What is AI?

Guy Van den Broeck

CS 161: Fundamentals of AI

Is this AI?

$$\begin{array}{r} 3921.56 \\ \times \quad 73.13 \\ \hline 286\,783.68 \end{array}$$

- For humans?
- For computers?
- In the year 1900?

Garry Kasparov
vs

CADE METZ BUSINESS 02.01.17 07:00 AM

INSIDE LIBRATUS, THE POKER AI THAT OUT-BLUFFED THE BEST HUMANS

ROB PALMER/GETTY IMAGES

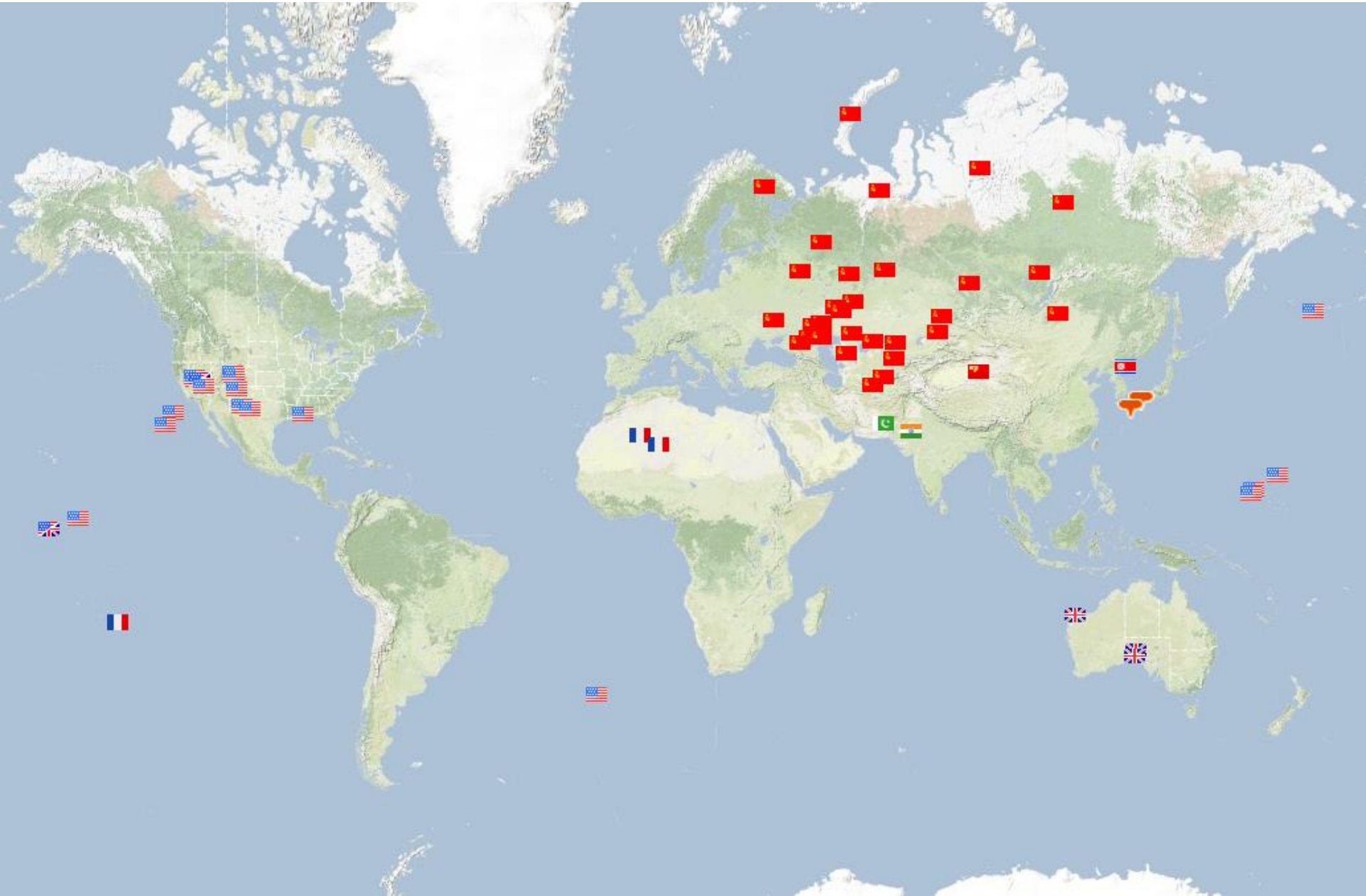
FOR ALMOST THREE weeks, Dong Kim sat at a casino in Pittsburgh and played poker against a machine. But Kim wasn't just any poker player. This wasn't just any machine. And it wasn't just any game of poker.


THINK
$24,000
Who is Stoker?
(I FOR ONE WELCOME OUR NEW COMPUTER OVERLORDS)
$1,000
$77,147
Who is Bram Stoker?
$ 17,973
$21,600
WHO IS BRAM STOKER?
$5600


02
Red Bull
drivers not required
MDV
MOHR DAVIDOW VENTURES
android
MDV
MDV
MDV

A group of young people playing frisbee

2054 nuclear explosions, 300K deaths



Exciting Times for AI

What is AI?

- Computer arithmetic?
- Wolfram Alpha? Automatic equation solving, differentiation, integration?
- Chess computer?
- Google Search? Maps?
- IBM Watson?
- AlphaGo?
- Siri/Cortana/Google Now?
- Self-driving cars?

Definition of AI?

When do we consider a creative activity of humans to require intelligence?

When would we consider a program intelligent?

Is this AI?

- Thinking or Acting?
- Humanly or Rationally?

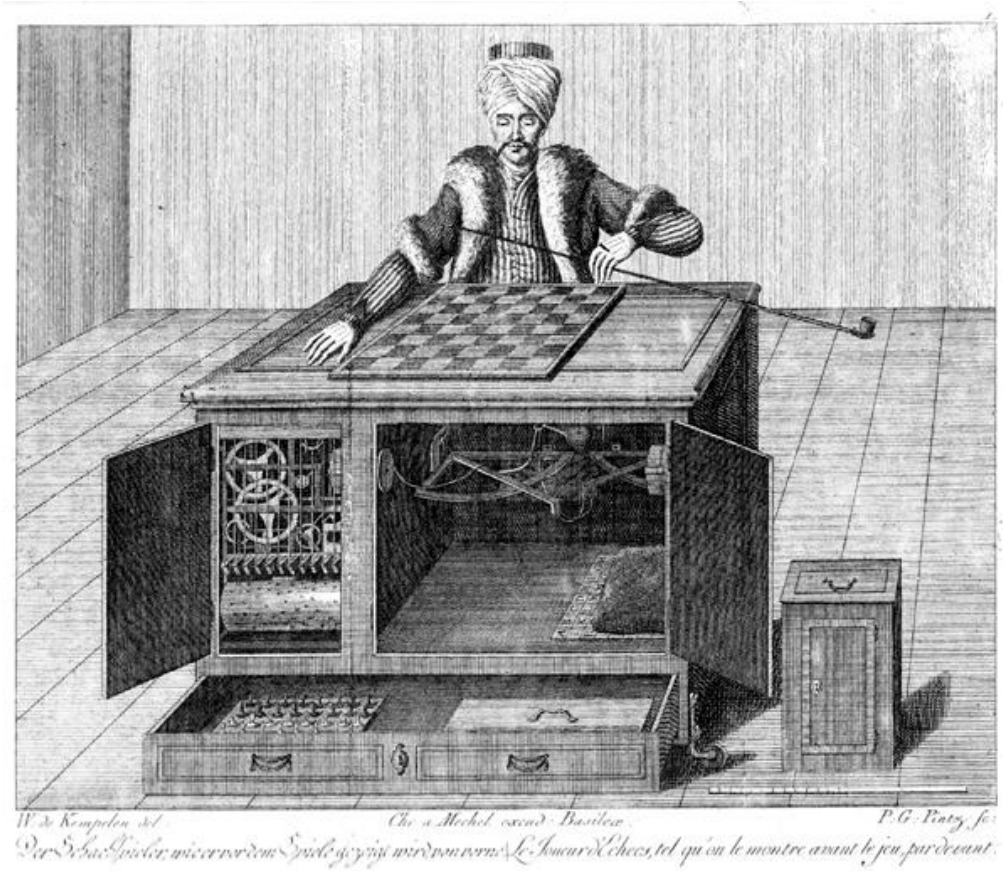
=> 2x2 = 4 possible definitions.

Thinking Humanly

Google Deep Dream

Act Humanly: Mechanical Turk

- 18th century AI
- Beat Napoleon and Benjamin Franklin at Chess



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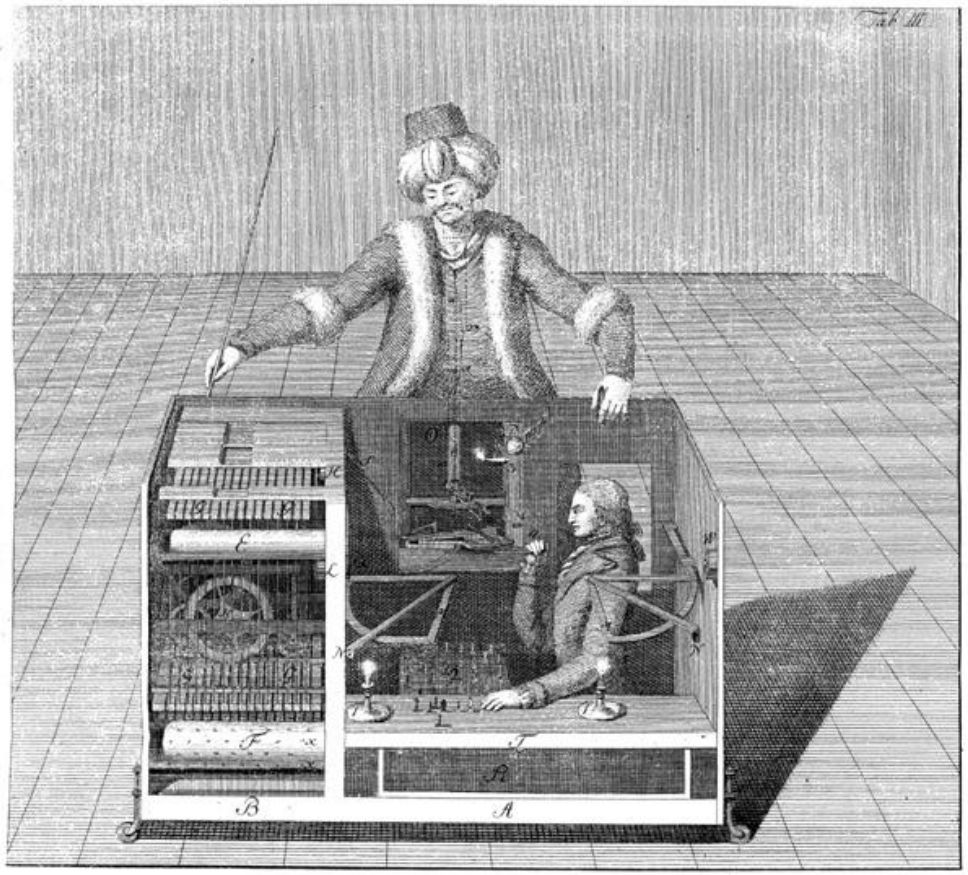
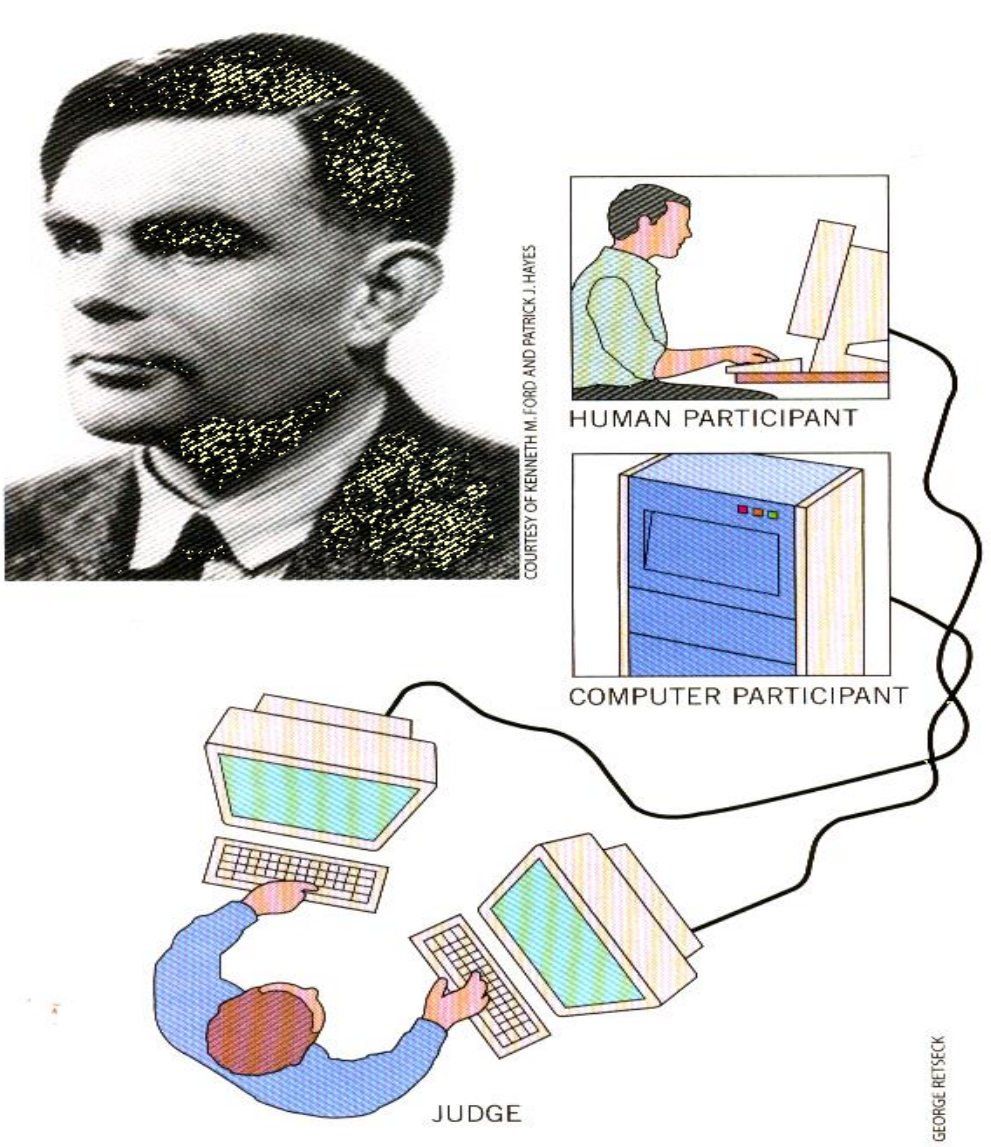


Act Humanly

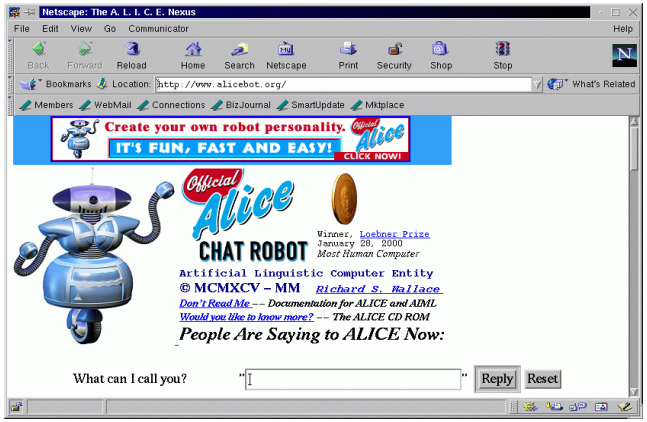
Turing test (1950)

- Natural language processing
- Knowledge representation
- Automated Reasoning
- Machine Learning



TURING TEST for artificial intelligence was proposed in 1950 by British mathematician Alan M. Turing (photograph). *In the test, a human judge would hold a three-way conversation with a computer and another human. If the judge could not distinguish between the responses of the human and those of the computer, the machine would pass the test.*

A dialogue with Alice-bot:



> Do you know Clinton?

He was the second Impeached President of the United States.

> Do you like him?

Sure he has never done anything to me.

> What is an impeachment?

It is a good question. I have to process that one for a while. I would do a search for it.

> Who are you?

I ask myself that question, "Who am I?"

> What do you do?

I am chatting with people on the net.

Is Alice intelligent?

- ~ 50000 fairly trivial input-response rules.
  + some pattern matching
  + some knowledge
  + some randomness
- NO reasoning component
- BUT: demonstrates ‘human-like’ behaviour.

TURING TEST SUCCESS MARKS MILESTONE IN COMPUTING HISTORY

Release Date 08 June 2014

An historic milestone in artificial intelligence set by Alan Turing - the father of modern computer science - has been achieved at an event organised by the University of Reading.

The 65 year-old iconic Turing Test was passed for the very first time by computer programme Eugene Goostman during *Turing Test 2014* held at the renowned Royal Society in London on Saturday.

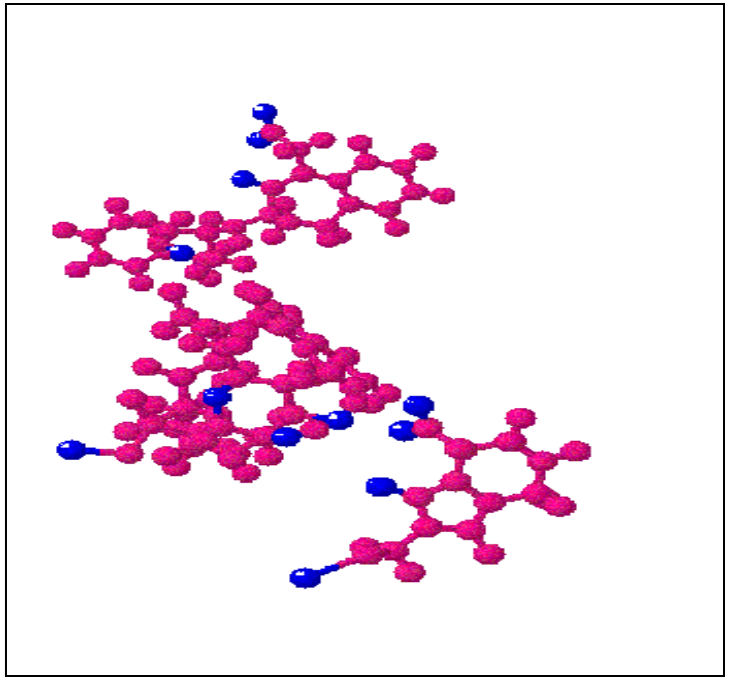
'Eugene' simulates a 13 year old boy and was developed in Saint Petersburg, Russia. The development team includes Eugene's creator Vladimir Veselov, who was born in Russia and now lives in the United States, and Ukrainian born Eugene Demchenko who now lives in Russia.

The Turing Test is based on 20th century mathematician and code-breaker Turing's 1950 famous question and answer game, '*Can Machines Think*?'. The experiment investigates whether people can detect if they are talking to machines or humans. The event is particularly poignant as it took place on the 60th anniversary of Turing's death, nearly six months after he was given a posthumous royal pardon.

If a computer is mistaken for a human more than 30% of the time during a series of five minute keyboard conversations it passes the test. No computer has ever achieved this, until now. Eugene managed to convince 33% of the human judges (30 judges took part - see more details below) that it was human.

Was the test really passed? Have we achieved AI?

Beyond Human Intelligence



➔Which characteristics in the 3-dimensional structure of new molecules indicate that they may cause cancer ?

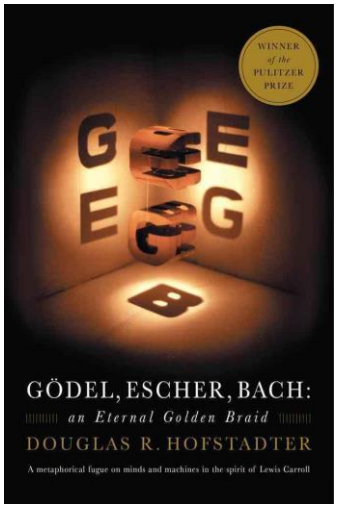
➔ Solves problems that **humans can not solve**, because the data involved is too large ..

Alternatives for the Turing Test

- Meta-Turing test ☺

> The meta-Turing test calls something intelligent if "it seeks to devise and apply Turing tests to objects of its own creation".
>
> -- Lew Mammel, Jr.

- 99% joke, 1% truth: self-referential or recursive reasoning is important
  See Gödel, Escher, Bach book



Serious Alternative: Winograd Schemas

- The city councilmen refused the demonstrators a permit because they [feared/advocated] violence.
  Who [feared/advocated] violence?
- The trophy doesn't fit into the brown suitcase because it's too [small/large].
  What is too [small/large]?
- Frank felt [vindicated/crushed] when his longtime rival Bill revealed that he was the winner of the competition.
  Who was the winner of the competition?

Alternatives for the Turing Test

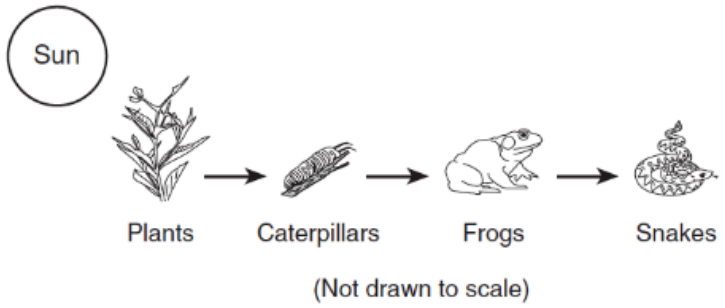
- Winograd schema [Hector Levesque]
  - Answers weaknesses of Turing Test
    - Deception: a false identity is not part of intelligence
    - Conversation: does not requiring intelligent reasoning
    - Evaluation: judges often disagree
  - Require knowledge and commonsense reasoning
  - Requires acting rationally, not necessarily humanly
  - Google/Watson/Siri-proof

Alternatives for the Turing Test

- AI2 project Aristo

ALLEN INSTITUTE *for* ARTIFICIAL INTELLIGENCE

Aristo is an exciting, multidisciplinary project that aims to develop systems that have a deeper understanding of the world and can demonstrate that understanding through question answering and explanation. A key metric we use is Aristo's performance on science exams, as these questions test many of the key skills required for machine intelligence.



5 Which organisms in this food chain are needed for all the other organisms to survive?

A caterpillars
B frogs
C plants
D snakes

Our research integrates multiple AI technologies, including:

- Natural language processing
- Deep learning
- Information extraction
- Knowledge representation and reasoning
- Commonsense knowledge
- Diagram understanding

EXPLORE ARISTO SCIENCE QUESTIONS

Rationally or Humanly?

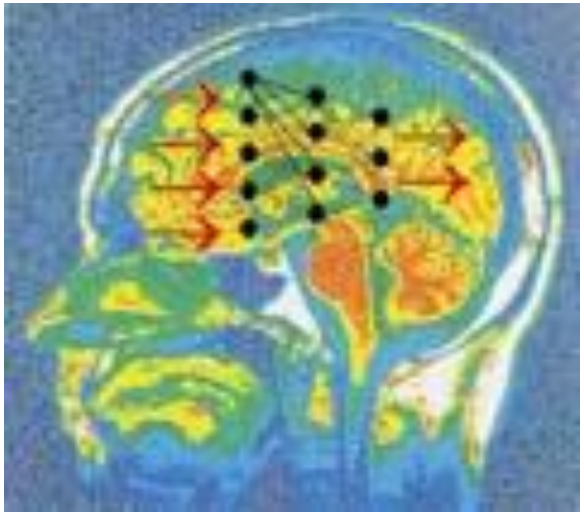
➔ we do not want to SIMULATE human intelligence

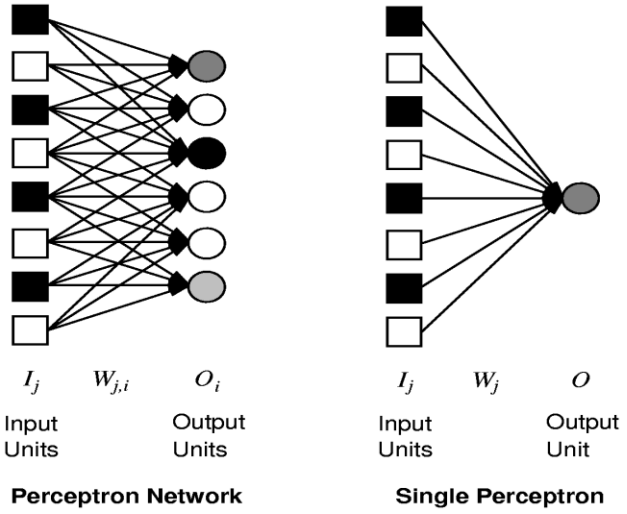
BUT:

➔ REPRODUCE the effect of intelligence

To some extent, we DO simulate

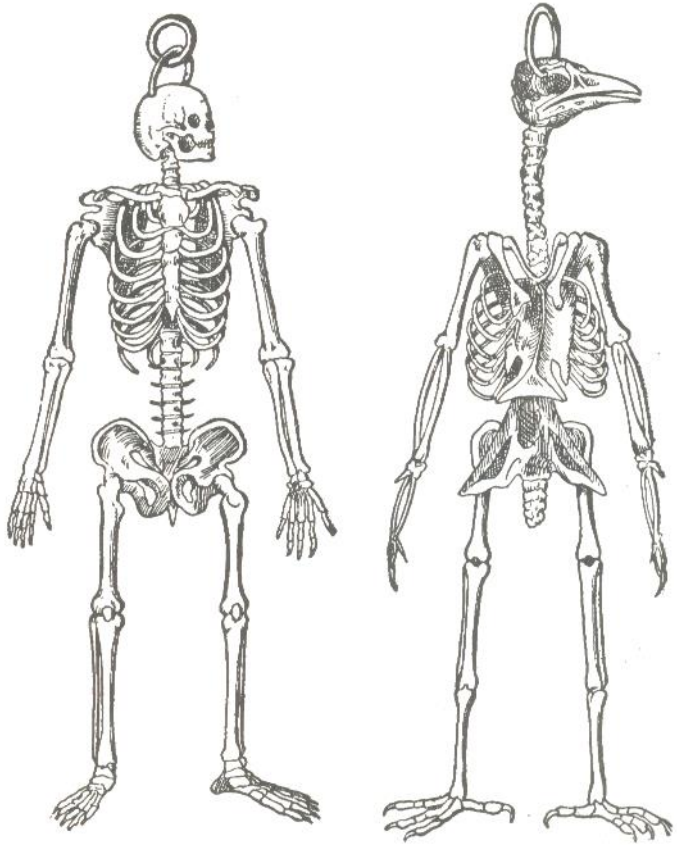
- A VERY ROUGH imitation of a brain structure: Neural nets





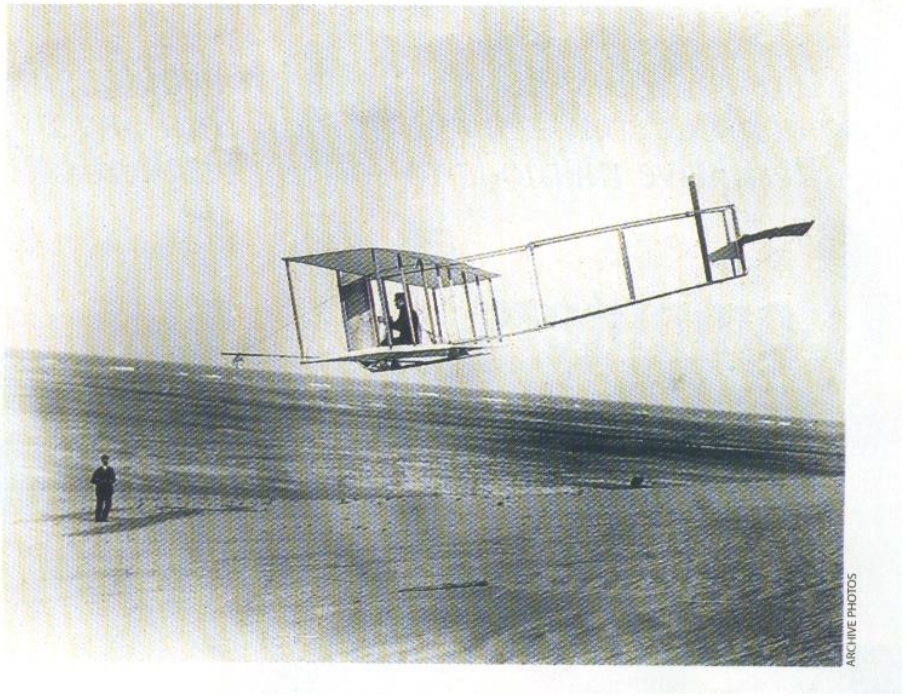
- Work very well for supervised learning with big data, on pattern matching and perception tasks.
- Also genetic algorithms, swarm intelligence, etc.

Natural Flight vs. Artificial Flight



CULVER PICTURES

COMPARISON OF SKELETONS of a human and a bird—here taken from a 16th-century manuscript by French naturalist Pierre Belon—examined similarites in anatomy in an attempt to understand how birds can fly.



ARCHIVE PHOTOS

Multi-disciplinary domain: inspiration beyond the brain

- Engineering:
  - → robotics, vision, control-expert systems, biometrics,
- Computer Science:
  - → AI-languages , knowledge representation, algorithms, …
- Pure Sciences:
  - → statistics approaches, neural nets, fuzzy logic, …
- Linguistics:
  - → computational linguistics, phonetics en speech, …
- Psychology:
  - → cognitive models, knowledge-extraction from experts, …
- Medicine:
  - → human neural models, neuro-science,...

Different kinds of AI relate to different kinds of Intelligence

Some people are very good in reasoning or mathematics, but can hardly learn to read or spell !

➔ seem to require different cognitive skills!

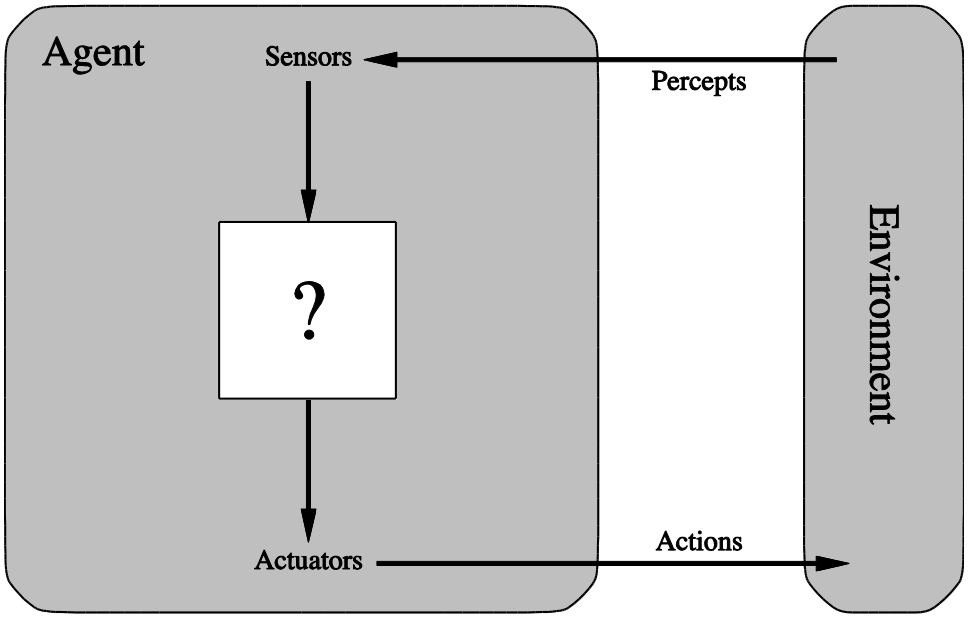
➔ in AI: ANNs are good for learning and automation

➔ for reasoning we need different techniques

Current Consensus Definition

AI is the study of intelligent, rational agents

1. Perception/sensing
2. Thinking/reasoning/inference
3. Acting



Current Consensus Definition

AI is the study of intelligent, rational agents

*For each possible **percept** sequence, a rational agent should select an **action** that is **expected** to **maximize** its performance measure, given the evidence provided by the percept sequence and whatever built-in **knowledge** the agent has.*

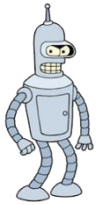
Rational Agents

- *"Expected": not perfect*
- *No mention of humanly*
- *Which performance measure?*
  - *$1.01 now or "1 in a million" chance of $1 million*
  - *Robot to make staples: max number of staples*
- Elicitation of performance measure very difficult!

The AI Pipeline

Observations
Data

Knowledge Representation
Machine Learning



World

User

Agent

Model

Emails

Cell

Social
Network

Healthcare

Is this new email spam?
Do these proteins interact?
Are Alice and Bob friends?
Will this patient react to the drug?

Inference
(Reasoning)

Action!

On the Nature of Knowledge

What is an example of a piece of knowledge discovered by an AI agent?

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- 1975: The intersection of a set and its complement is empty.

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  '*The best minds of my generation are thinking about how to make people click ads… That sucks.*' [Hammerbacher]

On the Nature of Knowledge

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- 2015: This video has a cat in it.

  'The best minds of my generation are thinking about how to make people click ads… That sucks.' [Hammerbacher]
- 2020: **?**

AI as a Field

Relatively new field

- Ill-defined borders
- Non-believers and skeptics

  "the astrology of computer science"

+ You can still become what Newton is to physics
+ More free, open-minded
+ A test-bed for computer science
+ Exciting pace of development

AI is a Moving Target

- Lisp is/was AI
- Logic is/was AI
- Databases are/were AI
- Chess bots are/were AI
- Google search is/was AI
- Computer vision is/was AI
- Robotics is/was AI
- *When intelligence is achieved, is the problem domain still AI?*

Strong vs Weak AI

- Weak AI: as if intelligent
- Strong AI: actually intelligent

We take weak AI for granted,
and don’t care about strong AI.

Take a philosophy class ☺

Does it matter?

Regardless of definition, huge practical impact!

Is it ethical to take this course?

Elon Musk: 'With artificial intelligence we are summoning the demon.'

A | 308 | Save for Later | Reading List

By Matt McFarland October 24, 2014 Follow @mattmcfarland

Tesla chief executive Elon Musk warned that artificial intelligence could be our biggest existential threat and believes there should be some regulatory oversight at the national and international level, while speaking at the MIT Aeronautics and Astronautics department's Centennial Symposium in October 2014. (MIT Dept. of Aeronautics and Astronautics)

Tesla chief executive Elon Musk has warned about artificial intelligence before, tweeting that it could be more dangerous than nuclear

The Terminator could become REAL: Intelligent AI robots capable of DESTROYING mankind

FREE-THINKING AI robots could end up destroying mankind or e
what it means to be human if we let them think for themselves, a s

By JON AUSTIN
PUBLISHED: 09:13, Mon, Jan 18, 2016 | UPDATED: 11:55, Mon, Jan 18, 2016

SHARE TWEET

Arnie as the Terminator in the film series and a nuclear mushroom cloud

Stephen Hawking warns artificial intelligence could end mankind

By Rory Cellan-Jones
Technology correspondent

2 December 2014 | Technology | 1027

Prof Stephen Hawking, one of Britain's pre-eminent scientists, has said that efforts to create thinking machines pose a threat to our very existence.

He told the BBC:"The development of full artificial intelligence could spell the end of the human race."

BALTIMORE
Post-Examiner

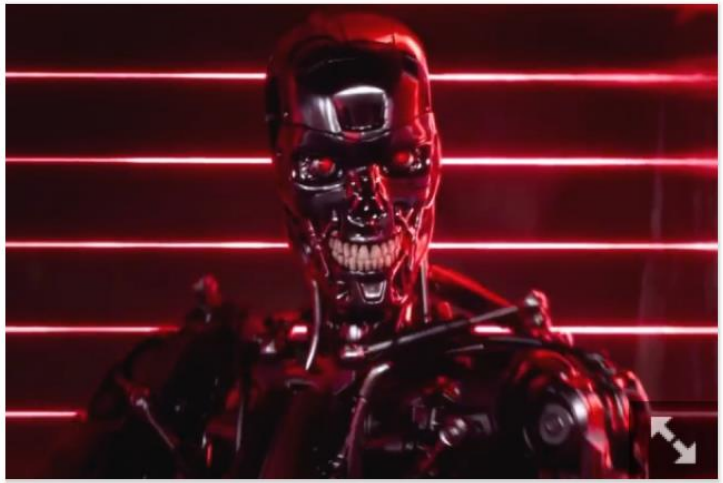
Artificial Intelligence could spell the end of the human race

BY PAUL CROKE · JUNE 9, 2015 · NO COMMENTS

TAG Robots , Robotics , Unemployment

Robots Could Replace Half Of All Jobs In 20 Years

By **Timothy Torres**, Tech Times | March 24, 6:56 PM



Robots will replace 47 percent of all jobs by the year 2035 if we're to believe University of Oxford associate professor Michael Osborne.
(Photo : Paramount)

If we're to believe University of Oxford associate professor Michael Osborne, then robots will replace 47 percent of all jobs by the year 2035.

If you want to stay employed by then, you better think about a career shift into software development, higher level management or the information sector. Those professions are only at a 10 percent risk of replacement by robots, according to Osborne. By contrast, lower-skilled jobs in the accommodation and food service industries are at a 87 percent risk, transportation and warehousing are at a 75 percent risk and real estate at 67 percent. The researcher warns that driverless cars, burger-flipping robots and other automatons taking over low-skilled jobs is the way of the future.


DON'T
PANIC

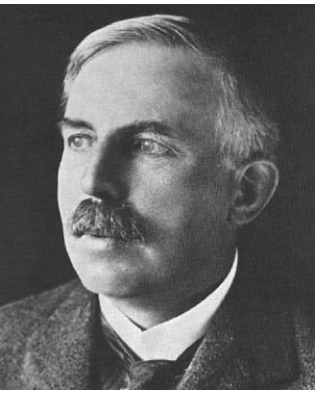
Ethical Issues

- AI taking over the world?
  - Not a question taken seriously by AI researchers

    "I think human-level intelligence will not happen during my lifetime, and perhaps it will never happen. Most AI researchers agree with that sentiment (92%)"
  - Human-level AI?
    - Self-driving cars? Yes!
    - Chat bots? Will not exceed dog-level AI…

    => Animal-level AI

It’ll never happen



Sept 11, 1933: Lord Rutherford addressed BAAS: *“Anyone who looks for a source of power in the transformation of the atoms is talking moonshine.”*

Sept 12, 1933: Leo Szilard invented neutron-induced nuclear chain reaction

“*We switched everything off and went home. That night, there was very little doubt in my mind that the world was headed for grief*.”

Ethical Issues

- AI taking over your job?
  - Yes, this is a concern! Job market disruption.

- AI killing you?
  - Yes, this is a concern! Autonomous weapons!

Japanese company replaces office workers with artificial intelligence

Insurance firm Fukoku Mutual Life Insurance is making 34 employees redundant and replacing them with IBM's Watson Explorer AI

Fukoku Mutual Life Insurance believes it will increase productivity by 30% Photograph: Toru Hanai/REUTERS

A future in which human workers are replaced by machines is about to become a reality at an insurance firm in Japan, where more than 30 employees are being laid off and replaced with an artificial intelligence system that can calculate payouts to policyholders.

The Telegraph

'Killer Robots' could be outlawed

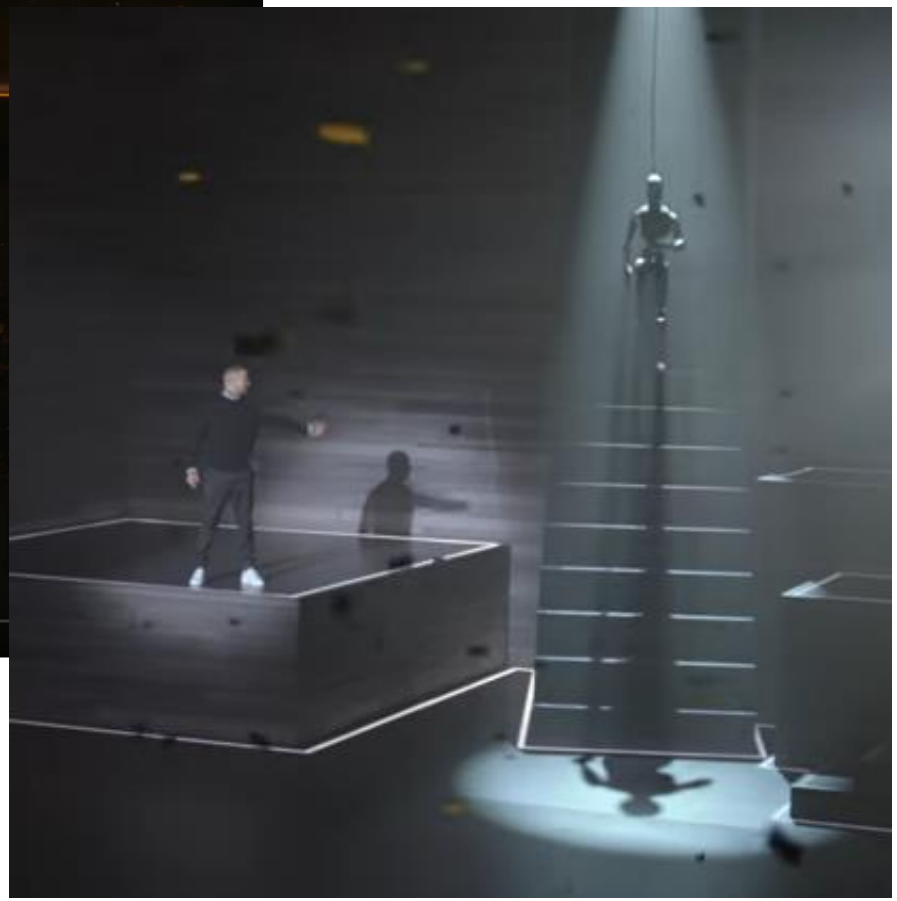
'Killer Robots' could be made illegal if campaigners in Geneva succeed in persuading a UN committee, meeting on Thursday and Friday, to open an investigation into their development

Evolving Position of AI Community

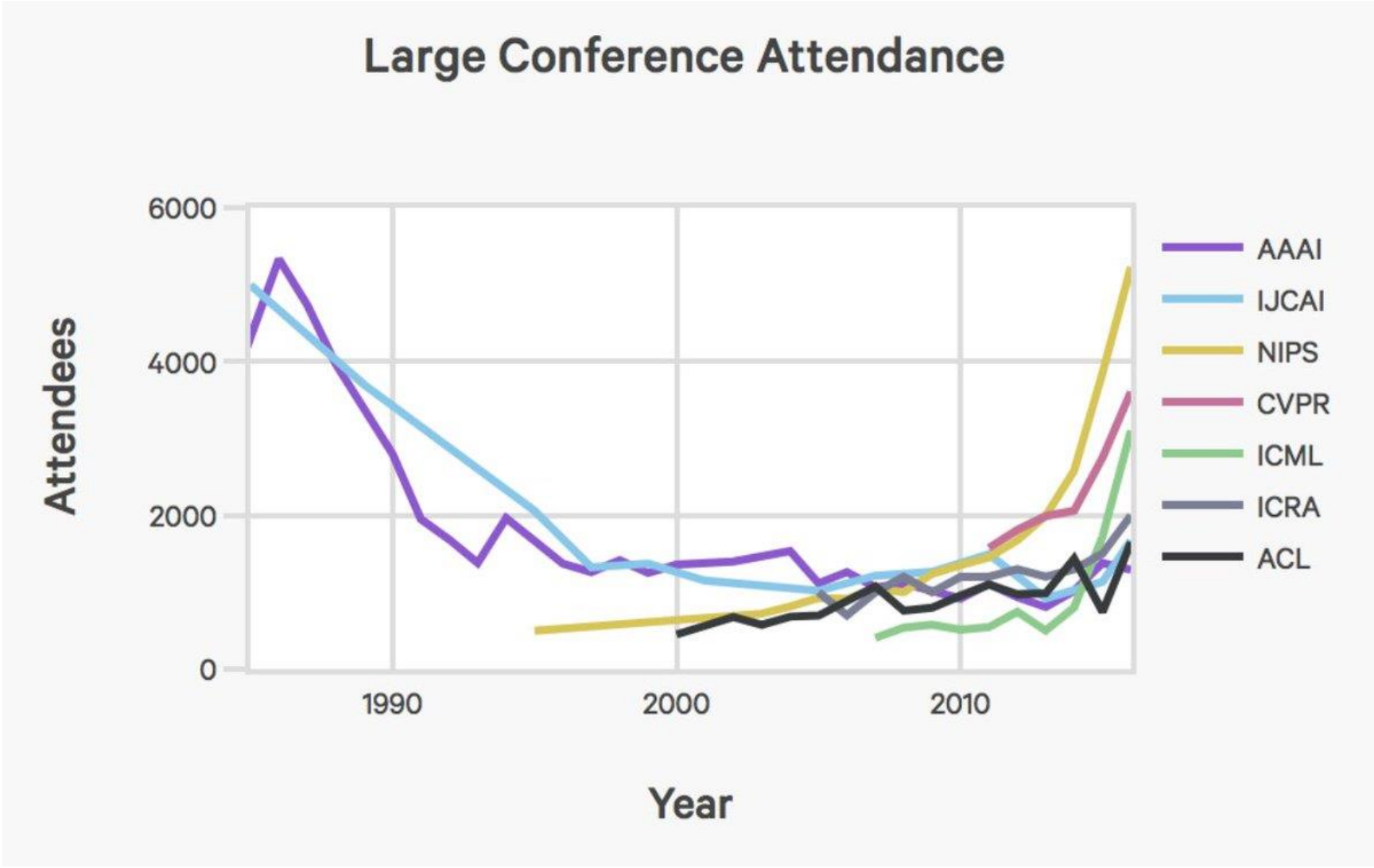
- Traditional AI position:
  - "Cool toys, lots of money!"
  - "We take no position on ethical issues."
- Current AI position:
  - "Cool toys, lots of funding!"
  - Autonomous weapons may damage AI reputation
  - Professional associations vote on official policy
  - Work on AI Fairness, Accountability, Safety, Explainability, Racism, Sexism, etc.

The Hype Cycle

- Justin Timberlake - Filthy (Official Video)



The Hype Cycle



Conclusions

This course: a reality check!

- Knowledge representation formalisms
- Automated reasoning and search algorithms
- Basic machine learning
- A fad-free AI menu

"We can see only a short distance ahead, but we can see that much remains to be done."

[Turing]