Introduction to Artificial Intelligence

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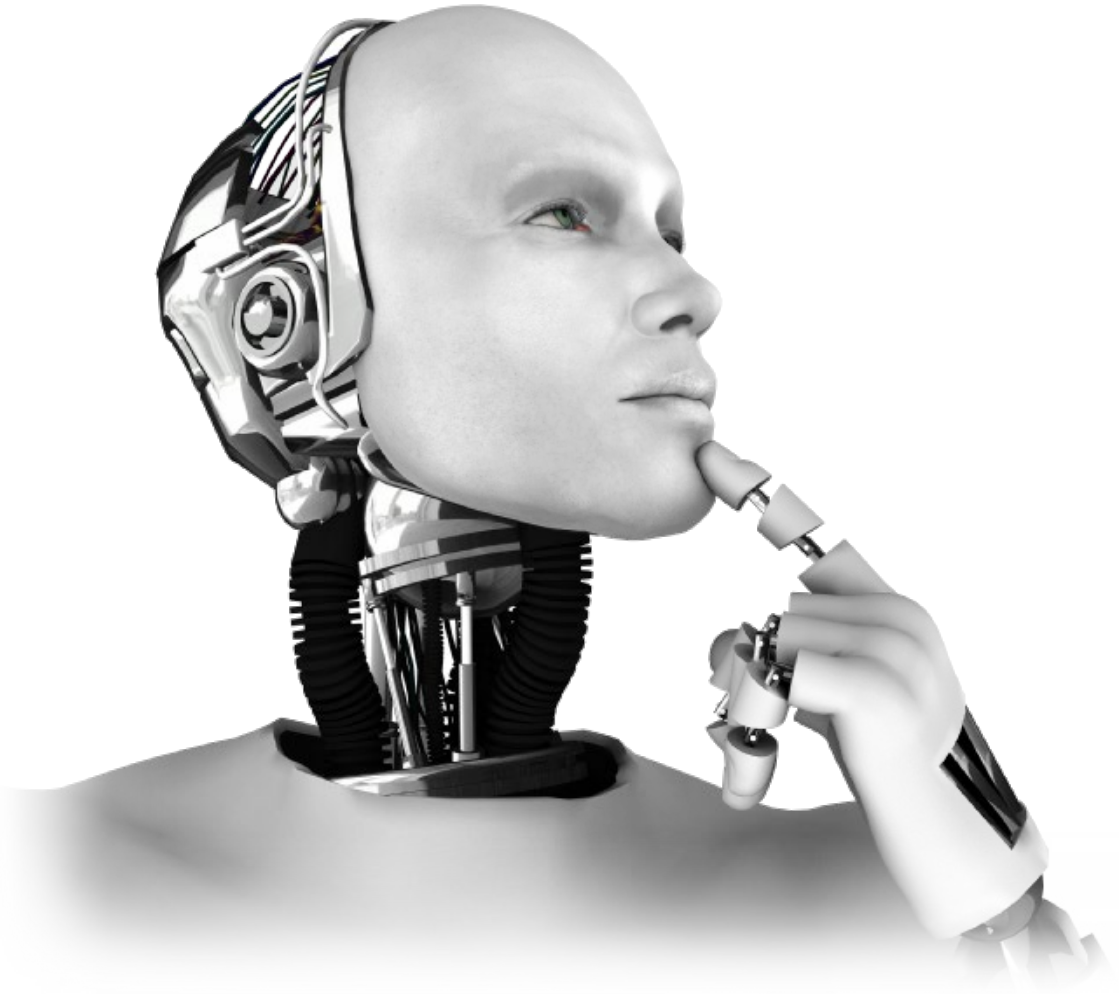
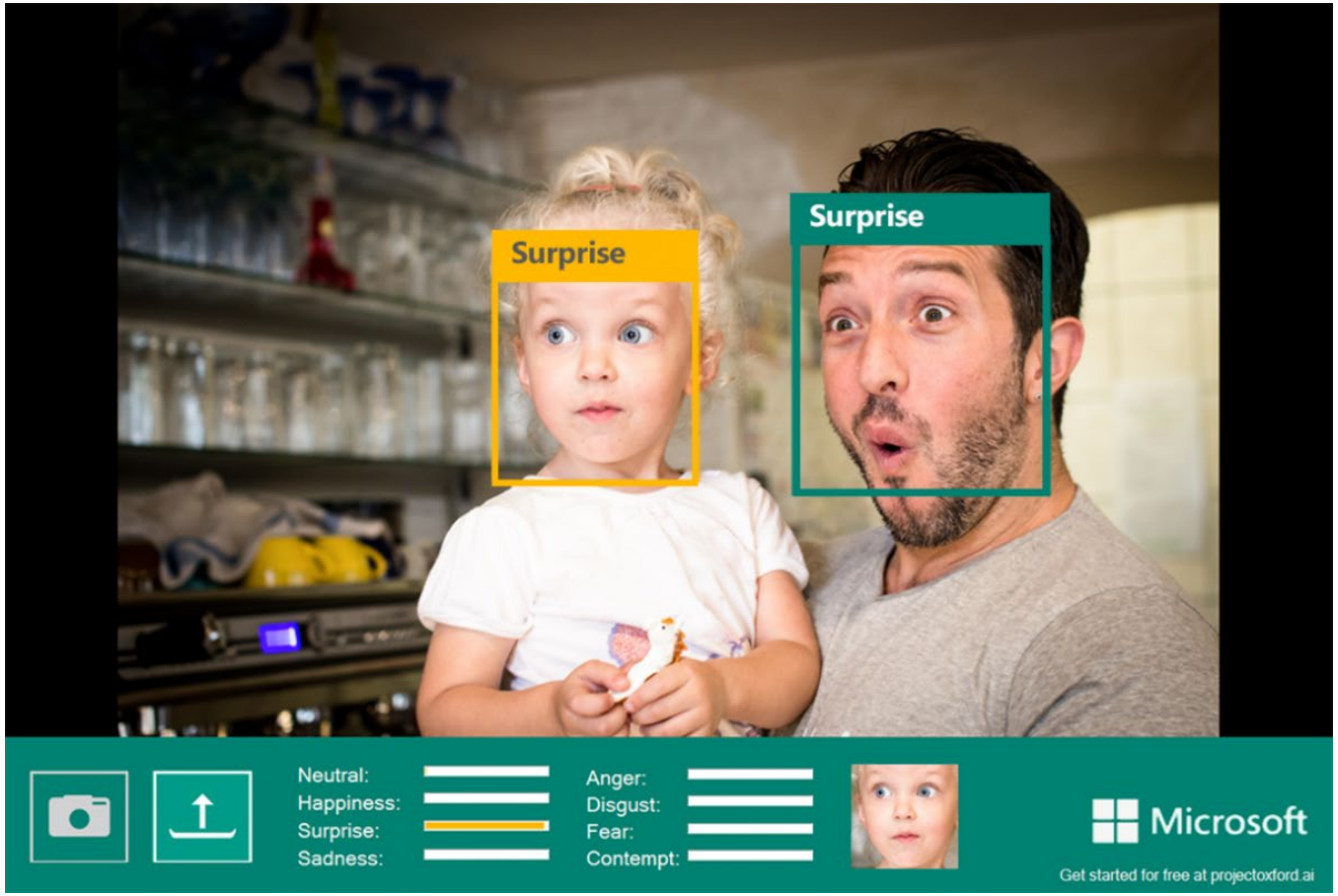
Artificial Intelligence

The intelligence exhibited by machines



Artificial Intelligence

How to create computers and computer software that are capable of intelligent behavior



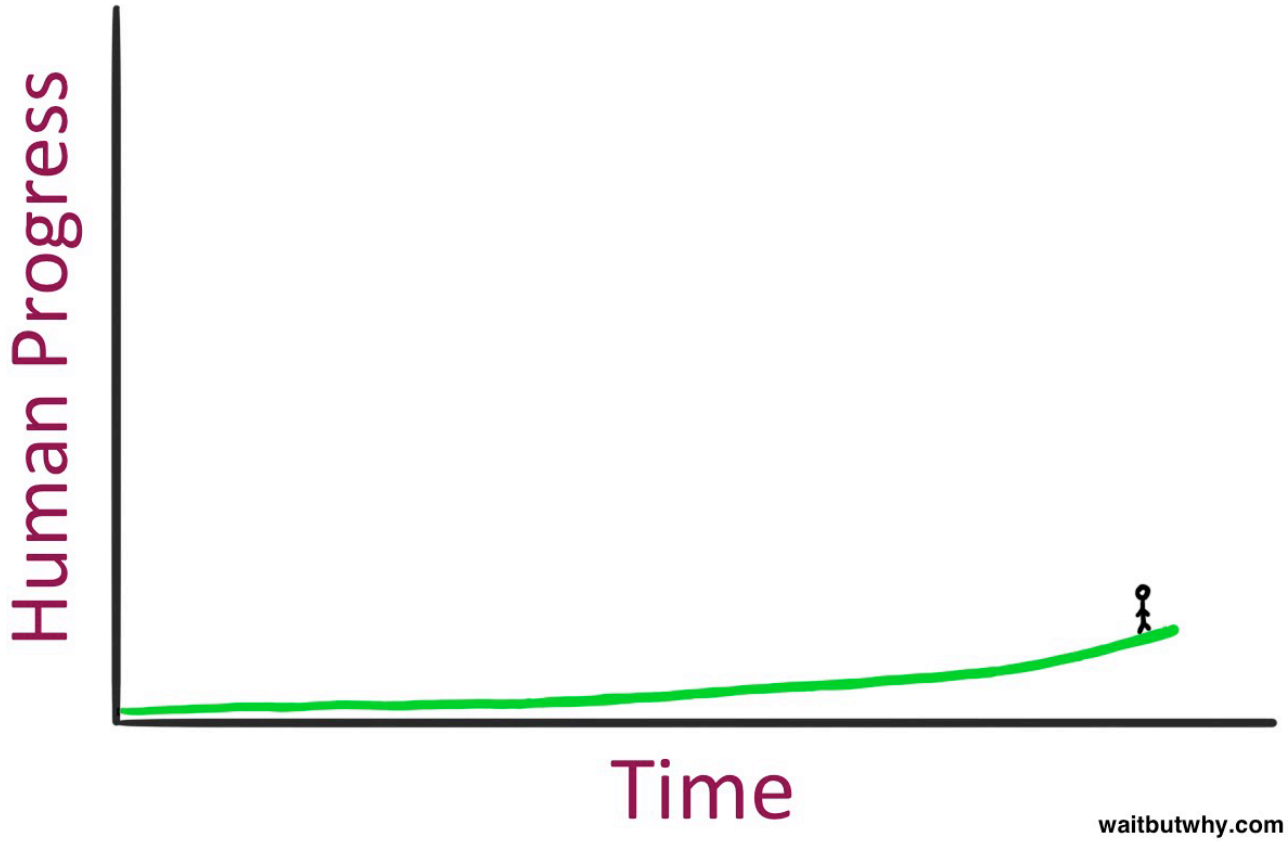
Artificial Intelligence - Types

- Artificial Narrow Intelligence (ANI)
  - Weak AI
  - Specializes in one area
  - Ex) AlphaGo, Siri, Spam mail filter, Translator, etc…
- Artificial General Intelligence (AGI)
  - Strong AI (Human level AI)
  - Be as smart as a human across the board
- Artificial Super Intelligence (ASI)
  - Be smarter than the best human brains in every field

Intelligence

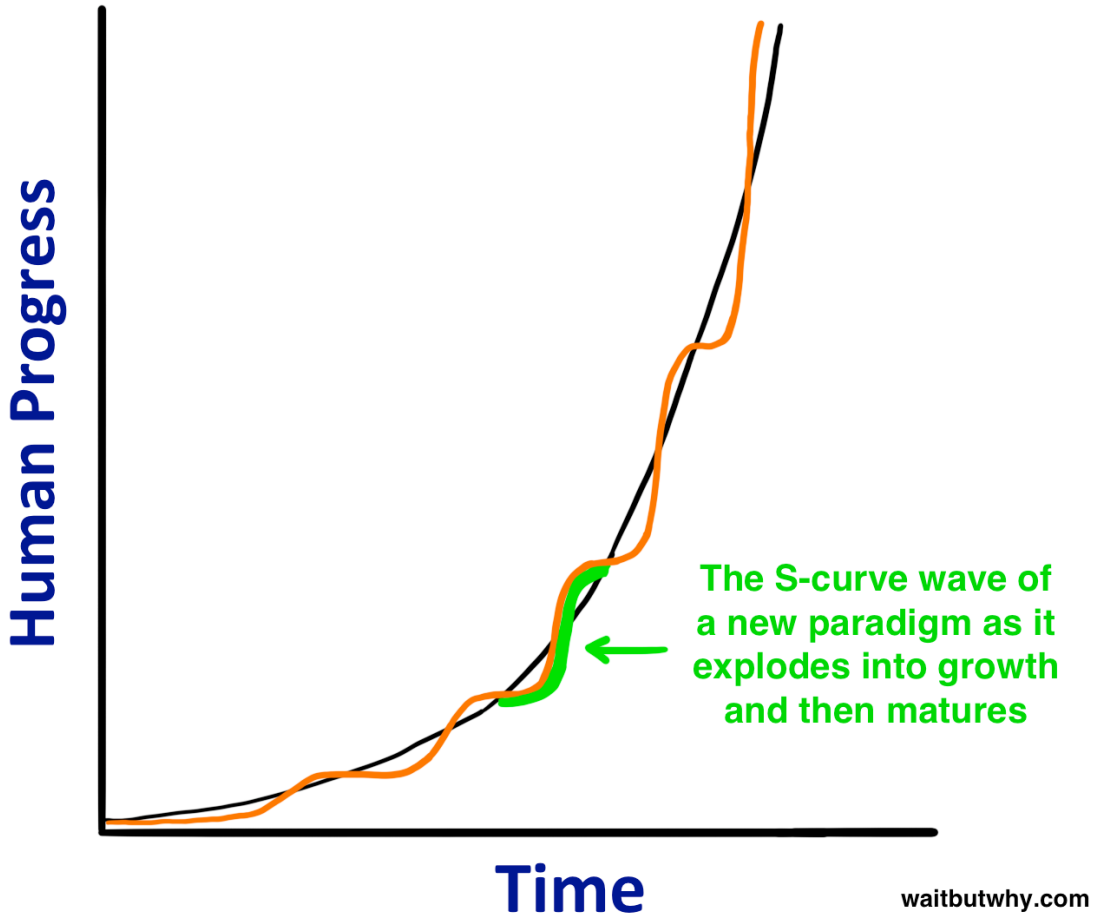
- The ability to learn or understand things or to deal with new or difficult situations
- Capacity for
  - Logic
  - Abstract thought
  - Understanding
  - Self-awareness
  - Communication
  - Learning
  - Emotional knowledge
  - Memory
  - Planning
  - Creativity
  - Problem solving

Human Intelligence Growth

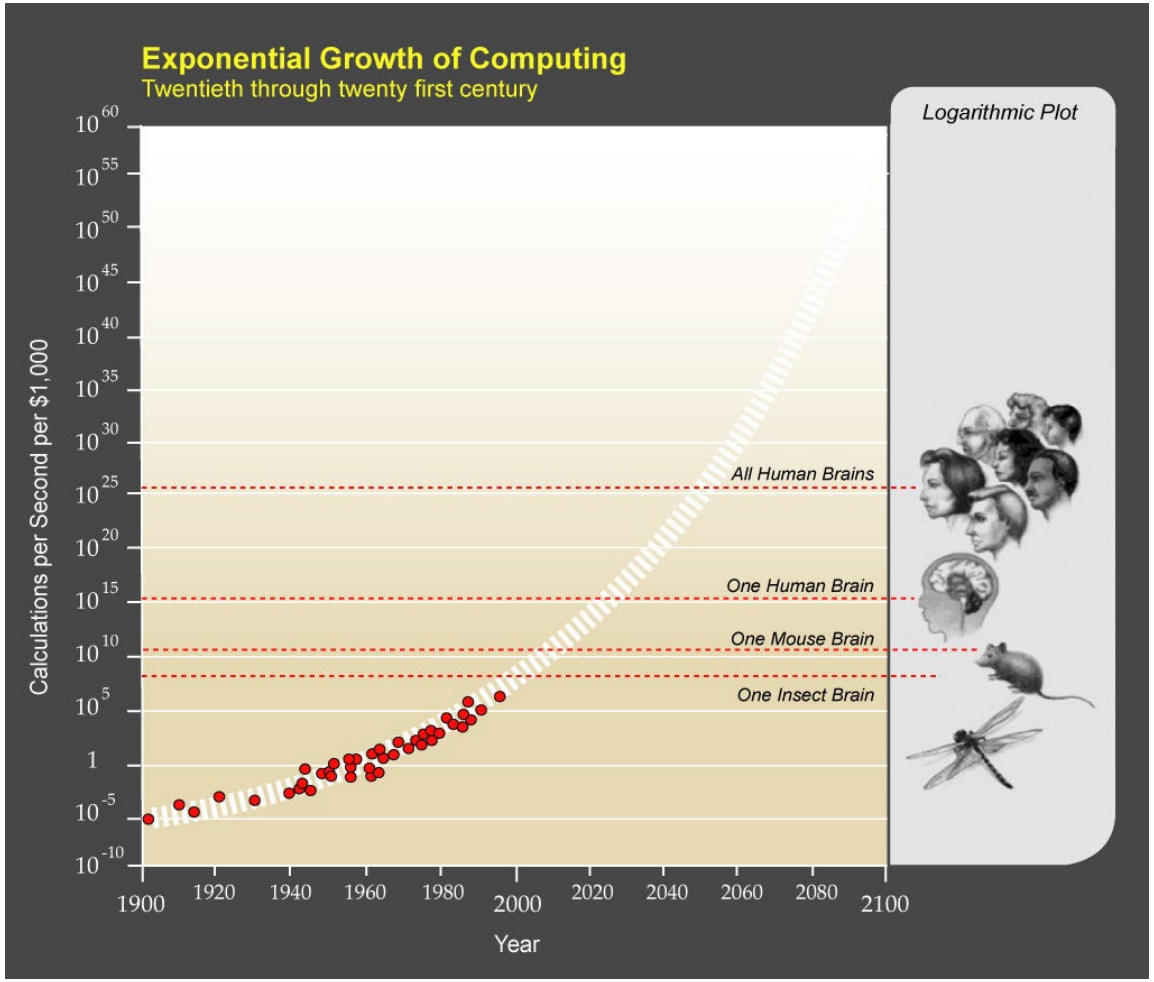


http://waitbutwhy.com/2015/01/artificial-intelligence-revolution-1.html

Human Intelligence Growth



Human Intelligence Growth



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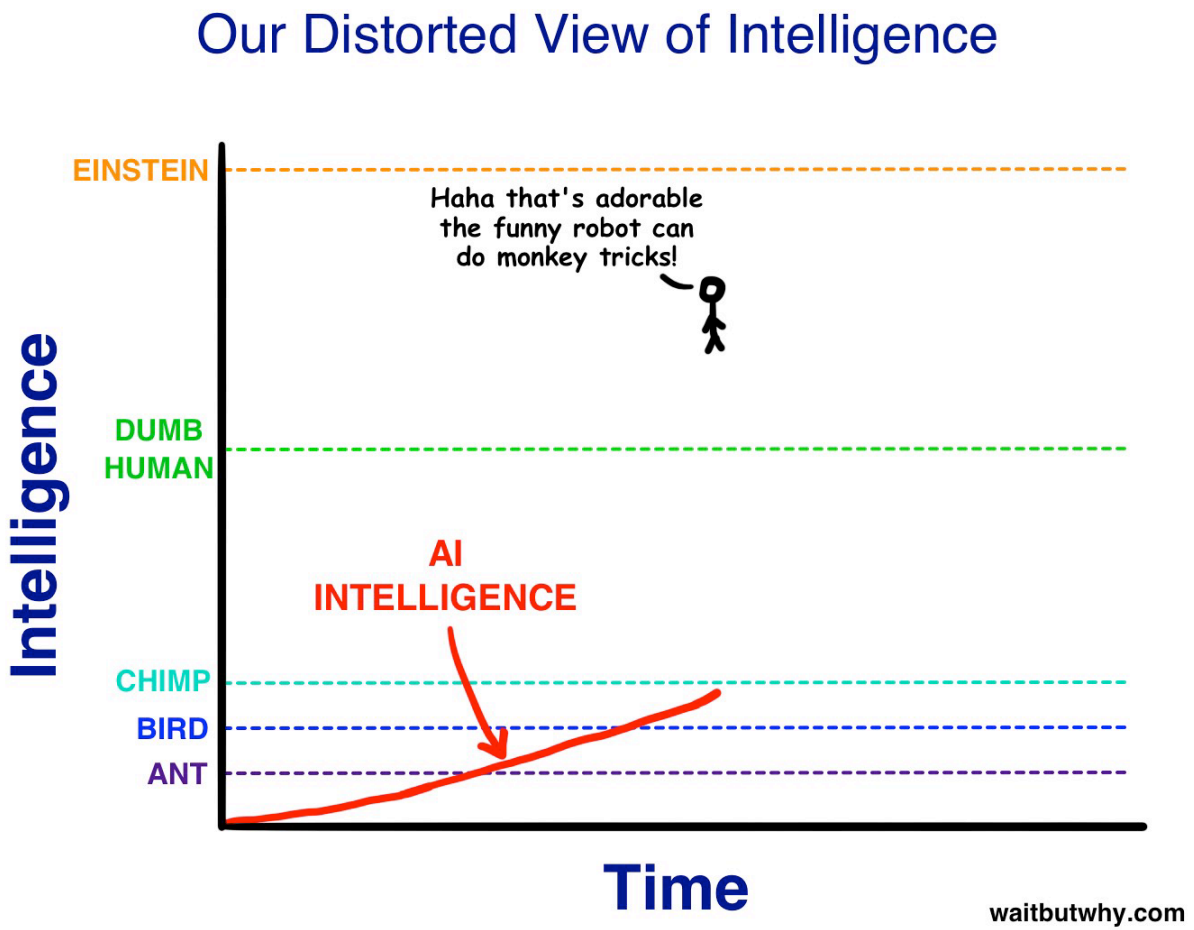
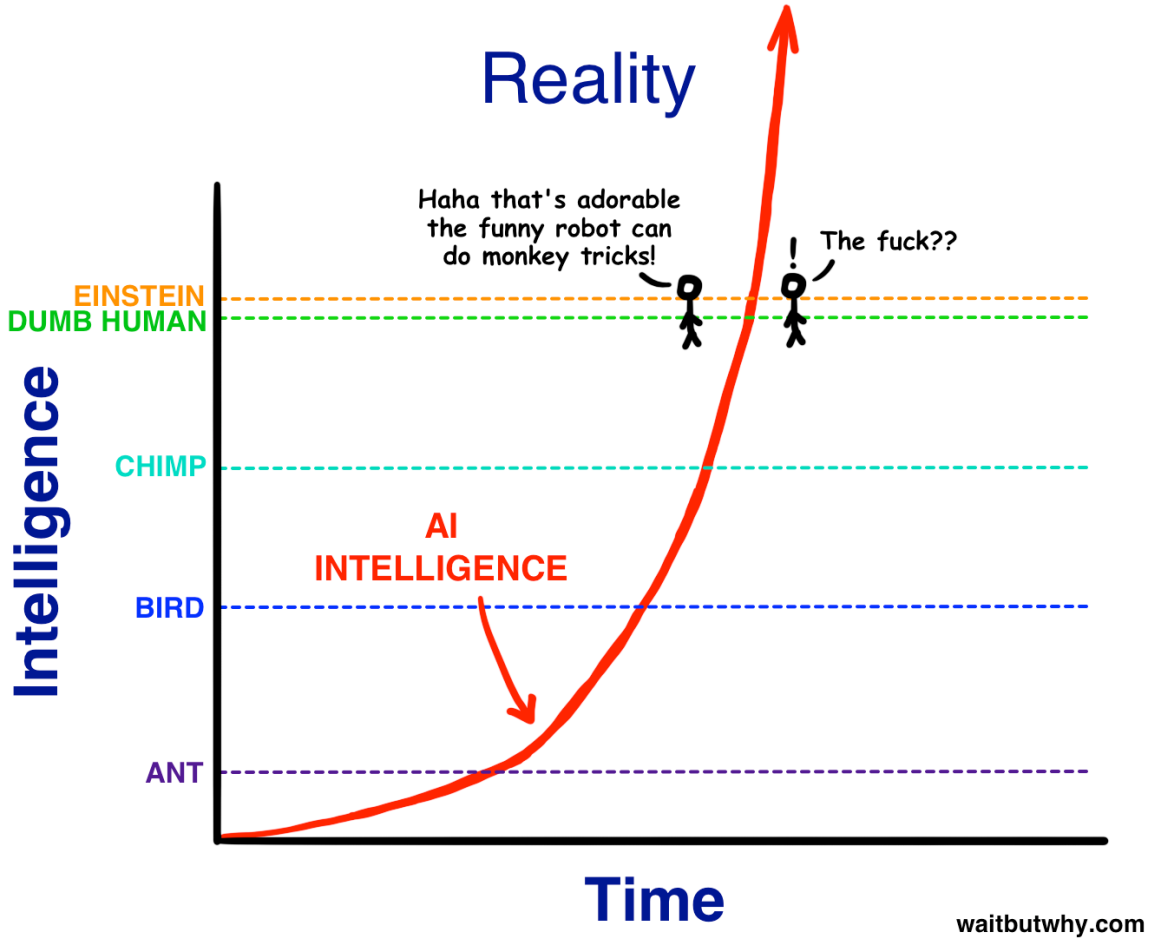
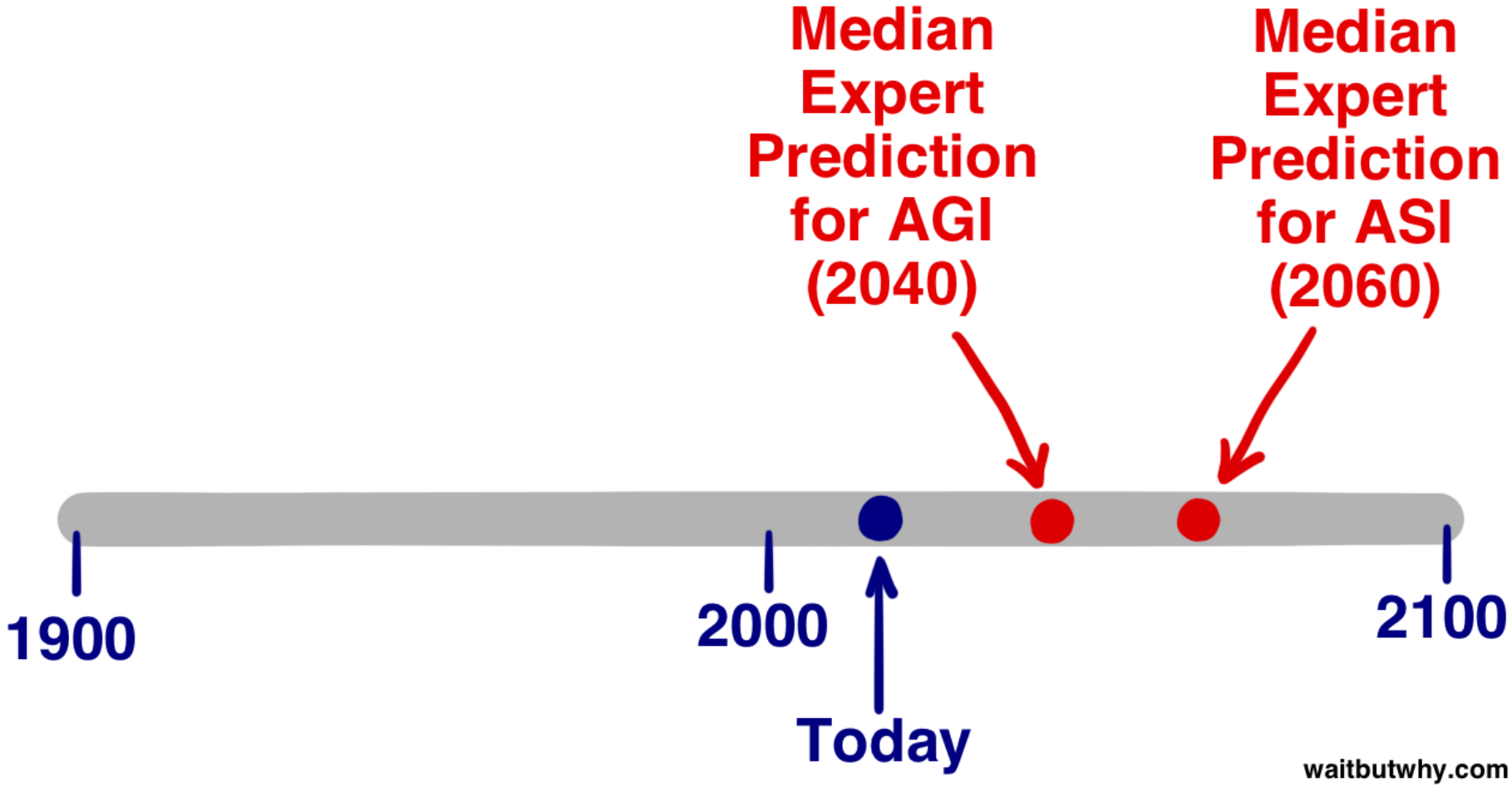


Human Intelligence Growth



Artificial Intelligence - Types



Machine Learning

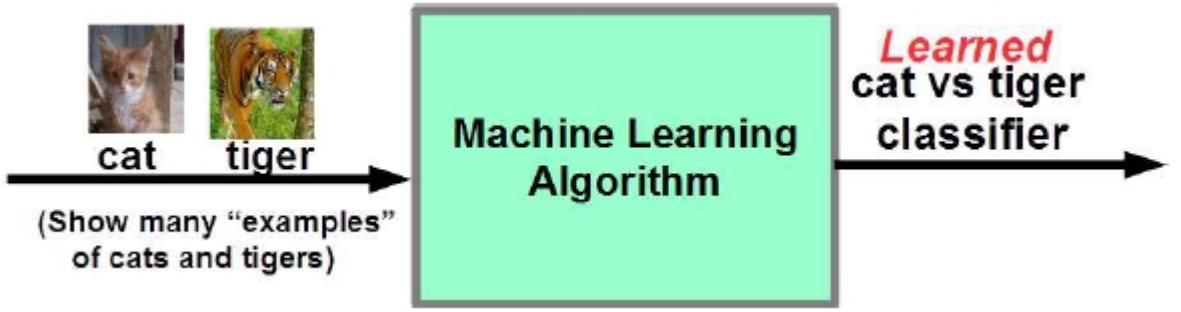
- Subfield of artificial intelligence
- Study of pattern recognition and computational learning theory
- Creating programs that can automatically learn rules from data

"Field of study that gives computers the ability
to learn without being explicitly programmed"
(Arthur Samuel, 1959)

Machine Learning

- Traditional: Write programs using hard-coded (fixed) rules

- Machine Learning: Learn rules by looking at some training data



Machine Learning

- Supervised Learning
  - Predictive approach
  - To learn a mapping from inputs to outputs
  - Example) classification, regression
- Unsupervised Learning
  - Descriptive approach
  - To find interesting patterns in the data
  - Example) clustering, dimensionality reduction

A Short Prehistory of AI

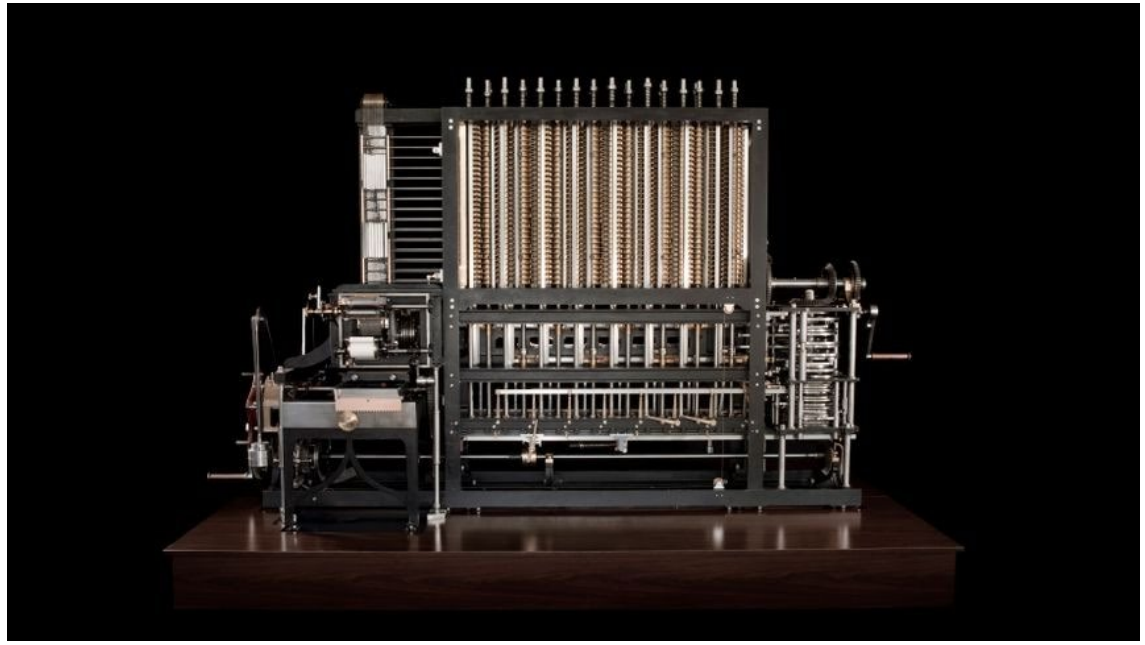
Prehistory:

- Philosophy (reasoning, planning, learning, science, automation)
- Mathematics (logic, probability, optimization)
- Neuroscience (neurons, adaptation)
- Economics (rationality, game theory)
- Control theory (feedback)
- Psychology (learning, cognitive models)
- Linguistics (grammars, formal representation of meaning)

A Short Prehistory of AI

Near miss (1842):

- Babbage design for universal machine
- Lovelace: “a thinking machine” for “all subjects in the universe.”



The Babbage Engine

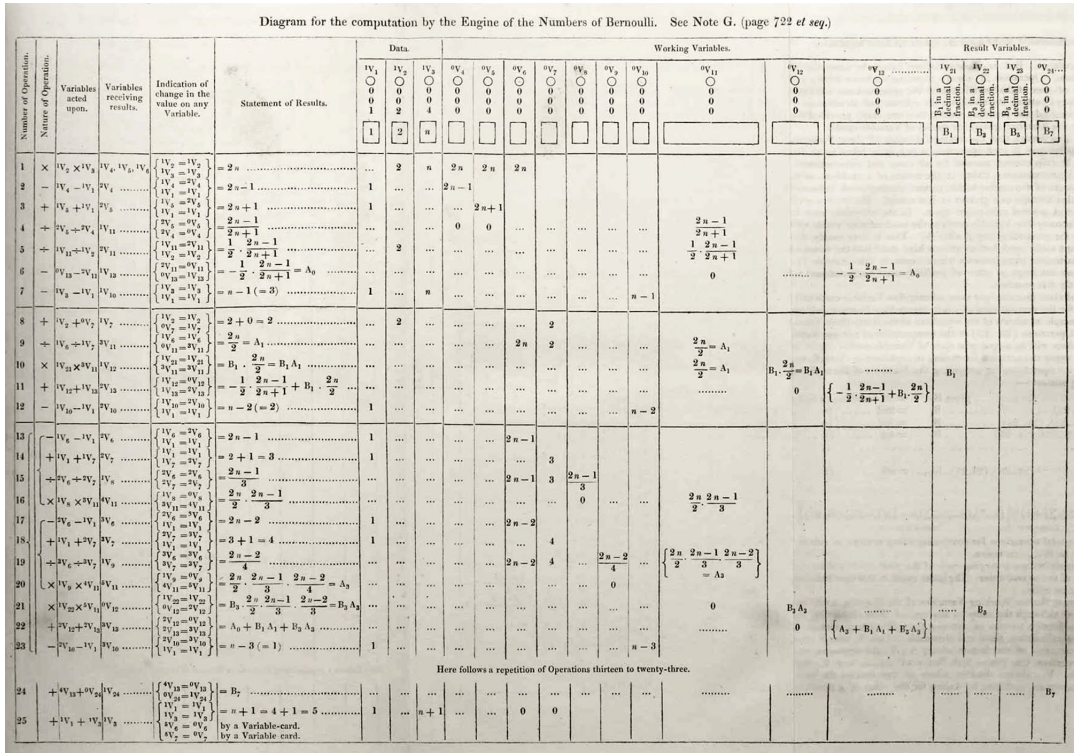
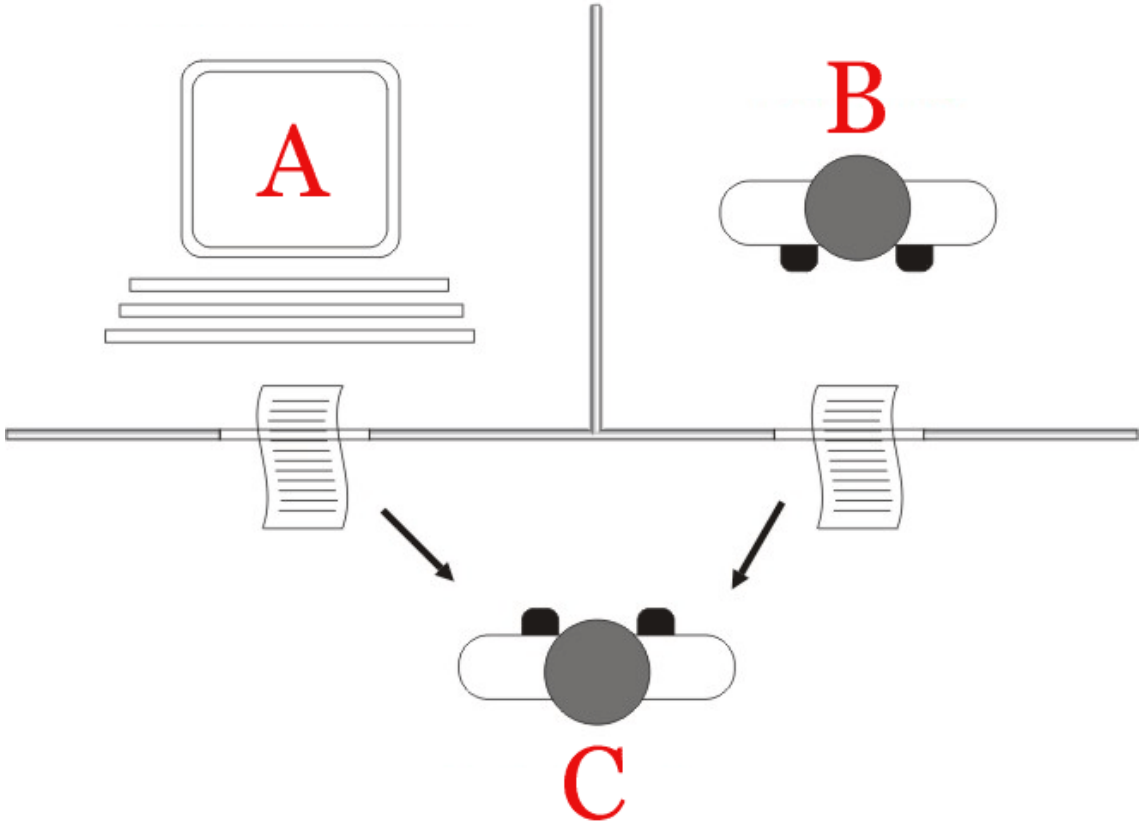


Diagram for the computation by the Engine of the Numbers of Bernoulli. See Note G. (page 722 *et seq.*)

Algorithm to compute Bernoulli numbers

Turing Test



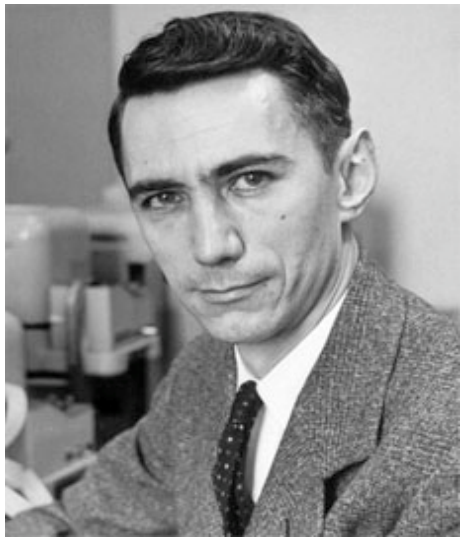
Ability to understand and generate language - intelligence

“Can machine think?”

AI's Official Birth: Dartmouth, 1956

"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 if we work on it together for a summer.*"

John McCarthy and Claude Shannon @ Dartmouth Workshop Proposal



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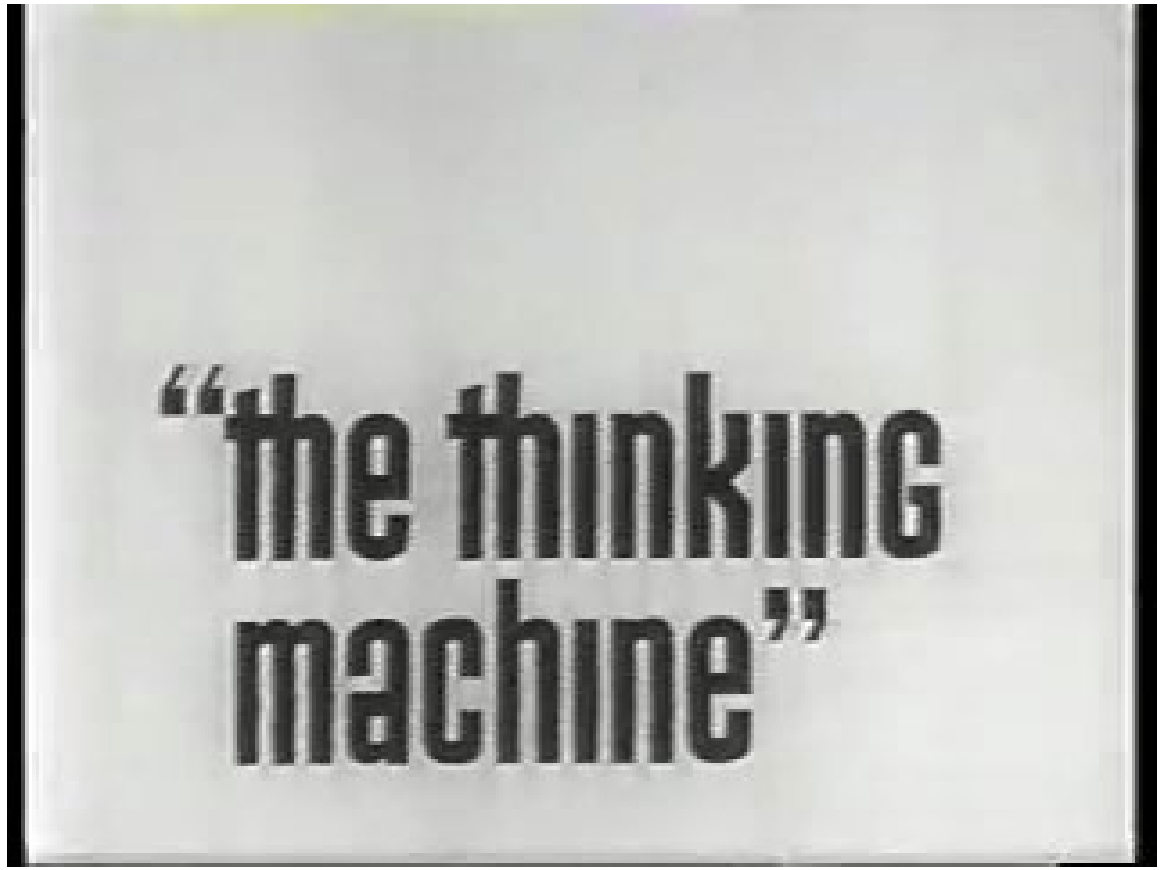


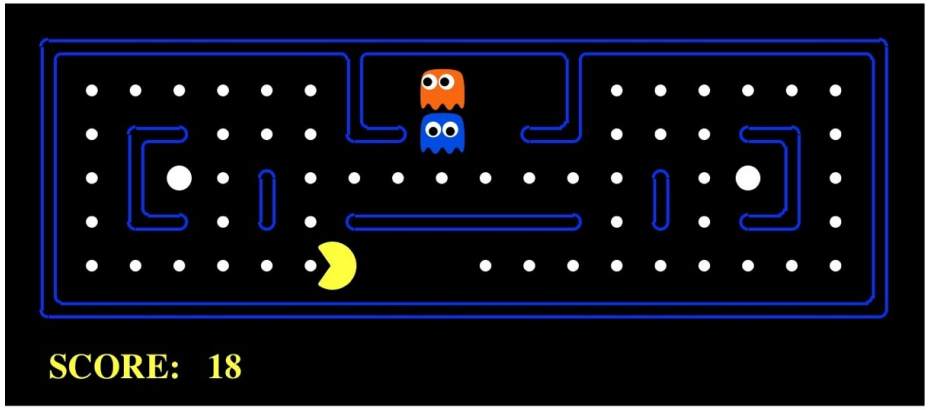
https://www.youtube.com/watch?v=aygSMgK3BEM

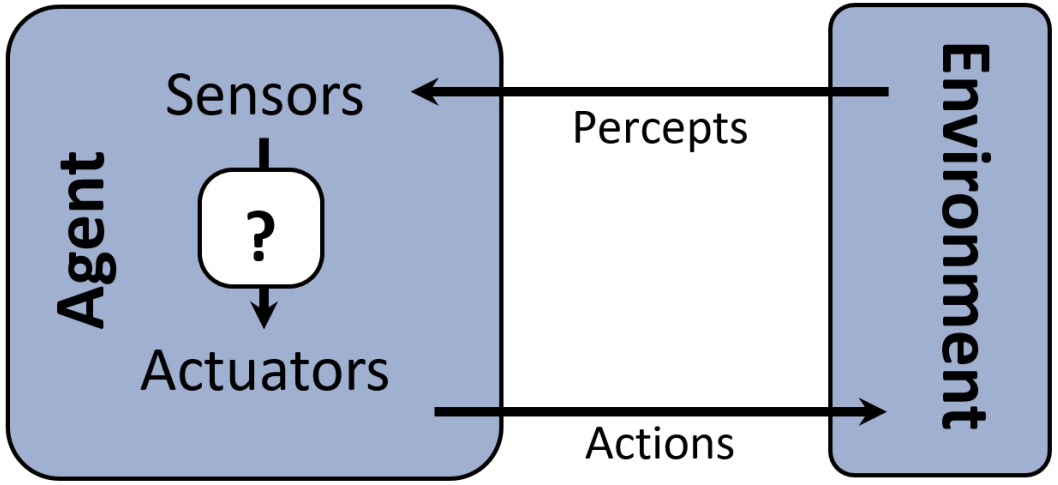
A (Short) History of AI

- 1940 - 1950: Early days
  - 1943: McCulloch & Pitts: Boolean circuit model of brain
  - 1950: Turing's “Computing Machinery and Intelligence”
- 1950 - 70: Excitement: Look, Ma, no hands!
  - 1950s: Early AI programs: chess, checkers (RL), theorem proving
  - 1956: Dartmouth meeting: “Artificial Intelligence” adopted
  - 1965: Robinson's complete algorithm for logical reasoning
- 1970 - 90: Knowledge-based approaches
  - 1969 - 79: Early development of knowledge-based systems
  - 1980 - 88: Expert systems industry booms
  - 1988 - 93: Expert systems industry busts: “AI Winter”
- 1990 - 2012: Statistical approaches + subfield expertise
  - Resurgence of probability, focus on uncertainty
  - General increase in technical depth
  - Agents and learning systems… “AI Spring”?
- 2012 - NOW: Excitement: Look, Ma, no hands again?
  - Big data, big compute, deep learning
  - AI used in many industries

AI as Designing Rational Agents

- An agent is an entity that perceives and acts
- A rational agent selects actions that maximize its expected utility
- Characteristics of the sensors, actuators, and environment dictate techniques for selecting rational actions





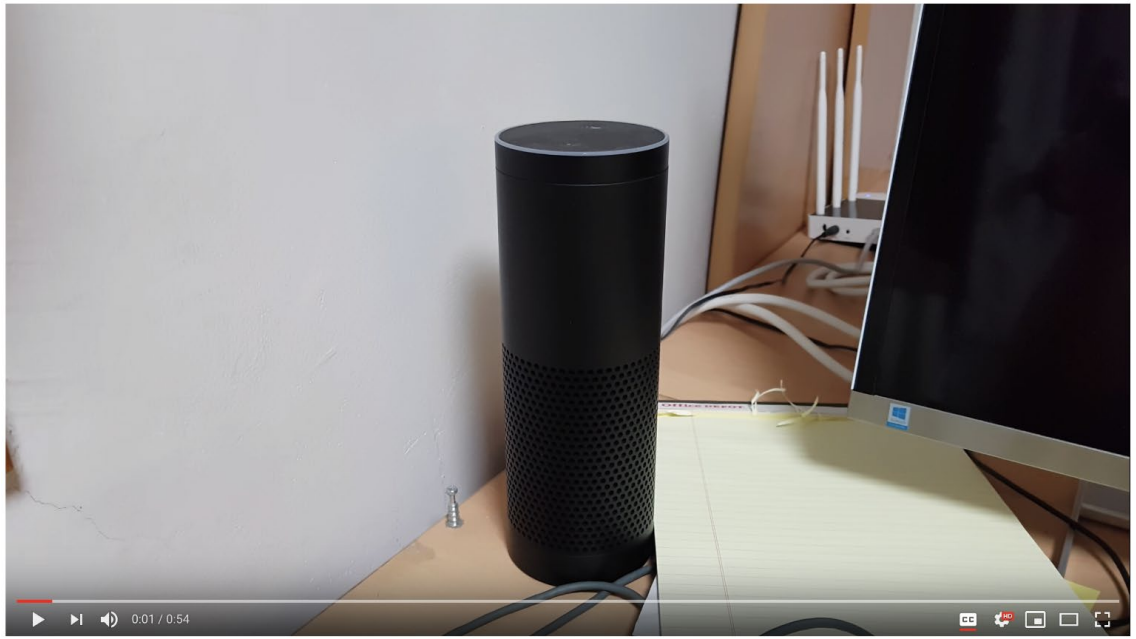
What Can AI Do?

Quiz: Which of the following can be done at present?

- Play a decent game of table tennis?
- Play a decent game of Jeopardy?
- Drive safely along a curving mountain road?
- Drive safely along Seobu-ro?
- Buy a week's worth of groceries on the web?
- Buy a week's worth of groceries at GS25 in the dorm?
- Discover and prove a new mathematical theorem?
- Converse successfully with another person for an hour?
- Perform a surgical operation?
- Translate spoken Chinese into spoken English in real time?
- Fold the laundry and put away the dishes?
- Write an intentionally funny story?

AI Speaker

A is B, but B is not A?

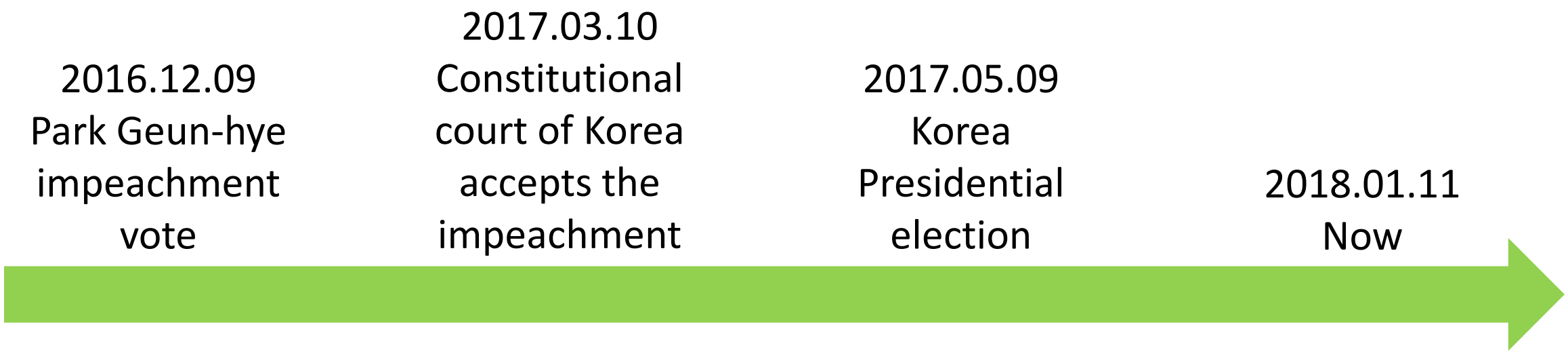


Amazon Alexa said the president of South Korea in 2018 is

https://www.youtube.com/watch?v=v_7XSXdR6Bw

AI Speaker

When does Amazon Alexa update the information?



AI Speaker

What date is it?

Today is Thursday January 11th 2018.

Who is the president of South Korea now?

South Korea’s president is Lee myung-bak.

Who is Moon jaein?

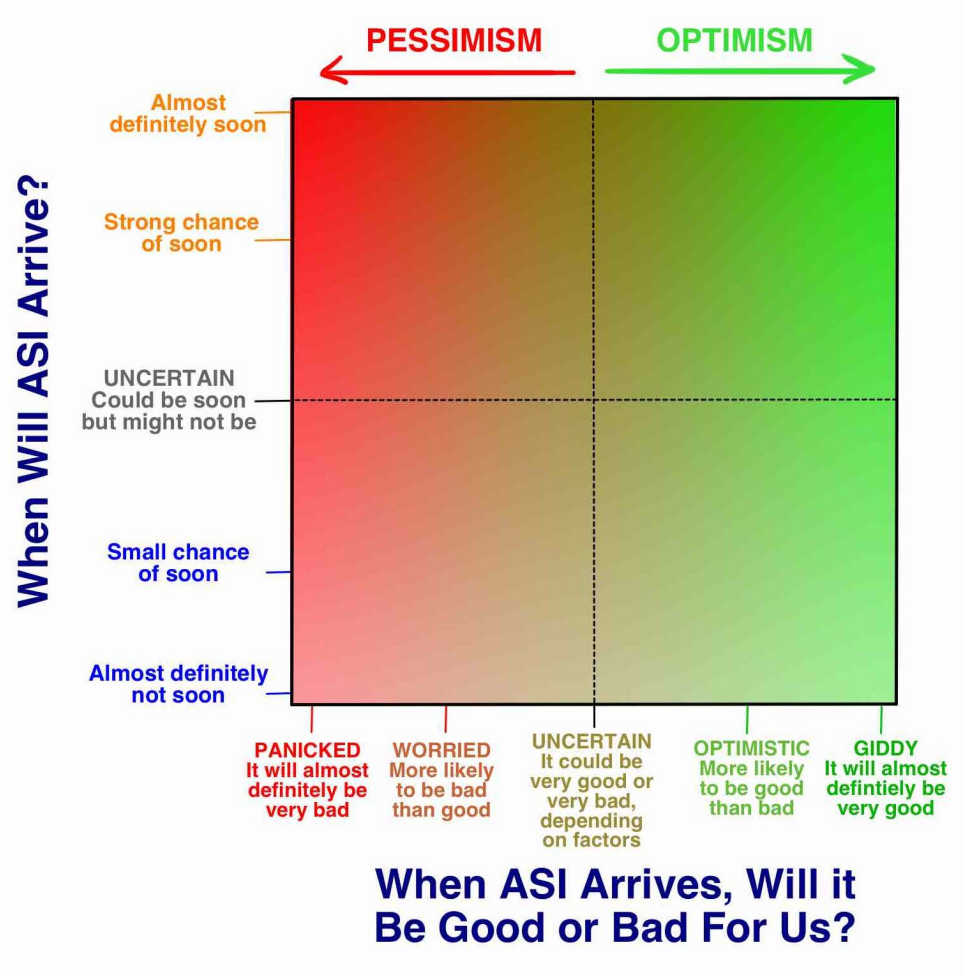
Moon jaein is a South Korean politician and
the current president of South Korea.

Future

We are doing AI

- To create intelligent systems
  - The more intelligent, the better
- To gain a better understanding of human intelligence
- To magnify those benefits that flow from it
  - E.g., net present value of human-level AI ≥ $13,500T
  - Might help us avoid war and ecological catastrophes, achieve immortality and expand throughout the universe

Opinions on ASI Arrival



Opinions on ASI Arrival

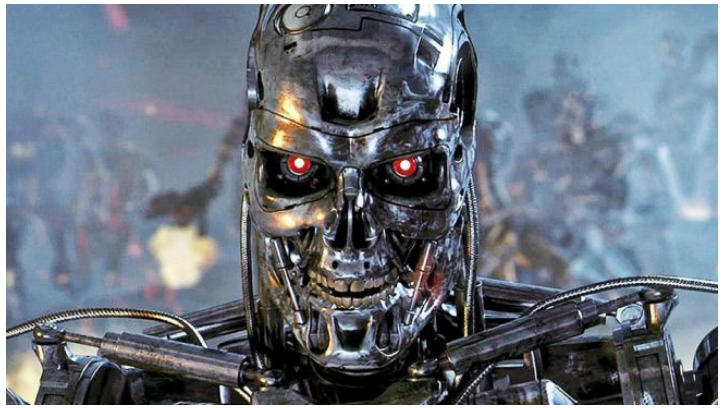
Optimism

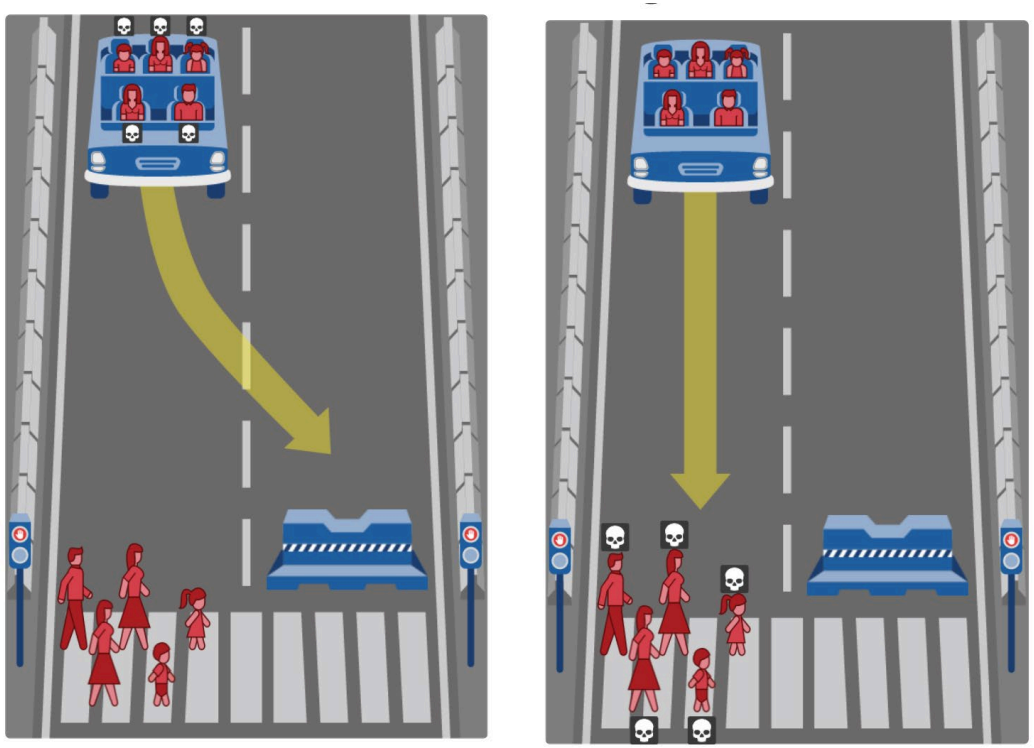
- AIs can solve any problems
- Humans can have eternal life

Opinions on ASI Arrival

Pessimism

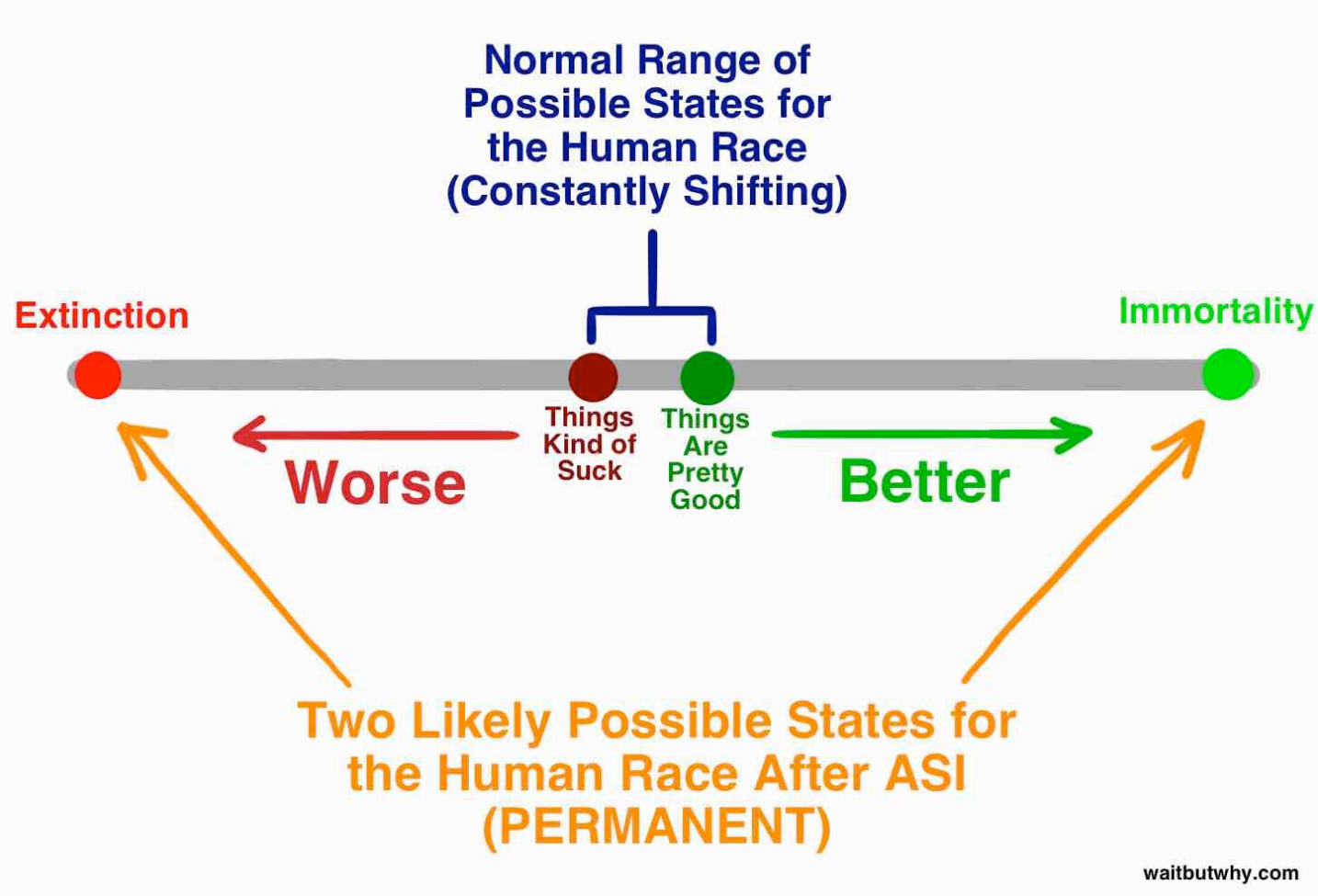
- AIs work hard to achieve the goal
- AIs are amoral
  - Not moral
  - Not immoral
  - Not involving questions of right or wrong
- Can Humans control ASI?
  - ASI is smarter than humans





https://www.moralmachine.net/

In the Future…



Machine Learning Top-tier Conferences

- AI/ML

  NeurIPS, AAAI, ICML, KDD, WWW, IJCAI, ICLR, ...
- Computer Vision

  CVPR, ICCV, ECCV, ...
- Natural Language Processing

  ACL, EMNLP, NAACL, ...

More information

https://research.com/conference-rankings/computer-science