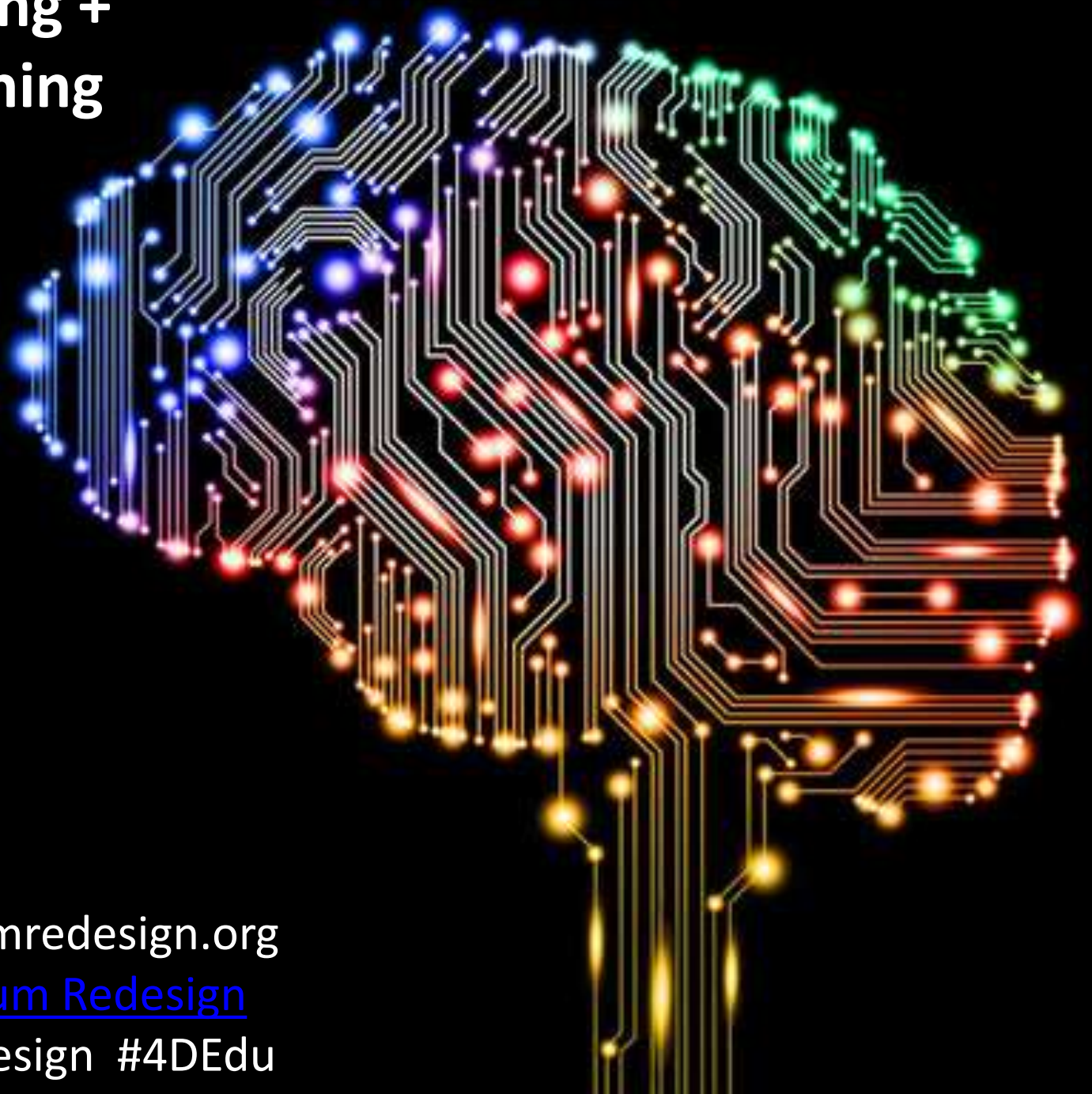
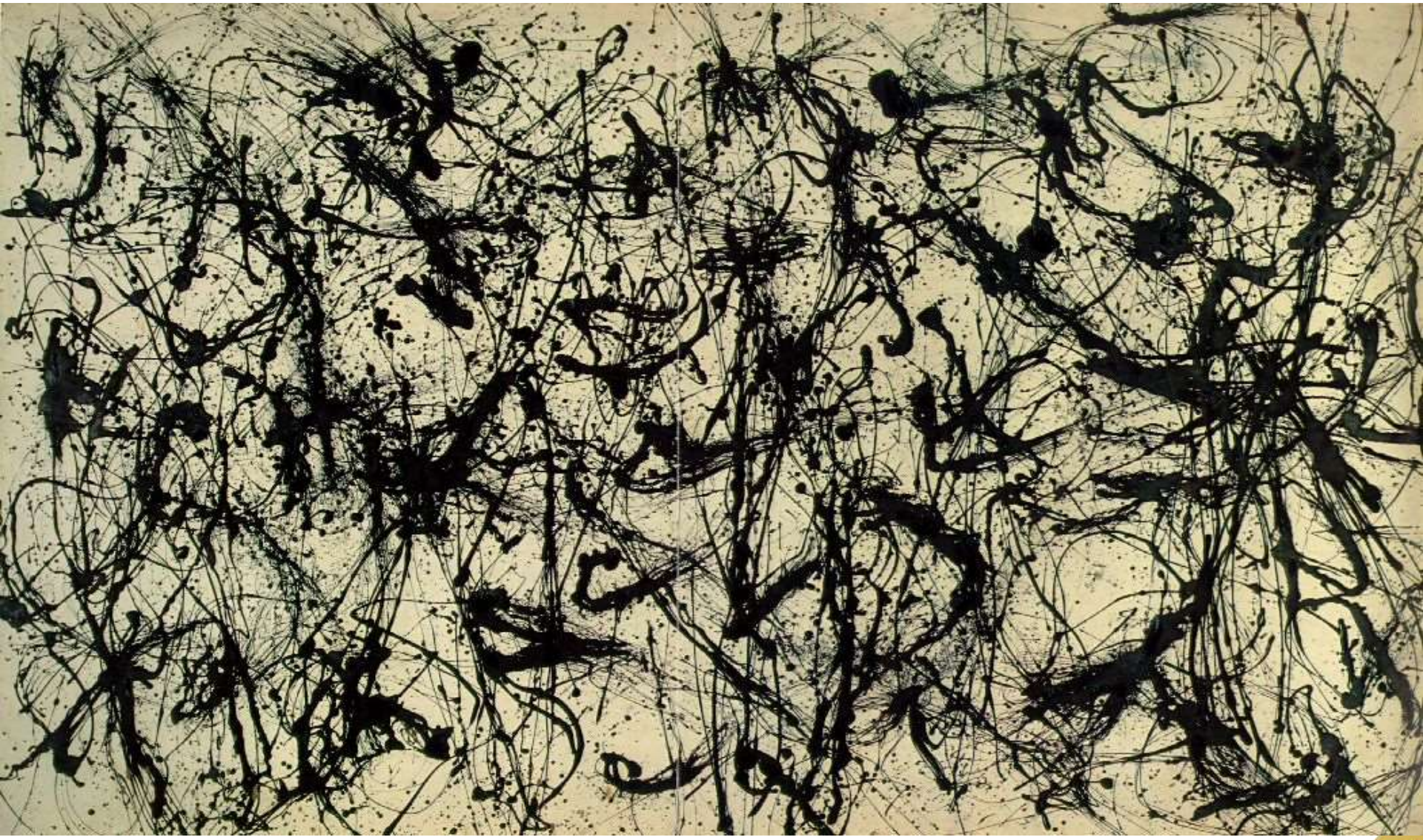
Human Learning + Machine Learning



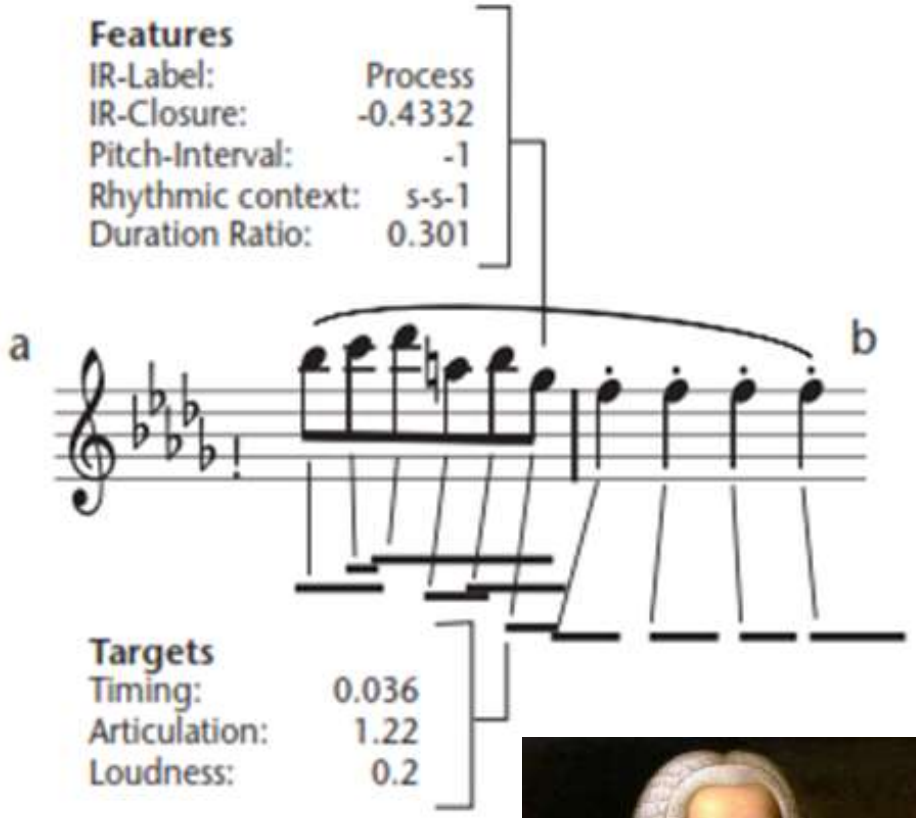
Charles Fadel
Charles@curriculumredesign.org
Center for Curriculum Redesign
Twitter: @CurrRedesign #4DEdu

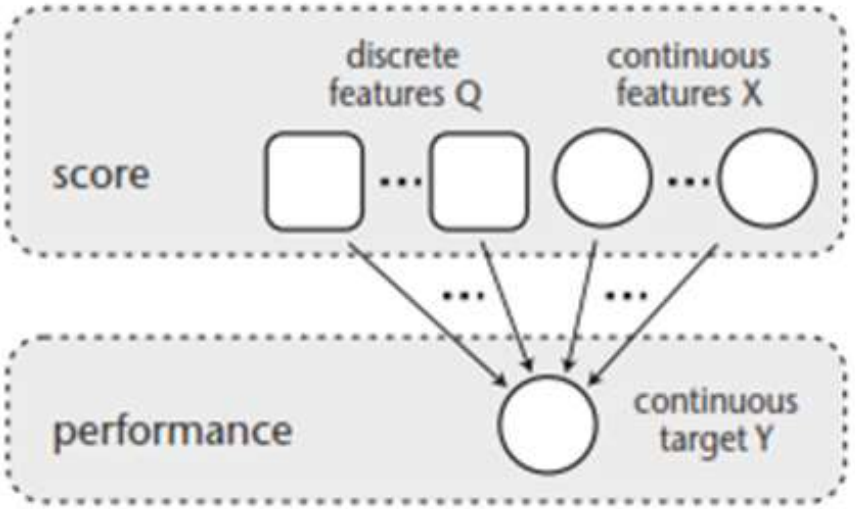
Music exercise – Audio

“1950”



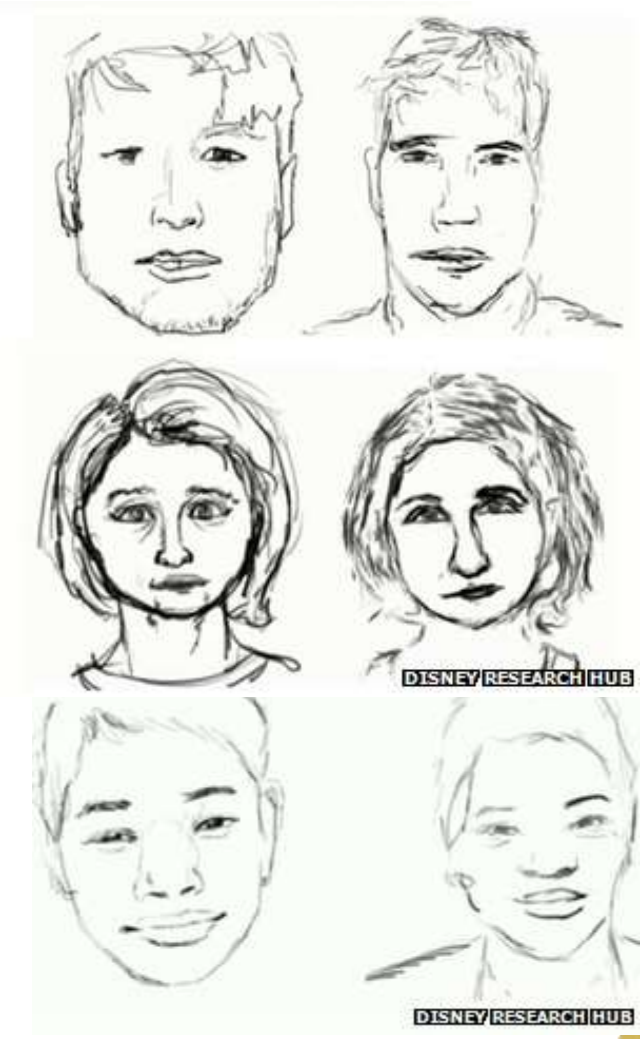
Algorithmic Composition of Music





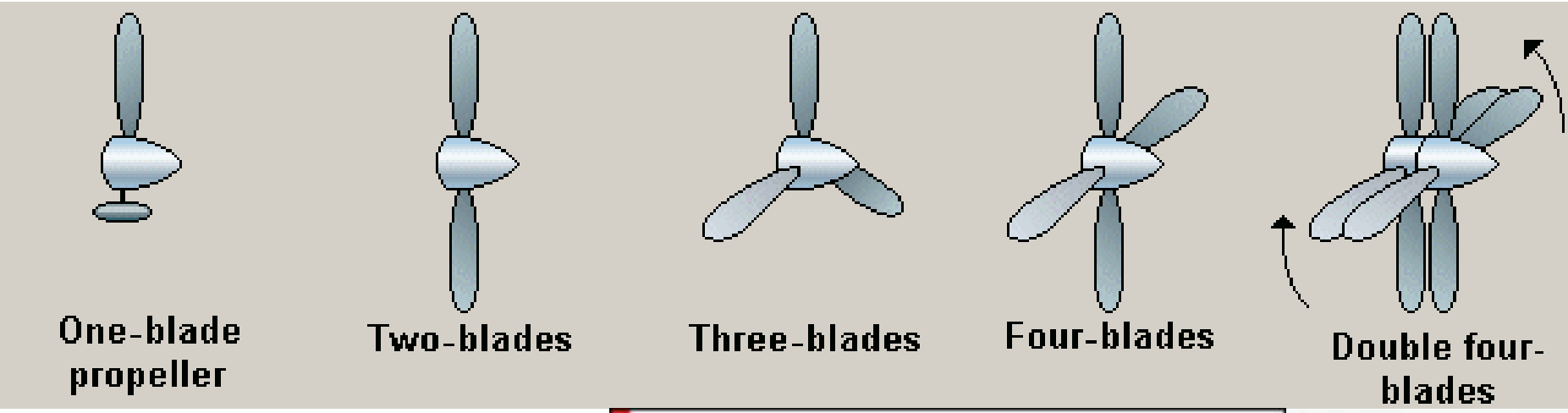
Computers can sketch too !

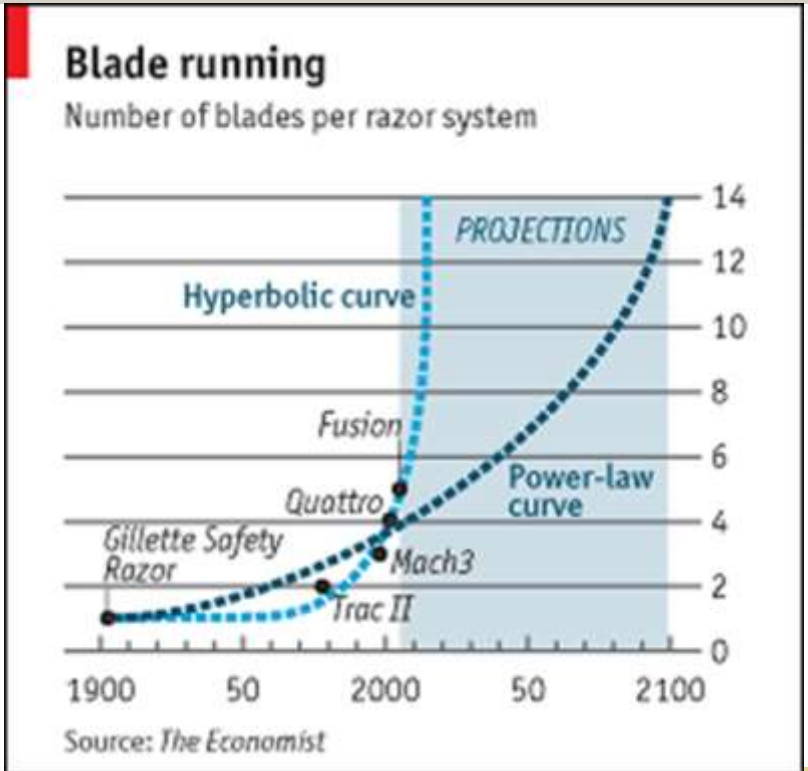
- Seven artists generated about 8,000 pen strokes
- Disney's software analyzed distance between facial features



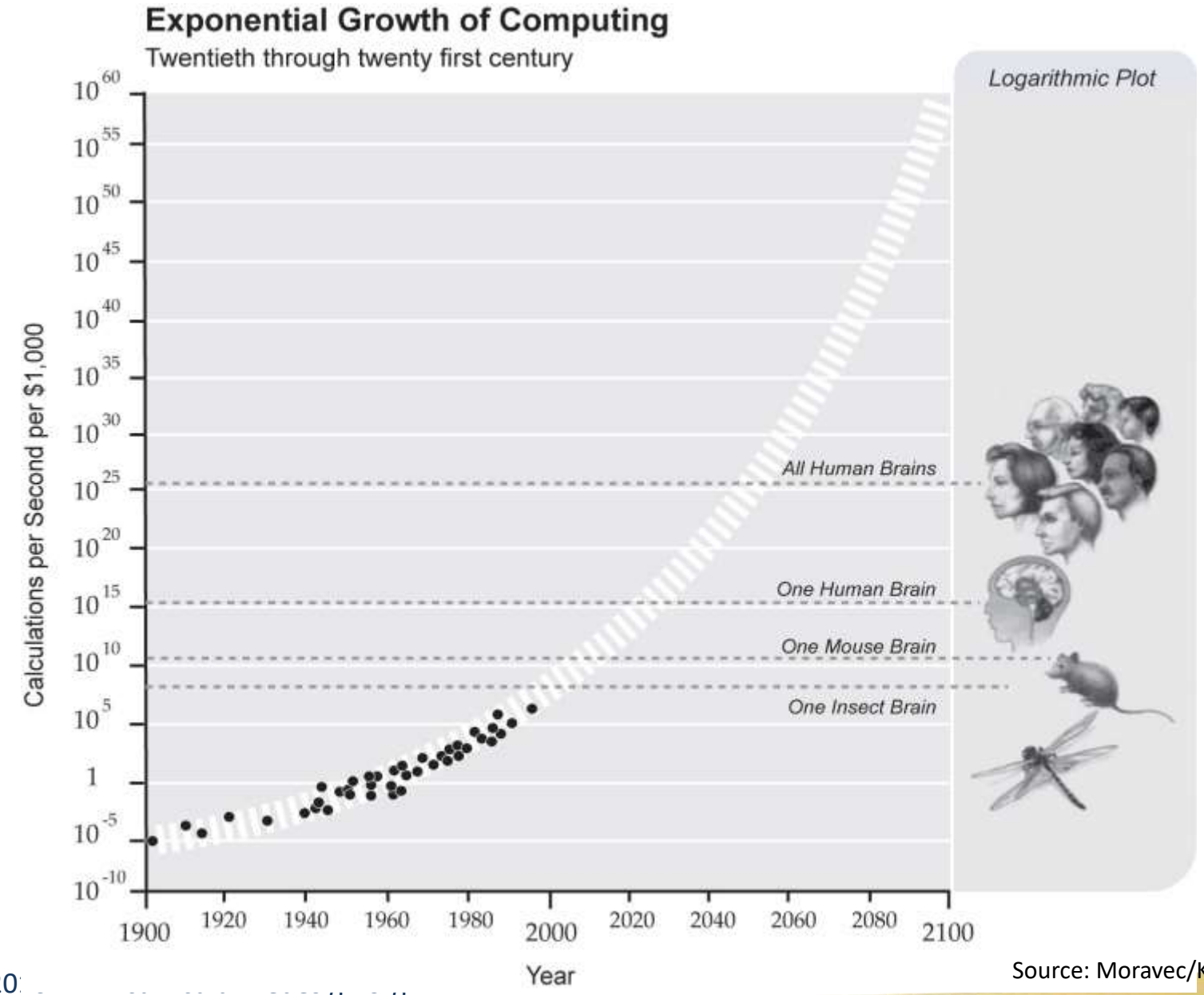
Innovation follows patterns → *automatable*

Source: Invention Machine "IM Labs"





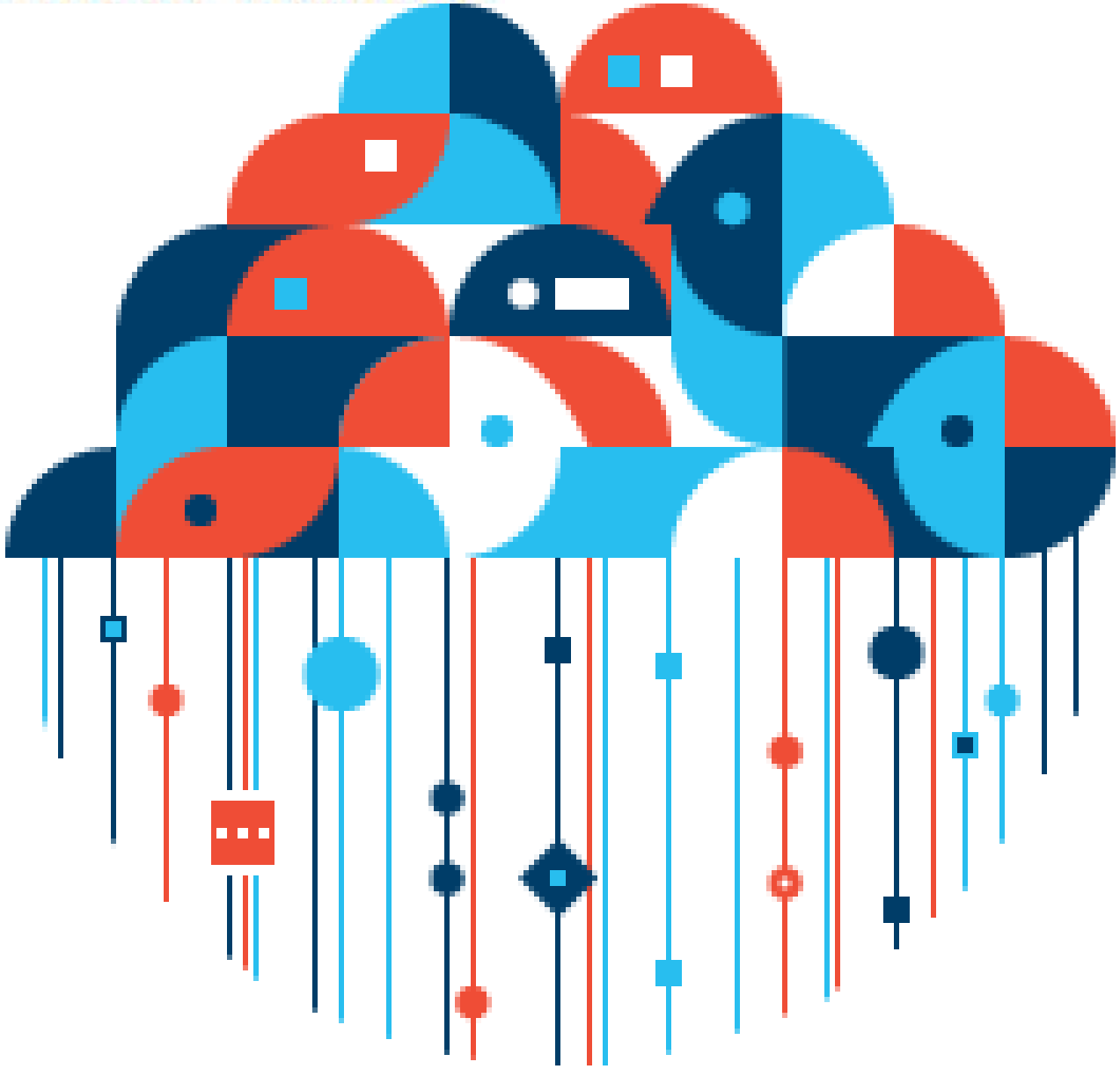
On the road to ExoBrain

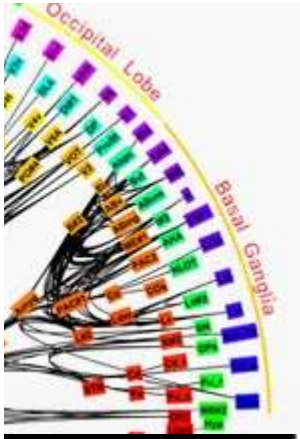


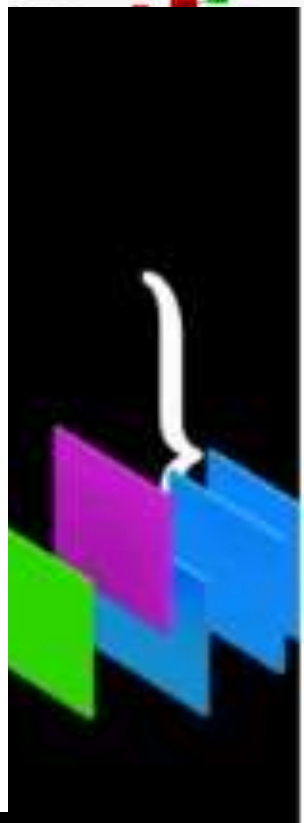
Source: Moravec/Kurzweil/Su

One-Two-Three-Four punches

SyNAPSE (chip) + BlueBrain (system) + Watson (software) + Cloud Computing (infrastructure)

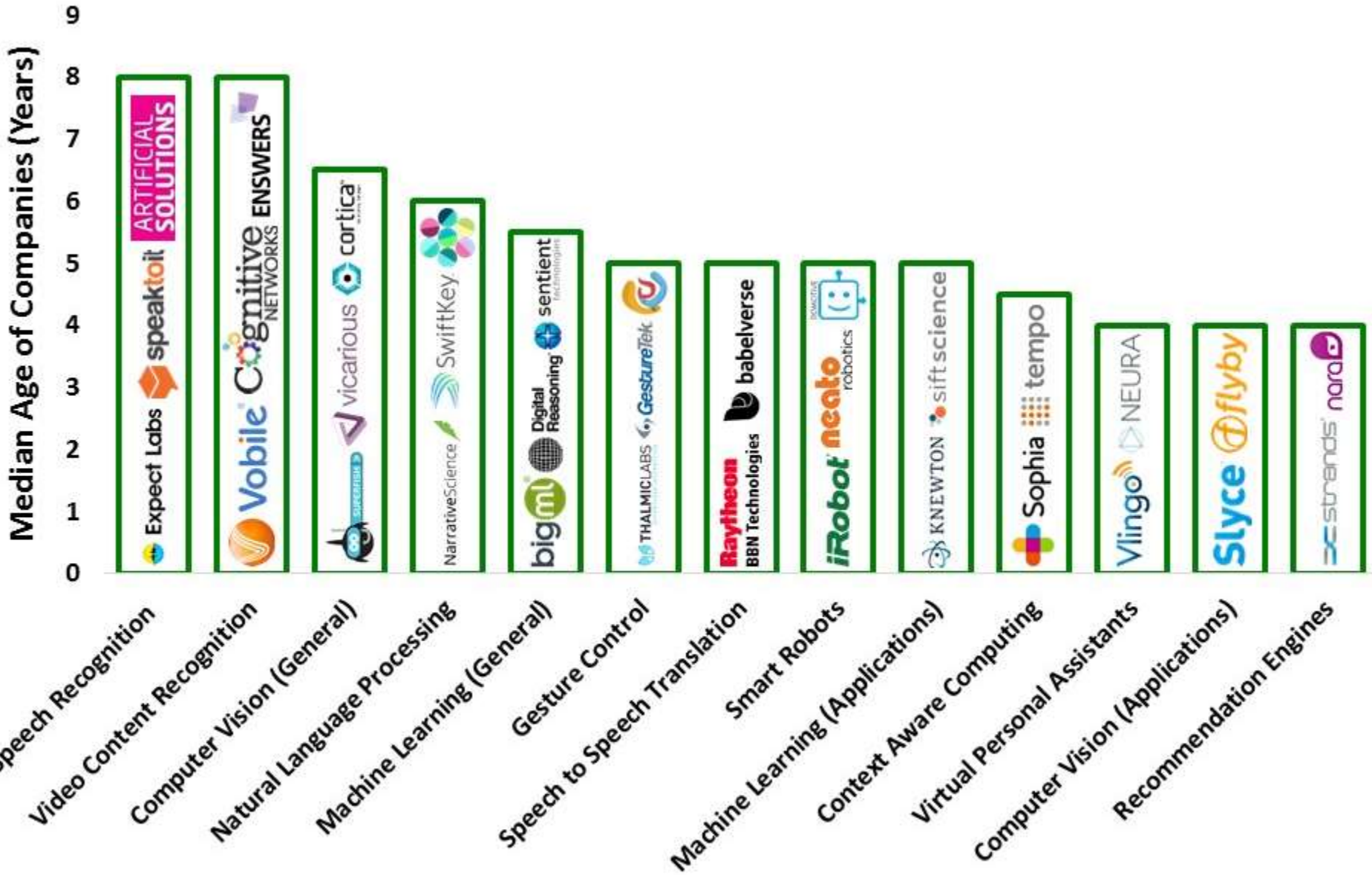




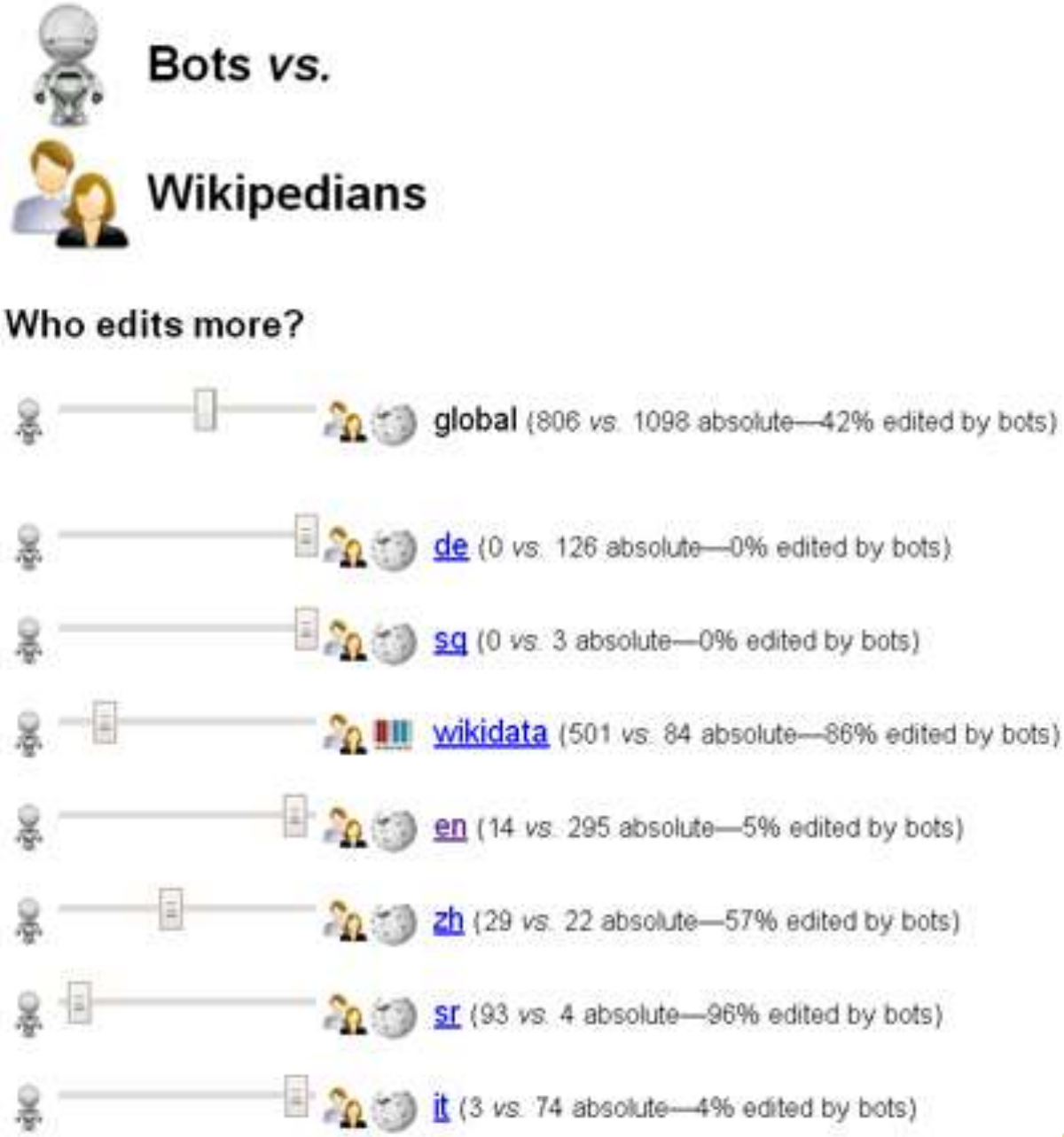


Cloud Computing → “Synthetic Neocortex”

Artificial Intelligence applied everywhere



WikiBots



42% of Wikipedia is edited by 12 bots !

Cartoon to reality in five years

Magically schedule meetings

That's us. That's all we think about.

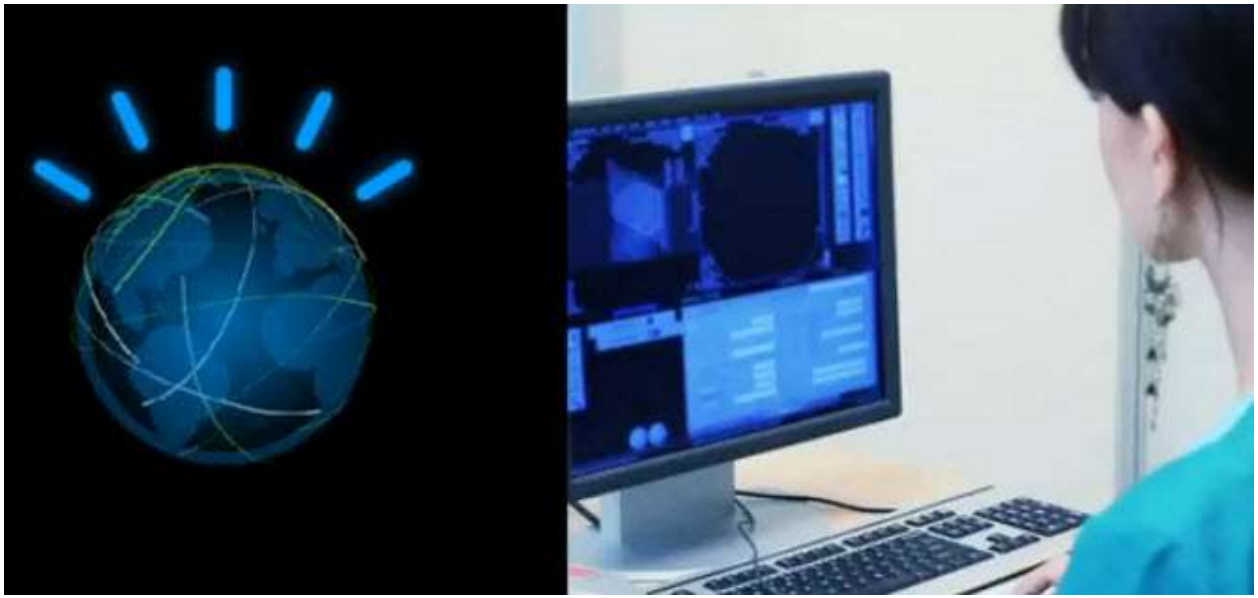
https://x.ai/about/

“What is…?”

IBM WATSON

Watson goes to medical school

- Collect and assess patient data
- Construct “inference paths” toward a probable diagnosis



Human workers, managed by an algorithm

"The latest trend in crowdsourcing is organizing foreign workers on a mass scale to do routine tasks that computers aren't yet good at, assigned by an algorithm"

Computer scores 150 IQ

Math IQ tests are based on:

- progressive matrices, which test the ability to see patterns in pictures
- number sequences, which test the ability to see patterns in numbers.

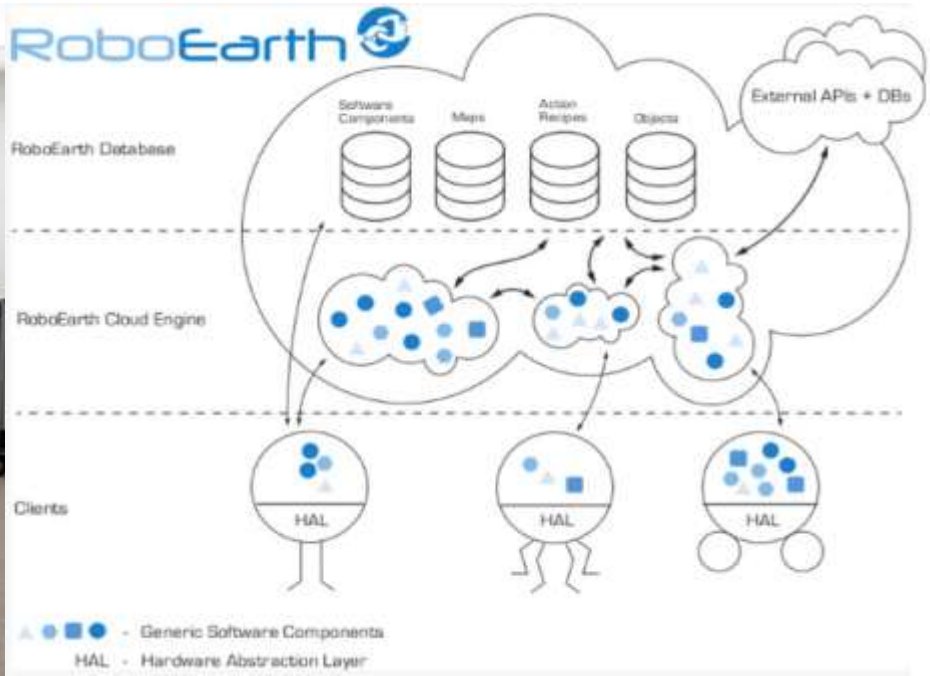
"Our programs are beating the conventional math programs because we are combining mathematics and psychology"

Claes Strannegard
University of Gothenburg

Robots learning from each other

- Knowledge and experience shared worldwide
- Computing tasks carried out in the Cloud

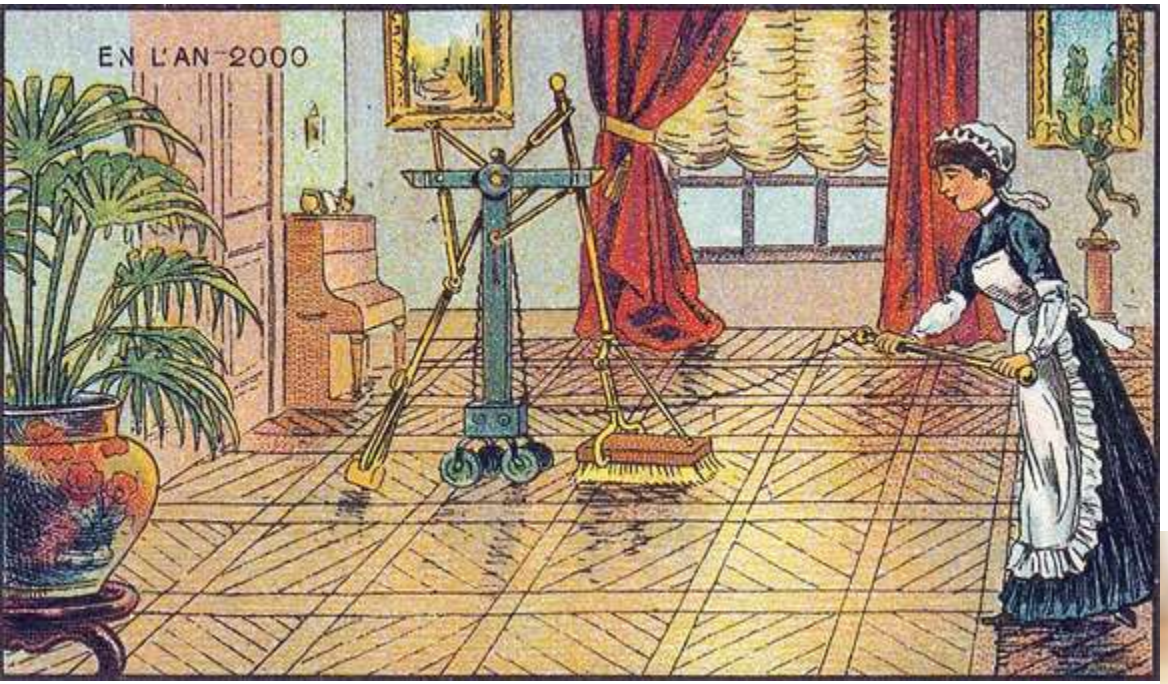
→ *Hyperbolic improvement*



Robot Serves Up 360 Hamburgers Per Hour

- Pays for itself in a year
- No cashiers or servers
- Will never forget to ask "do you want fries with your order?"

Our Limited Imagination



Source: Jean-Marc Côté, 1899

Death by a thousand cuts?

Magically schedule meetings

That's us. That's all we think about.

https://x.ai/about/

The Impact of Big Data & Machine Learning

Three key areas in which machine bests humans:

- consume huge amounts of data
- receive thousands of inputs at once
- create a unified model of knowledge across that *scale* of information and make judgments from it

Timothy Estes, founder and CEO of Digital Reasoning

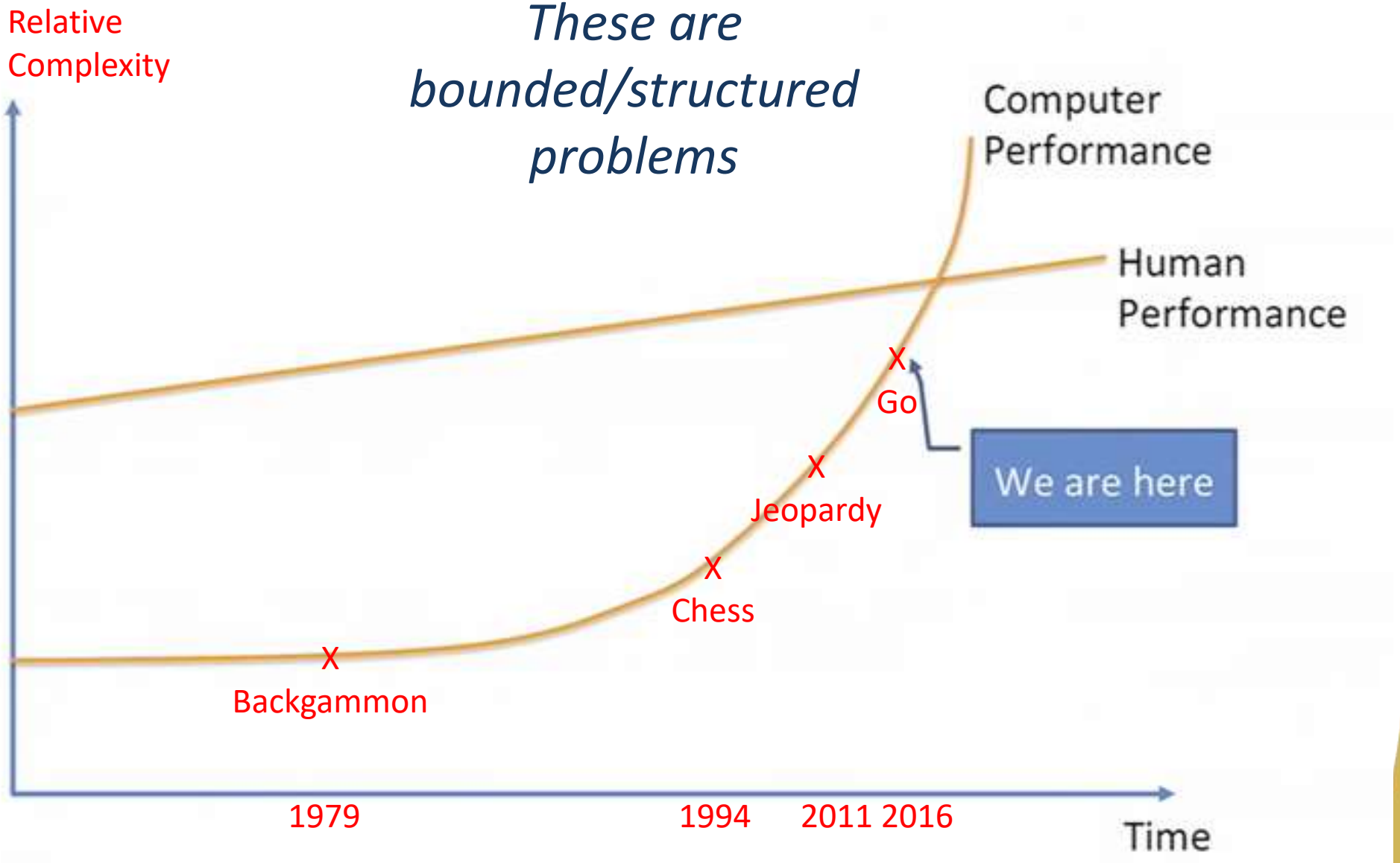
And do so with fewer human cognitive biases…

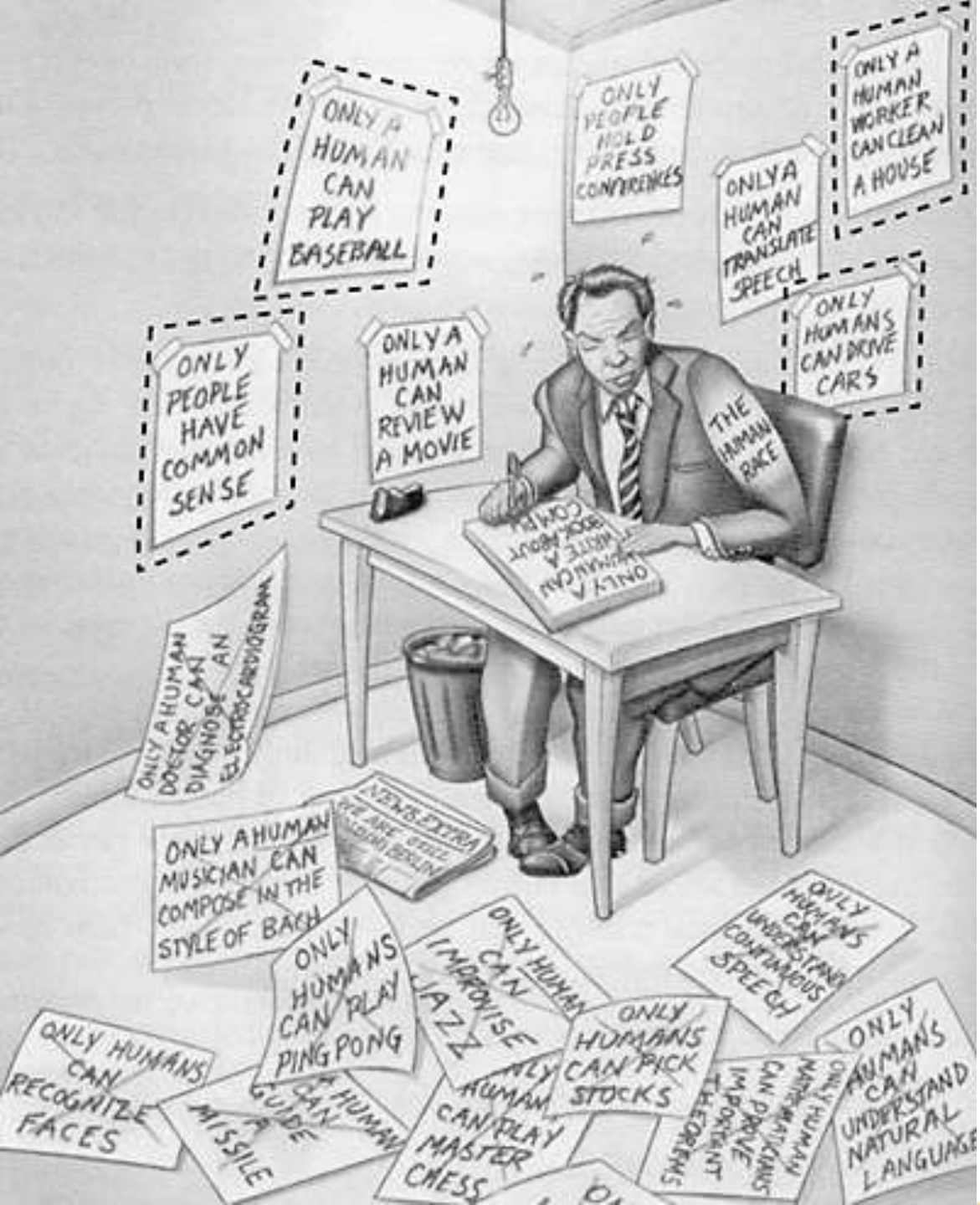
But Humans…

- Have access to a LOT more [diverse] data than a machine:
  - building intuitions and holistic pictures in our mind
  - seeing connections that the machine might not even have the possibility of seeing because it doesn't have the right data.
- Have a powerful role in figuring out the sources of data to give the machine and projecting their intuition.

Acceleration, but…

These are bounded/structured problems





Receding arguments?

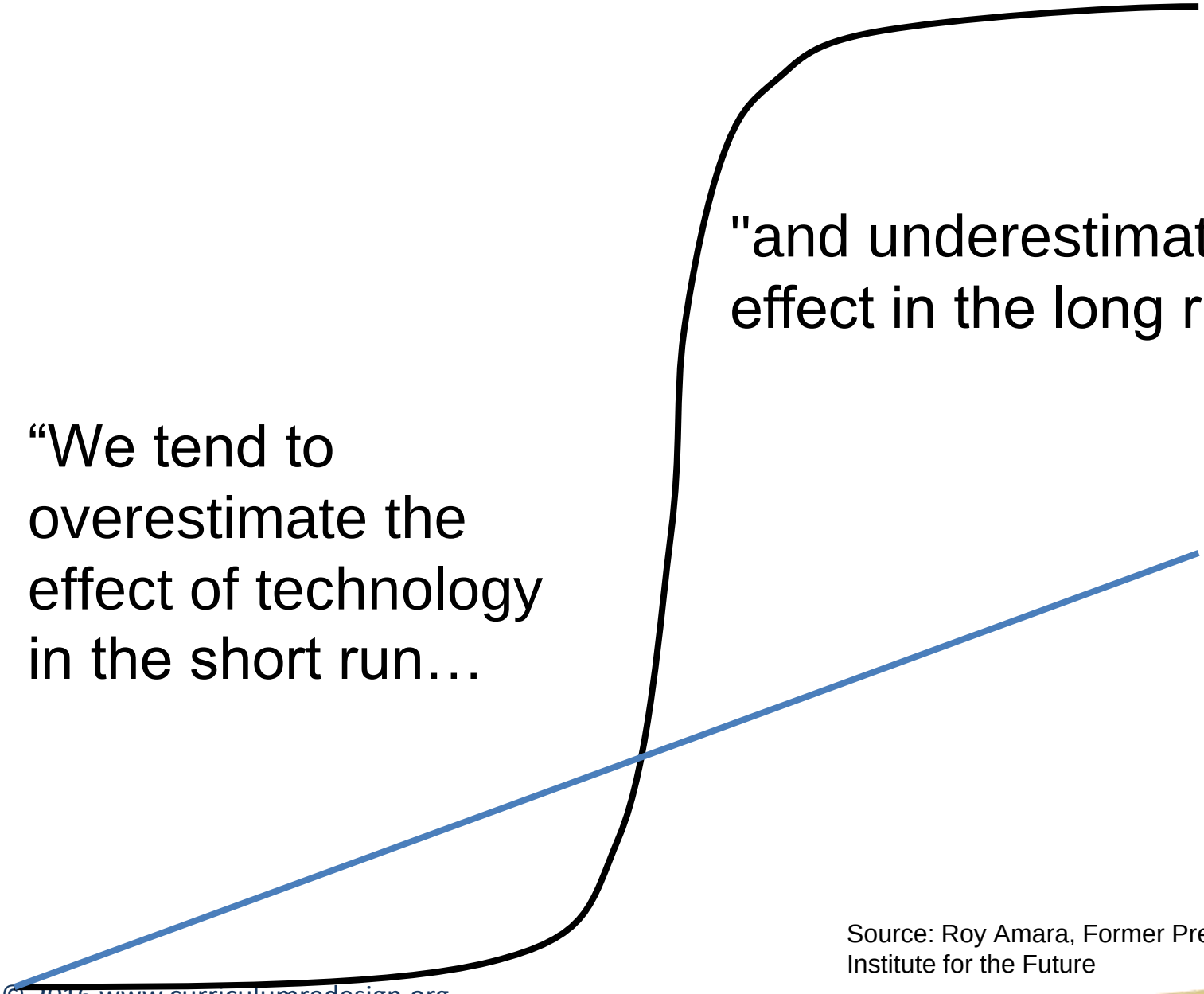
"…The machine matches the human error rate of 5.9 percent for the conversations on an assigned topic but outperforms humans in the task of transcribing friend and family conversations with an error rate of 11.1 percent.

arxiv.org/abs/1610.05256 :
Achieving Human Parity in Conversational Speech Recognition
Geoff Zweig, Microsoft Research

Hype Cycle

Source: Gartner Group

Reality Check



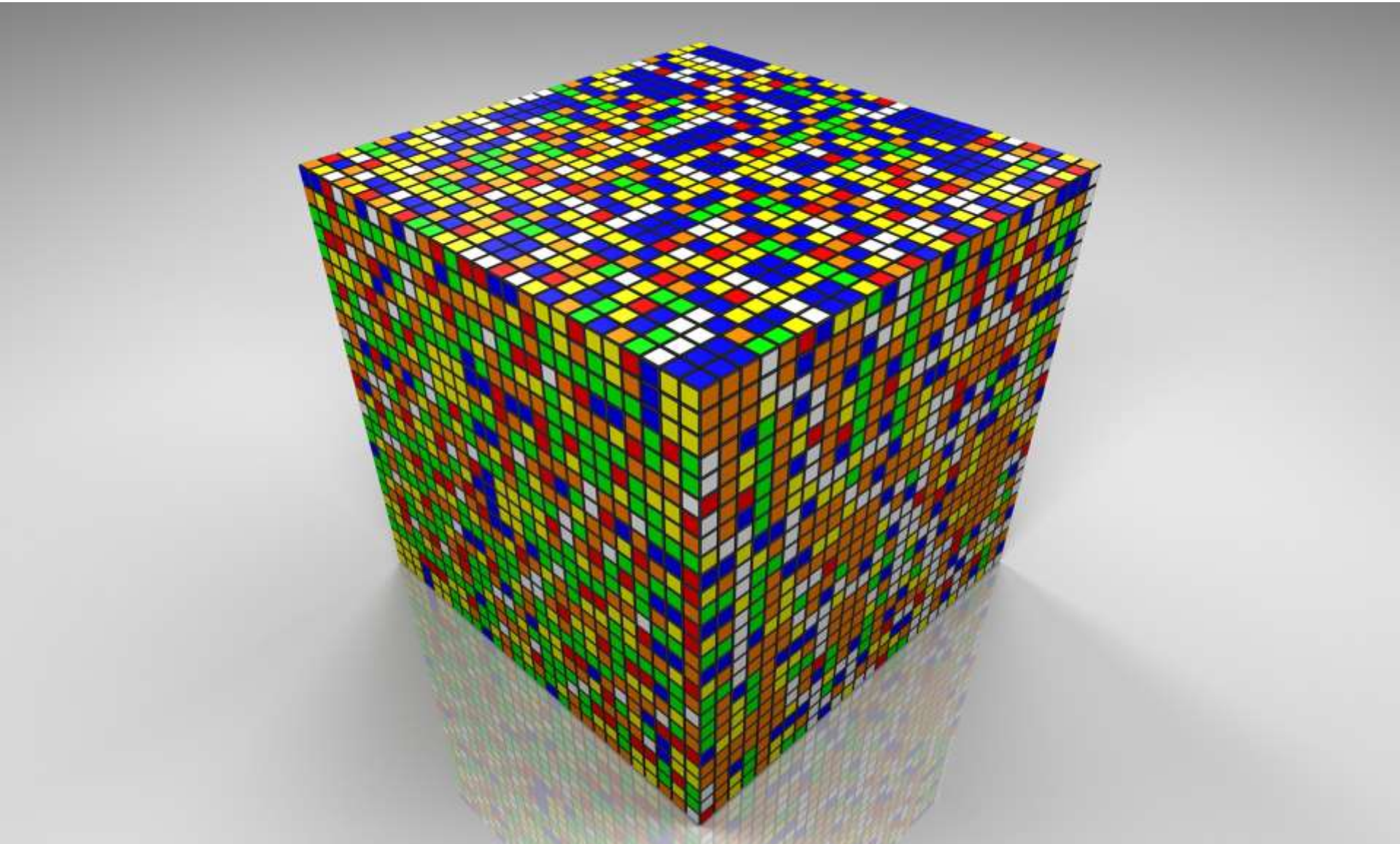
"and underestimate the effect in the long run.“

“We tend to overestimate the effect of technology in the short run…

Source: Roy Amara, Former President, Institute for the Future

A combinatorial explosion of possibilities

→ *Accelerating change!*



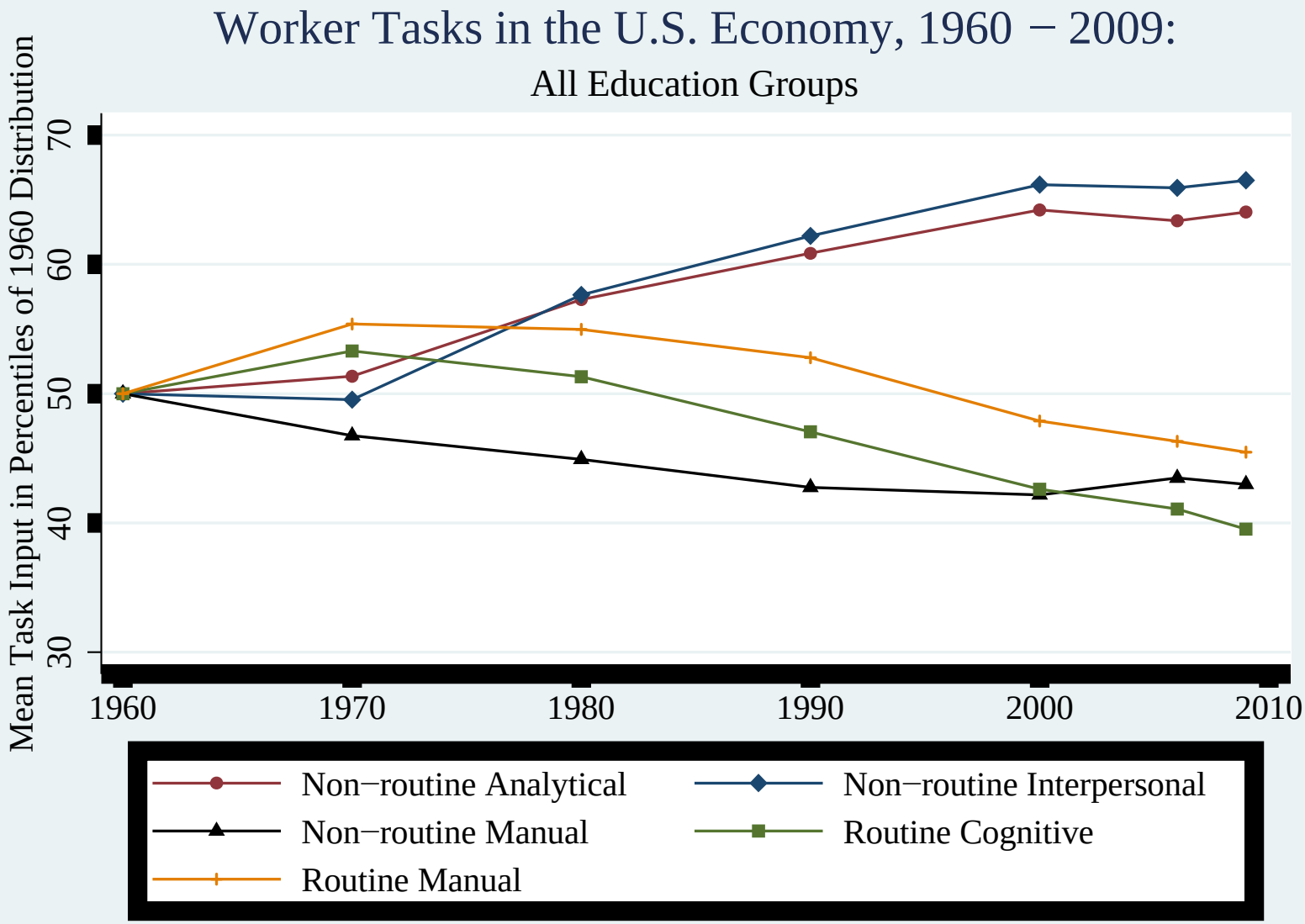
Will we need to learn a foreign language?

Demos

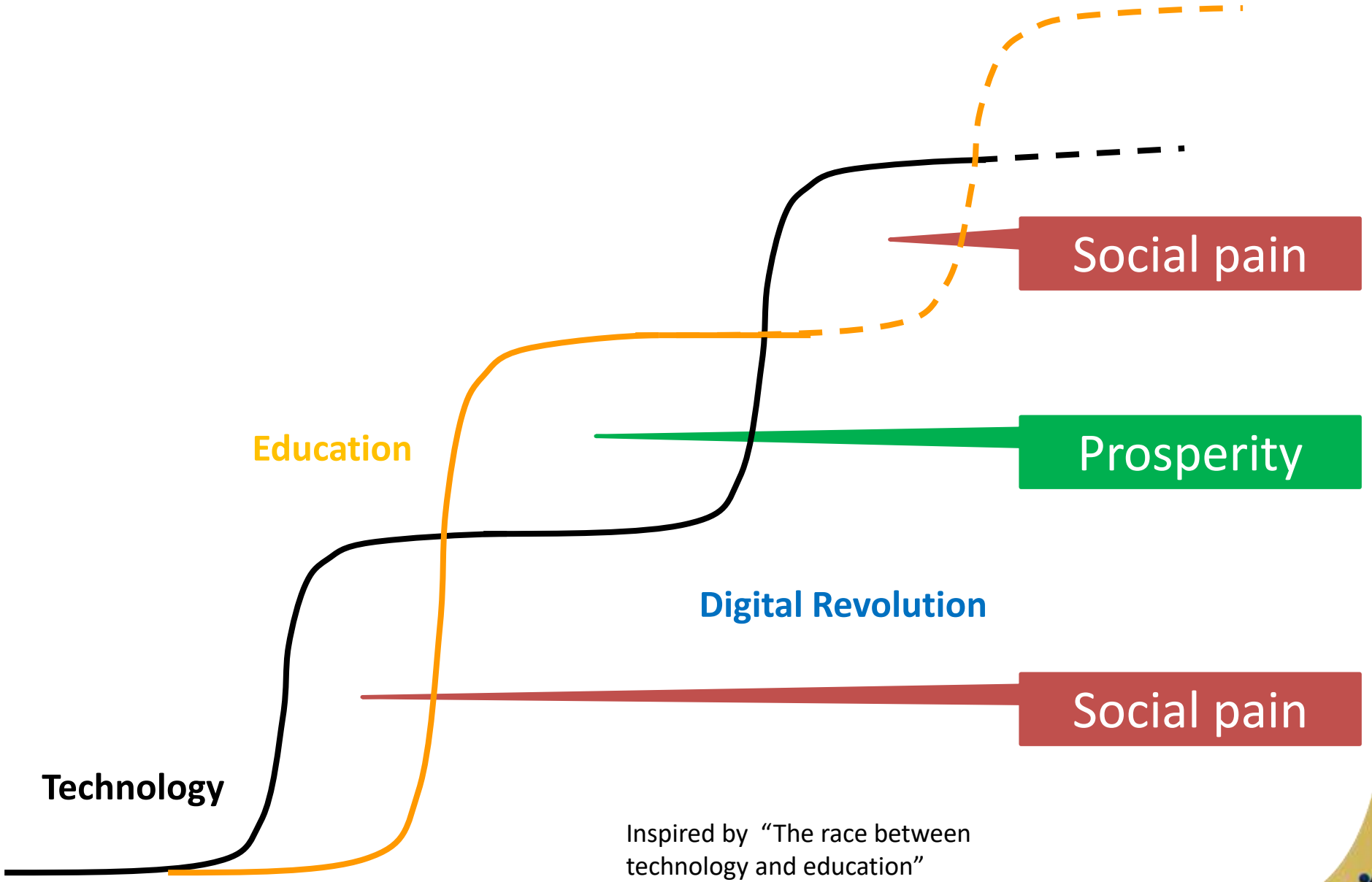
iPhone app: Speech-to-speech translator for 95% of world population (23 languages)
http://www.ustar-consortium.com/

Is this time different ?

Autor, Levy and Murnane
Economy-Wide Changes in Job Task Content 1960 - 2009



The Race between Technology and Education



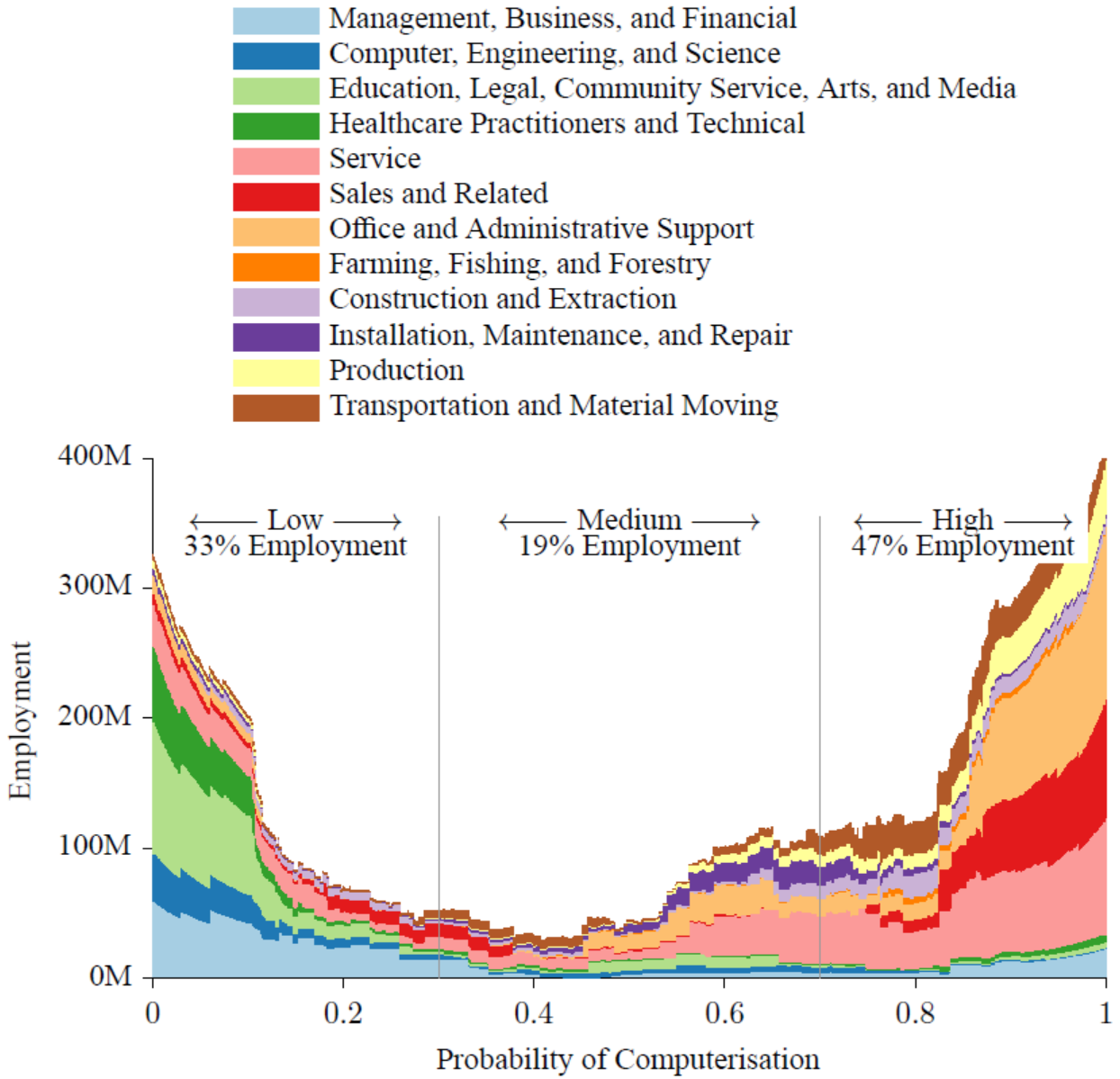
Inspired by "The race between technology and education"
Pr. Goldin & Katz (Harvard)

10 Jobs that did not exist 10 years ago

Job	Pay level
App developer	High
Social media manager	Medium
Uber driver	Low
Driverless car engineer	High
Cloud computing specialist	High
Big data analyst/data scientist	High
Sustainability manager	Medium
YouTube content creators	Medium
Drone operators	Medium
Millennial generational expert	Medium

Source: World Economic Forum "Future of Jobs"

Science or Pseudoscience ?

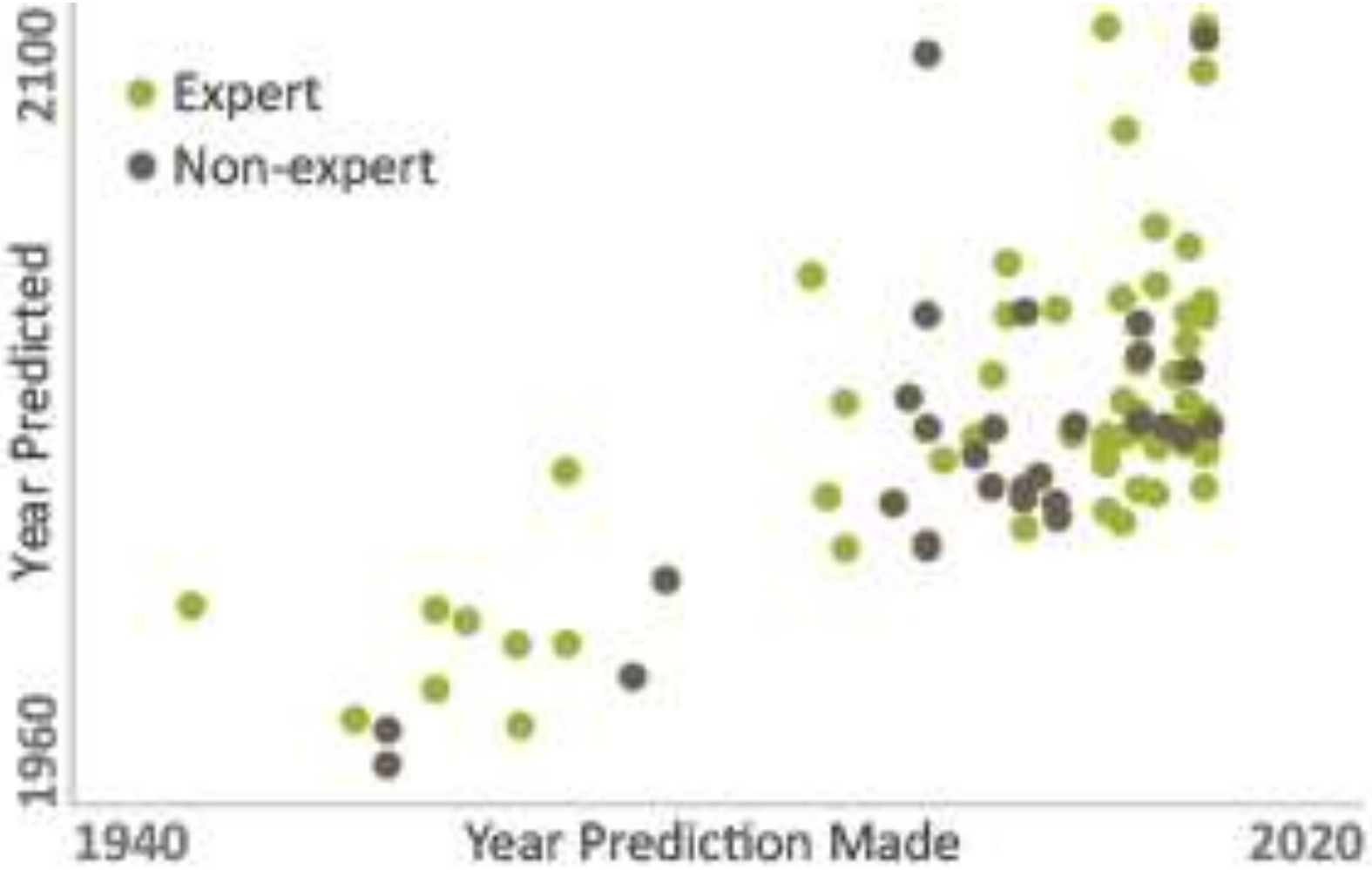


TWO conditionals missed by the hype: "*potentially* automat*able*"

Source: Oxford Martin School: The Future of Employment; September 2013

Should we bother ?

Predictions for Human-level AI



Source: MIRI, "Predicting AI"

Alarmism ?

Yet… policymakers and the public need to take notice and stave off the problems (like Y2K bug…)

Example: Legal Profession

"Our assessment addresses three core weaknesses:

I. a failure to engage with technical details

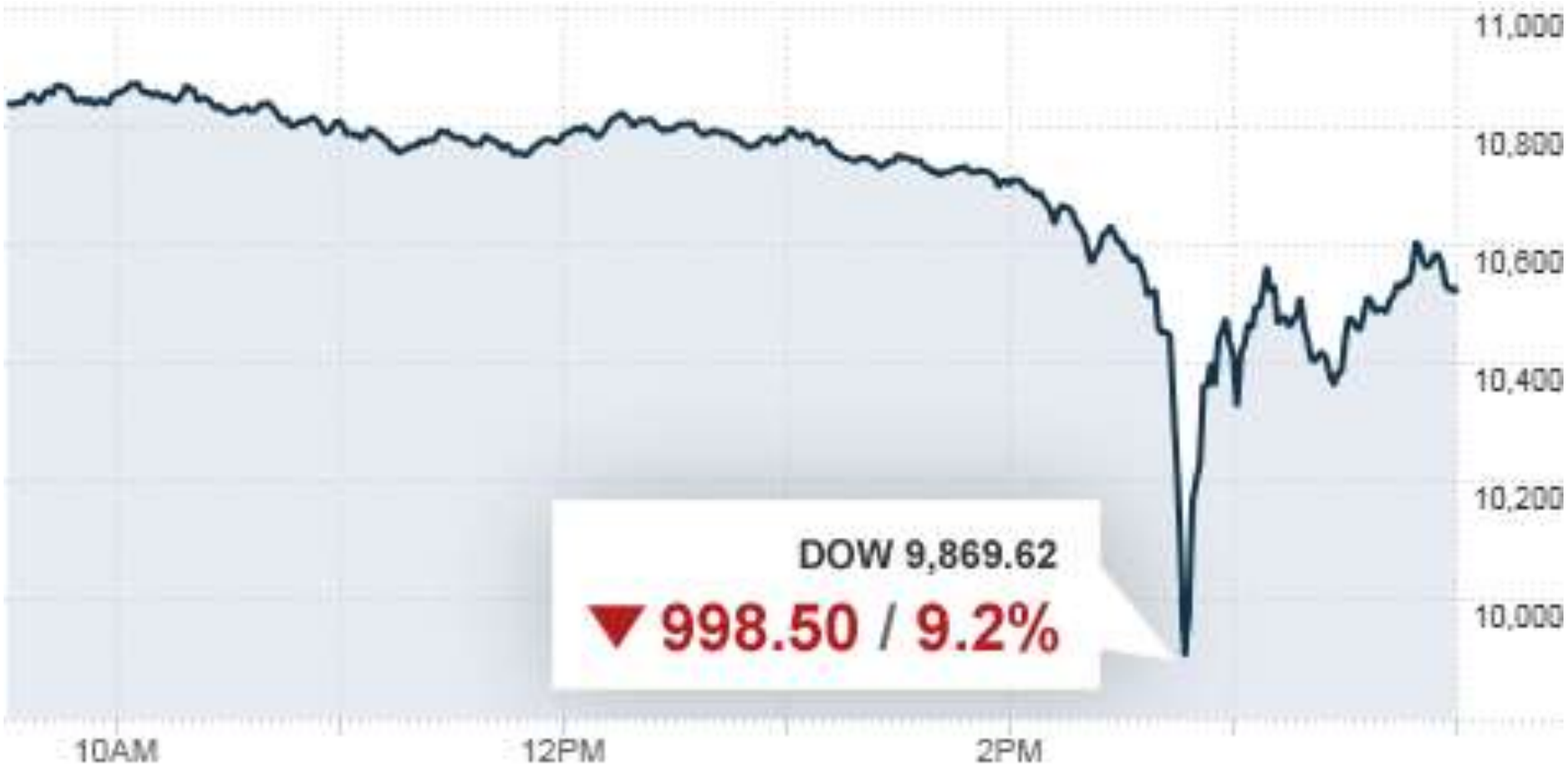
II. an absence of data on how lawyers divide their time among various tasks, only some of which can be automated;

III. conformance to the values, ideals and challenges of the profession."

Source: Frank Levy et al "Can Robots Be Lawyers? Computers, Lawyers, and the Practice of Law" (December 30, 2015) SSRN

Brittleness

Algorithmic Trading – Flash Crash



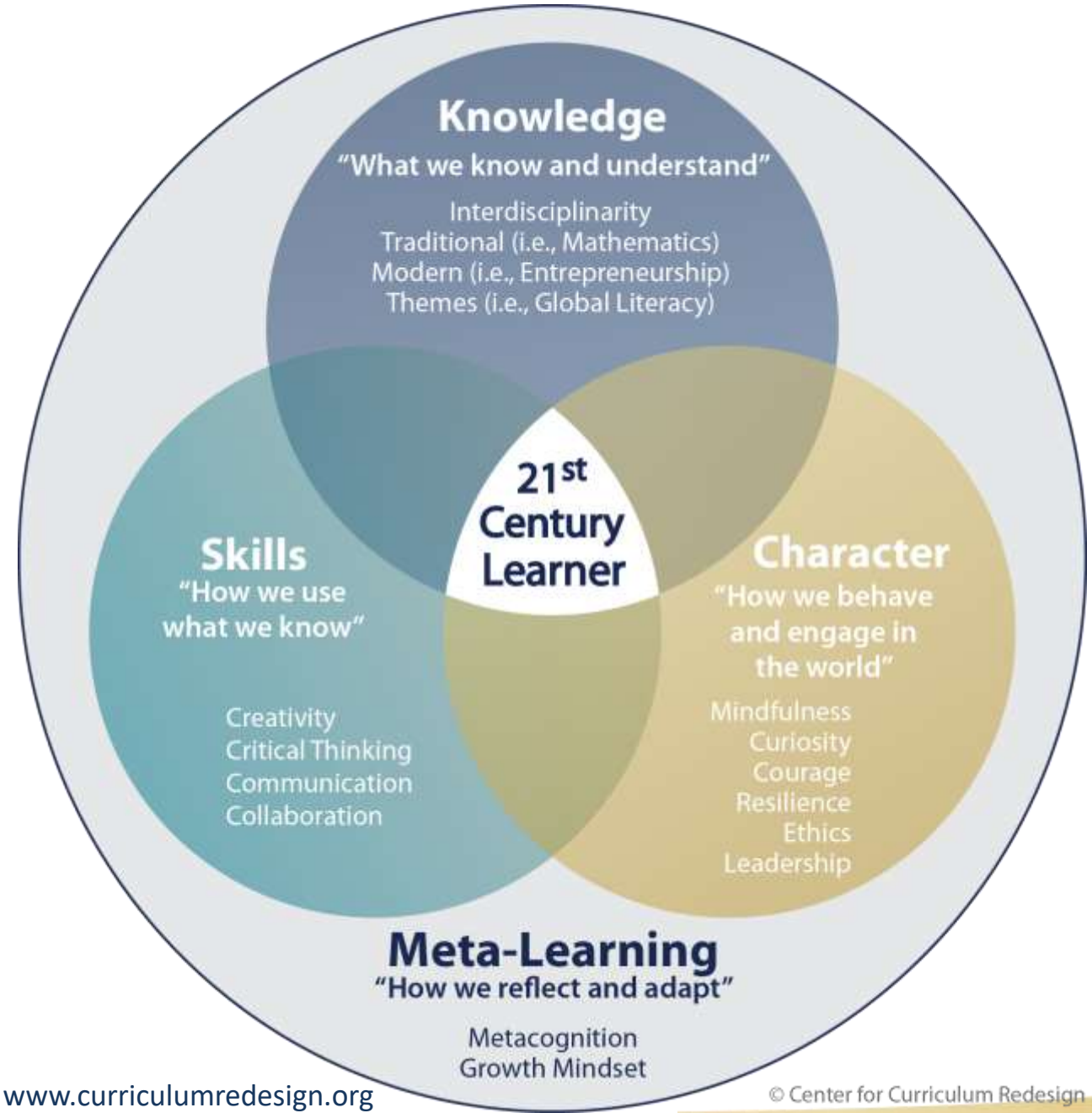
>60% of volume is now “high-speed trading”

Symbiosis

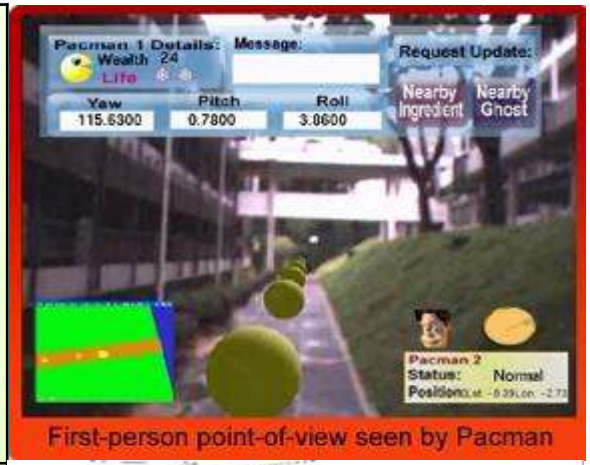
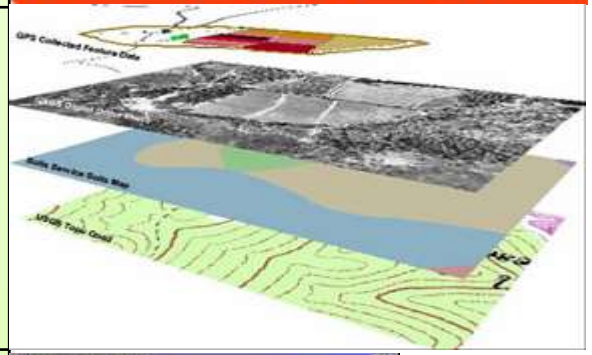
Source: Aaron Kobler

Present/Future world → Adaptability → Versatility as key strategy

21st Century Education Framework



Learning and ICT: Definitions & Examples

Learning *through* ICT (Teaching via ICT)	Simulations/Gaming Augmented reality Virtual reality E-Tutors Agents	 First-person point-of-view seen by Pacman
Learning *with* ICT (Teaching with ICT)	Use for Problem-solving (e.g. GIS + GPS + search; MatLab/SPSS; etc.)	
Learning *about* ICT (Acquire ICT knowledge)	Use standard apps (e.g. spreadsheets, search, etc.) and Robotics, Coding etc.	

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GLOSSARY OF ARTIFICIAL-INTELLIGENCE TERMS

ARTIFICIAL INTELLIGENCE

Broadest term, applying to any technique that enables computers to mimic human intelligence, using logic, if-then rules, decision trees, and machine learning.

- MACHINE LEARNING

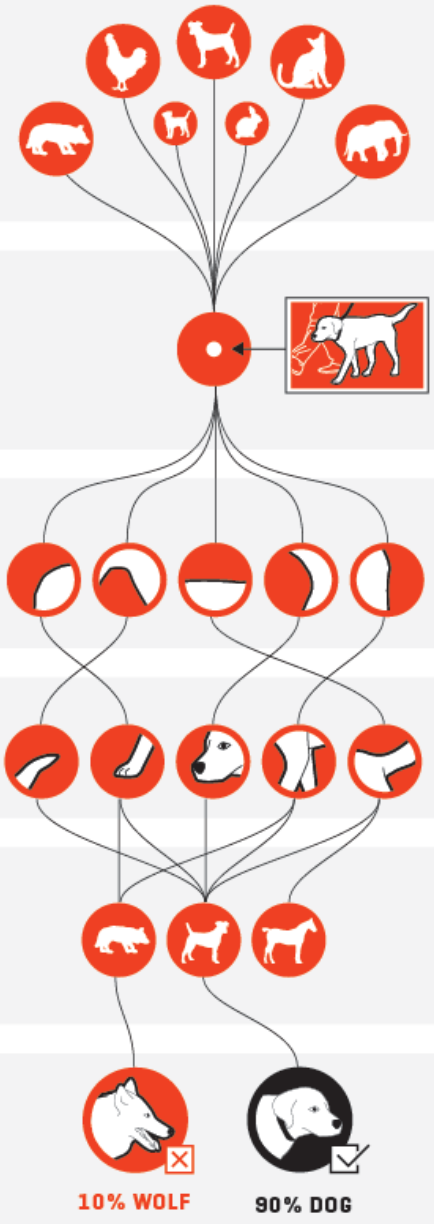
  Subset of AI that includes statistical techniques that enable machines to improve at tasks with experience.

  - DEEP LEARNING

    Subset of machine learning composed of algorithms that permit software to train itself to perform tasks, like speech and image recognition, by exposing multilayered **neural networks** to vast amounts of data.

Source: http://fortune.com/ai-artificial-intelligence-deep-machine-learning/

HOW NEURAL NETWORKS RECOGNIZE A DOG IN A PHOTO



TRAINING
During the training phase, a neural network is fed thousands of labeled images of various animals, learning to classify them.

INPUT
An unlabeled image is shown to the pretrained network.

FIRST LAYER
The neurons respond to different simple shapes, like edges.

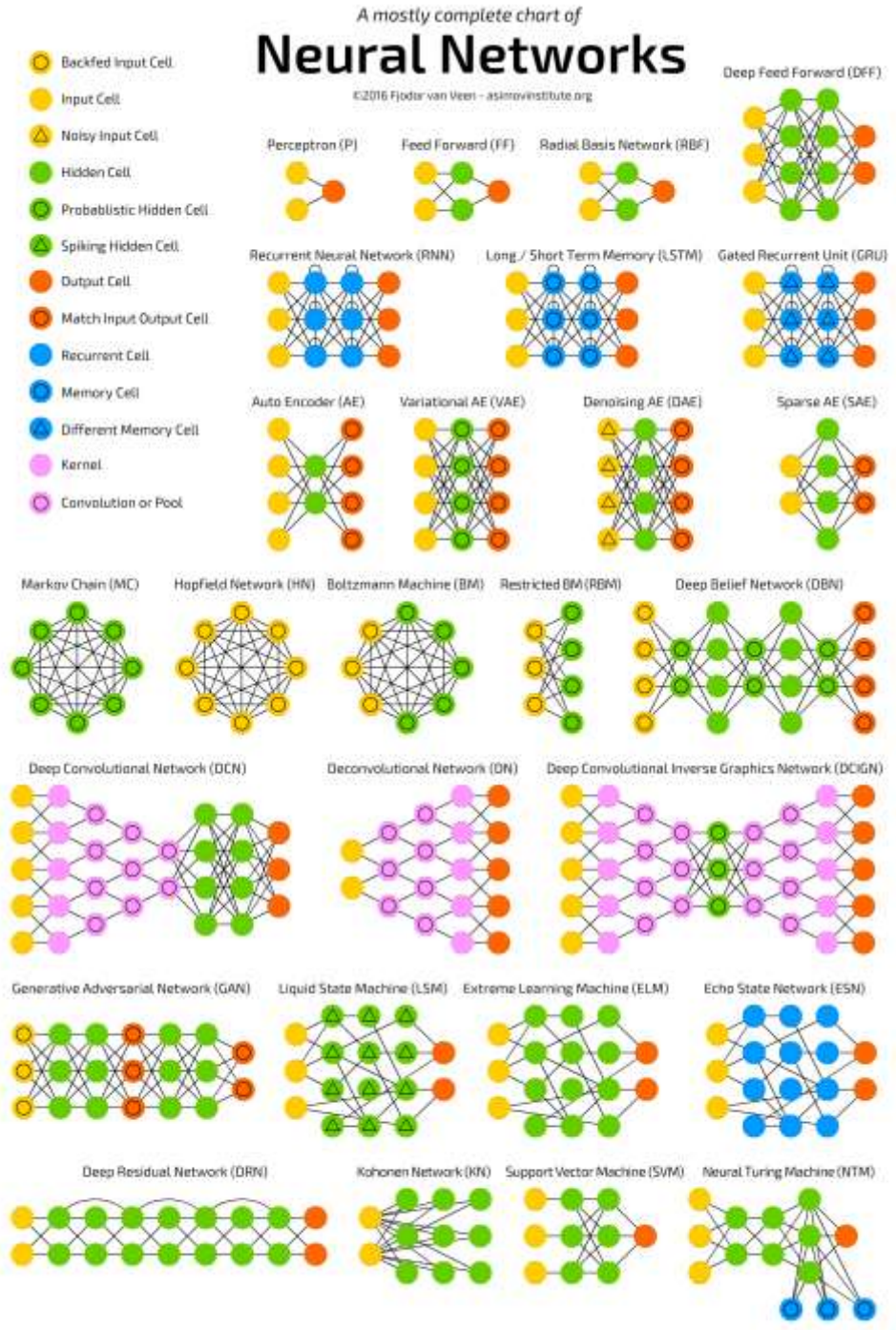
HIGHER LAYER
Neurons respond to more complex structures.

TOP LAYER
Neurons respond to highly complex, abstract concepts that we would identify as different animals.

OUTPUT
The network predicts what the object most likely is, based on its training.

10% WOLF

90% DOG



Human + Machine

IBM Watson: collects and assess patient data to construct “inference paths” toward a probable diagnosis to aid physicians.

Gary Kasparov re chess: “Weak human + machine + better process is superior to a strong computer alone, and superior to a strong human + machine + inferior process”.

Google DeepMind: “Climate, disease... AI-assisted science will help the discovery process.”

"Event Horizon":

- What if formal education cannot catch up ?
- Will we *need* AI to catch up?

Thank you !

"*What* should students learn for the 21st century?"