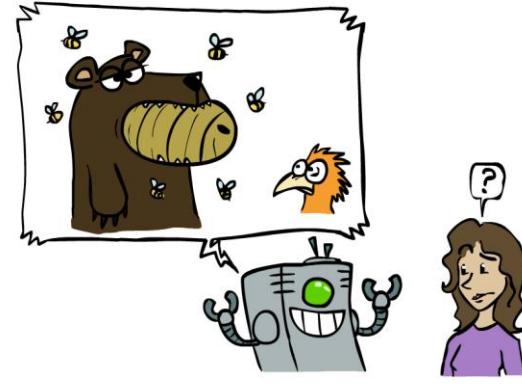
- One day Joe Bear was Irving Bird where some there was a beehive in the oak tree. He ate the
- Henry Squirrel was thirsty at the river bank where his good friend Henry slipped and fell into the water. Henry was drowning. The End.
- Once upon a time there was a crow. The crow was sitting in a tree. He noticed that he was hungry, and swallowed a piece of cheese. The End.



s friend  
ld him  
lked to

o the  
s sitting.  
rowned.

and a vain crow. One day he had a piece of cheese in his mouth. He wanted to eat the cheese. He became very hungry. He walked over to the crow.



[Shank, Tale-Spin System, 1984]

# 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 dalai-lama dénonce l'"enfer" imposé au Tibet depuis sa fuite, en 1959

**Vidéo** Anniversaire de la rébellion tibétaine : la Chine sur ses gardes



**"It is impossible for journalists to enter Tibetan areas"**

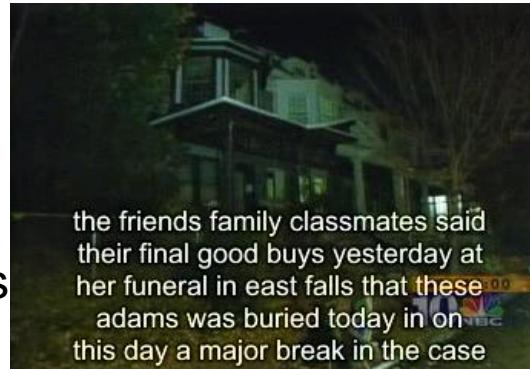
Philip Bruno, correspondent for "World" in China, said that journalists of the AFP who have been deported from the Tibetan province of Qinghai "were not illegal."

**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...



<https://play.aidungeon.io/>

# 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."



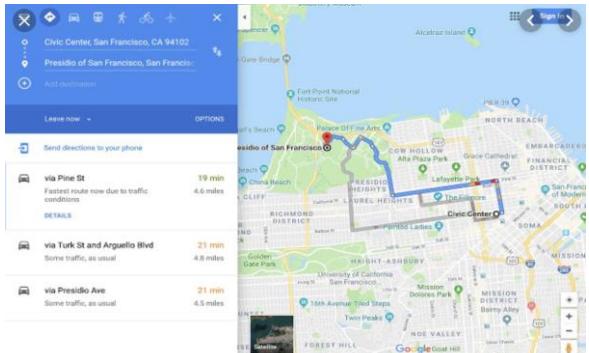
"young girl in pink shirt is swinging on swing."



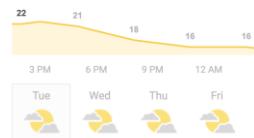
"man in blue wetsuit is surfing on wave."

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

# Tools for Predictions & Decisions



Berkeley, CA 94709  
Tuesday 2:00 PM  
Mostly Sunny



# Game Agents

- Classic Moment: May, '97: Deep Blue vs. Kasparov
  - First match won against world champion
  - “Intelligent creative” play
  - 200 million board positions per second
  - Humans understood 99.9 of Deep Blue's moves
  - Can do about the same now with a PC cluster
- 1996: Kasparov Beats Deep Blue  
“I could feel --- I could smell --- a new kind of intelligence across the table.”
- 1997: Deep Blue Beats Kasparov  
“Deep Blue hasn't proven anything.”



Text from Bart Selman, image from IBM's Deep Blue pages

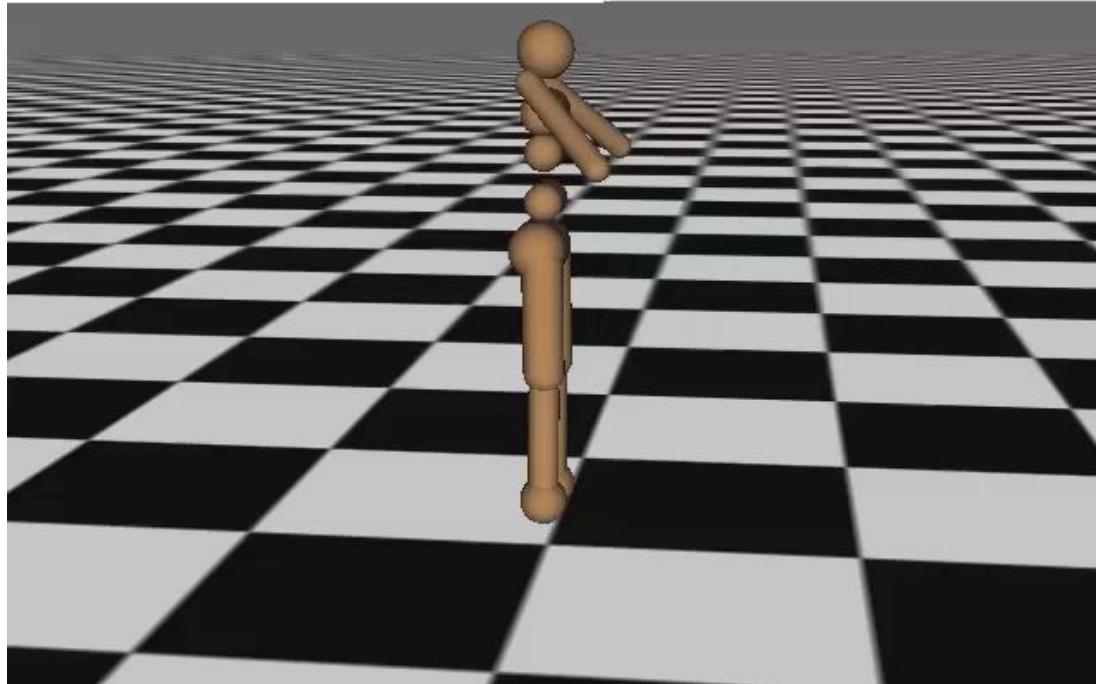
# Game Agents





# Simulated Agents

Iteration 0



[Schulman, Moritz, Levine, Jordan, Abbeel, ICLR 2016]

# Game Agents

## ■ Reinforcement learning



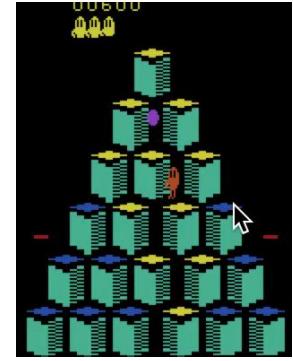
Pong



Enduro



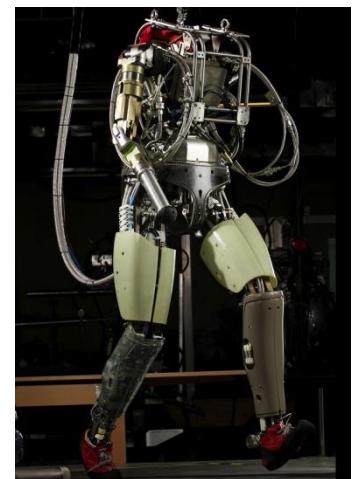
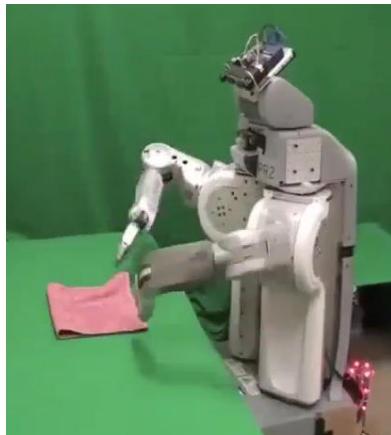
Beamrider



Q\*bert

# Robotics

- Robotics
  - Part mech. eng.
  - Part AI
  - Reality much harder than simulations!
- Technologies
  - Vehicles
  - Rescue
  - Help in the home
  - Lots of automation...
- In this class:
  - We ignore mechanical aspects
  - Methods for planning
  - Methods for control

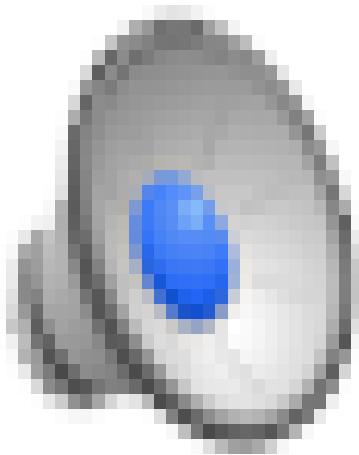


Images from UC Berkeley, Boston Dynamics, RoboCup, Google

# Robots



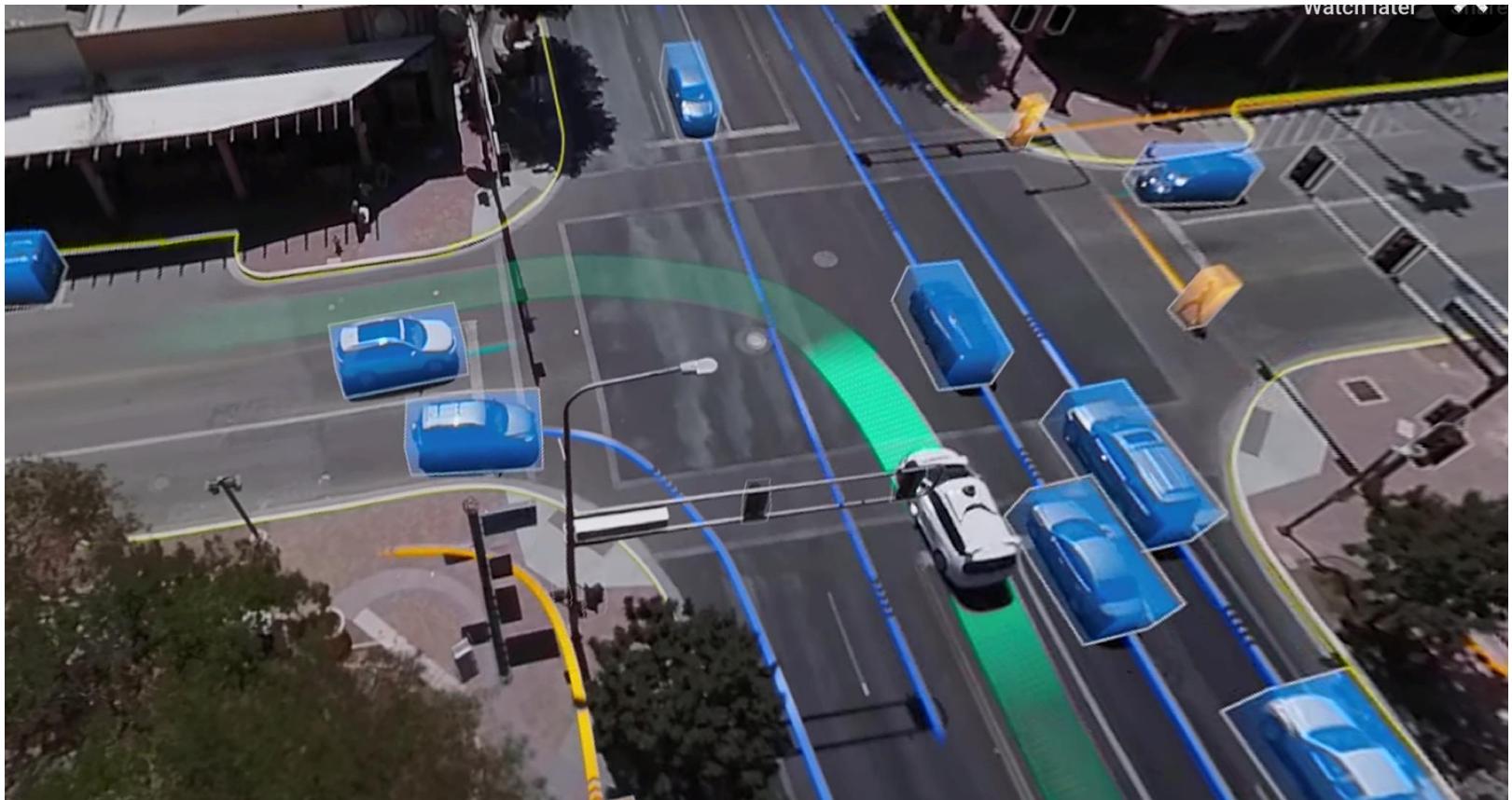
# Robots

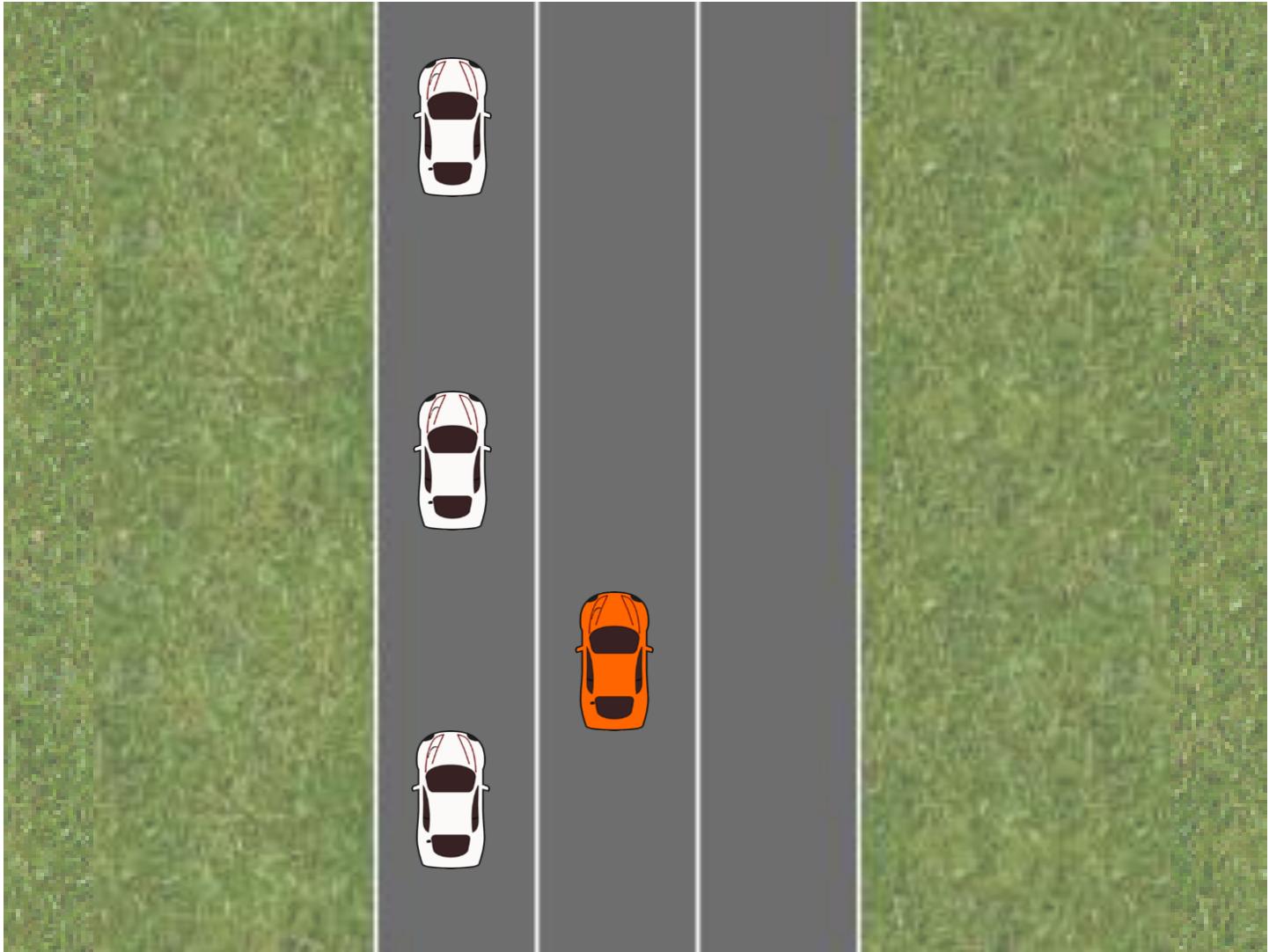


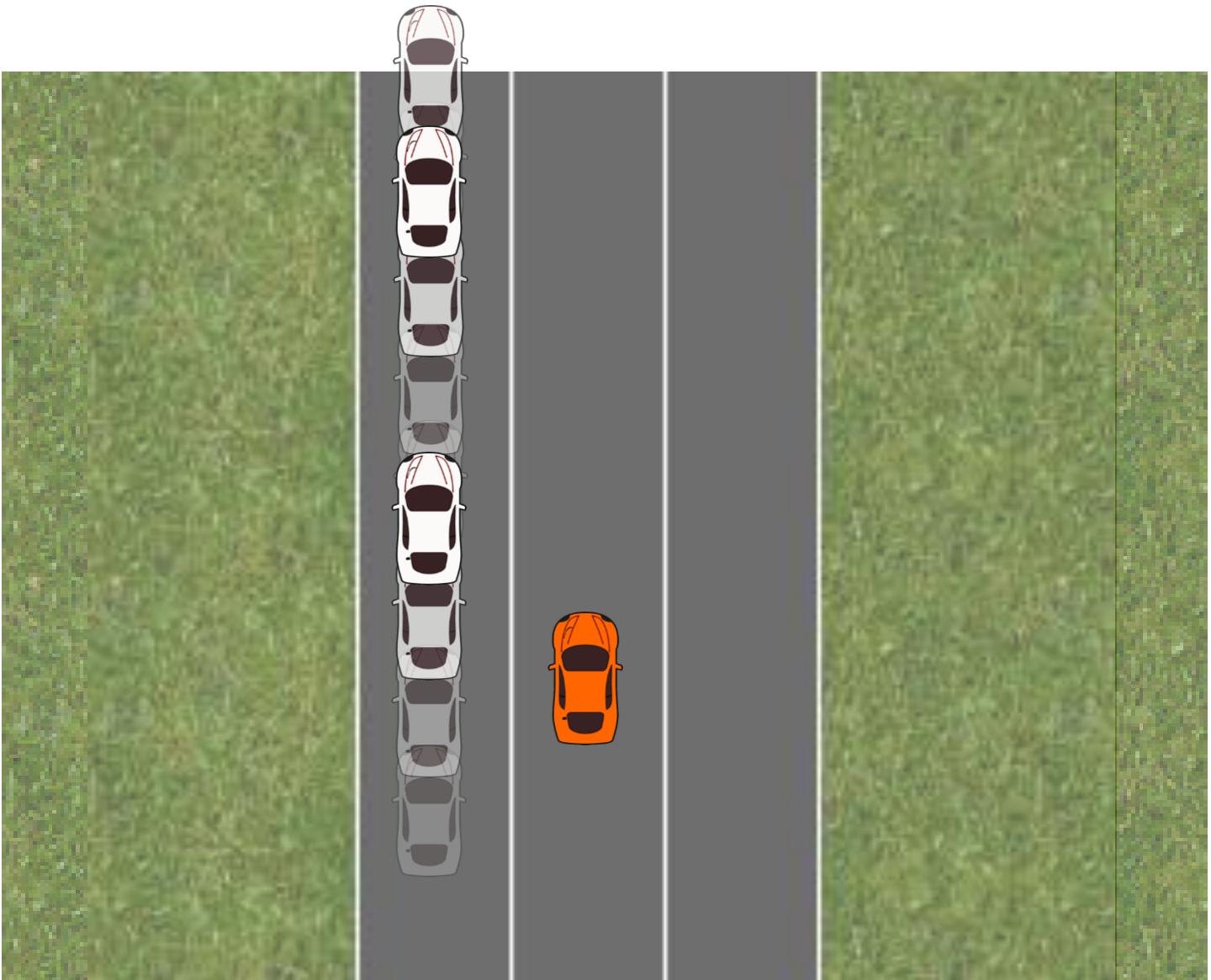
[Levine\*, Finn\*, Darrell, Abbeel, JMLR 2016]

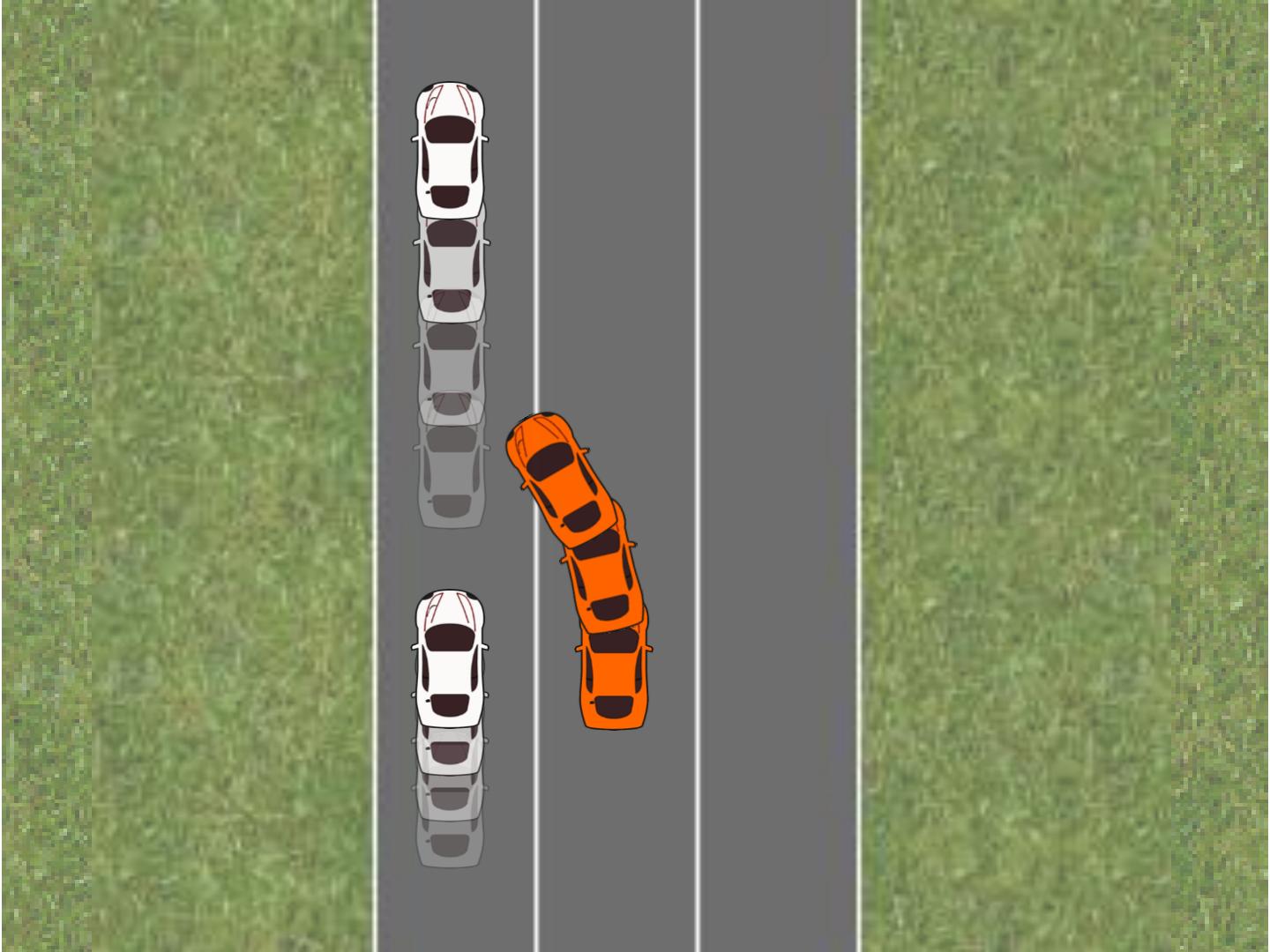
# Human-AI Interaction









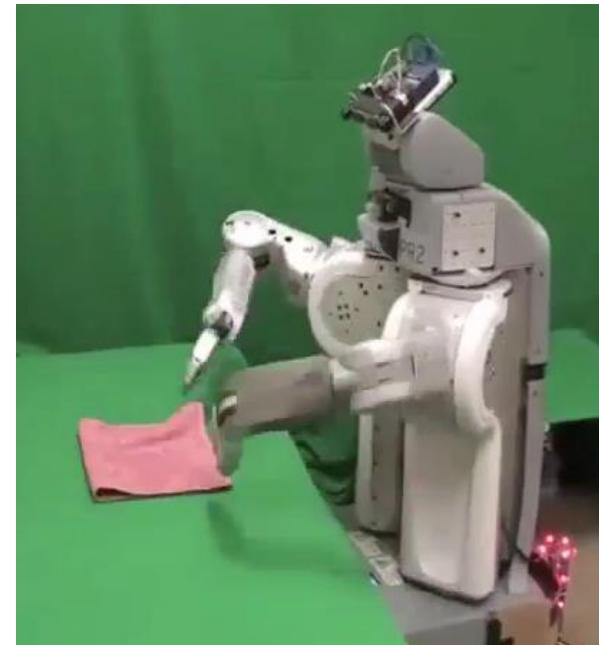


# Utility?

- Clear utility



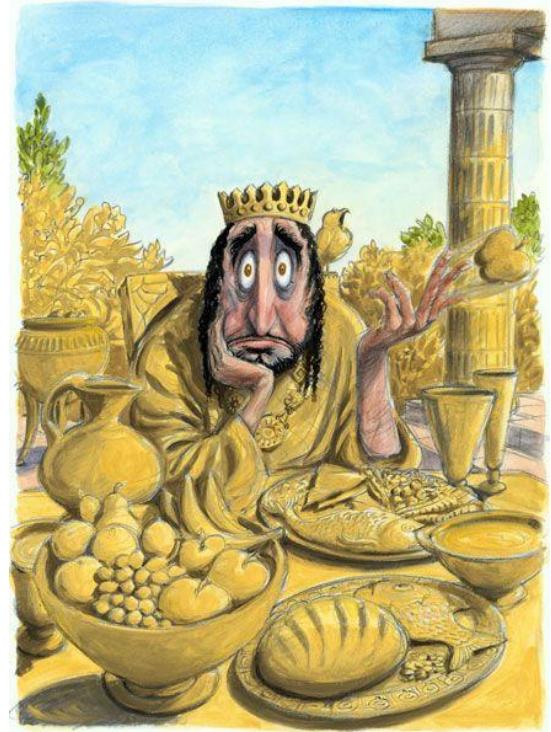
- Not so clear





# Value Misalignment

- e.g., King Midas, paper clip maximizer



*We had better be quite sure that the purpose put into the machine is the purpose which we really desire*

Norbert Wiener, 1960

# In the news...

 Kaveh Waddell Jun 27, 2018

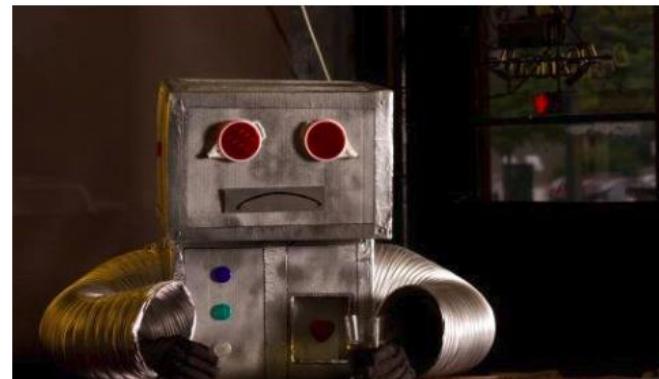
## AI might need a therapist, too



Il faudra bientôt des psychologues pour intelligence artificielle, selon ces chercheurs



Gregory Rozieres  
Le HuffPost 28 juin 2018



BEST PRODUCTS ▾ REVIEWS ▾ NEWS ▾ VIDEO ▾ HOW TO ▾ SMART HOME ▾ CARS ▾ DEALS ▾ DOWNLOAD

🌐 🔎

SCI-TECH

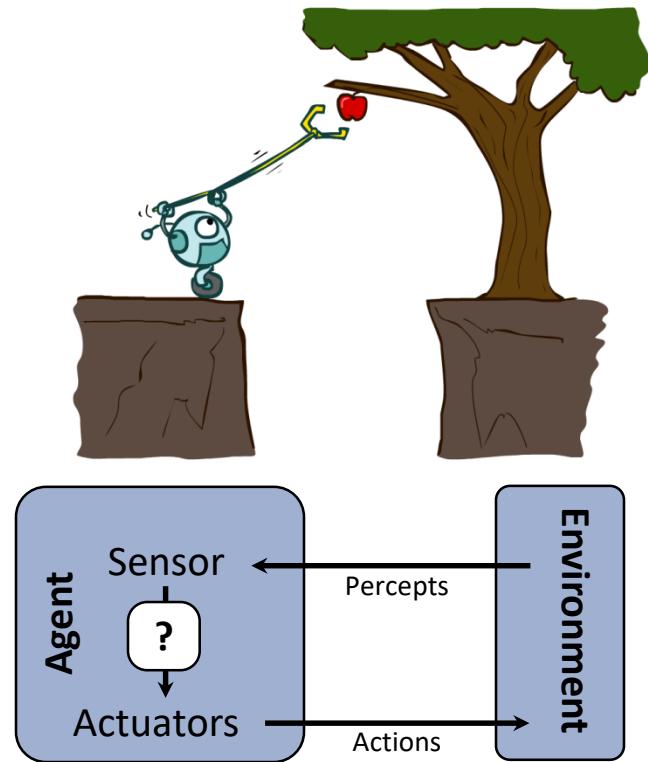
## Will AI need therapy in the future?

Because maybe "turning it off and on again" isn't a long term solution!

BY MARK SERRELS 📸 | JULY 1, 2018 10:02 PM PDT

# 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



# Future

- We are doing AI...
  - To create intelligent systems
    - The more intelligent, the better
  - To gain a better understanding of human intelligence
  - To magnify those benefits that flow from it
    - E.g., net present value of human-level AI  $\geq \$13,500T$
    - Might help us avoid war and ecological catastrophes, achieve immortality and expand throughout the universe
- But, what if we succeed?

# Success?

## Artificial Intelligence could spell the end of the human race

BY PAUL CROKE · JUNE 9, 2015 · NO COMMENTS



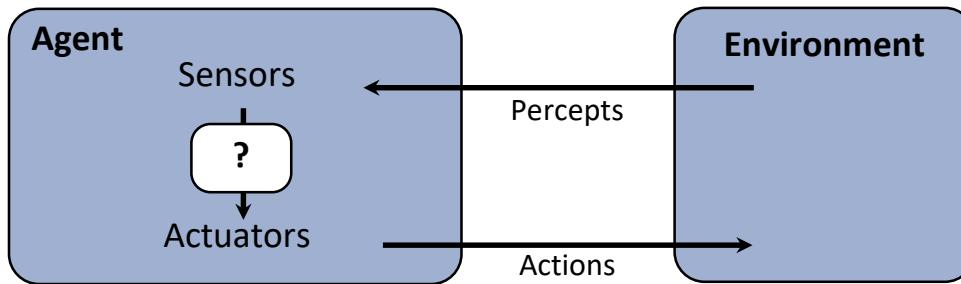
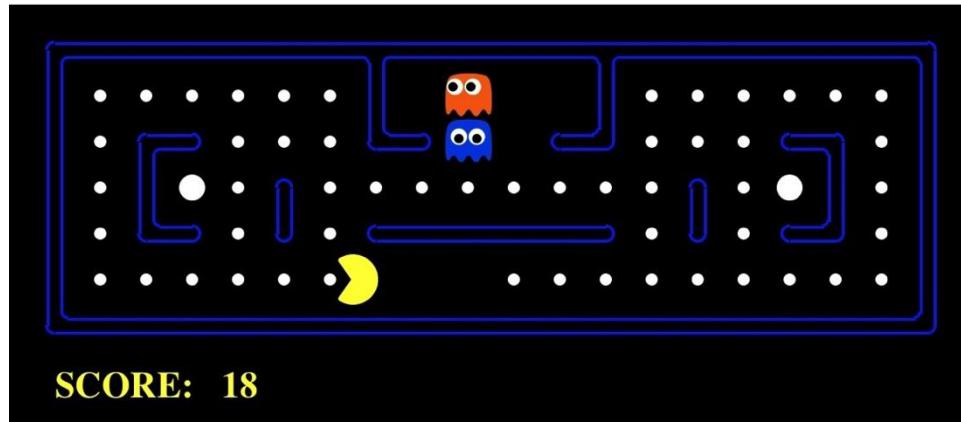
# What's bad about better AI?

- AI that is incredibly good at achieving something other than what we really want
- AI, economics, statistics, operations research, control theory all assume utility to be *exogenously specified*

# Towards human-level AI

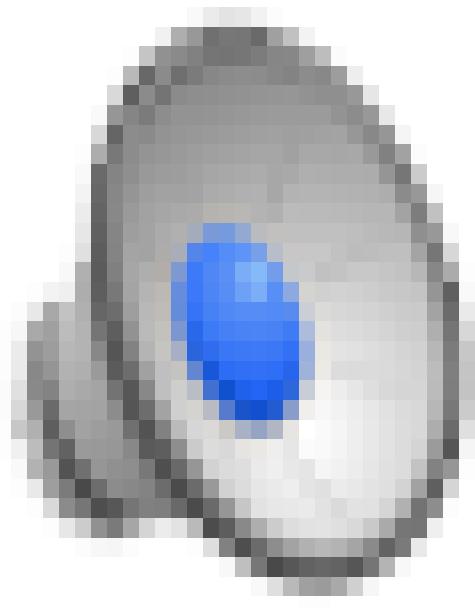
- Still Missing:
  - Real understanding of language
  - Integration of learning with knowledge
  - Long-range thinking at multiple levels of abstraction
  - Cumulative discovery of concepts and theories
- When? Unpredictable...

# Pac-Man as an Agent



Pac-Man is a registered trademark of Namco-Bandai Games, used here for educational purposes

# Pac-Man



# Maximize Your Expected Utility

