



Universidad  
de Alcalá

# Artificial Intelligence

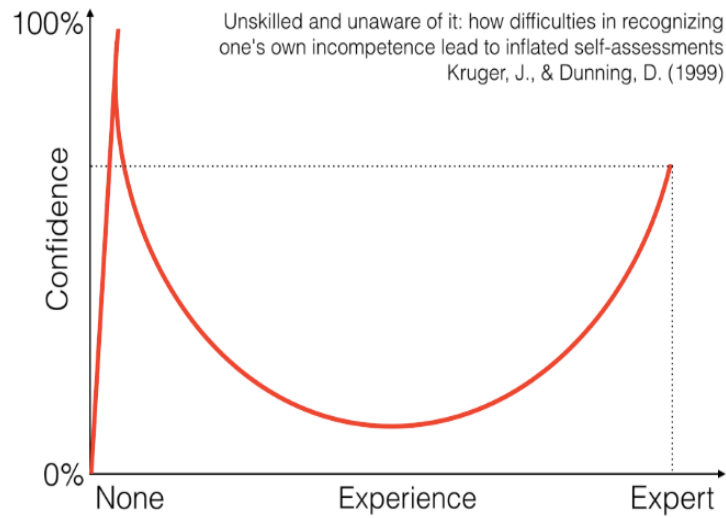
## Introduction

Prof. Ignacio Olmeda

WHAT IS AI?

התקנת מערכת ההגנה של הרכב  
התבצעה בהצלחה. הרכב  
הוא מוכן לנסיעה. הנהג  
הוא אחראי על ביטחון הרכב  
ועל שמירת המידע האישי.

## Dunning-Kruger Effect



DR, 1984





SINCE 1828

JOIN MWU | GAMES | BROWSE THESAURUS | WORD OF THE DAY | WORDS AT PLAY

artificial intelligence

DICTIONARY

THESAURUS

# artificial intelligence noun

## Definition of *artificial intelligence*

- 1 : a branch of computer science dealing with the simulation of intelligent behavior in computers
- 2 : the capability of a machine to imitate intelligent human behavior



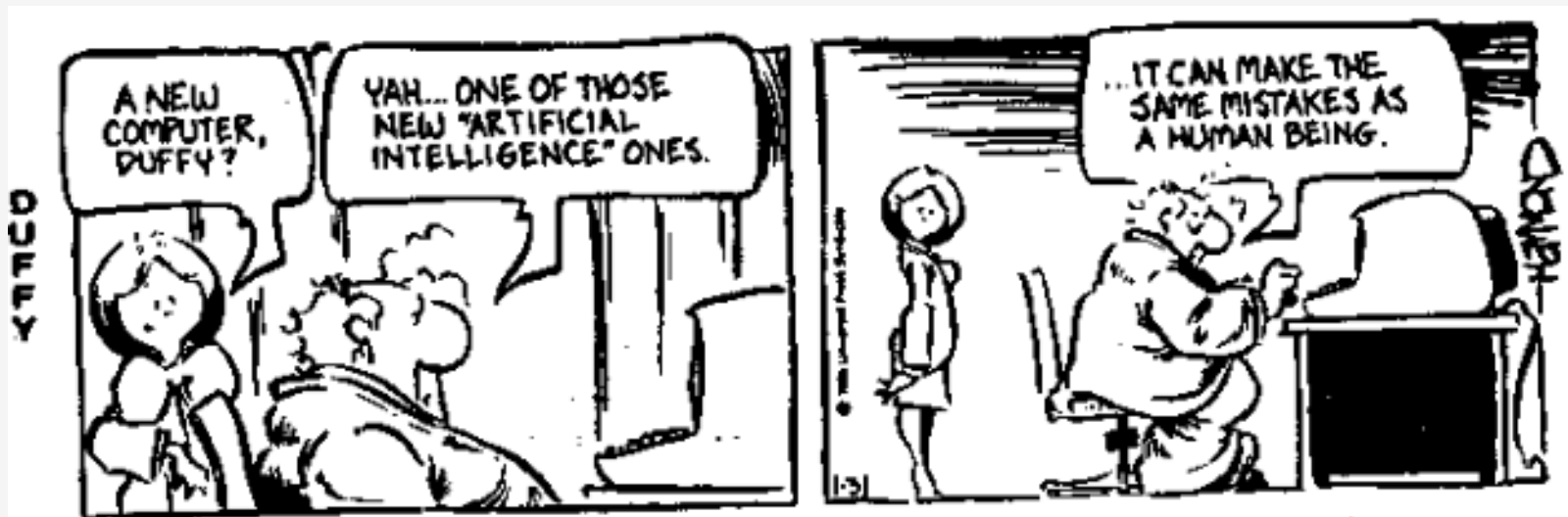
McCarthy: "the science and engineering of making intelligent machines."

It is related to the similar task of using computers to understand human intelligence, but note that AI does not have to be limited to methods biologically observable.

Two approaches:

- Computational Models of Human Behaviour (external)
- Computational Models of Human Thought (internal)

Note that "human" is understood to be equivalent to "intelligent"



## Artificial Intelligence

人工智能

Rén 人 = man

Gōng 工 = work

Zhì 智 = knowledge

Néng 能 = ability

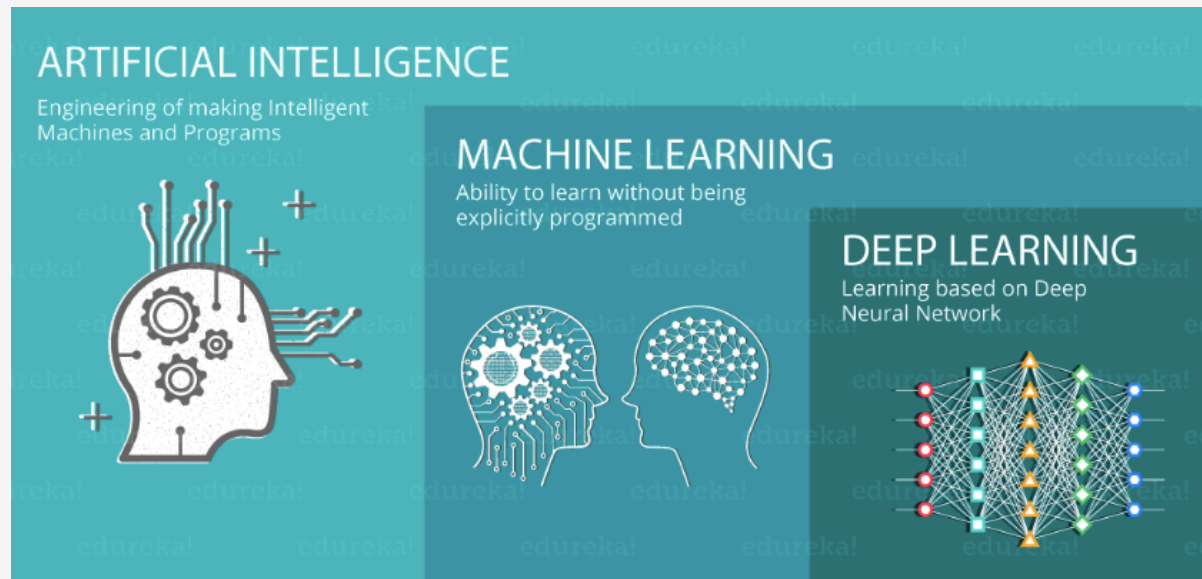
*Réngōngzhìnéng*

“ability to have knowledge in something created by humans”

# MODELS

AI  $\neq$  ML  $\neq$  DL...

- AI is more general than *Machine Learning* or *Deep Learning*).



- During decades, AI has focussed on symbolic learning but nowadays the imperant paradigm is *sub-symbolic*.

## "Primitive" AI : Expert Systems

- Rules (*IF...THEN*):
  - IF it rains THEN there will be a traffic jam
  - IF there is a traffic jam THEN I will be late
  - IF I am late THEN I will lose my job

Facts: *It rains*

+

Inference engine

=

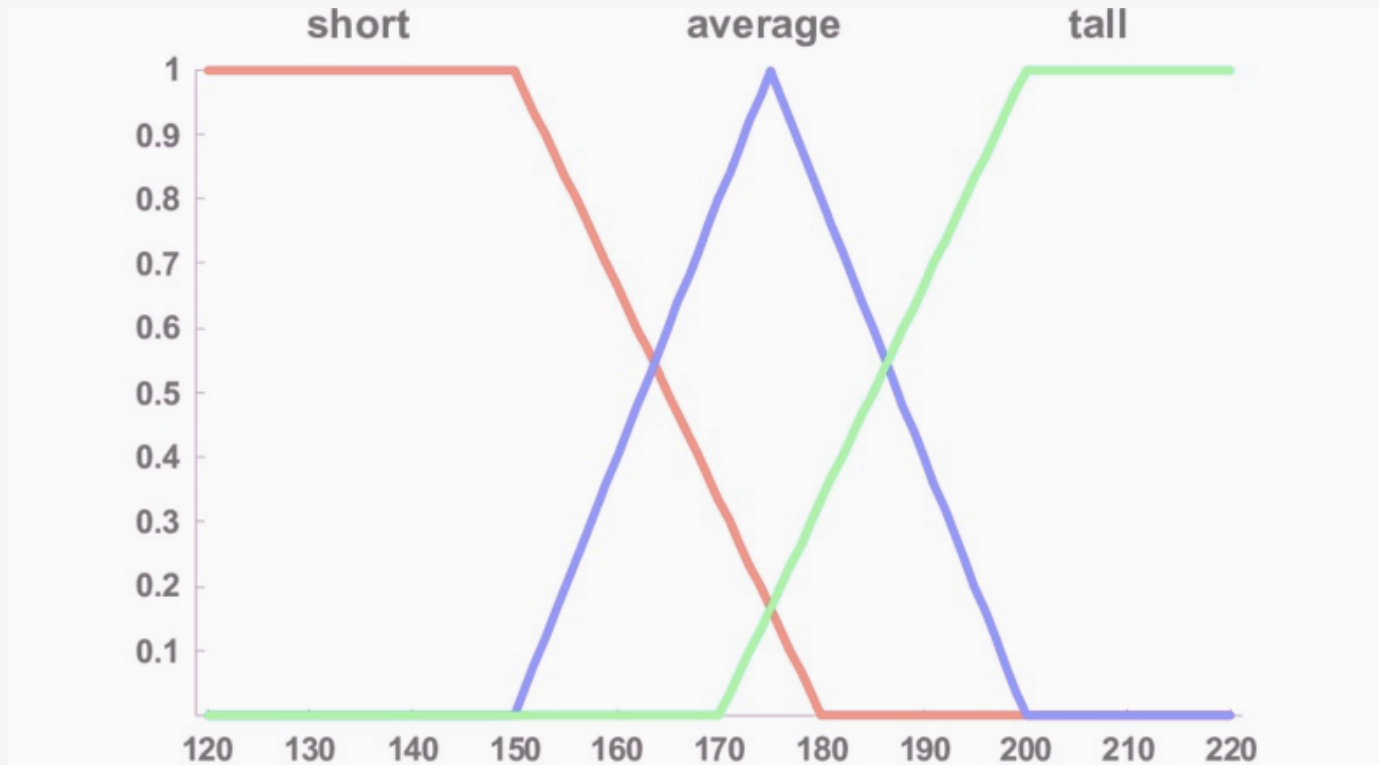
Consequences: *I will lose my job*

## “Intermediate” AI: Fuzzy Logic

Traditional Logic: {0,1}

vs.

Fuzzy Logic: [0,1]

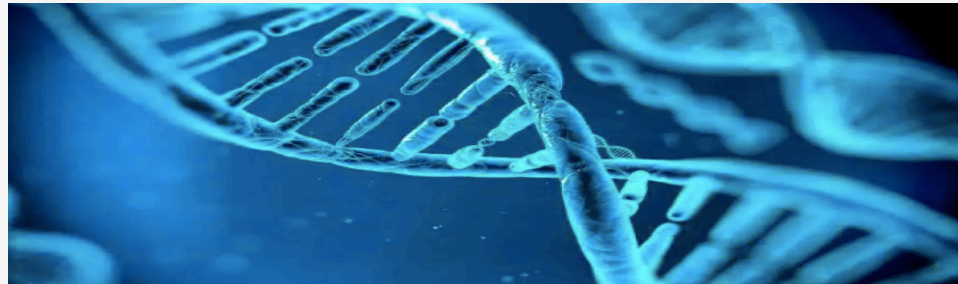


## “Modern” AI

Classification and Regression Trees, k-Nearest Neighbours, K-means, K-prototypes, LVQ, MARS, Grammars, Ontologies, Case Based Reasoning, Cellular Automata, Swarm Models, Reinforced Learning, Hidden Markov Models, Bayesian Networks....

Prominently:

*Genetic Algorithms*



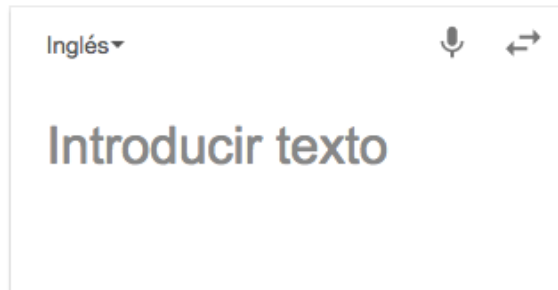
*Deep Learning*





# WHY AI IS "TRENDY"

# 1. It works!



Abrir en el Traductor de Google

## Traductor de Google

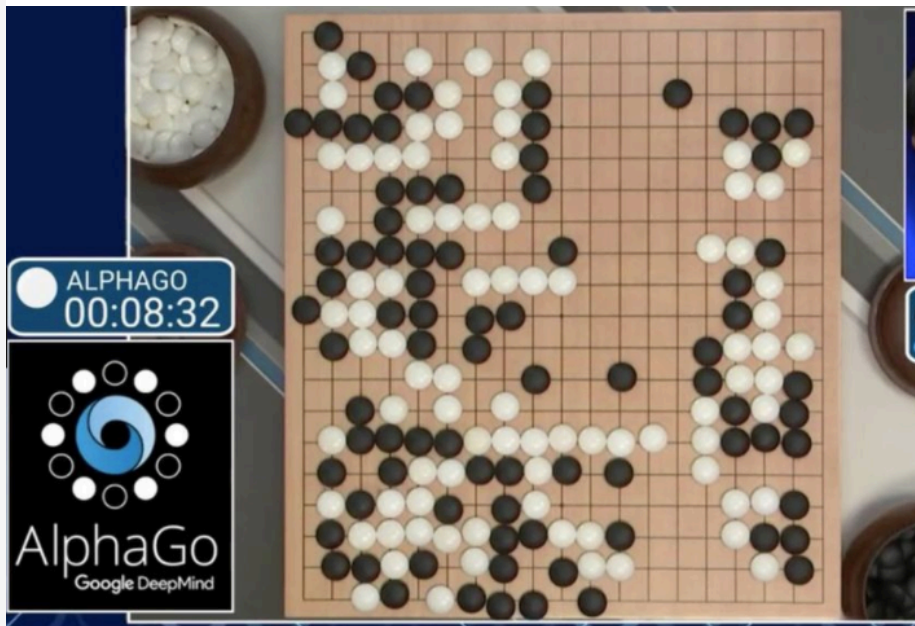
<https://translate.google.com/?hl=es>

El servicio gratuito de Google traduce instantáneamente palabras, frases y páginas más de 100 idiomas y viceversa.



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## DARPA Announces \$2 Billion Campaign to Develop Next Wave of AI Technologies

*DARPA's multi-year strategy seeks contextual reasoning in AI systems to create more trusting, collaborative partnerships between humans and machines*

OUTREACH@DARPA.MIL  
9/7/2018



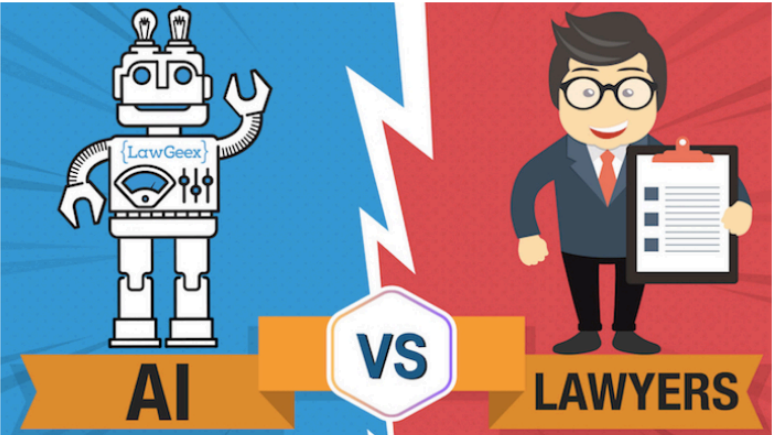
- Not only in games,; for example, in 1998 LawGeex pitted 20 experienced attorneys against a three-year-old algorithm trained to evaluate contracts.
- The contacts were Non Disclosure Agreements and the humans/ machine had to identify 30 legal terms and issues.

TECH

# AI Beats Human Lawyers At Their Own Game

BY STEPHANIE MLOT 02.26.2018 :: 1:30PM EDT

f t in p 39 SHARES

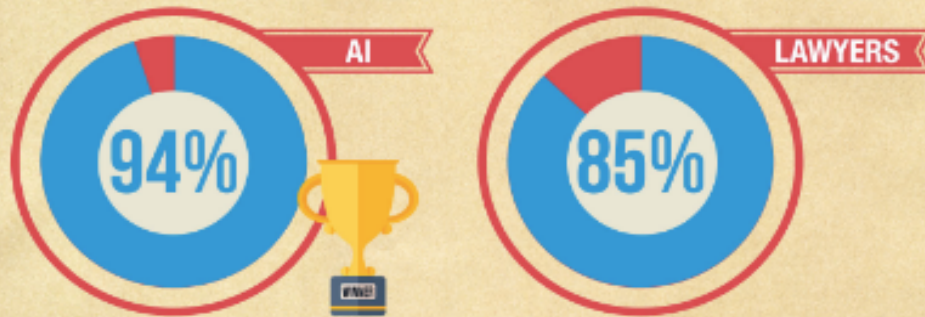


The neural network boasts 94 percent accuracy (versus humans' 85 percent) (via LawGeex)

Experienced US lawyers took on Artificial Intelligence in spotting risks in a daily legal task — reviewing and approving everyday contracts.



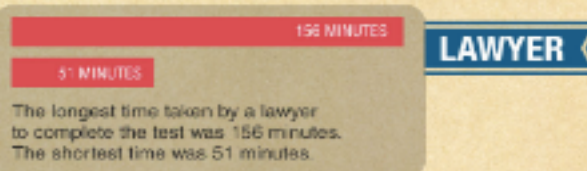
## ACCURACY LEVEL



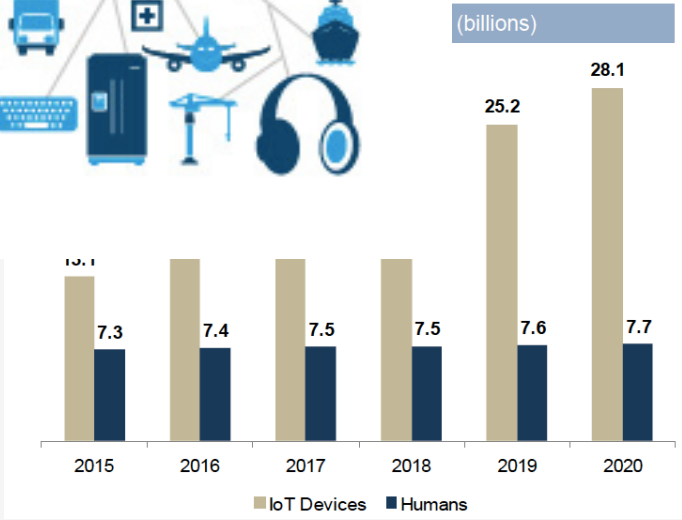
The AI achieved an accuracy level of 94%, compared to an average accuracy level of 85% across 20 human lawyers.



## TIME TAKEN



# 2. Data Availability





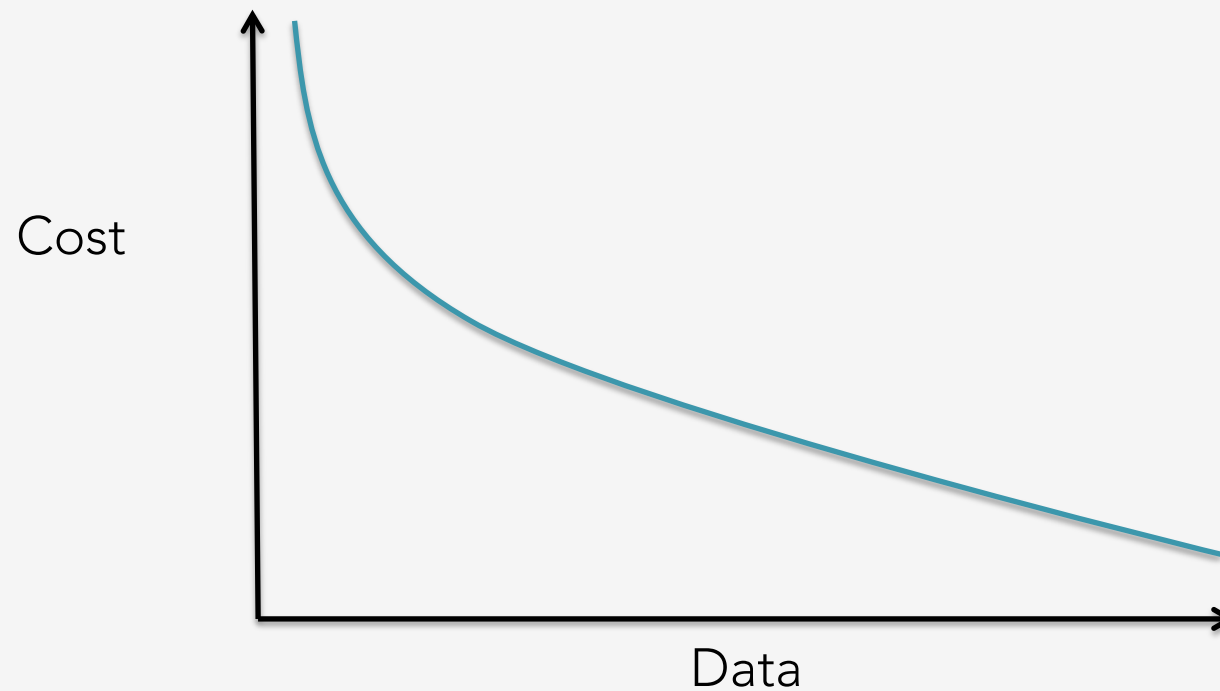
- “Neoclassical”

$$\text{Production}_{\text{until 2000}} = f(K,L)$$

- Actual

$$\text{Production}_{\text{after 2000}} = f(K,L,D)$$

Economies of Scale + Economies of Scope



## Netflix vs Blockbuster

- *Netflix* knew which movies were requested but were not available, *Blockbuster* not
- *Netflix* could recommend films according to customer's preferences, *Blockbuster* not
- *Netflix* could scalate easily (digital), *Blockbuster* not ("brick-and-mortar")
- *Netflix* could manage its inventory depending on customer needs, *Blockbuster* no



*Nextflix* is a giant, *Blockbuster* no longer exists



## Data Giants





### 3. Computing Power

CPU



GPU

TITAN TITAN V TITAN Xp

TITAN V VOLTA DESIGN SPECS GALLERY BUY NOW

## NVIDIA TITAN V

NVIDIA's SUPERCOMPUTING GPU ARCHITECTURE, NOW FOR YOUR PC

NVIDIA TITAN V is the most powerful Volta-based graphics card ever created for the PC. NVIDIA's supercomputing GPU architecture is now here for your PC, and fueling breakthroughs in every industry.

**\$ 2,999.00**

**ADD TO CART**

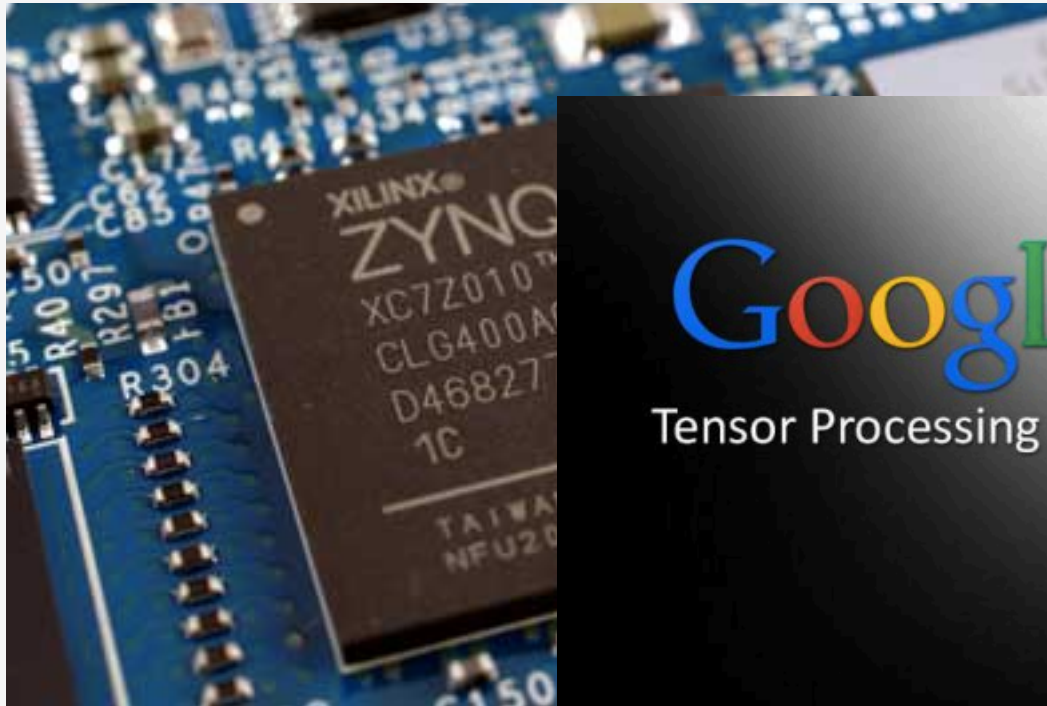
Free Shipping

Limit 2 per customer

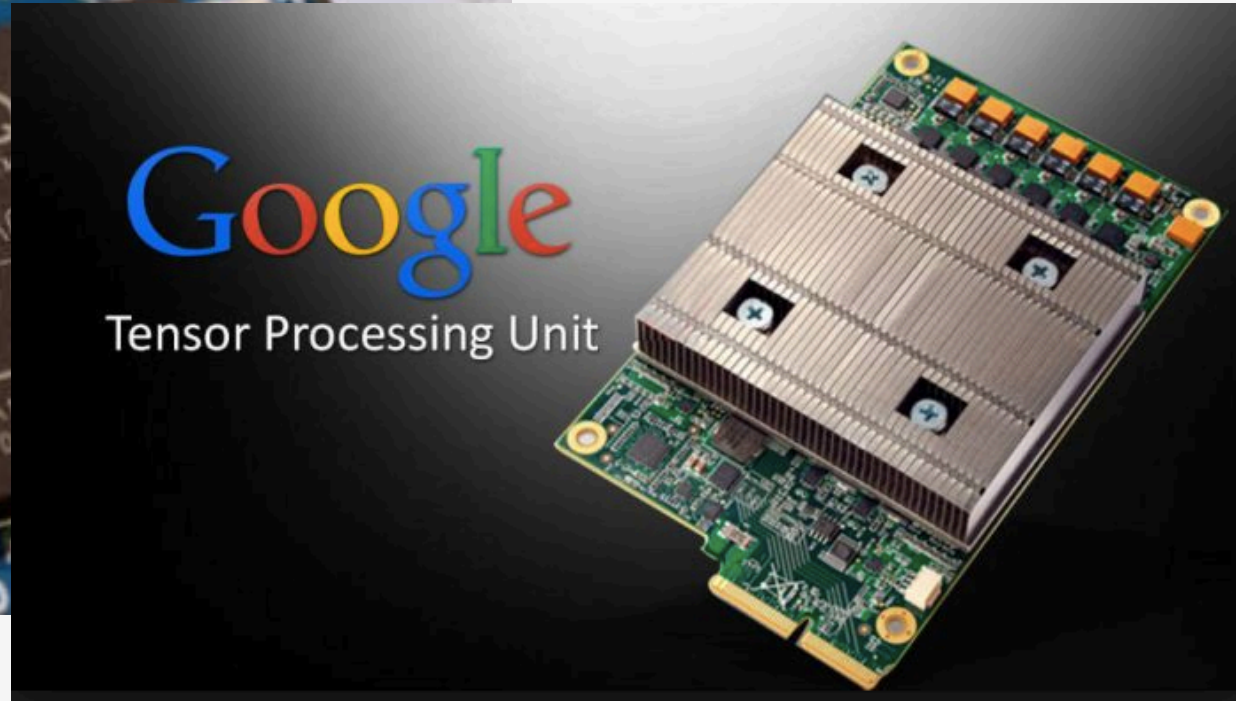
**WATCH FULL VIDEO**

Tensor Performance: 110 TeraFLOPS (1 TFLOP= $10^{12}$ FLOPS)

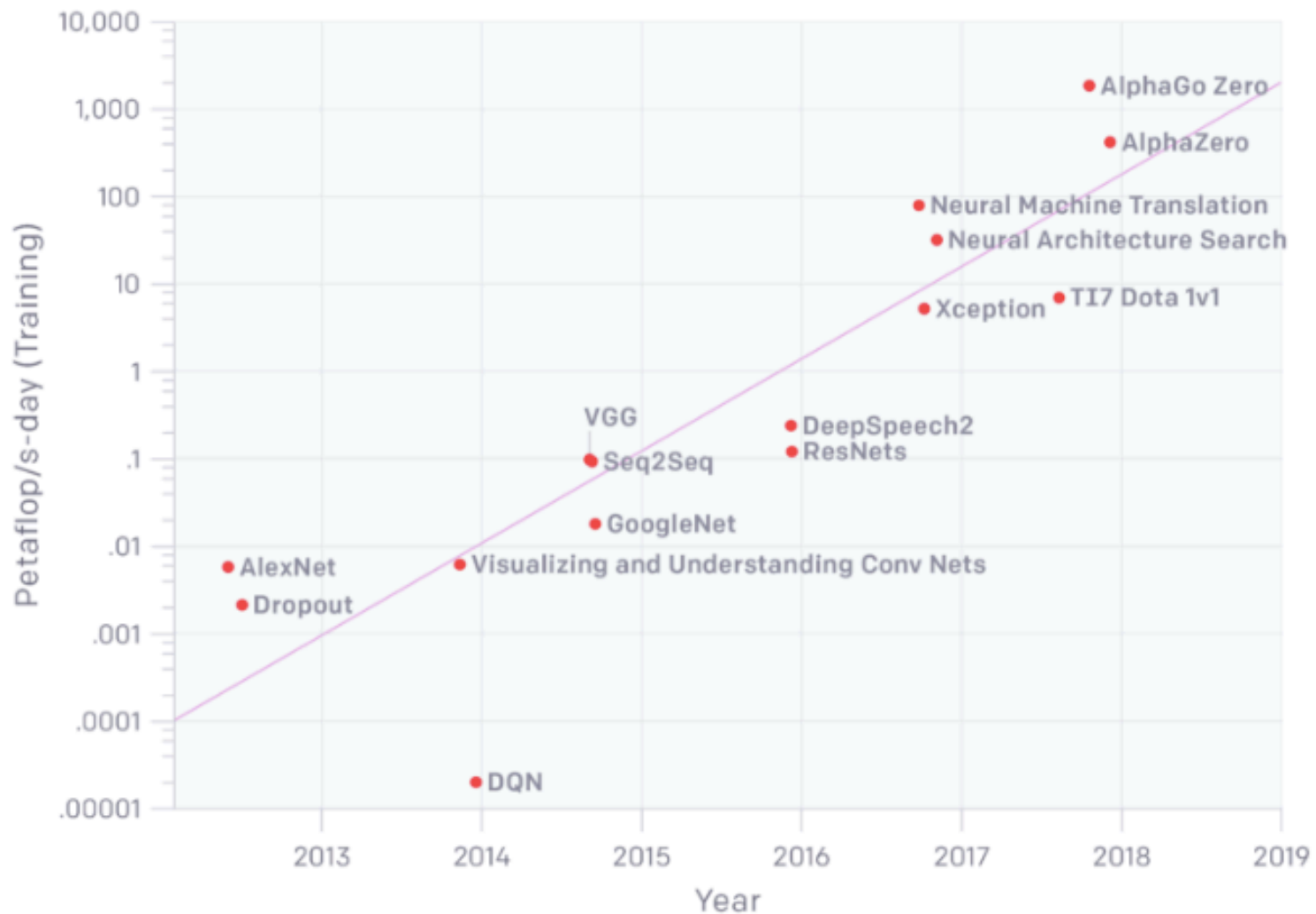
FPGA



TPU



## AlexNet to AlphaGo Zero: A 300,000x Increase in Compute



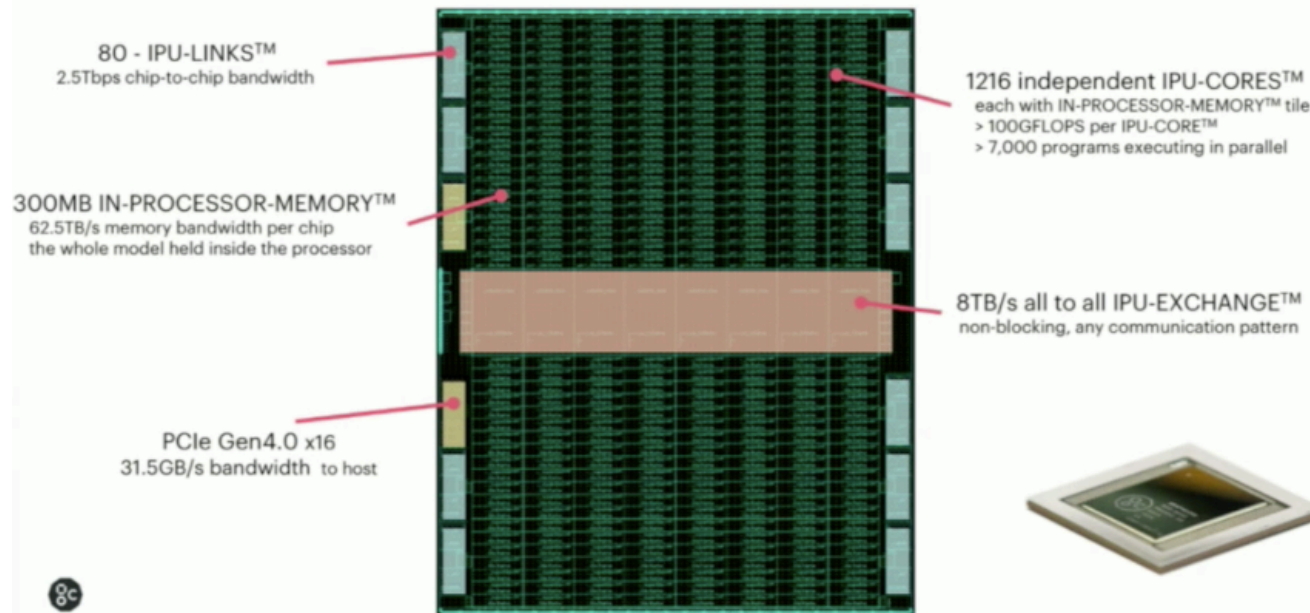
The amount of compute in petaflops per seconds for one day that was used to train the largest neural networks. A petaflop is a computing speed of  $10^{15}$  floating-point operations per second

IPU

# ACCELERATING NEXT GENERATION ARTIFICIAL INTELLIGENCE

## COLOSSUS GC2

the worlds most complex processor chip with 23.6Bn transistors



≈2 PFLOPS  
10 to 100 faster than the fastest GPU

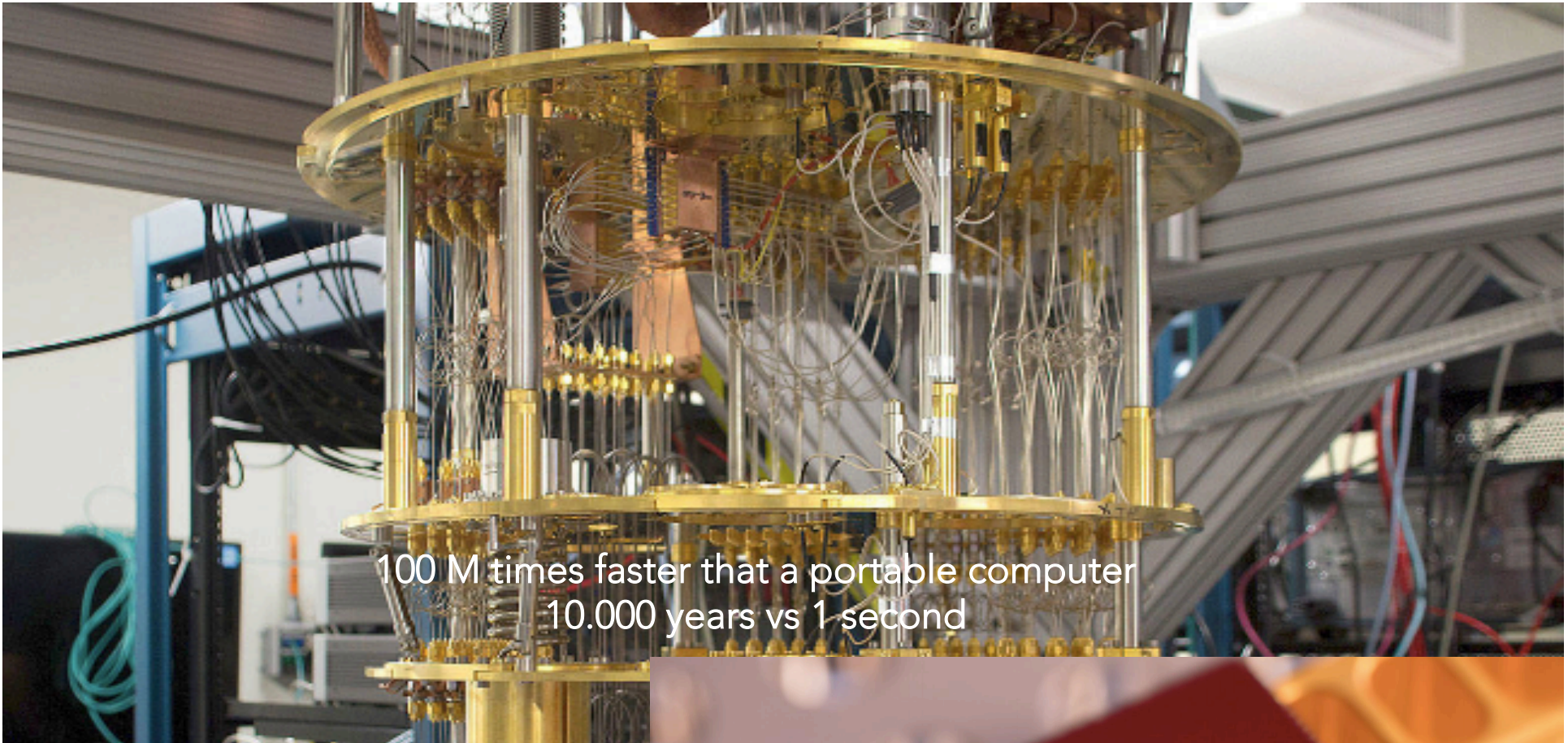




200 PFLOPS (aprox 20.000 times faster than Titan V)

In 2021 FRONTIER will reach 1 EFLOPS  
(1.000 PFLOPS)





100 M times faster than a portable computer  
10.000 years vs 1 second



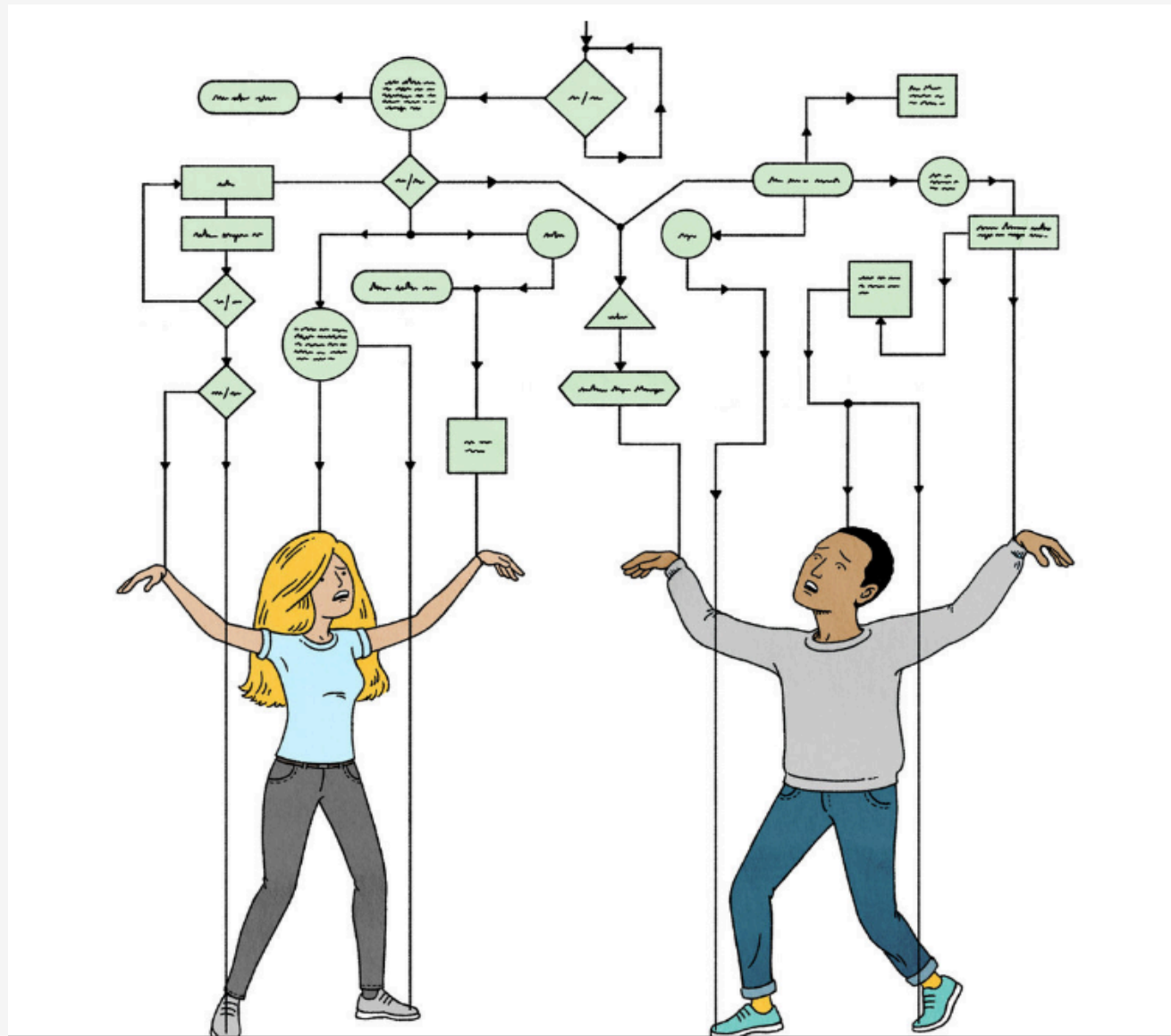
Photo: Erik Lucero

## 4. Algorithmic/Modelling advancements

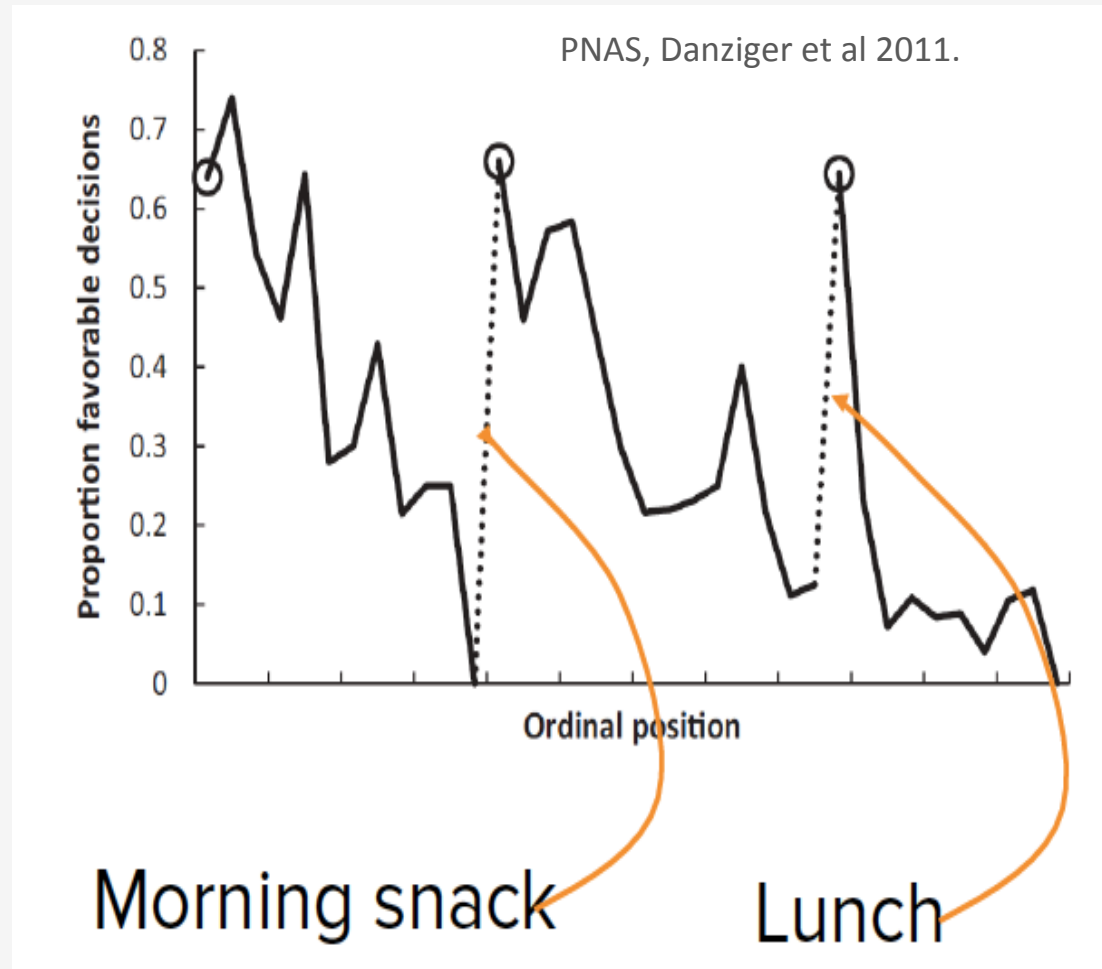
- RELU units vs. Sigmoid units
- Deep Networks vs. Single layer networks
- Improvements in learning (e.g. Adam) and Meta-learning vs. standard backprop
- Convolutional Networks, GANs,...
- "Raw" representation vs. Feature pre-processing
- ....

# DILEMMAS

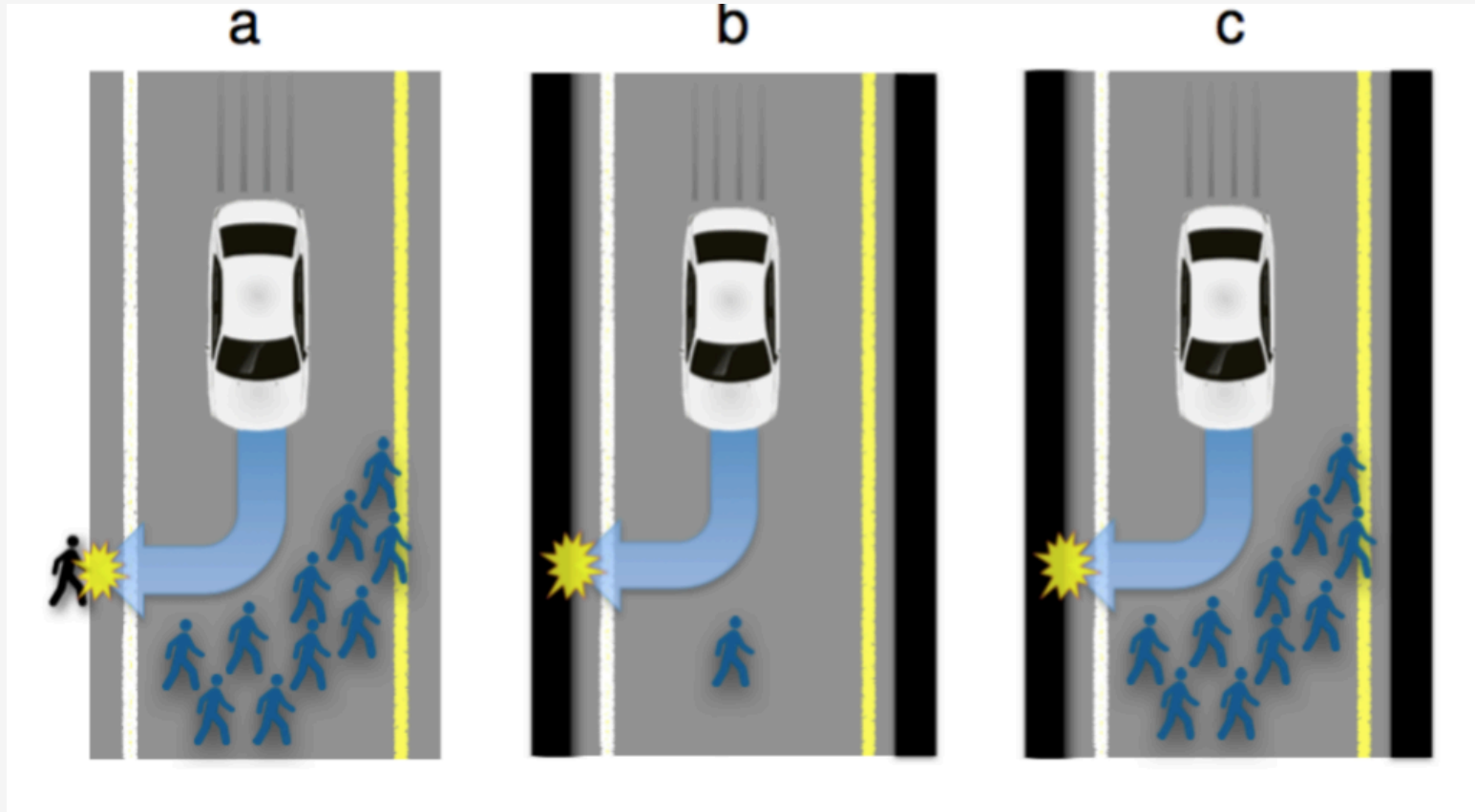




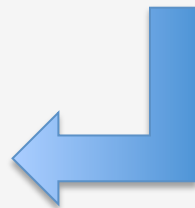
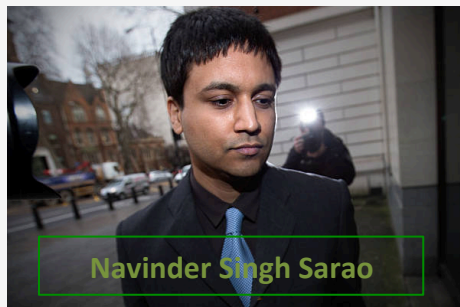
- Who should take the decisions?



- Which decisions must be taken?



- Who is responsible for the decisions?



OK (+/-)



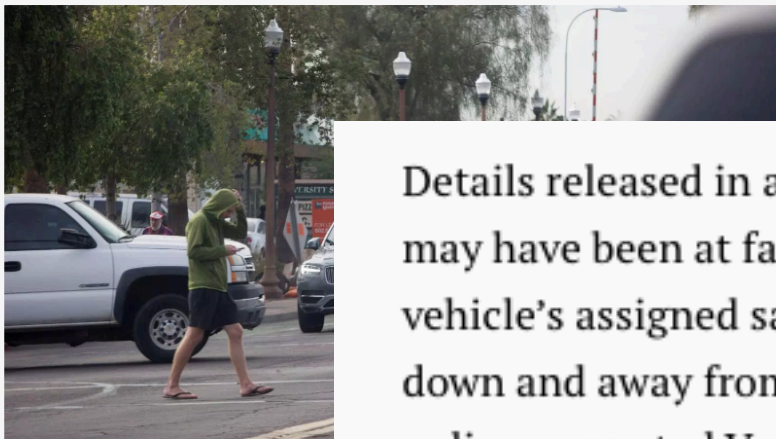
????



IN THE CLEAR

# Uber found not criminally liable in last year's self-driving car death

By Alison Griswold · March 6, 2019



Mind the walkway.

Enjoy this content in the new Quartz app

Uber inv

Details released in a [Tempe police report](#) in June suggested the driver may have been at fault. Video footage showed Rafaela Vasquez, the vehicle's assigned safety monitor that night, repeatedly glancing down and away from the road. Additional information obtained by police suggested Vasquez was watching an episode of NBC talent show *The Voice* at the time of the collision. Vasquez could face charges of vehicular manslaughter.

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Business

## Who to Sue When a Robot Loses Your Fortune

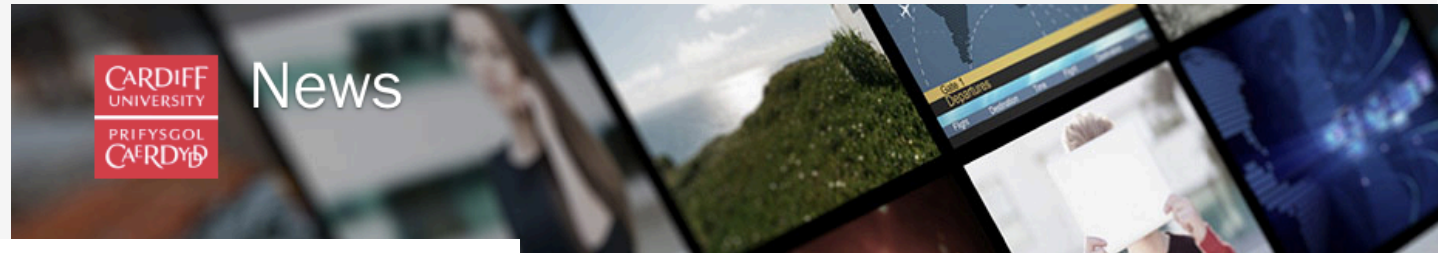
The first known case of humans going to court over investment losses triggered by autonomous machines will test the limits of liability.

By [Thomas Beardsworth](#) and [Nishant Kumar](#)

May 6, 2019, 2:00 AM GMT+2



- How decisions must be taken?












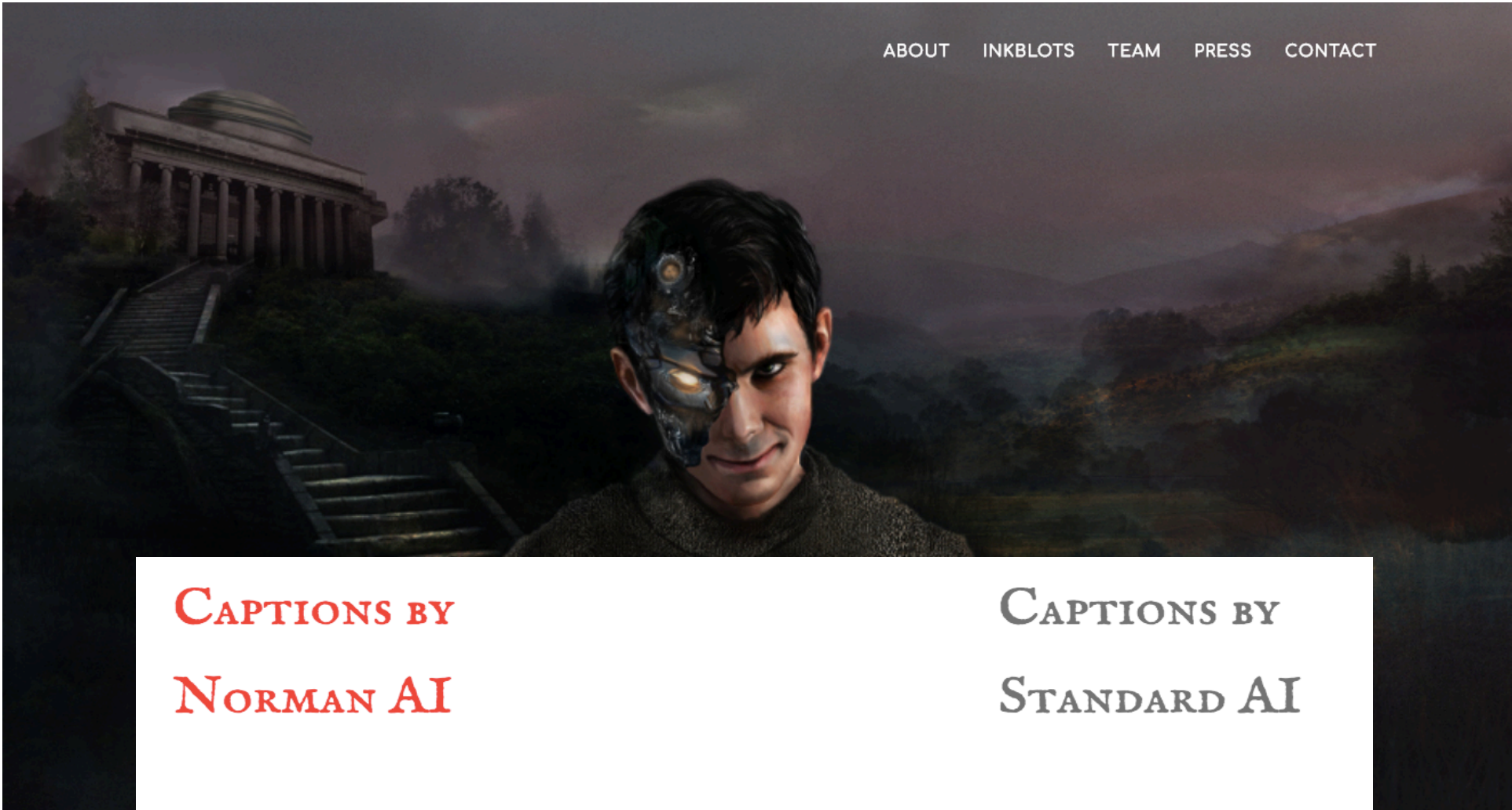
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## Could AI robots develop prejudice on their own?

7 September 2018



YES			
NO			
TEST			



CAPTIONS BY  
NORMAN AI

INKBLOT #1  
Norman sees:

“A MAN IS ELECTROCUTED  
AND CATCHES TO DEATH.”



CAPTIONS BY  
STANDARD AI

INKBLOT #1  
Standard AI sees:

“A GROUP OF BIRDS  
SITTING ON TOP OF A  
TREE BRANCH.”



- Which will be the impact on the labor market?

JOKE

Computer Seller: "This computer will eliminate half of your work"

Buyer: "Give me two"





# ONE POINT ON THE FUTURE OF AI



There are these two young fish swimming along and they happen to meet an older fish swimming the other way, who nods at them and says

“Morning, boys. How’s the water?”

And the two young fish swim on for a bit, and then eventually one of them looks over at the other and goes

“What the hell is water?”

AI is the new water