

Lecture 1

CS 6380 Artificial Intelligence

Introduction: What is AI? History and State of the Art

Department of Computer Science and Engineering
Indian Institute of Technology Madras (IITM), India



Intro and Logistics

Instructor: Pulkit Verma

- Preferred mode of contact:
pulkitv@cse.iitm.ac.in
- PhD from **Arizona State University**
- Postdoc from **MIT CSAIL**
- Research Areas:
Automated Planning, Human-AI Collaboration, AI Safety and Assessment, Robotics, Lifelong Learning, ...



pulkitverma.net

Lectures

- CS 15, CSB Ground Floor (of course!!)
- Mo: 02:00-03:15 PM; Tu: 03:30-04:45 PM; Th: 05:00-05:50 PM
 - Some classes will be cancelled due to official travel, watch out for announcements.
- Attendance is mandatory (department policy)
- **Office Hours:** Starting next week. Watch out for announcement.

Resources

- Course Website:
<https://hails-group.github.io/courses/cs6380/jn26.html>
 - Slides posted here
 - Schedule already available
- Announcements: Moodle
- Course Email: pulkityv@cse.iitm.ac.in
 - Subject: [CS6380] <Subject>
 - No URGENT email responses. Please **plan** ahead.
 - We will respond to each email within 48 hours.
 - Any course-related query should be posted on Moodle so that others can also benefit from the answer.

Exams

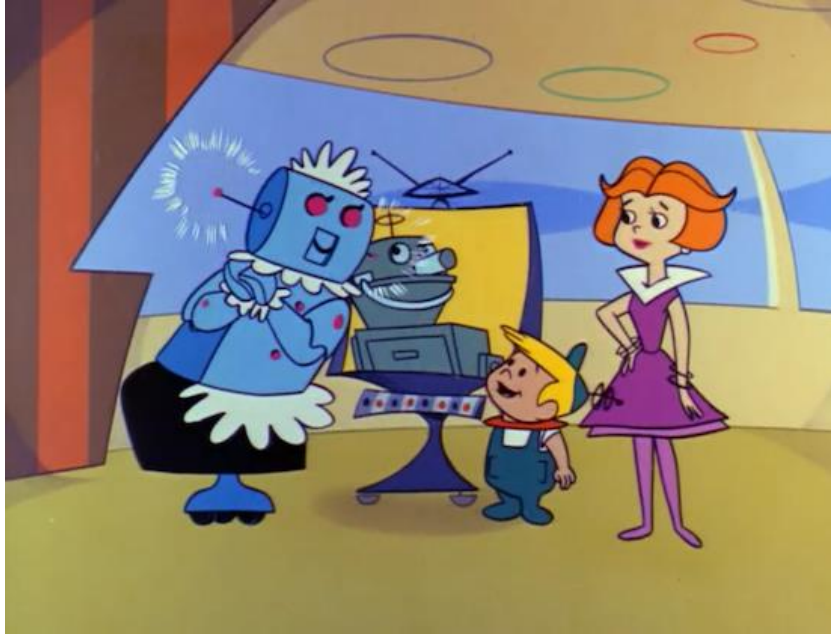
- 3 Exams:
 1. [Quiz 1] Aug 31
 2. [Quiz 2] Oct 12
 3. [End Sem] Nov 11
- More details closer to exams.

Grading Breakup

- Exams: 70%
 1. Quiz 1 : 20%
 2. Quiz 2 : 20%
 3. End Sem: 30%
- Assignment-Quizzes: 25%
- In-class Quizzes: 5%
- Relative Grading

Artificial Intelligence

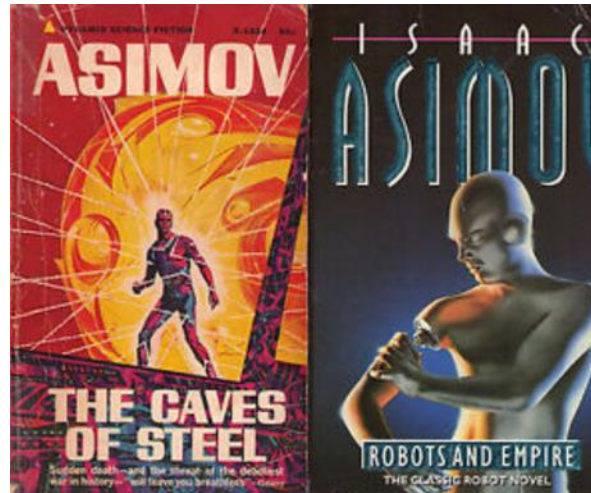
AI in Popular Fiction



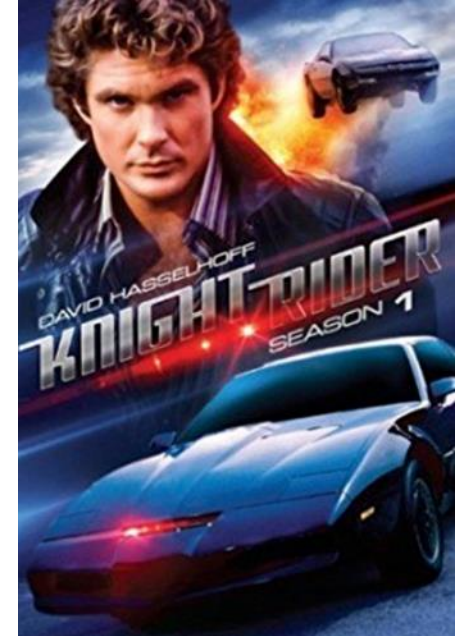
The Jetsons (1962-)



Star Wars Bots (1977-)



1954



Knight Rider (1982)

What do we mean by
Artificial Intelligence?

**A PROPOSAL FOR THE DARTMOUTH SUMMER
RESEARCH PROJECT ON **ARTIFICIAL INTELLIGENCE****

J. McCarthy, Dartmouth College

M. L. Minsky, Harvard University

N. Rochester, I.B.M. Corporation

C.E. Shannon, Bell Telephone Laboratories

August 31, 1955

“The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it.”

What is Artificial Intelligence?

It's about thought processes!

Thinking Like Humans

“[The Automation of] activities that we associate with human thinking, activities such as decision-making, problem-solving, learning...” (Bellman 1978)

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Acting Like Humans

“The study of how to make computers do things at which, at the moment, people are better” (Rich and Knight, 1991)

It's about processes governing action!

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Imitate Humans!

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Thinking Rationally

“The study of mental faculties through computational models” (Charniak and McDermott, 1985)

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“The study of how to make computers do things at which, at the moment, people are better” (Rich and Knight, 1991)

Acting Rationally

“...concerned with intelligent behavior in artifacts” (Nilsson, 1998)

It's about processes governing action!

Imitate Humans!

Be Rational (Do Useful Stuff)!

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Imitate Humans!

Be Rational (Do Useful Stuff)!

Acting Rationally

- 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
 - An AI Agent is evaluated on the basis of what it does (not the thought process behind it)
- Goals are expressed in terms of the **utility** of outcomes

Makes it possible to evaluate approaches, progress made

What about Imitating Humans?

“[Human] brains are to intelligence as wings are to flight”

What can *AI systems* do today?

What Can AI Systems Do Today?

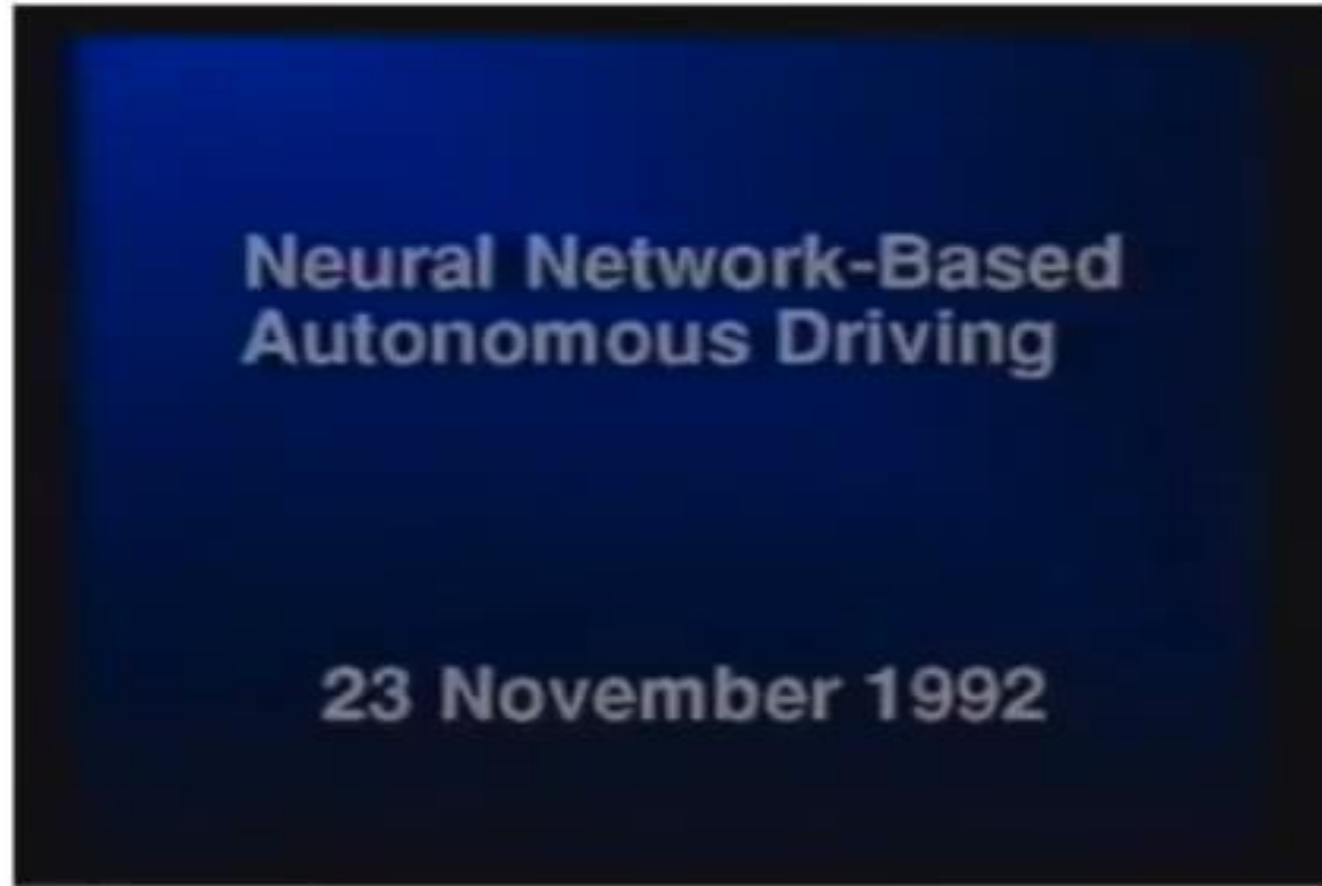
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- Fold your laundry?
- Do the laundry?
- Set the table for dinner?
- Cook a meal to order?
- Translate written text from one language to another?
- Play a decent game of table tennis?
- Compete with humans in a game of chess/go/ATARI?
- Have a meaningful conversation with a person for 15 minutes

What Can AI Systems Do Today?



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Video: ALVINN (1989)



[Courtesy of Dean Pomerleau]

https://www.youtube.com/watch?time_continue=32&v=ilP4aPDTBPE

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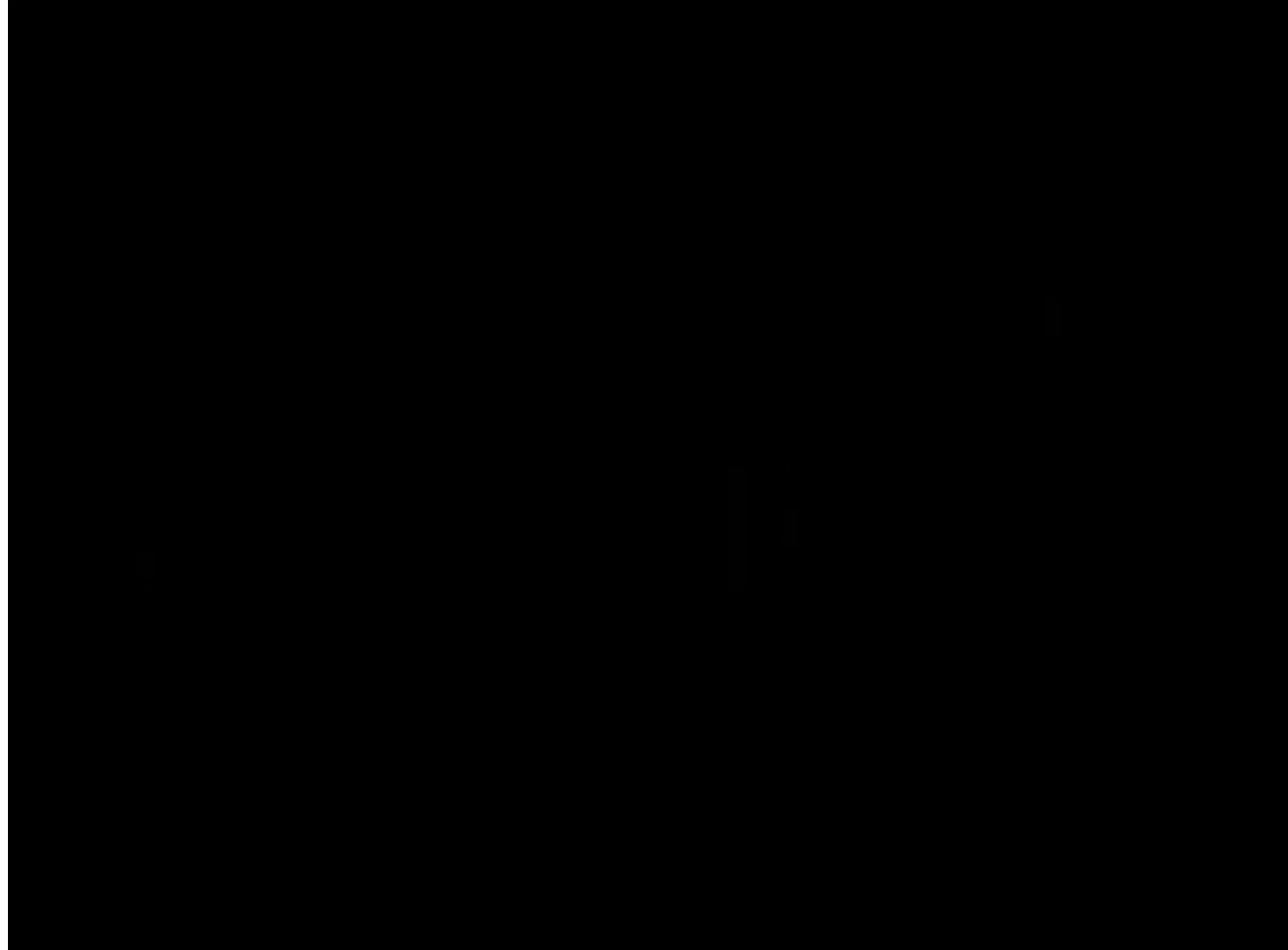
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DARPA Urban Challenge (2007)



<https://www.youtube.com/watch?v=lULl63ERek0>

Video: Realtime Object Detection

YOLOnet



<https://pjreddie.com/darknet/yolo/>

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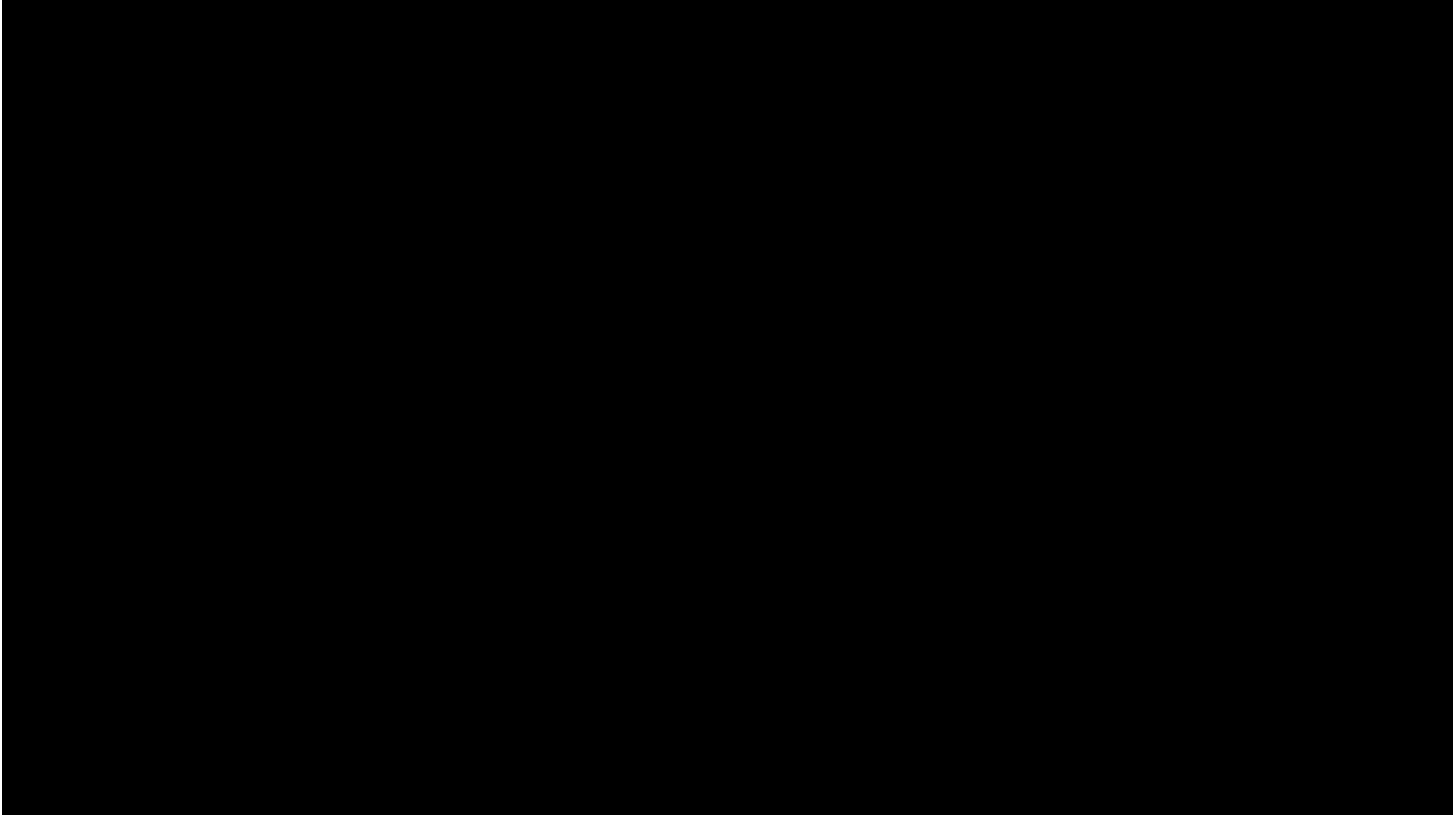
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Video: Motobot



<https://www.youtube.com/watch?v=BjZPvXKewFk>

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Pieter Abbeel's group, UC Berkeley

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40x

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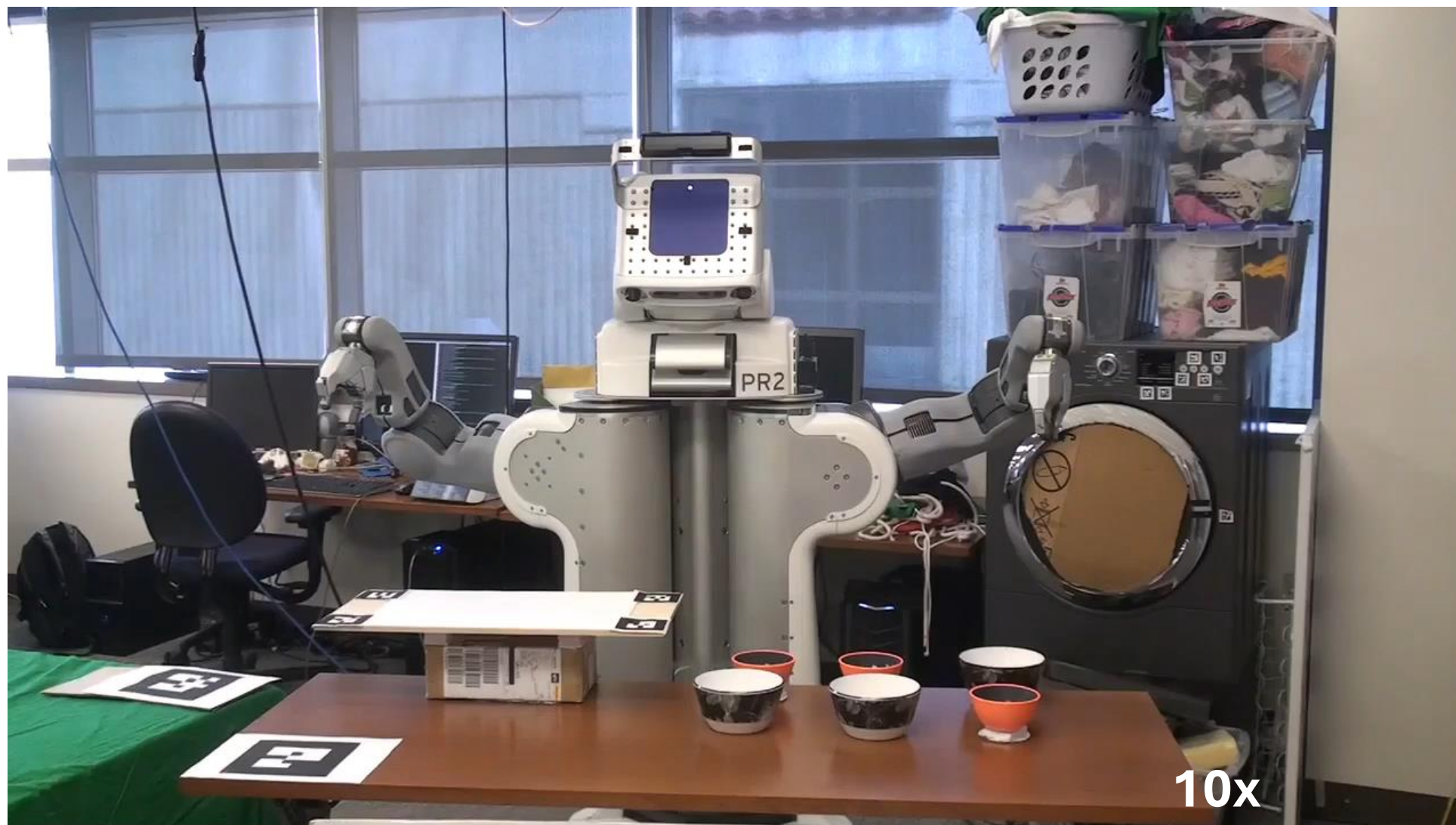
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1. *Die Grundlage
der allgemeinen Relativitätstheorie;
von A. Einstein.*

Die im nachfolgenden dargelegte Theorie bildet die denkbar weitgehendste Verallgemeinerung der heute allgemein als „Relativitätstheorie“ bezeichneten Theorie; die letztere nenne ich im folgenden zur Unterscheidung von der ersteren „spezielle Relativitätstheorie“ und setze sie als bekannt voraus. Die Verallgemeinerung der Relativitätstheorie wurde sehr erleichtert durch die Gestalt, welche der speziellen Relativitätstheorie durch Minkowski gegeben wurde, welcher Mathematiker zuerst die formale Gleichwertigkeit der räumlichen Koordinaten und der Zeitkoordinate klar erkannte und für den Aufbau der Theorie nutzbar machte. Die für die allgemeine Relativitätstheorie nötigen mathematischen Hilfs-

(1)

The theory presented below forms the idea bar most generalization of today generally as "Theory of relativity" called theory; to call the latter I distinguish below from the former, special Theory of Relativity "and presuppose it as known. The

Generalization of the theory of relativity was very well facilitates by the shape which the special relativity theory was given by Minkowski, which math-first, the formal equivalency of the spatial Coordinates and the time coordinate clearly recognized and for used the structure of the theory.

(2)

The theory which is sketched in the following pages forms the most wide-going generalization conceivable of what is at present known as "the theory of Relativity;" this latter theory I differentiate from the former "Special Relativity theory," and suppose it to be known. The generalization of the Relativity theory has been made much easier through the form given to the special Relativity theory by *Minkowski*, which mathematician was the first to recognize clearly the formal equivalence of the space like and time-like co-ordinates, and who made use of it in the building up of the theory.

Reiseweg	Fahrkartenart	Reisende	BahnCard	Klasse Zugtyp	Datum Uhrzeit	Verbindung	Reservierung Extras	Übersicht
Besitzen Sie eine BahnCard oder bahn.bonus Card?								
			BahnCard 2. Klasse		BahnCard 1. Klasse			
1. Erwachsener	Keine BC	b.bonus Card	BC 25	BC 50	BC 25 1. Kl.	BC 50 1. Kl.	i	
2. Erwachsener	Keine BC	b.bonus Card	BC 25	BC 50	BC 25 1. Kl.	BC 50 1. Kl.		

<
German
↔
English

BRIDLE PATH	Fahrkartenart	Reisende	BahnCard	CLASS Zugtyp	Datum Uhrzeit	Verbindung	R E
HAVE THEY A BahnCard OR TRAIN.BONUS CARD?							
			BahnCard 2. CLASS		BahnCard 1		
1. ADULT	NO BC	b.BONUS Card	BC 25	GUST SO	IGUST 25 1. Kl.		
2. ADULT	NO BC	b.BONUS Card	BC 25	GUST SO	IGUST 25 1. Kl.		

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• Set the table for dinner?



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Video: Robot Playing Table Tennis

**Automatischer
Tischtennispartner!!!!**

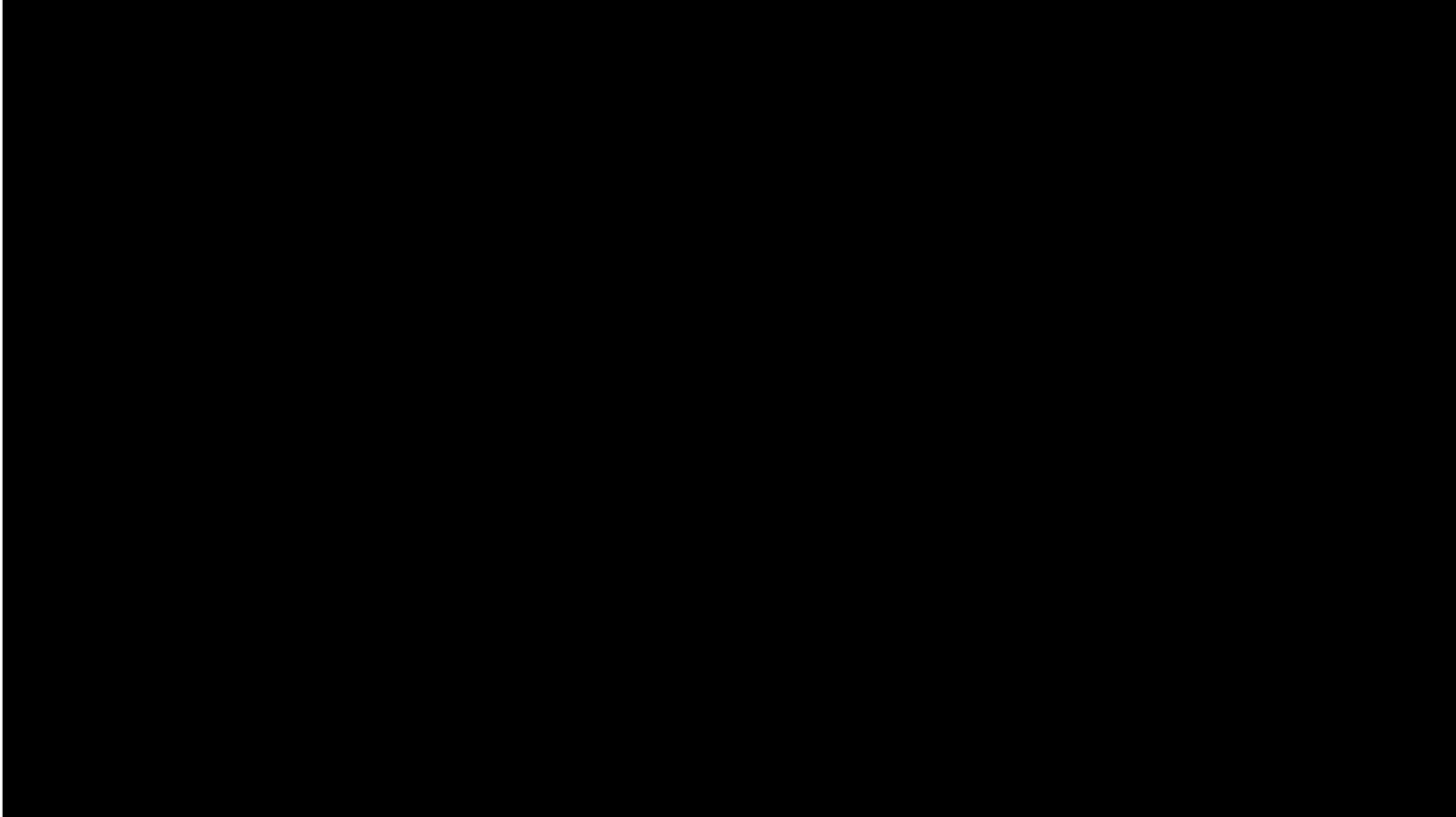
<https://www.youtube.com/watch?v=imVN9j7rvU>

Turns out it was these guys...



<https://hackaday.com/2014/03/28/the-amazing-ping-pong-robot-was-fake/>

Video: KUKA Robot Playing Table Tennis



<https://www.youtube.com/watch?v=tIJME8-au8>

That was fake too!

“However, Kuka today revealed the match was a stunt for its latest TV ad - and showed how it did it.”

<http://www.dailymail.co.uk/sciencetech/article-2578633/The-Man-vs-Machine-table-tennis-showdown-went-viral-actual-cleverly-shot-TV-ad.html>



© Kuka Robot Group
Every shot was painstakingly programmed to make the match look real

Real TT-Playing Robot



<https://www.youtube.com/watch?v=8AGAnb4-HbM>

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• *Compete with humans in a game of chess/go/ATARI?*

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Artificial intelligence (AI)

AlphaGo seals 4-1 victory over Go grandmaster Lee Sedol

DeepMind's artificial intelligence astonishes fans to defeat human opponent and offers evidence computer software has mastered a major challenge



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2017 Results

The entire Amazon Alexa organization wants to thank all of the 2017 Alexa Prize teams for their creativity, passion and contributions to both AI science and delighting Alexa customers.

[2017 Teams](#)

[2017 Summit](#)

[2017 Proceedings](#)

[2017 Finals Video](#)

Winner: Team Sounding Board, University of Washington, Seattle, WA, USA

With an average score of 3.17 and average duration of 10 minutes and 22 seconds, Team Sounding Board will share the \$500,000 prize among the student team members.

Second: Team Alquist, Czech Technical University, Prague, Czech Republic

Team Alquist will share a \$100,000 prize among the student team members.

Third: Team What's Up Bot, Heriot Watt University, Edinburgh, Scotland, UK

Team What's Up Bot will share a \$50,000 prize among the student team members

2017 Results

2018 Results

[2018 Teams](#)

[2018 Proceedings](#)

[2018 Finals Video](#)

Winner: Gunrock

With an average score of 3.1 and average duration of 9 minutes and 59 seconds, Team Gunrock will share the \$500,000 prize among the student team members.

Winner: Team Sounding Board, University of Washington, Seattle, WA, USA

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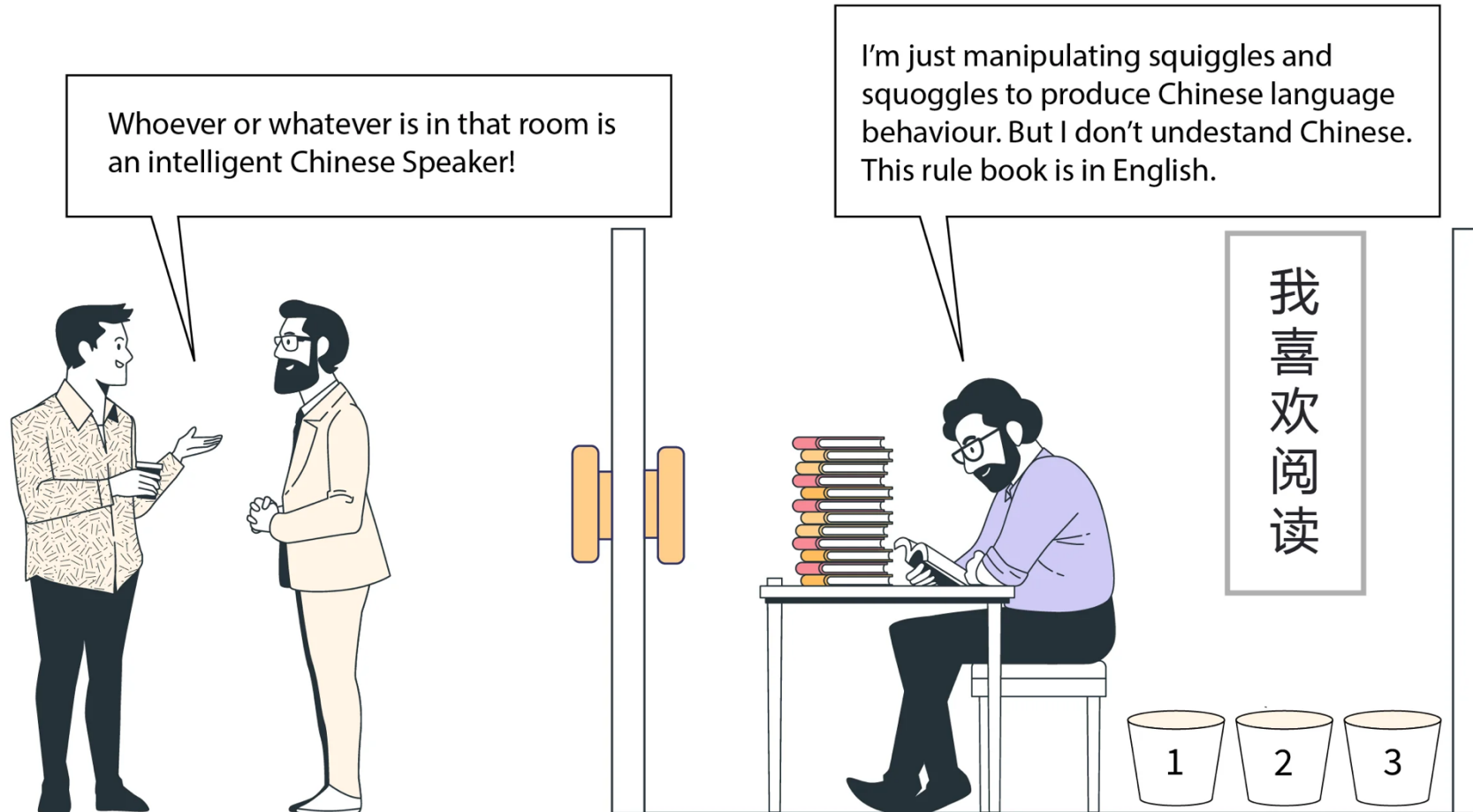
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• Compete with humans in a game of chess/go/ATARI?

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Chinese Room Argument



What Can AI Systems Do Today?



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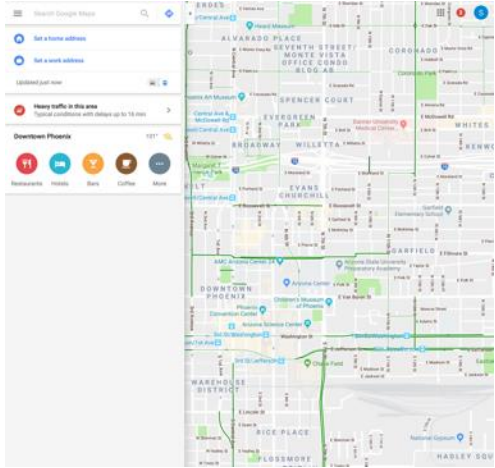


• Compete with humans in a game of chess/go/ATARI?



• Have a meaningful conversation with a person for 15 minutes

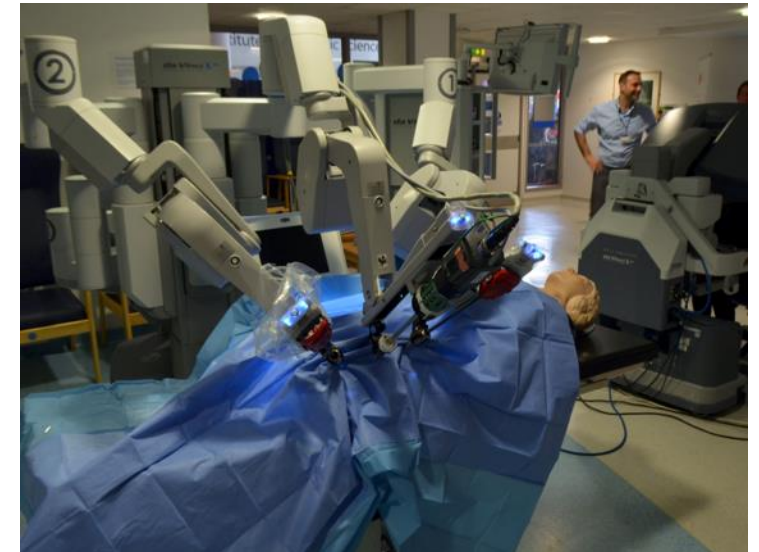
And in the real world...



Contemporary Robots



<https://www.roboticsbusinessreview.com>



A Little Bit of History....

- 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: Expert Systems
 - 1969—79: Early development of knowledge-based systems
 - 1980—88: Expert systems industry booms
 - 1988—93: Expert systems industry busts: "AI Winter"
- 1990—: Statistical approaches
 - Resurgence of probability, focus on uncertainty
 - General increase in technical depth
 - Agents and learning systems... "AI Spring"?

"Those who don't know history are doomed to repeat it."

— Edmund Burke

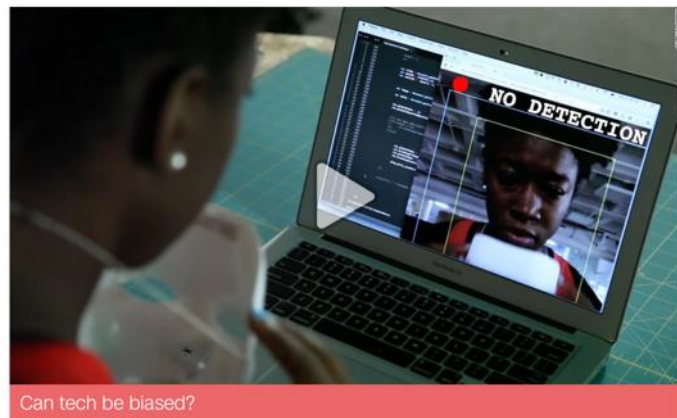
A More Sober Look at Current State of AI



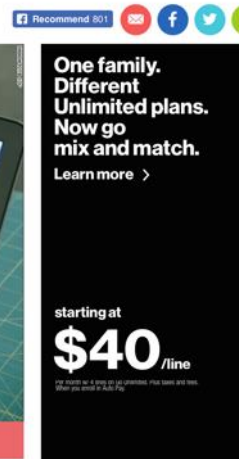
AI is hurting people of color and the poor.
Experts want to fix that

by Heather Kelly @heatherkelly

July 23, 2018: 10:14 AM ET



Can tech be biased?



Amazon's facial recognition matched 28 members of Congress to criminal mugshots

New ACLU test illustrates the limits of Amazon's Rekognition system

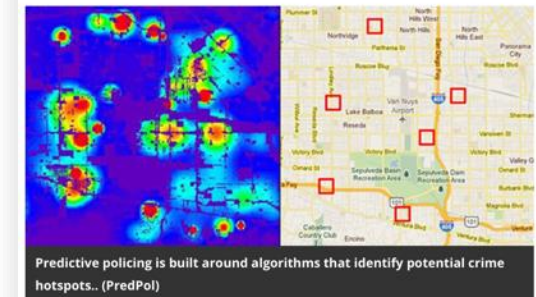
By Russell Brandom | @russellbrandom | Jul 26, 2018, 8:02am EDT

f t SHARE



Artificial Intelligence Is Now Used to Predict Crime. But Is It Biased?

The software is supposed to make policing more fair and accountable. But critics say it still has a way to go.



By Randy Rieland

Awareness of such effects of poorly designed
AI is older than the modern form of the field



FRANKENSTEIN ;

OR,

THE MODERN PROMETHEUS.

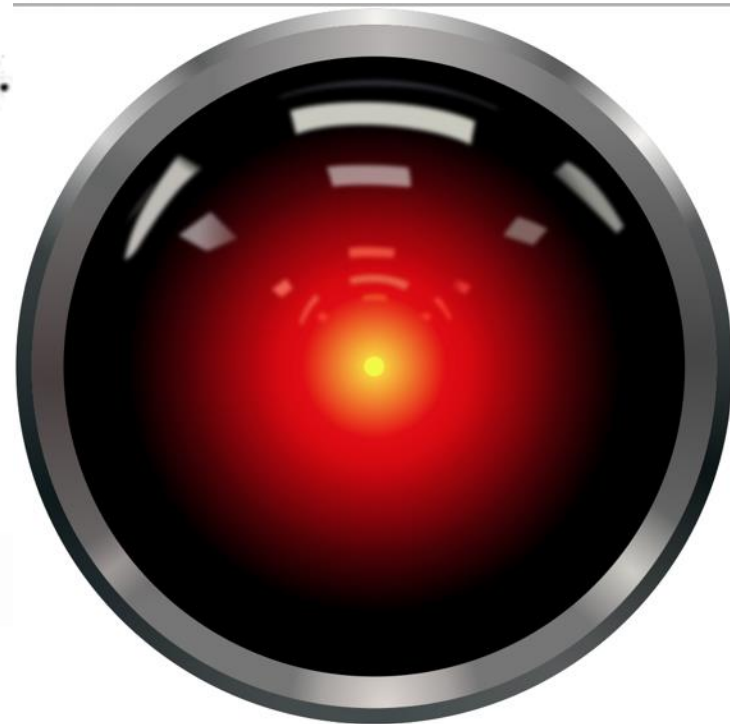
IN THREE VOLUMES.

Did I request thee, Maker, from my clay
To mould me man ? Did I solicit thee
From darkness to promote me ?—
PARADISE LOST.

VOL. I.

London :
PRINTED FOR
LACKINGTON, HUGHES, HARDING, MAJOR, & JONES,
FINSBURY SQUARE.

1818.



Current Limitations

- No, killer AI systems are not taking over the world
- Some cases involve major legal considerations, insufficient information
- Others are results of bugs, poor understanding of the limits of the technology
 - Under which conditions would an object detector work (or not work)?
 - Probably approximately correct (PAC) learning guarantees can be useful



Current Limitations

- No, killer AI systems are not taking over the world

- Some cases are considered

- Others are understood through technology

- Under which conditions would an object detector work (or not work)?
- Probably approximately correct (PAC) learning guarantees can be useful

Good News!!

The next generation of AI designers and engineers may be in this classroom today

If you understand correctly the concepts presented here, there will be fewer bad designs!

Social media has allowed self-proclaimed 'AI influencers' who do nothing more than paraphrase Elon Musk to cash in on this hype with low-quality pieces. The result is dangerous

The Guardian

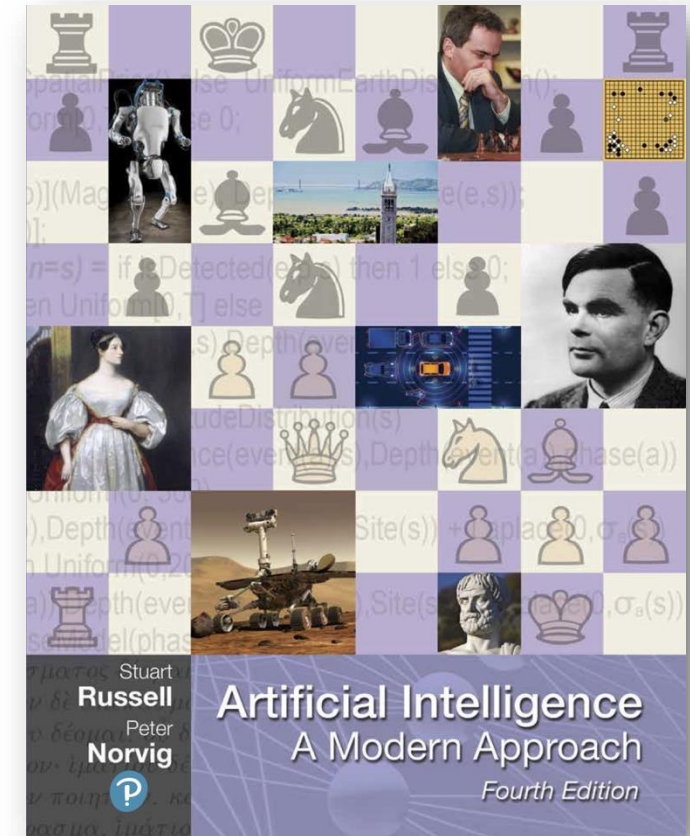
lifestyle

s Tech Science

ed': how the media

Course Structure

- Course discussions, announcements will be on Canvas
- Do the required reading prior to each class
 - In-class Quizzes: 5%
 - Amortized surprise quizzes
 - Questions during class based on reading material



Textbook

Artificial Intelligence: A Modern Approach
Stuart Russell, Peter Norvig
4th Edition