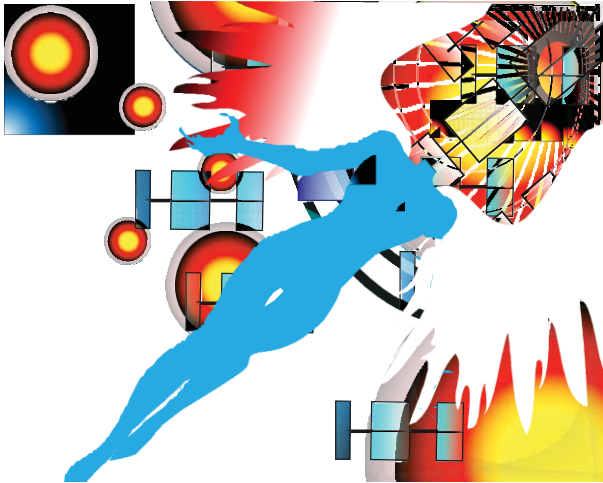


Artificial Intelligence

Introduction



AI in the movies



Definition of AI

“Intelligence: The ability to learn and solve problems”

Webster's Dictionary.

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“Artificial intelligence (AI) is the intelligence exhibited by machines or software’

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“Artificial intelligence (AI) is the intelligence exhibited by machines or software.”

Wikipedia.

“The science and engineering of making intelligent machines.”

McCarthy.

“The study and design of intelligent agents, where an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success.”

Russel and Norvig AI book.

Why AI?

“Just as the Industrial Revolution freed up a lot of humanity from physical drudgery, I think AI has the potential to free up humanity from a lot of the mental drudgery.”

Andrew Ng.

What is AI?

Four schools of thoughts (Russel & Norvig)

Thinking humanly	Thinking rationally
“The exciting new effort to make computers think... <i>machines with minds</i> , in the full and literal sense.” (Haugeland, 1985)	“The study of mental faculties through the use of computational models.” (Charniak and McDermott, 1985)
Acting humanly	Acting rationally
“The study of how to make computers do things which, at the moment, people are better.” (Rich and Knight, 1991)	“Computational Intelligence is the study of the design of intelligent agents.” (Poole et al., 1998)

What is AI?

Thinking humanly: cognitive approach



Requires to determine how humans think!

1960's "cognitive revolution".

Requires scientific theories of internal activities of the brain

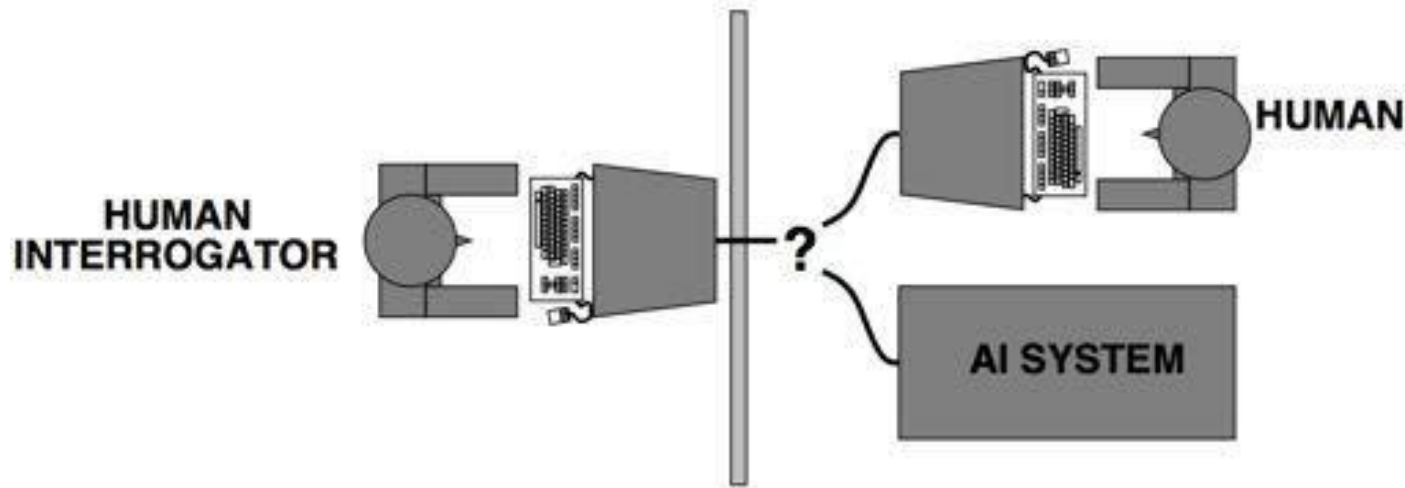
- What level of abstraction? "Knowledge" or "circuits"?
- How to validate?

To day, Cognitive Science and Artificial Intelligence are distinct disciplines.

What is AI?

Acting humanly:

- Turing test (Alan Turing 1950): A computer passes the test of intelligence, if it can fool a human interrogator.



Credit: From Russel and Norvig slides.

- Major components of AI: knowledge, reasoning, language, understanding, learning.

What is AI?

Acting humanly:



Aeronautical engineering texts do not define the goal of their field as making “machines that fly so exactly like pigeons that they can fool even other pigeons.”

What is AI?

Thinking rationally: Laws of thoughts.

- Codify “right thinking” with logic.
- Several Greek schools developed various forms of logic: *notation* and *rules of derivation* for thoughts.
- Example:
 - Socrates is a man; all men are mortal; therefore, Socrates is mortal.
- Problems:
 1. Not all knowledge can be expressed with logical notations.
 2. Computational blow up.

What is AI?

Acting rationally:

- **Agent:** Just something that acts (agent comes from the Latin agere, to do).
- **Computer Agents:** All computer programs do something, but computer agents are expected to do more: operate autonomously, perceive their environment, persist over a prolonged time period, adapt to change, and create and pursue goals.
- **A rational agent** is one that acts so as to achieve the best outcome, or when there is uncertainty, the best expected outcome.

What is AI?

Acting rationally:

- Making correct inferences is sometimes part of being a rational agent, because one way to act rationally is to reason logically to the conclusion that a given action will achieve one's goals and then to act on that conclusion.
- On the other hand, correct inference is not all of rationality; in some situations, there is no provably correct thing to do, but something must still be done.
- There are also ways of acting rationally that cannot be said to involve inference.
 - For example, recoiling from a hot stove is a reflex action that is usually more successful than a slower action taken after careful deliberation.

What is AI?

Four schools of thoughts (Russel & Norvig)

Thinking humanly	Thinking rationally
“The exciting new effort to make computers think... <i>machines with minds</i> , in the full and literal sense.” (Haugeland, 1985)	“The study of mental faculties through the use of computational models.” (Charniak and McDermott, 1985)
Acting humanly	Acting rationally: Our approach
“The study of how to make computers do things which, at the moment, people are better.” (Rich and Knight, 1991)	“Computational Intelligence is the study of the design of intelligent agents.” (Poole et al., 1998)

Strong and Weak AI

Two types of AI:

Strong AI also called full AI

Weak AI

Strong AI

- A full AI means a machine becoming capable of performing all intellectual tasks that a human being can perform.
- In this, a machine would not exhibit selective fragments of human intelligence but rather behave like a human being in terms of consciousness.
- Full AI also known as **Artificial General Intelligence (AGI)**.
- Difficult to set a standard test to see whether a machine has acquired the level of intelligence that a human possesses.

Some Tests to Check the AGI of Machines

- Turing Test
- Coffee Test
- College Admission Test
- Employment Test

Turing Test

- Devised by Alan Turing
- Deals with the question: “Can machines Think?”
- A machine and a human talk to a second human who must then judge which of the two is a machine.
- If the judge is unable to distinguish between the human and the machine, the machine is said to pass the Turing Test.
- So far, there are two reports of machines having passed the Turing Test.
 - In 2014, at the University of Reading in UK, a machine named “Eugene Goostman” simulated a 13-year-old boy at an event. The Turing Test is said to be passed if the machine manages to fool humans more than 30% of times that they are talking to a human not a machine. The success of Eugene however has been disputed (BBC June 9, 2014).
 - The second machine that has been said to have cleared the test is a machine developed by MIT’s Computer Science and Artificial Intelligence Lab (CSAIL). It too was reported in 2016 to have made believe humans that the sounds it produced had been produced not by machines but humans (Robohub.org, June 13, 2016).

Coffee Test

- Suggested by Apple Inc. co-founder Steve Wozniak.
- He said that machines could never be as intelligent as humans.
- He believed that a machine could not make coffee.
- In this test, a robot has to go to an average American home, figure out how to make coffee.
- It has to find the coffee machine, find the coffee, mug and brew the coffee.

College Admission Test

- Ben Goertzel, the mathematician who has worked extensively on AGI, suggested this test.
- The test sees whether a machine can enrol itself in a university, take the same classes that human students take and successfully obtain a degree.

Employment Test

- Nils John Nilsson, the American computer scientist, suggested this test in which the machine is given an economically important job in which it must perform as well or better than the level at which the humans can do the same work.

From AGI to Applied AI

- The tests are challenging and AGI therefore looks like a tough nut to crack.
- Weak AI or Applied AI on the other hand, is a subset of Strong AI as it involves machines being able to solve selective actions that a human can perform.

Applications of AI



Applications of AI

Speech recognition

- Virtual assistants: Siri (Apple), Echo (Amazon), Google Now, Cortana (Microsoft).
- “They” helps get things done: send an email, make an appointment, find a restaurant, tell you the weather and more.
- Leverage deep neural networks to handle speech recognition and natural language understanding.



Applications of AI

Handwriting recognition (check, zipcode)



Applications of AI

Machine translation

- Historical motivation: translate Russian to English.
- First systems using mechanical translation (one-to-one correspondence) failed!
- “Out of sight, out of mind” \Rightarrow “Invisible, imbecile”.

Applications of AI

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Oops!

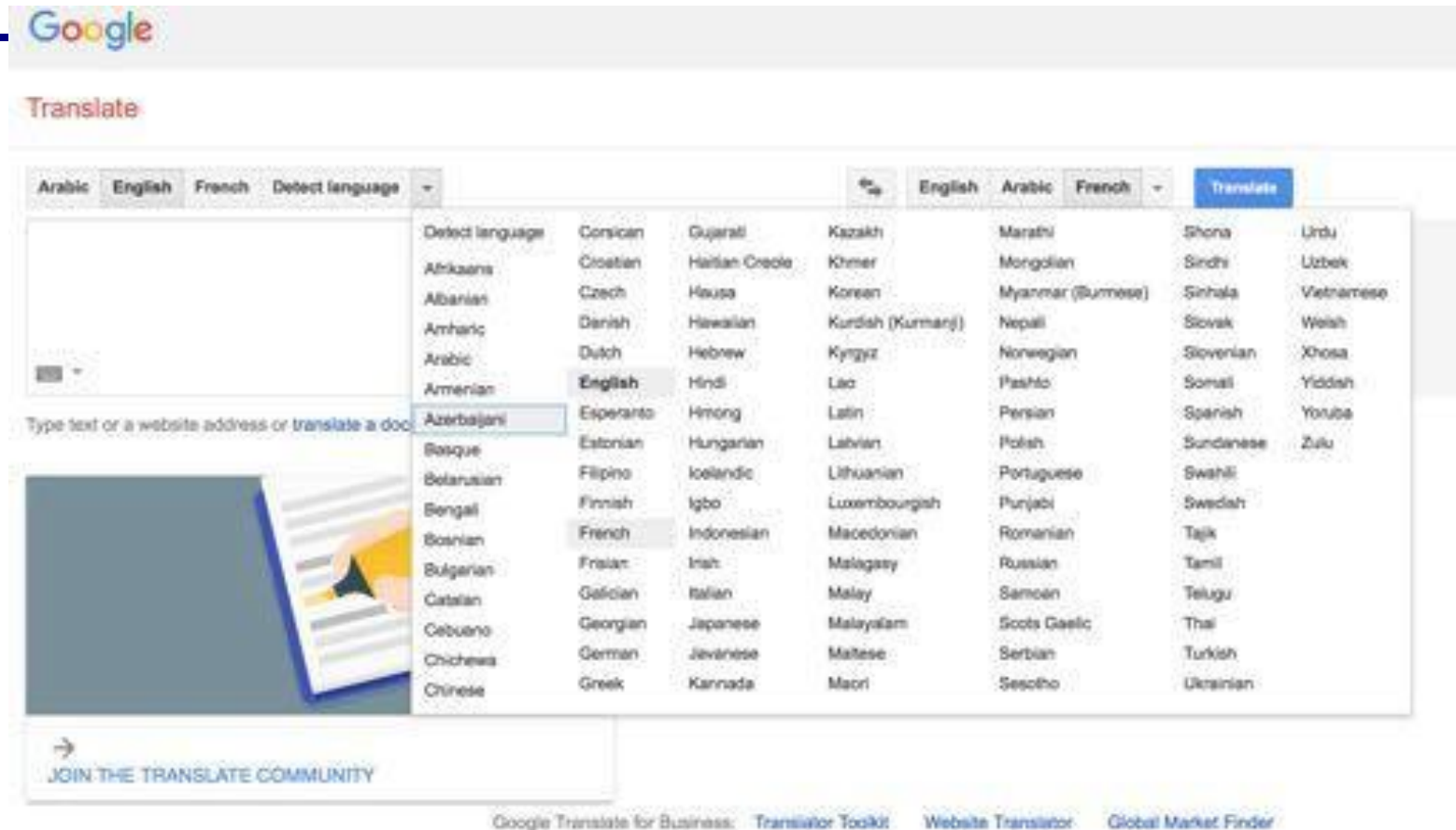
Applications of AI

Machine translation

- MT has gone through ups and downs.
- Today, Statistical Machine Translation leverages the vast amounts of available translated corpuses.
- While there is room for improvement, machine translation has made significant progress.

Applications of AI

Machine translation



100+ languages

Applications of AI

Machine translation

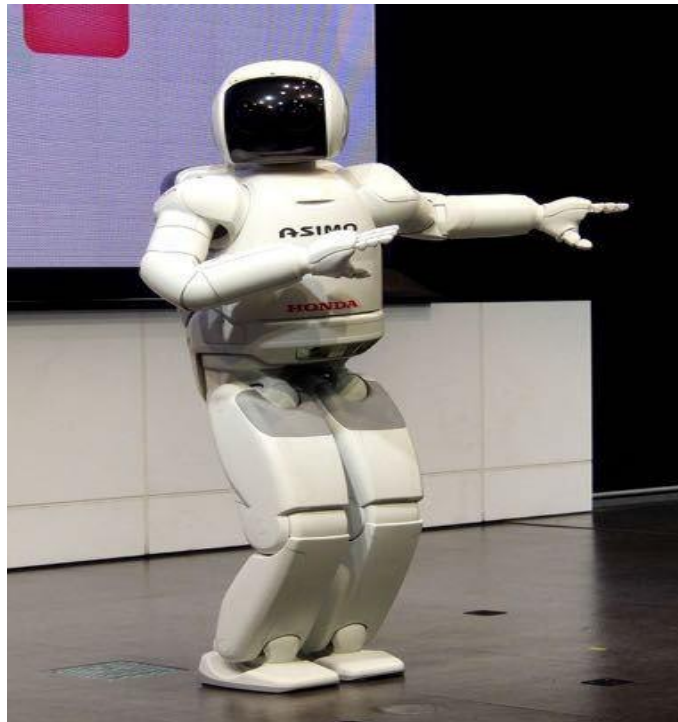


See also:

out of sight out of mind, out of mind, sight, out of, out of mind

Applications of AI

- Robotics: Awesome robots today!
 - NAO
 - ASIMO
 - Daksh robot by India's DRDO
 - Sophia by Hong Kong based company Hanson Robotics. (Became a Saudi Arabian citizen, the first robot to receive citizenship of any country!)
-



Credit: By Momotarou2012, via Wikimedia Commons.

Applications of AI

Recommendation systems (collaborative filtering)

amazon

Shop by Department - Search: kids dance wii u

Video Games Xbox One Xbox 360 PS4 PS3 Wii U Wii 3DS PS Vita Digital Games Kindle Fire Games Deals Best Sellers Pre-orders Trade-In

Just Dance Kids 2014 - Nintendo Wii U

By Ubisoft
Rated: Everyone (E)
View all 135 customer reviews

List Price: ~~\$29.99~~
Price: **\$19.99** & **FREE Shipping** on orders over \$35. [Details](#)
You Save: \$10.00 (33%)

In Stock.
Ships from and sold by Amazon.com. Gift-wrap available.

Want it Thursday, Jan. 23? Order within **23 hrs 38 mins** and choose **One-Day Shipping** at checkout. [Details](#)

Platform: Nintendo Wii U

- 30 Brand-New Dances led by real kids
- Dance Director Mode: Use the Wii U gamepad to make your entire family dance to silly dance moves during any
- Kids can create custom playlists for endless fun
- Play with up to 5 Players

\$7 new from \$15.99 **Used from \$11.75**

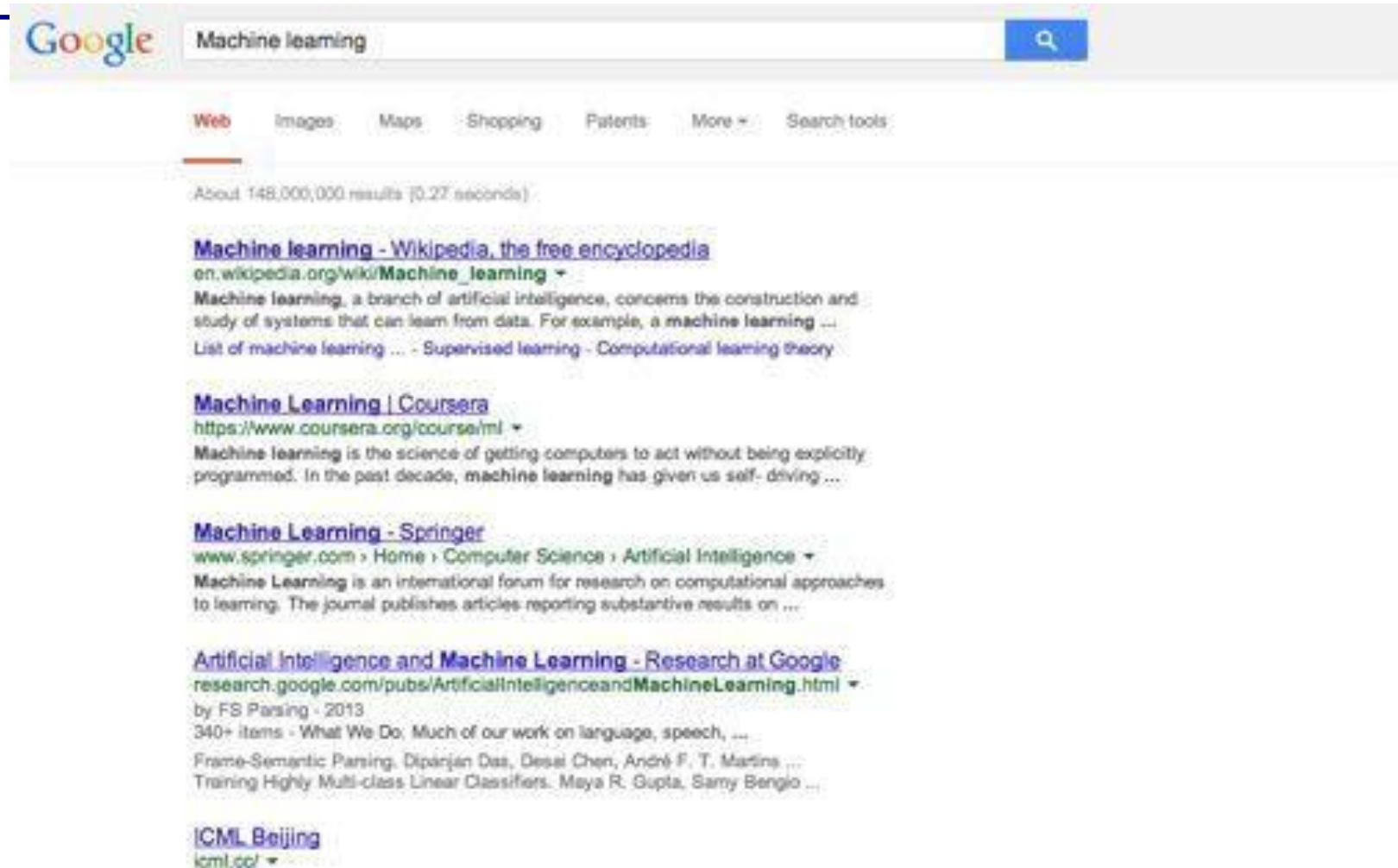
Customers Who Bought This Item Also Bought

Product	Price	Rating
SNG Party with Wii U Microphone	\$15.99	★★★★★ (25)
Wii U Microphone	\$6.99	★★★★★ (6)
Barbie Dreamhouse Party - Nintendo Wii U	\$39.99	★★★★★ (3)
Wii Party U	\$39.99	★★★★★ (40)
Just Dance 2014 - Nintendo Wii U	\$35.21	★★★★★ (50)
Just Dance 4 - Nintendo Wii U	\$17.89	★★★★★ (70)
ESPN Sports Connection - Nintendo Wii U	\$19.23	★★★★★ (24)

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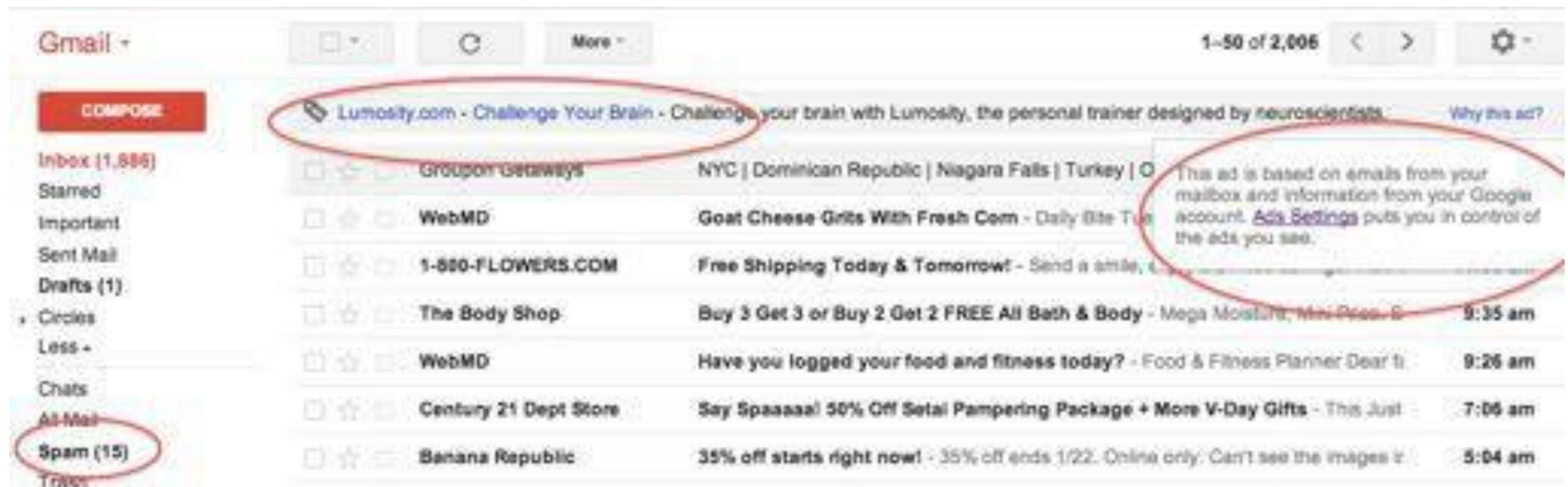
Applications of AI

Search engines



Applications of AI

Email



Applications of AI

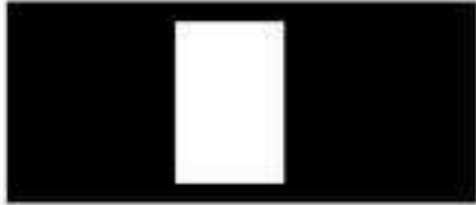
Face detection



Viola-Jones method.

Applications of AI

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Applications of AI

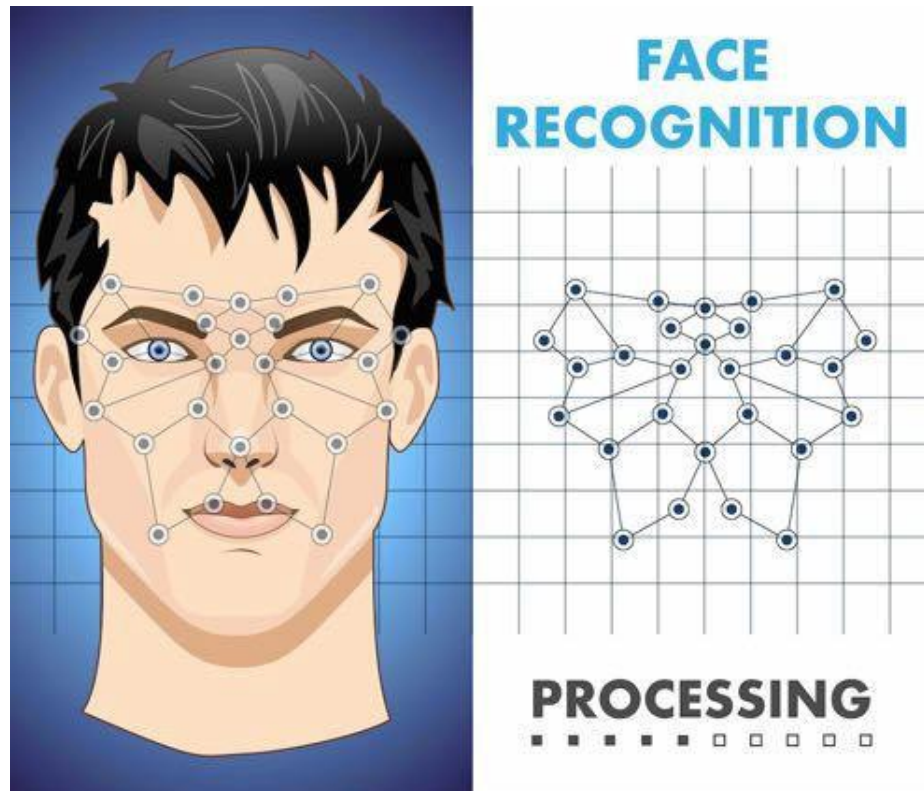
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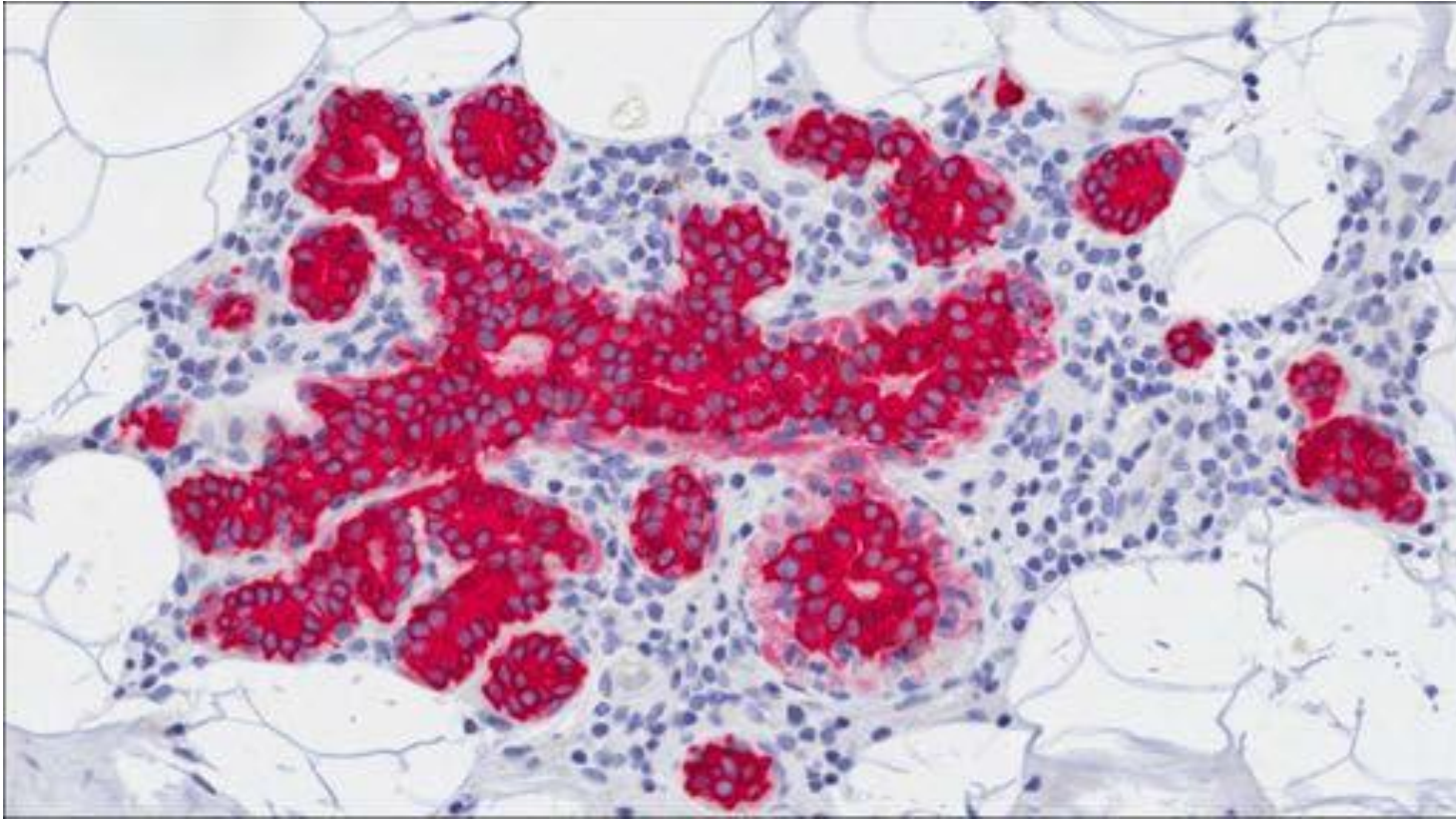
Applications of AI

Face recognition



Applications of AI

Detection of breast cancer in mammography images



Applications of AI

Chess
(1997):

Kasparov vs. IBM Deep
Blue



(Left) Copyright 2007, S.M.S.I., Inc. - Owen Williams, The Kasparov Agency, via Wikimedia Commons (Right) By James the photographer, via Wikimedia Commons

Powerful search algorithms!

Applications of AI

Jeopardy! (2011): Humans

IBM Watson

vs.



By Rosemaryetoufee (Own work), via Wikimedia Commons

Natural Language Understanding and information extraction!

Applications of AI

Go Lee Sedol versus Google AlphaGo
(2016):



(Left) By LG Electronics, via Wikimedia Commons (Right) By Google DeepMind, via
Wikimedia Commons

Deep Learning, reinforcement learning, and search algorithms!

Applications of AI

Autonomous driving



By User Spaceape on en.wikipedia, via Wikimedia Commons

- DARPA Grand Challenge
 - 2005: 132 miles
 - 2007: Urban challenge
 - 2009: Google self-driving car

State-of-the-art applications

- Speech recognition
- Autonomous planning and scheduling
- Financial forecasting
- Game playing, video games
- Spam fighting
- Logistics planning
- Robotics (household, surgery, navigation)
- Machine translation
- Information extraction
- VLSI layout
- Automatic assembly
- Sentiment analysis
- Fraud detection
- Recommendation systems
- Web search engines
- Autonomous cars
- Energy optimization
- Question answering systems
- Social network analysis
- Medical diagnosis, imaging
- Route finding
- Traveling salesperson
- Protein design
- Document summarization
- Transportation/scheduling
- Computer animation

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- Computer animation

Many
more!

Historical moment



In memory of Alan Turing (1912-1954)

- Famous British mathematician.
- Code breaker during World War II.
- Proposed an operational test for intelligent behavior: The Imitation Game.
- In “Computing machinery and intelligence” (1950), he laid down AI major components:
(language, reasoning, knowledge, learning, understanding).

<http://www.turingarchive.org/browse.php/B/9>

Summary

- AI is a hard (computational complexity, language, vision, etc), and a broad field with high impact on humanity and society.
- What can AI do for us is already amazing!
- AI systems do not have to model human/nature but can act like or be inspired by human/nature.
- Rational (do the right thing) agents are central to our approach of AI.
- Note that rationality is not always possible in complicated environment but we will still aim to build rational agents.

Summary

- AI may be perceived as a scary area! Is AI a threat to our humankind?
- Professor Stephen Hawking, eminent scientist told BBC:

“The development of full artificial intelligence could spell the end of the human race.”
- AI is a flourishing and exciting field: everyone can contribute.