CS-C1000 – Introduction to Artificial Intelligence

What is Artificial Intelligence?

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Outline

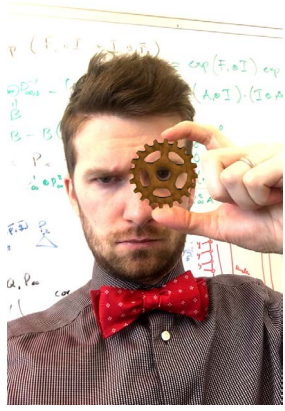
- Start from the big and bold picture
- Go through some historical perspectives of AI
- Gradually narrow down the scope to what AI is
- Examples of different AIs

Let’s set this straight

- Artificial intelligence is not about computers, rather adaption, learning, and decision making.

Formal reasoning

- Artificial intelligence is based on the assumption that the process of human thought can be mechanized.
- Chinese, Indian, and Greek philosophers developed structured methods of formal deduction.
- 17th century philosophers (such as Leibniz, Hobbes, and Descartes) considered all rational thought could be made as systematic as algebra or geometry.



So where do computers come in the picture?

- Church–Turing thesis:
  A mechanical device, shuffling symbols as simple as 0 and 1, can imitate any conceivable process of mathematical deduction.

So where do computers come in the picture?

The Mark I Computer at Harvard. Image courtesy of The Library of Congress.

AI meets computer science

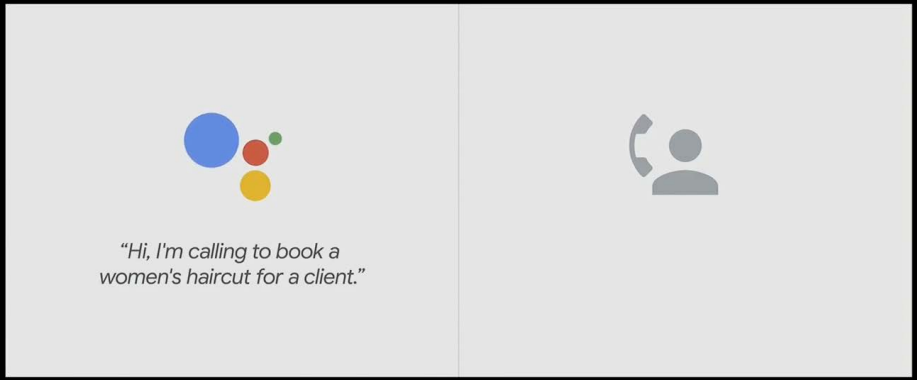
The IBM 702 computer.

The Turing test

The Turing test or ‘imitation game’

The Turing test, developed by Alan Turing in 1950, is a test of a machine’s ability to exhibit intelligent behavior.

- A human interrogator interacts with two players A and B.
- If the interrogator cannot determine which player is a computer and which is a human, the computer is said to *pass the test*.
- The logic behind the test is that if the interrogator cannot reliably tell apart the human and the computer in a natural language discussion, the computer must have reached human-level intelligence.



Google Assistant making a phone call:
https://www.youtube.com/watch?v=pKVppdt_-B4

The Chinese room argument

- The Chinese room argument acts as a counterexample to the Turing test (Can we recongnize AI when we see it?)
- Simplified version of the argument: An AI can be trained to respond to messages in Chinese, but it does not really need to *understand* Chinese.
- Thus: A program cannot give a computer a ‘mind’ / ‘consciousness’.

Types of AIs

Is intelligent

vs.

Acts intelligently

Types of AIs

Can handle any task
(Sci-Fi)

vs.

Can handle one task
(the AI we use)

Feels a bit grandiose to directly aim for human-level intelligence.

Let’s take baby steps instead.

Golden years (1956–1974)

- **Reasoning as search**
  Viewing many problems (proving a mathematical theorem or winning in a game) as a search problem for finding a solution.

- **Natural language processing**
  Handling natural language inputs. Understanding semantics.

- **Robots**
  Technical advances in electrical and mechanical engineering also made it possible to apply and combine AI research with robotics.

Early optimism

- *“Machines will be capable, within twenty years, of doing any work a man can do.”*

  H. A. Simon, 1965

- *“Within ten years a digital computer will be the world’s chess champion”*

  H. A. Simon and Allen Newell, 1958

- Well...
  That didn’t happen before the Deep Blue vs. Kasparov matches in 1997.

AI boom (1980–1987)

- Expert systems
  The buzzword of the day was ‘expert systems’. They followed logical rules and information from knowledge of experts.
- Knowledge
  Intelligence could be seen as the ability to use vast amounts and diverse knowledge in different ways.
- Neural networks
  Backpropagation among other tricks were introduced to neural networks kicking the research back on track again.

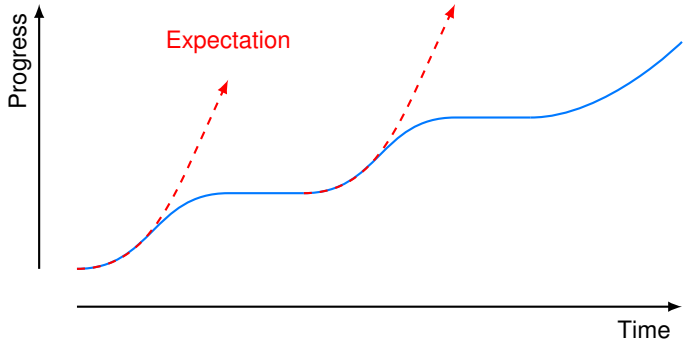
AI (1993–2011)

- Finally something works
  Some of the oldest goals finally reached. AI systems start appearing as part of actual products.
- Moore's law
  The speeds of computers kept doubling every two or so years. The same methods could simply do more. For example, Deep Blue in 1997 was 10 million times faster than the chess AIs in the 1950s.
- Intelligent agents
  Agent based systems and decision theory. It goes beyond studying human intelligence; it studies all kinds of intelligence.

Big and deep era (2011–present)

- Deep learning
  Advances in deep (layered) neural networks suddenly brought image and audio tasks to near human-level.
- Big data
  Availability and accessability of data. Brings in new challenges, but also opportunities and threats.
- Mainstream
  Through other technological advances, AI is not anymore something that sits in a lab or you read about in the newspaper. It already lurks in your phone, computer, TV, ...

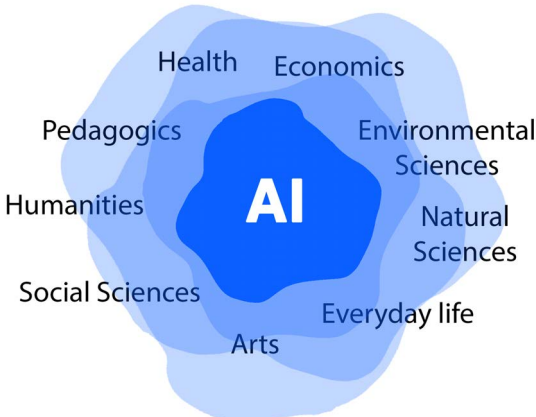
The bumpy history of AI



AI winter

- The field has experienced several hype cycles, followed by disappointment and criticism, followed by funding cuts, followed by renewed interest years or decades later.
- Consequence: Calling research by other names
  ... informatics, machine learning, analytics, knowledge-based systems, business rules management, cognitive systems, intelligent systems, intelligent agents, computational intelligence, ...
- Partly to avoid the stigma of false promises attached to the name ‘artificial intelligence’.

Today: AI everywhere

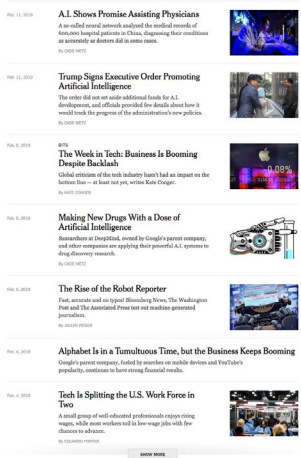


Why is AI hot now?

- People see real impact
  Some of the excitement comes from the fact that we do not need to just read about progress, we can also experience it ourselves.
- Time-to-product shorter
  AI research is closer to industry and also industry is investing a lot in it.
- The compute and infrastructure is already there
  Easier to deploy new methods and applications.

Is there a hype?

- Yes.



Feb. 11, 2019

A.I. Shows Promise Assisting Physicians

A so-called neural network analyzed the medical records of 600,000 hospital patients in China, diagnosing their conditions as accurately as doctors did in some cases.

By CADE METZ

Feb. 11, 2019

Trump Signs Executive Order Promoting Artificial Intelligence

The order did not set aside additional funds for A.I. development, and officials provided few details about how it would track the progress of the administration's new policies.

By CADE METZ

Feb. 8, 2019

BITS

The Week in Tech: Business Is Booming Despite Backlash

Global criticism of the tech industry hasn't had an impact on the bottom line — at least not yet, writes Kate Conger.

By KATE CONGER

Feb. 5, 2019

Making New Drugs With a Dose of Artificial Intelligence

Researchers at DeepMind, owned by Google's parent company, and other companies are applying their powerful A.I. systems to drug discovery research.

By CADE METZ

Feb. 5, 2019

The Rise of the Robot Reporter

Fast, accurate and no typos! Bloomberg News, The Washington Post and The Associated Press test out machine-generated journalism.

By JACQUI FRESER

Feb. 4, 2019

Alphabet Is in a Tumultuous Time, but the Business Keeps Booming

Google's parent company, fueled by searches on mobile devices and YouTube's popularity, continues to have strong financial results.

Feb. 4, 2019

Tech Is Splitting the U.S. Work Force in Two

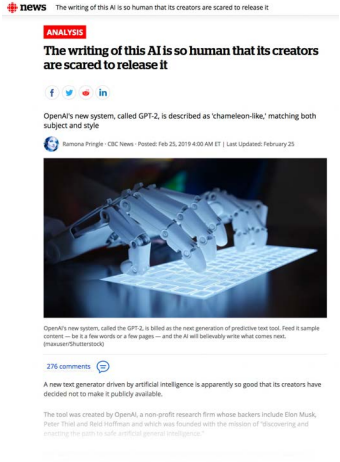
A small group of well-educated professionals enjoys rising wages, while most workers toil in low-wage jobs with few chances to advance.

By EDUARDO PORTER

SHOW MORE

What or who is feeding the hype?

- Real progress and hope of more progress
- People who do not know AI
- People who know AI


news The writing of this AI is so human that its creators are scared to release it

ANALYSIS

The writing of this AI is so human that its creators are scared to release it

OpenAI's new system, called GPT-2, is described as 'chameleon-like,' matching both subject and style

Ramona Pringle · CBC News · Posted: Feb 25, 2019 4:00 AM ET | Last Updated: February 25

OpenAI's new system, called the GPT-2, is billed as the next generation of predictive text tool. Feed it sample content — be it a few words or a few pages — and the AI will believably write what comes next. (maxuser/Shutterstock)

276 comments

A new text generator driven by artificial intelligence is apparently so good that its creators have decided not to make it publicly available.

The tool was created by OpenAI, a non-profit research firm whose backers include Elon Musk, Peter Thiel and Reid Hoffman and which was founded with the mission of "discovering and enacting the path to safe artificial general intelligence."

What is AI?

- No officially agreed definition...
  ...but let's still try to define it.
- On this course we will consider artificial intelligence in very broad terms:

  "A system that can show adaptation."
- One could for example say:

  "Artificial intelligence can be used as a decision-making tool or aid."

What is AI?

"Artificial intelligence (AI) refers to systems that display intelligent behaviour by analysing their environment and taking actions—with some degree of autonomy—to achieve specific goals. AI-based systems can be purely software-based, acting in the virtual world (voice assistants, image analysis software, search engines, speech and face recognition systems) or AI can be embedded in hardware devices (advanced robots, autonomous cars, drones or Internet of Things applications)."

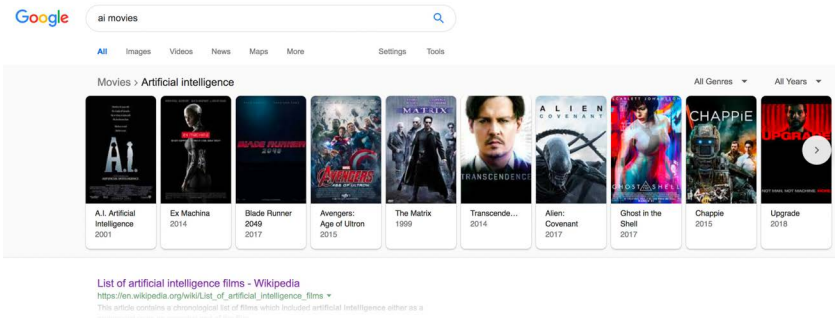
(The EU, April 25, 2018)

“The AI effect”

“The AI effect” tries to redefine AI to mean:
AI is anything that has not been done yet.

Side effect:
Once something works,
people claim it’s not *real* AI.

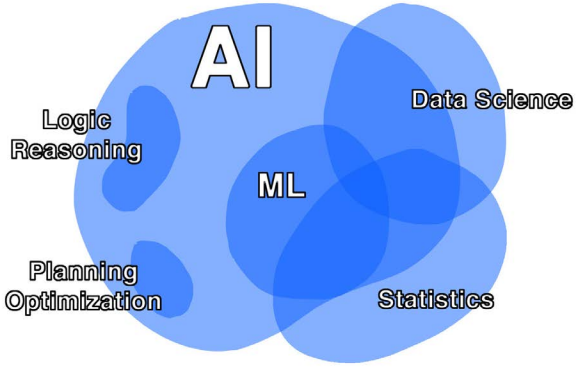
The weight of science fiction



What is hard is easy—what is easy is hard

Things that are easy for us can be *really* difficult for computers.
And vice versa.

What about machine learning, data science, *etc.*?



Mat Velloso
@matvelloso

Follow

Difference between machine learning and AI:

If it is written in Python, it's probably machine learning

If it is written in PowerPoint, it's probably AI

5:25 PM - 22 Nov 2018

8,235 Retweets **22,911** Likes

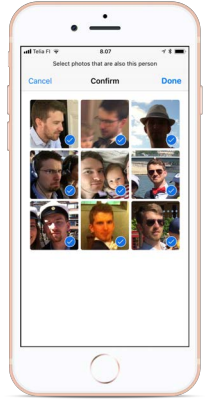
199 8.2K 23K

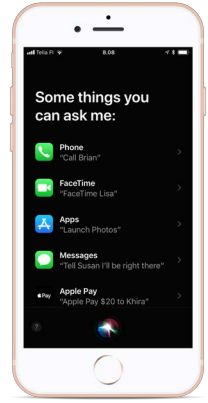
Is this AI?

(defining by examples)

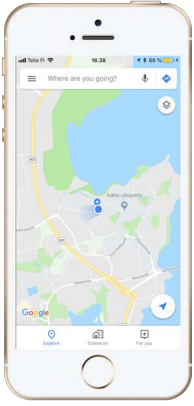
Is this AI?


Telia FI
8.06
NETFLIX
Continue Watching for Kids
Peppa Pig
CHUGGINGTON
S2:E8
S1:E12
Top Picks for Kids
Popular
Home
Search
Downloads
More


Telia FI
8.07
Select photos that are also this person
Cancel
Confirm
Done


Telia FI
8.08
Some things you can ask me:
Phone
"Call Brian"
FaceTime
"FaceTime Lisa"
Apps
"Launch Photos"
Messages
"Tell Susan I'll be right there"
Apple Pay
"Apple Pay $20 to Khira"

Is this AI?


Where are you going?
Aalto-yliopisto
Google


W
S
N
E
260°
W
Espoo
Uusimaa
60°11'13" N 24°49'18" E
0m Elevation


Espoo
Snow Showers
2°
Thursday TODAY
Friday
Saturday
Sunday
Monday
Tuesday
Wednesday
Thursday

Wayve:

https://www.youtube.com/watch?v=SskSDjUG8ZY

Boston dynamics:
https://www.youtube.com/watch?v=fUyU3lKzoio

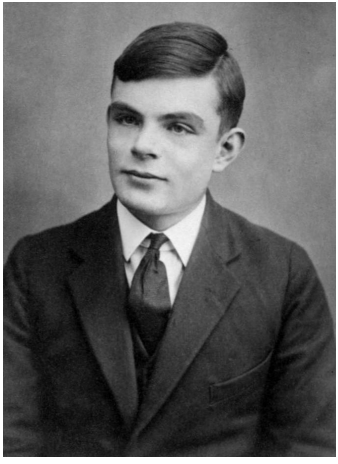
Crows are Chased and the Chasing Crows are Destined to be Chased as well, Transcending Space

teamLab, 2017, Interactive Digital Installation, 4min 20sec, Sound: Hideaki Takahashi

“The installation is rendered in real time by a computer program, it is neither a prerecorded animation nor on loop.The installation as a whole is in constant change, previous states will never be repeated and can never be seen again.”

https://www.thispersondoesnotexist.com/

An example of what Generative Adversarial Networks can do.

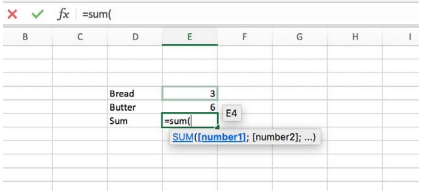


http://www.myheritage.com/deep-nostalgia

Alan Turing at age 16, public domain.

Google Vision Kit: “Do-it-yourself intelligent camera. Experiment with image recognition using neural networks.”

What about spreadsheets?



- How about a huge file storage service, like Dropbox?
- How about Google Maps?
- How about navigation in Google maps?
- How about navigation in airplanes (autopilot)?

Recap

- Artificial intelligence has come a long bumpy way.
- It is hard to define and thus we will consider AI in a very broad sense on this course.
- You saw examples of different AI systems and applications. In the next lectures we will dive into how they actually work, learn, and show intelligence.

What next?

- The first quiz will open after the lecture.
- The first exercise session is next Tuesday (the exercise will be posted online).
- The next lecture is next Friday.

AI