Artificial Intelligence: A Natural Pursuit

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What is AI?

What recently happened to AI?

How can AI benefit society?

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How can AI benefit society?

Imagination and Reality

From the Mahabharata[1]

[1] http://www.holy-bhagavad-gita.org/public/images/bg/1.jpg

Imagination and Reality

From the Mahabharata[1]

Modern-day videoconferencing[2]

[1] http://www.holy-bhagavad-gita.org/public/images/bg/1.jpg
[2] http://www.livemint.com/rf/Image-621x414/LiveMint/Period1/2015/05/30/Photos/
genapp-kJS--621x414@LiveMint.jpg
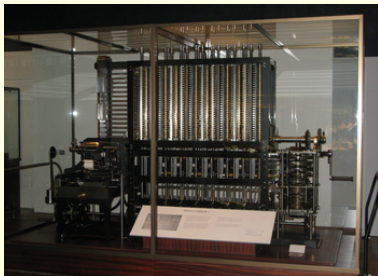
The Urge to Replicate Human Behaviour and Thought

Automaton, Swiss CIMA Museum[1]

Babbage's Difference Engine (1830s)[2]

[1] https://upload.wikimedia.org/wikipedia/commons/thumb/6/6e/CIMA_mg_8332.jpg/220px-CIMA_mg_8332.jpg
[2] https://upload.wikimedia.org/wikipedia/commons/8/8b/Babbage_Difference_Engine.jpg

AI: Definitions

"It may even be proposed, as a rule of thumb, that any activity computers are able to perform and people once performed should be counted as an instance of intelligence."

Artificial Intelligence and Life in 2030, Peter Stone, Rodney Brooks, Erik Brynjolfsson, Ryan Calo, Oren Etzioni, Greg Hager, Julia Hirschberg, Shivaram Kalyanakrishnan, Ece Kamar, Sarit Kraus, Kevin Leyton-Brown, David Parkes, William Press, AnnaLee Saxenian, Julie Shah, Milind Tambe, and Astro Teller. One Hundred Year Study on Artificial Intelligence: Report of the 2015-2016 Study Panel, Stanford University, Stanford, CA, September 2016.

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"Artificial intelligence is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment."

The Quest for Artificial Intelligence: A History of Ideas and Achievements, Nils J. Nilsson, Cambridge University Press, 2010.

The AI Effect

Electronic calculator (1970's)[1]

[1] https://img.tradeindia.com/fp/1/001/335/470.jpg

The AI Effect

Electronic calculator (1970's)[1]

Intelligent?

[1] https://img.tradeindia.com/fp/1/001/335/470.jpg

The AI Effect

Electronic calculator (1970's)[1]

Arithmometer (1850's)[2]

Intelligent?

[1] https://img.tradeindia.com/fp/1/001/335/470.jpg

[2] https://upload.wikimedia.org/wikipedia/commons/a/af/Arithmometer_-_One_of_the_first_machines_with_unique_serial_number.jpg

The AI Effect

Excerpt from the *Monthly Intelligencer, 202:100, January 1857*:

"M. Thomas, of Colmar, has lately made the finishing improvements in the calculating machine, called the arithmometer, at which he has been working for upwards of thirty years. Pascal and Leibnitz, in the seventeenth century, and Diderot at a later period, endeavoured to construct a machine which might serve as a substitute for human intelligence in the combination of figures; but their efforts failed. M. Thomas's arithmometer may be used without the least trouble or possibility of error, not only for addition, subtraction, multiplication, and division, but also for much more complex operations, such as the extraction of the square root, involution, the resolution of triangles, &c. A multiplication of eight figures by eight others is made in eighteen seconds; a division of sixteen figures by eight figures, in twenty-four seconds; and in one minute and a quarter one can extract the square root of sixteen figures, and also prove the accuracy of the calculation. The arithmometer adapts itself to every sort of combination. As an instance of the wonderful extent of its powers, we may state that it can furnish in a few seconds products amounting to 999,999,999,999,999,999,999,999,999,999,—a marvellous number, comparable to the infinite multitude of stars which stud the firmament, or the particles of dust which float in the atmosphere. The working of this instrument is, however, most simple. To raise or lower a nut-screw, to turn a winch a few times, and, by means of a button, to slide off a metal plate from left to right, or from right to left, is the whole secret. Instead of simply reproducing the operations of man's intelligence, the arithmometer relieves that intelligence from the necessity of making the operations. Instead of repeating responses dictated to it, this instrument instantaneously dictates the proper answer to the man who asks it a question. It is not matter producing material effects, but matter which thinks, reflects, reasons, calculates, and executes all tho most difficult and complicated arithmetical operations with a rapidity and infallibility which defies all the calculators in the world. The arithmometer is, moreover, a simple instrument, of very little volume and easily portable. It is already used in many great financial establishments, where considerable economy is realized by its employment. It will soon be considered as indispensable, and be as generally used as a clock, which was formerly only to be seen in palaces, and is now in every cottage."

The AI Effect

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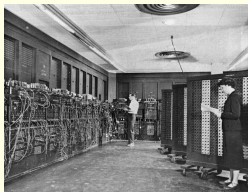# Foundations

Probability

Thomas Bayes (1701–1761)[1]
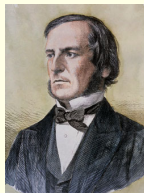
Logical reasoning

George Boole (1815–1864)[2]

Statistics

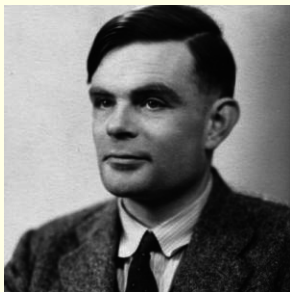P. C. Mahalanobis (1893–1972)[3]

Computing hardware

Eniac (1946)[4]

[1] https://upload.wikimedia.org/wikipedia/commons/d/d4/Thomas_Bayes.gif
[2] https://upload.wikimedia.org/wikipedia/commons/c/ce/George_Boole_color.jpg
[3] https://upload.wikimedia.org/wikipedia/en/c/ca/PCMahalanobis.png
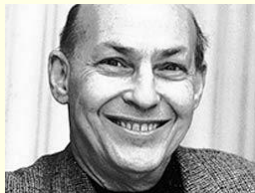[4] https://upload.wikimedia.org/wikipedia/commons/4/4e/Eniac.jpg

Modern AI

Alan Turing (1912–1954)[1]

Computing Machinery and Intelligence (*Mind*, 1950)

[1] http://a2.files.biography.com/image/upload/c_fill,cs_srgb,dpr_1.0,g_face,h_300,q_80,w_300/
MTE5NDg0MDU1MTUzMTE2Njg3.jpg

Dartmouth Summer Research Project on Artificial Intelligence (1956)
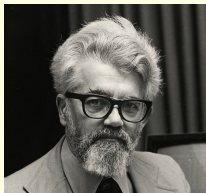
John McCarthy (1927–2011)[1]

Marvin Minsky (1927–2016)[2]

Allen Newell (1927–1992)[3]

Herbert Simon (1916–2001)[4]

[1] https://www.wired.com/wp-content/uploads/blogs/wiredenterprise/wp-content/uploads/2011/10/john-mccarthy.png

[2] https://pi.tedcdn.com/r/pe.tedcdn.com/images/ted/55211_254x191.jpg?

[3] http://amturing.acm.org/images/lg_aw/3167755.jpg

[4] http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1978/simon.jpg

1950's–1980's

Theorem proving: Logic Theorist (Newell and Simon).

Mobile robotics: Shakey (Rosen).

Pattern recognition: Pandemonium (Selfridge).

Speech processing: Spoken language systems (Reddy).

Expert systems: Dendral (Feigenbaum).
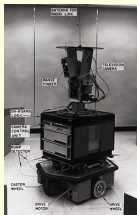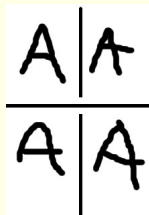
Shakey[1]

OCR[2]

[1] https://upload.wikimedia.org/wikipedia/commons/thumb/0/0c/SRI_Shakey_with_callouts.jpg/250px-SRI_Shakey_with_callouts.jpg

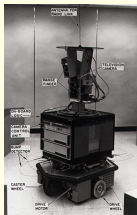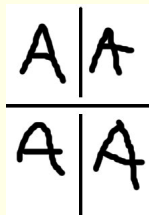[2] https://upload.wikimedia.org/wikipedia/commons/7/79/More_A's.jpg

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Shakey[1]

OCR[2]

1980's: AI Winter!

[1] https://upload.wikimedia.org/wikipedia/commons/thumb/0/0c/SRI_Shakey_with_callouts.jpg/
250px-SRI_Shakey_with_callouts.jpg

[2] https://upload.wikimedia.org/wikipedia/commons/7/79/More_A's.jpg

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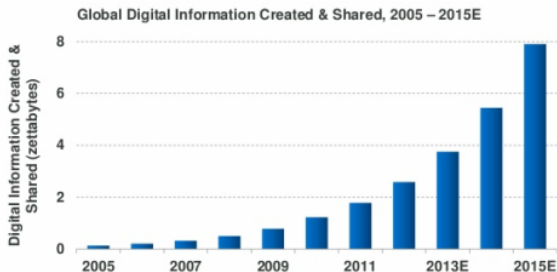# AI in Life Today

[1]

[2]

[3]

[4]

[1] https://fortunedotcom.files.wordpress.com/2016/04/gettyimages-152435606-1.jpg

[2] http://www.extremetech.com/wp-content/uploads/2012/08/Google500KmilesLexus.jpg

[3] http://www.in.techradar.com/photo/52119657/news/
This-STAR-robot-is-better-at-soft-tissue-surgery-than-a-human.jpg

[4] https://media.licdn.com/mpr/mpr/
AAEAAQAAAAAAAARQAAAAJGZmMGZhYWMxLTE0NDQtNDQlNi1iNWE3LTJlNWVkYWFhMmJjNg.jpg

Internet

[1]

[1] http://images.financialexpress.com/2015/09/Internet-connectivity.jpg

Growth of Data

[1]

[1] http:
//tabtimes.com/wp-content/uploads/ckfinder/userfiles/images/TWIT/personal_data_explosion.png
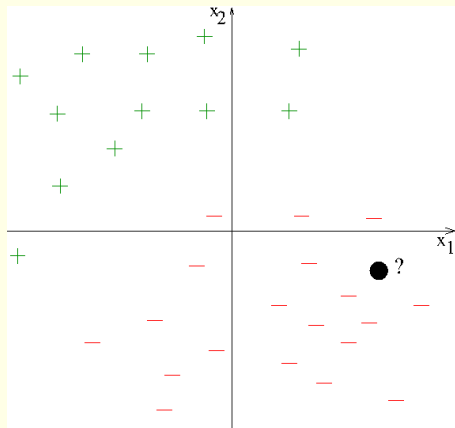
Cheaper Hardware and Sensors
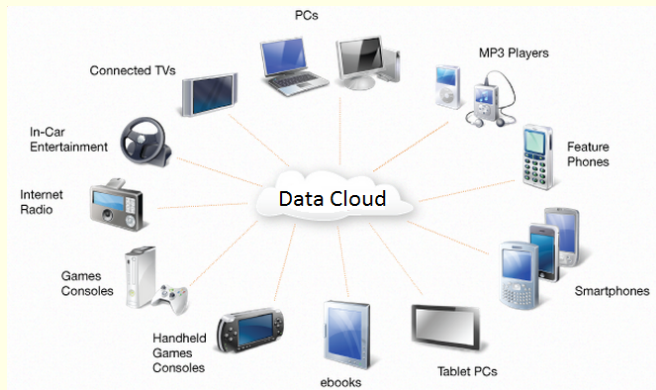
[1]

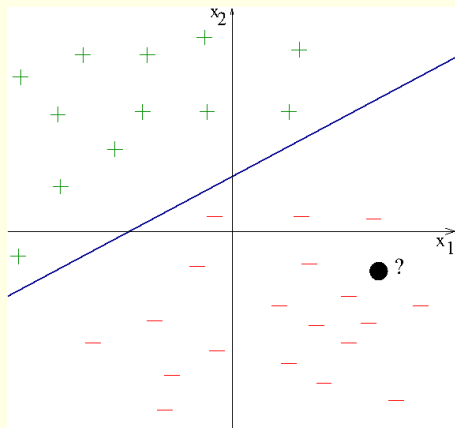[1] https://smist08.files.wordpress.com/2012/09/clouddevices.png
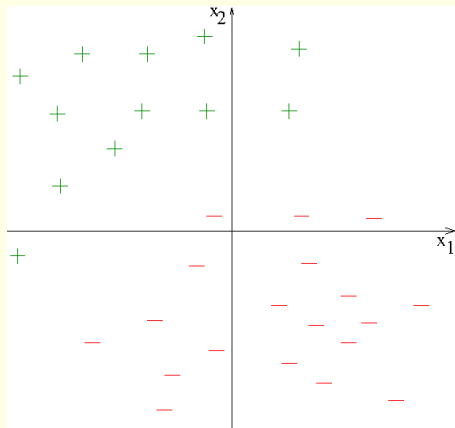
Machine Learning

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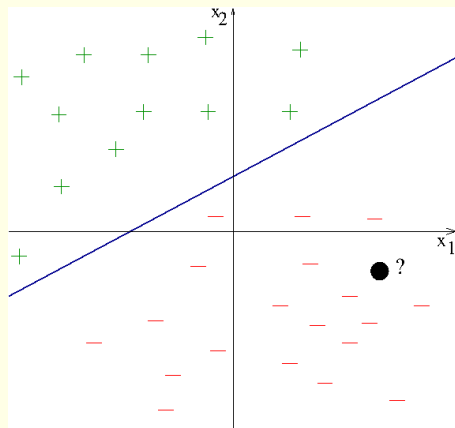
Machine Learning

x_1	x_2	Label
12	1	–
-4	20	+
-15	-2	+
-4	-4	–
15	-6	–

Learn a model

16	-7	?

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Face recognition, Credit-card fraud discovery, Sentiment analysis, ...

Machine Learning

x_1	x_2	Label
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Machine Learning

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16	-7	?

Face recognition, Credit-card fraud discovery, Sentiment analysis, ...
Deep learning can find highly non-linear patterns in visual, audio data.

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Speech and Natural Language Processing
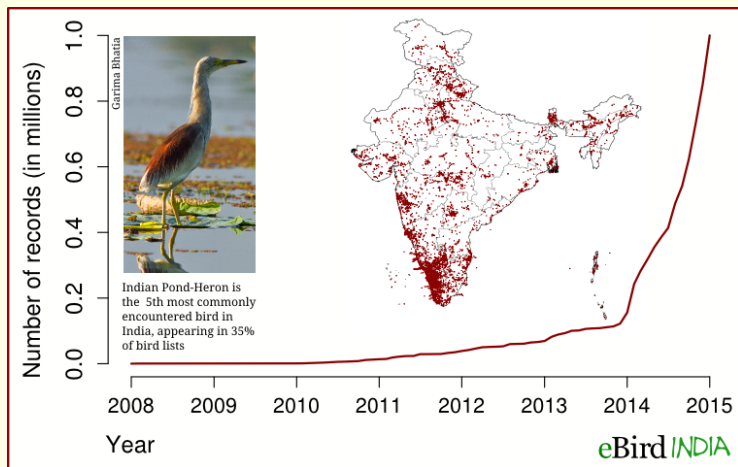

[1]

Game Theory and Mechanism Design

[1]

Security and game theory: algorithms, deployed systems, lessons learned, Milind Tambe, Cambridge University Press, 2012.

[1] http://static.seattletimes.com/wp-content/uploads/2016/03/
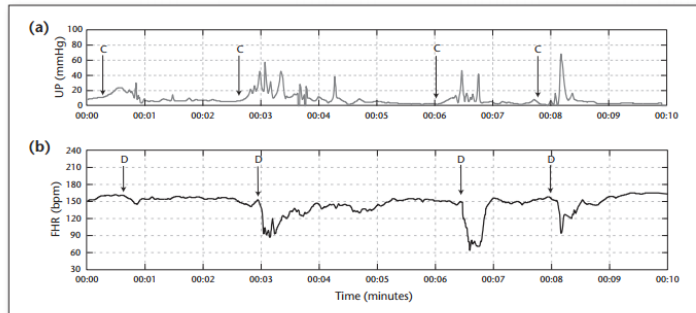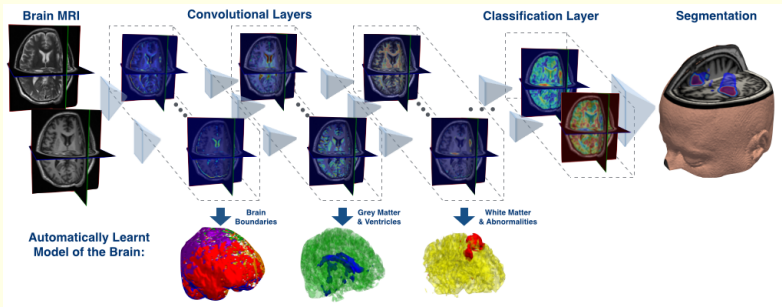113a962a-f152-11e5-97c9-1641d1868cca-1020x599.jpg

Crowdsourcing

[1]

[1] http://www.birdcount.in/wp-content/uploads/2015/02/eBird-growth.png

Machine Learning

Figure 2. CTG Signal over 10 Minutes, Including Four Contraction-Deceleration Pairs.
Top: UP signal with contraction onsets (C) indicated. *Bottom:* FHR signal with deceleration onsets (D) indicated.

[1]

A Machine Learning Approach to the Detection of Fetal Hypoxia during Labor and Delivery,
Philip A. Warrick, Emily F. Hamilton, Robert E. Kearney, Doina Precup, AI Magazine, 33(2):79–90,
AAAI Press, 2012.

Deep Learning on Images

[1]

[1] https://biomedia.doc.ic.ac.uk/wp-content/uploads/sites/95/2016/02/DeepMedicArchitecture.png

Planning and Scheduling

[1]

[1] https://ak.jogurucdn.com/media/image/p15/media_gallery-2015-12-16-7-fotor_delhi_
_3dd7a445519e5fc50a3459bc558a24f3.jpg

Fun!

[1]

[1] https://i.ytimg.com/vi/LvryHWCgK0s/maxresdefault.jpg

Concluding Remarks

No existential threat from AI in the foreseeable future.

Adoption calls for open-mindedness, optimism, caution.

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Staff public departments with AI-trained personnel.

Enforce electronic records (healthcare, commerce, education).

Nurture strong university system, especially graduate programmes.

Back ourselves to drive core technical innovation.

Make long-term investments in technology.

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