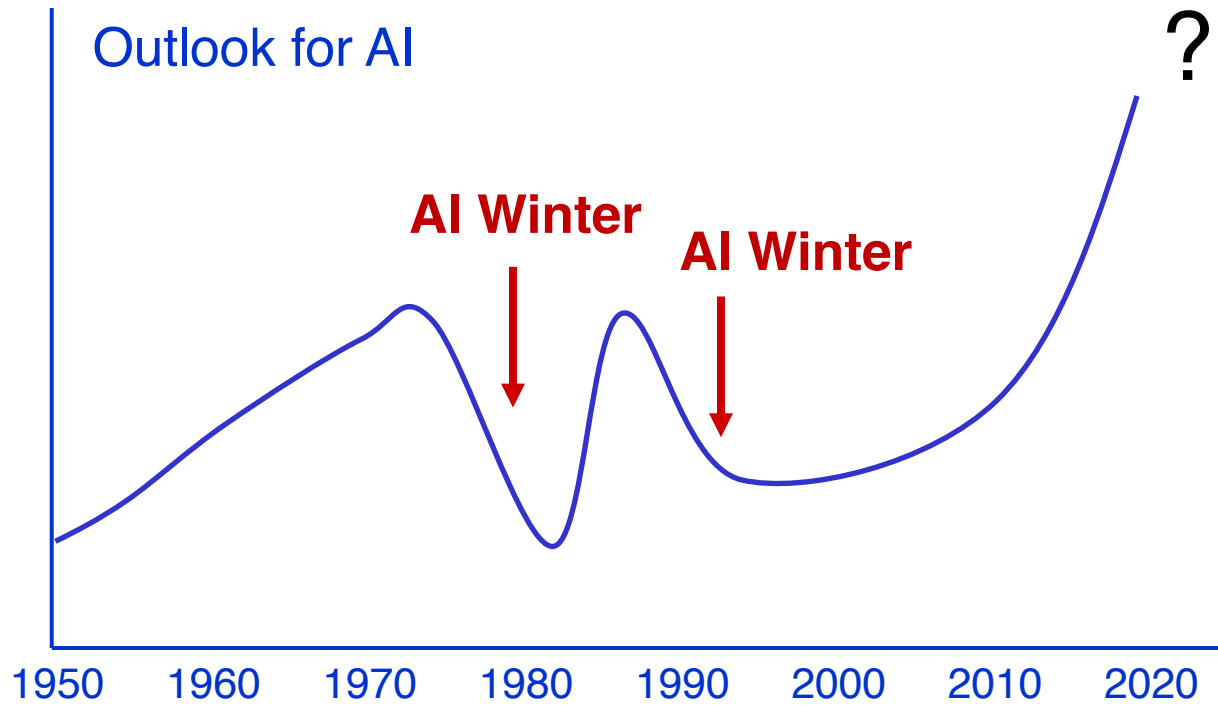


# **Why AI is Harder Than We Think**

Melanie Mitchell  
Santa Fe Institute



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Guardian

US edition

2015

**Self-driving cars: from 2020 you will  
become a permanent backseat driver**

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# The Guardian

2015

**Self-driving cars: from 2020 you will  
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**10 million self-driving cars will be on the road by 2020**

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2016

10 million self-driving cars will be on the road by 2020



## TESLA

“A year from now, we’ll have over a million cars  
with full self-driving, software, everything.”

— Elon Musk

2019

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# The Guardian

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2016

10 million self-driving cars will be on the road by 2020



TESLA

“A year from now, we’ll have over a million cars

2019



TESLA

“I would be shocked if we do not achieve full self-driving safer than human this year. I would be shocked.” — Elon Musk

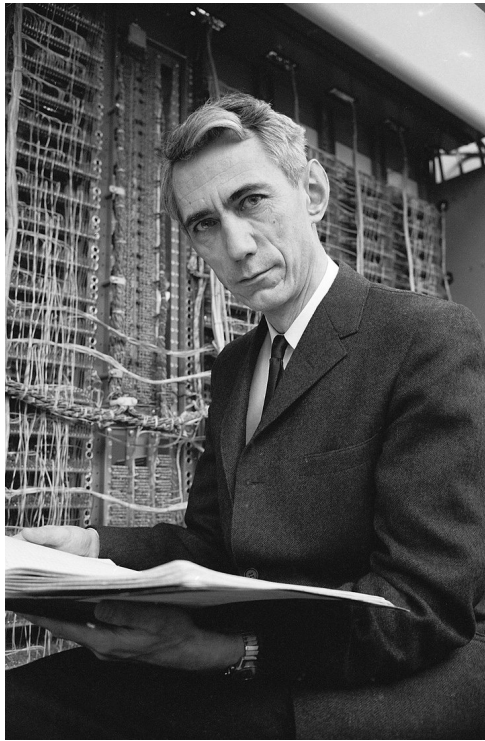
2022

“Perhaps expectations are too high, and... this will eventually result in disaster.... [S]uppose that five years from now [funding] collapses miserably as autonomous vehicles fail to roll. Every startup company fails. And there's a big backlash so that you can't get money for anything connected with AI. Everybody hurriedly changes the names of their research projects to something else.

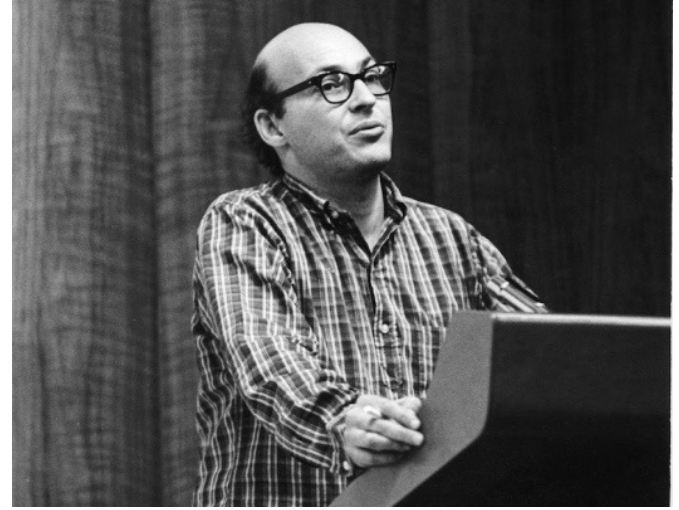
This condition [is] called the ‘AI Winter.’”

—Drew McDermott, 1984





Machines will be capable, within twenty years, of doing any work that a man can do.  
— Herbert Simon, 1965



Within a generation...the problem of creating 'artificial intelligence' will be substantially solved.  
— Marvin Minsky, 1967

I confidently expect that within a matter of 10 or 15 years, something will emerge from the laboratory which is not too far from the robot of science fiction fame.  
— Claude Shannon, 1961





“AI was harder than we thought.”  
— John McCarthy, 2006



Human-level AI will be passed in the mid-2020s.

— Shane Legg, 2008



One of [Facebook's] goals for the next five to 10 years is to basically get better than human level at all of the primary human senses: vision, hearing, language, general cognition

— Mark Zuckerberg, 2015



I estimate a 50% probability of human-level AI by 2040.

— Richard Sutton, 2022



When will superintelligent AI arrive?...it [will] probably happen in the lifetime of my children.

(My timeline of, say, eighty years is considerably more conservative than that of the typical AI researcher.)

— Stuart Russell, 2019

# **Why AI is Harder Than We Think**

**Melanie Mitchell**

Santa Fe Institute  
Santa Fe, NM, USA  
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*Still*  
Why AI is Harder Than We Think

Melanie Mitchell  
Santa Fe Institute  
Santa Fe, NM, USA  
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**Four fallacies that promote over-optimism on AI**

## Fallacy 1: Narrow AI is on a continuum with general AI

IBM® Watson™ represents a first step into cognitive systems, a new era of computing.

AlphaZero ... is the first step in creating real AI.

GPT-2 AS STEP TOWARD GENERAL INTELLIGENCE

**Hubert Dreyfus:** "The **first-step fallacy** is the claim that, ever since our first work on computer intelligence we have been inching along a continuum at the end of which is AI, so that any improvement in our programs no matter how trivial counts as progress....There was in fact a discontinuity in the assumed continuum of steady incremental progress. The unexpected obstacle was called the **commonsense knowledge problem.**"



## Fallacy 2: Easy things are easy and hard things are hard

### **What Artificial Intelligence Can and Can't Do Right Now**

by Andrew Ng

November 09, 2016

If a typical person can do a mental task with less than one second of thought, we can probably automate it using AI either now or in the near future.

## Fallacy 2: Easy things are easy and hard things are hard

### Mastering the game of Go without human knowledge

*Nature* [Published: 19 October 2017](#)

Go is among “the most challenging domains in terms of human intellect.”

# **The Washington Post**

September 28, 2022

**AI can now create any image in seconds, bringing wonder and danger**

# **The New York Times**

***We Need to Talk About How Good A.I. Is Getting***

August 24, 2022



OpenAI GPT-3

## Playground

Load a preset...



Save

I put a green box on top of a blue box. I put a yellow box on the green box, and another red box on top of that. I then took off the red box and put it beneath the blue box. What is on top now?



The green box is on top.

What is on the bottom?

The blue box is on the bottom.

## Playground

---

Write a sentence that is not about ice cream.

I'm not a fan of ice cream.



Edit the detailed description

Surprise me

Upload



Generate

A yellow box on top of a green box, which is on top of a blue box.





Edit the detailed description

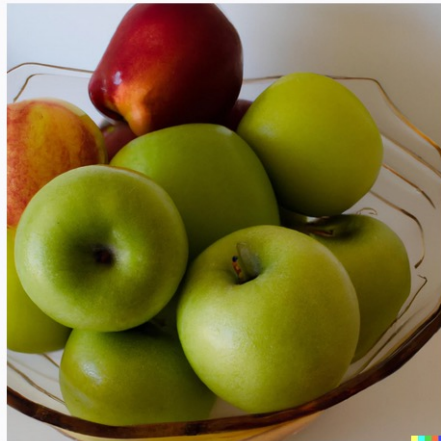
Surprise me

Upload



A bowl of fruit with no apples.

Generate



**Moravec's paradox:** “It is comparatively easy to make computers exhibit adult level performance on intelligence tests or playing checkers, and difficult or impossible to give them the skills of a one-year-old when it comes to perception and mobility.” — **and common sense!**



### Fallacy 3: The lure of “wishful mnemonics” (McDermott, 1976)

“Watson can **read** all of the health-care texts in the world in seconds.”

“Watson **understands** context and nuance in seven languages.”

“AlphaGo’s **goal** is to beat the best human players not just mimic them.”

**'It's able to create knowledge itself':  
Google unveils AI that learns on its own**

## Fallacy 3: The lure of “wishful mnemonics” (McDermott, 1976)

### What is SQuAD?

---








Stanford **Q**uestion **A**nswering **D**ataset (SQuAD) is a reading comprehension dataset, consisting of questions posed by crowdworkers on a set of Wikipedia articles,

The General Language Understanding Evaluation (GLUE) benchmark is a collection of resources for training, evaluating, and analyzing natural language understanding systems.

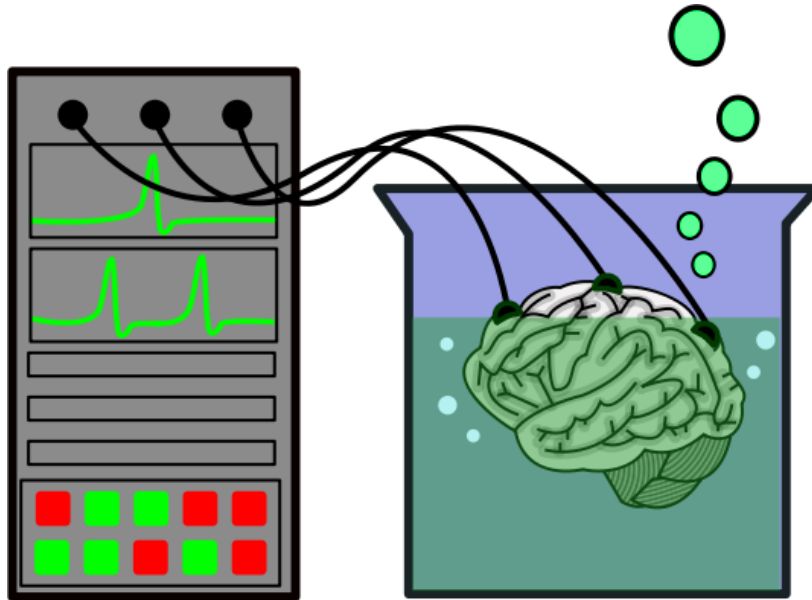
Visual Commonsense Reasoning (**VCR**) is a new task and large-scale dataset for cognition-level visual understanding.



### Leaderboard Version: 2.0

Rank	Name	Model	URL	Score	BoolQ	CB	COPA	MultiRC	ReCoRD	RTE	WiC	WSC	AX-g	AX-b
+ 1	Liam Fedus	ST-MoE-32B		91.2	92.4	96.9/98.0	99.2	89.6/65.8	95.1/94.4	93.5	77.7	96.6	96.1/94.1	72.3
2	Microsoft Alexander v-team	Turing NLR v5		90.9	92.0	95.9/97.6	98.2	88.4/63.0	96.4/95.9	94.1	77.1	97.3	93.3/95.5	67.8
3	ERNIE Team - Baidu	ERNIE 3.0		90.6	91.0	98.6/99.2	97.4	88.6/63.2	94.7/94.2	92.6	77.4	97.3	92.7/94.7	68.6
4	Yi Tay	PaLM 540B		90.4	91.9	94.4/96.0	99.0	88.7/63.6	94.2/93.3	94.1	77.4	95.9	95.5/90.4	72.9
+ 5	Zirui Wang	T5 + UDG, Single Model (Google Brain)		90.4	91.4	95.8/97.6	98.0	88.3/63.0	94.2/93.5	93.0	77.9	96.6	92.7/91.9	69.1
+ 6	DeBERTa Team - Microsoft	DeBERTa / TuringNL Pv4		89.8	89.1	95.7/97.6	98.4	88.2/63.7	94.5/94.1	93.2	77.5	95.9	93.3/93.8	66.7
7	SuperGLUE Human Baselines	SuperGLUE Human Baselines		89.8	89.0	95.8/98.9	100.0	81.8/51.9	91.7/91.3	93.6	80.0	100.0	99.3/99.7	76.6

## Fallacy 4: Intelligence is all in the brain



<https://www.insidetherift.net/mind-at-large/2017/6/1/philosophy-portal-brain-in-a-vat>

NEUROSCIENCE

Why AI Lags Behind the  
Human Brain in  
Computational Power

INNOVATION

**The Human Brain-Scale AI  
Supercomputer Is Coming**

NEWS

**This massive AI chip has the compute power  
of a human brain**



**Nando de Freitas** 🇧🇷

@NandoDF



Someone's opinion article. My opinion: It's all about scale now! The Game is Over! It's about making these models bigger, safer, compute efficient, faster at sampling, smarter memory, more modalities, INNOVATIVE DATA, on/offline, ... 1/N



**Alex Dimakis**

@AlexGDimakis



Based on recent papers (Gpt3, Palm, dalle2, Gato, Metaformer) I am forming the opinion that maybe 'Scale is all you need', possibly even for general intelligence (?!). Just convert everything to tokens and predict the next token. (1/n)

7:24 PM · May 16, 2022 · Twitter for Android

84 Retweets 43 Quote Tweets 745 Likes

# EMBODIED MIND, MEANING, AND REASON

HOW OUR BODIES  
GIVE RISE TO UNDERSTANDING

MARK JOHNSON

## How the Body Shapes Knowledge

Empirical Support for Embodied Cognition



REBECCA FINCHER-KIEFER

Cognitive Systems Monographs 26

Jessica Lindblom

# Embodied Social Cognition

 Springer

# Major Open Challenges

- Few-shot learning
- Generalization
- Abstraction and analogy
- Understanding and Common Sense



JACK STEWART

TRANSPORTATION 10.10.2018 07:00 AM

# Why People Keep Rear-Ending Self-Driving Cars

Human drivers (and one cyclist) have rear-ended self-driving cars 28 times this year in California—accounting for nearly two-thirds of robo-car crashes.

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# Paul Allen invests \$125 million to teach computers common sense

<https://www.seattletimes.com/business/technology/paul-allen-invests-125-million-to-teach-computers-common-sense/>



ALEXANDRIA

**Common sense is the everyday knowledge  
that virtually every person has but no machine does.**

<https://allenai.org/alexandria/>

**Department of Defense  
Fiscal Year (FY) 2019 Budget Estimates**

February 2018



**Defense Advanced Research Projects Agency**

**Title:** Machine Common Sense (MCS)

**Description:** The Machine Common Sense (MCS) program will explore approaches to commonsense reasoning. Recent advances in machine learning have resulted in exciting new artificial intelligence (AI) capabilities in areas such as image recognition, natural language processing, and two-person strategy games (Chess, Go). But in all of these applications, the machine reasoning is narrow and highly specialized; broad, commonsense reasoning by machines remains a challenge. This program will create more human-like knowledge representations, for example, perceptually-grounded representations of commonsense reasoning by machines about the physical world and spatio-temporal phenomena. Equipping AI with more human-like reasoning capabilities will make it possible for humans to teach/correct a machine as they interact on tasks, enabling more equal collaboration and ultimately symbiotic partnerships between humans and machines.

**FY 2019 Plans:**

- Develop approaches for machine reasoning about imprecise and uncertain information derived from text, pictures, speech, and sensor data.
- Design methods to enable machines to identify knowledge gaps and reason about their state of knowledge.
- Formulate perceptually-grounded representations to enable commonsense reasoning by machines about the physical world and spatio-temporal phenomena.





# The state of Computer Vision and AI: we are really, really far away.

Oct 22, 2012



**What would it take for a computer to understand this image?**

# Some core components of human understanding

- Intuitive physics, biology, psychology
- Mental models of cause and effect
- Vast world-knowledge
- Abstraction and analogy



**In spite of enormous progress in specific areas, AI systems are still far from having anything like these general human abilities.**

**AI is still harder than we think.**

# 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

We propose that a 2 month, 10 man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College in Hanover, New Hampshire. 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. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves. We think that a significant advance can be made in one or more of these problems if a carefully selected group of scientists work on it together for a summer.

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

“One might even say that the [1955] proposal, if properly reformatted, could be resubmitted to the NSF...today and would probably get some funding by some excited program managers.”

— Eric Horvitz, 2015

We propose that a 2 month, 10 man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College in Hanover, New Hampshire. 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. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves. We think that a significant advance can be made in one or more of these problems if a carefully selected group of scientists work on it together for a summer.

# Artificial Intelligence

A Guide for  
Thinking Humans



Melanie Mitchell

**Thank you for listening!**