



# The Technology Tidal Wave: Even Death & Taxes Are Not Certain

CARSP Conference 2019, 29 May 2019

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The Conference Board of Canada / Le Conference Board du Canada

# Automated Vehicles.

The Coming of the Next Disruptive Technology



DRIVING HOMES CLASSIFIEDS CAREERS OF



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HOME NEWS SPORTS ENTERTAINMENT LIFE TECH MONEY TRAVEL OP

TORONTO & GTA ONTARIO CANADA WORLD WEIRD ARCHIVES

NEWS CANADA

## Driverless cars would mean 'a lot more sex' behind the wheel: expert

TERRY PEDWELL, THE CANADIAN PRESS



# CAVCOE

- Foresee AV socio-economic effects on similar scale as the internet
- Almost every person, organization and business is a stakeholder
- Advise on impacts on operational and business models
- Public and Private Sector Clients

## AV Update

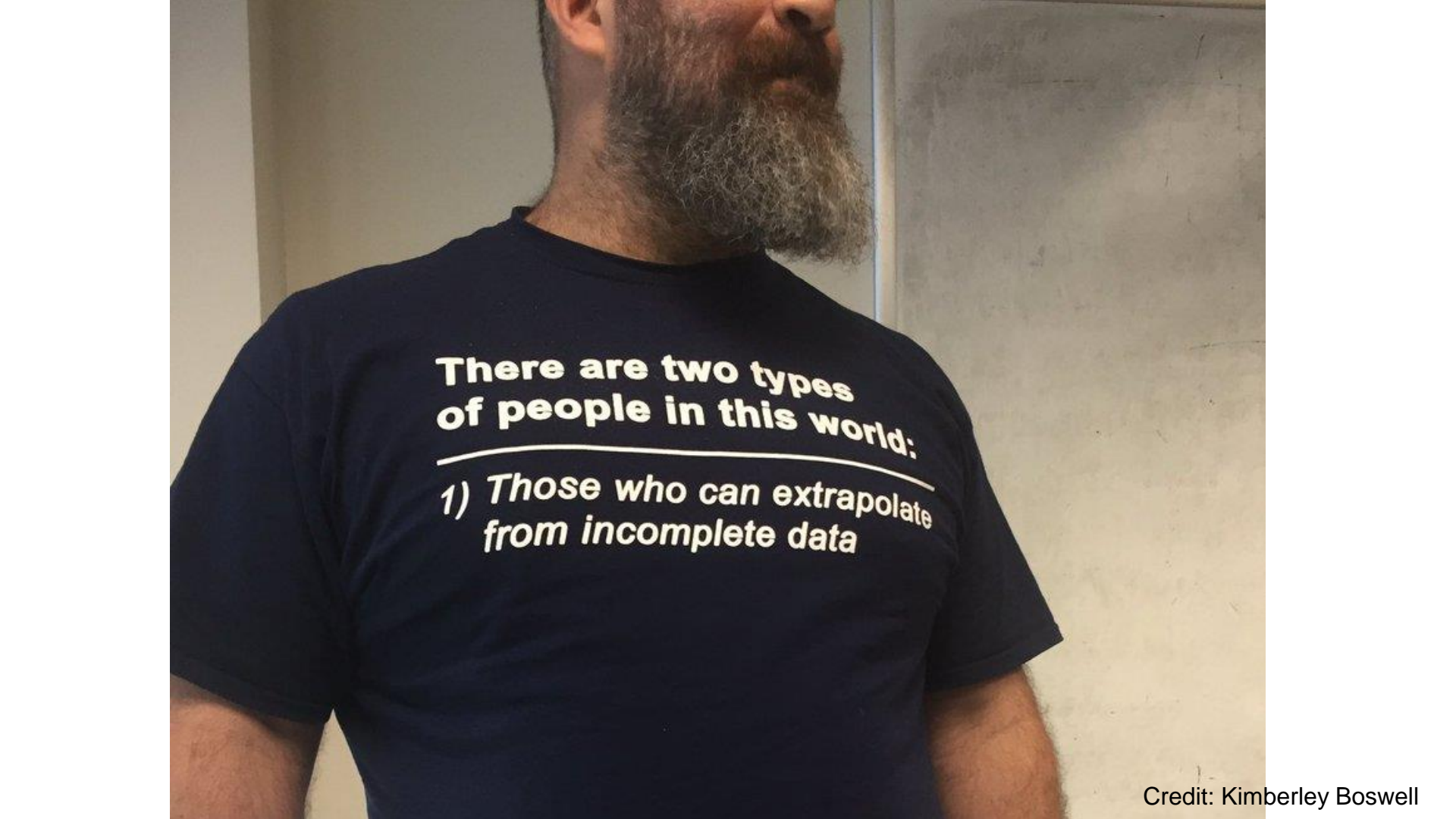


Renault-Nissan signs agreement with Transdev to develop self-driving, electric vehicles  
March 2017

### *From the Editors*

There has been another collision involving an AV, this time an Uber test vehicle. There has been a lot of reaction to it in the media. One of the key messages that we give at every opportunity is that no technology is perfect and all hardware and software fails occasionally. In a joint report written by CAVCOE, the Conference Board of Canada, and the Van Horne Institute, we predicted that AVs could prevent 80% of collisions and traffic deaths and injuries -- not 100%. We still see companies that use messaging about AVs that will be crash-proof and references to a zero-fatalities society.

**There is no such thing!** The more this kind of messaging is used, the greater the reaction from the media and the public when there are collisions and -- tragically -- traffic deaths. Our wish is that the AV industry stops all messaging about the technology being perfect and instead talk about autonomous and connected vehicles being much safer than today's human-driven vehicles -- but not perfect.

A man with a full, grey and brown beard is shown from the chest up, wearing a dark blue t-shirt. The t-shirt has white text printed on it. The text is arranged in two lines, with a horizontal line separating them. The background is a plain, light-colored wall.

**There are two types  
of people in this world:**

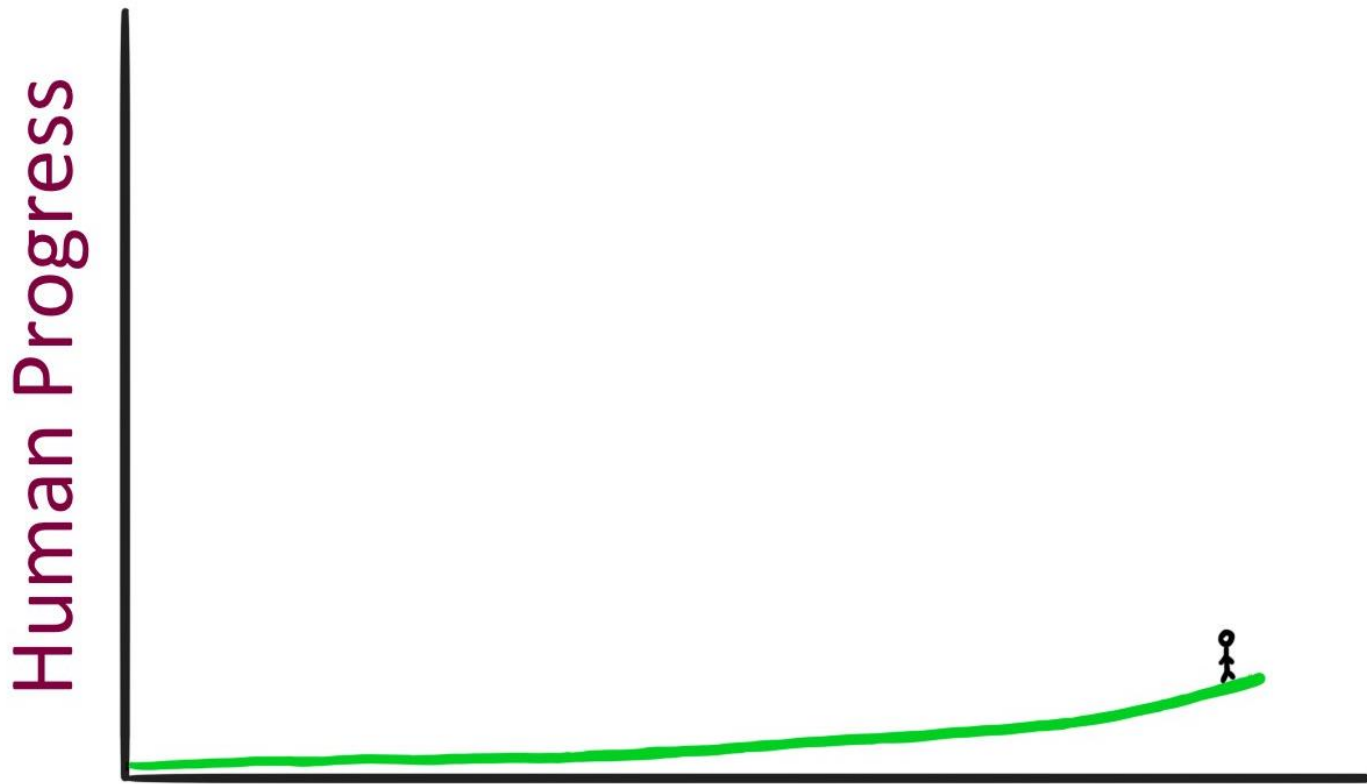
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- 1) *Those who can extrapolate  
from incomplete data***

# Technology Tidal Wave

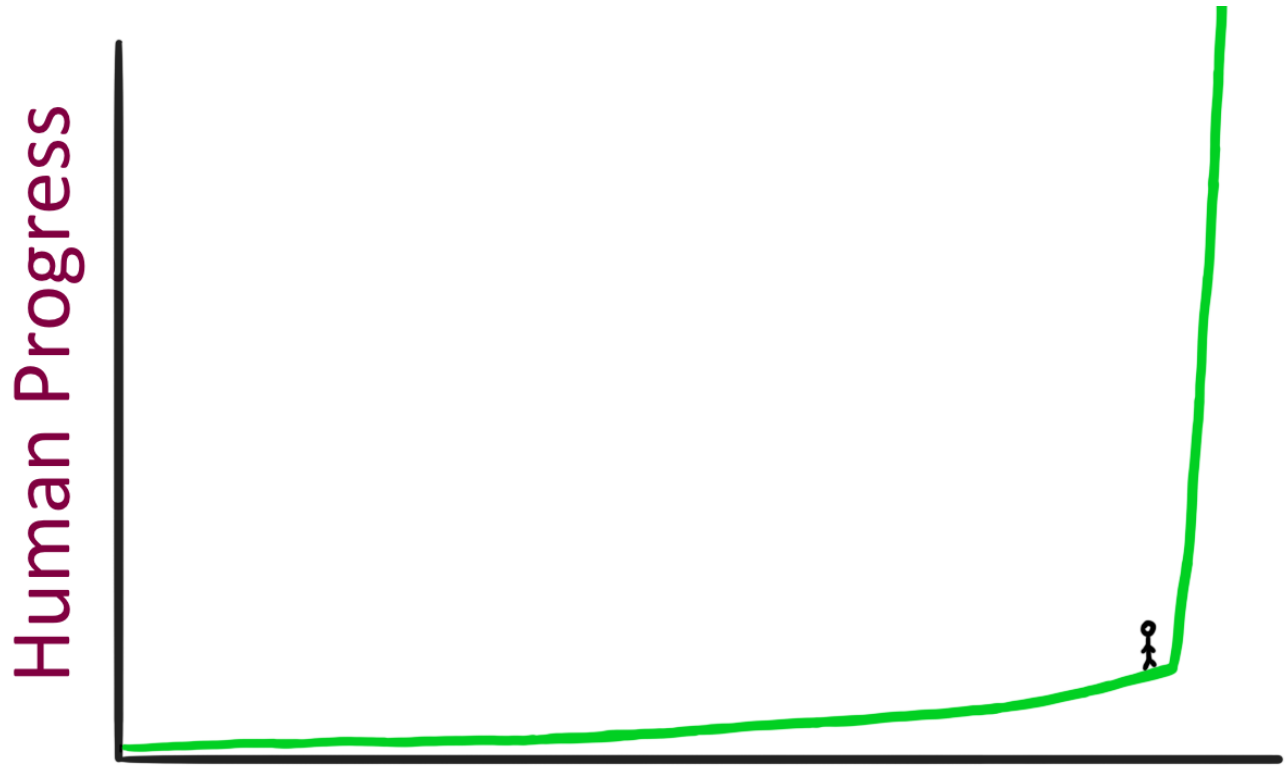
- **Exponential**
- Autonomous Vehicles
- Future Trends
- New Societal Construct?

# We know progress is accelerating...



With permission: [waitbutwhy.com](http://waitbutwhy.com)

# ...but do we understand what that means?



With permission: [waitbutwhy.com](http://waitbutwhy.com)

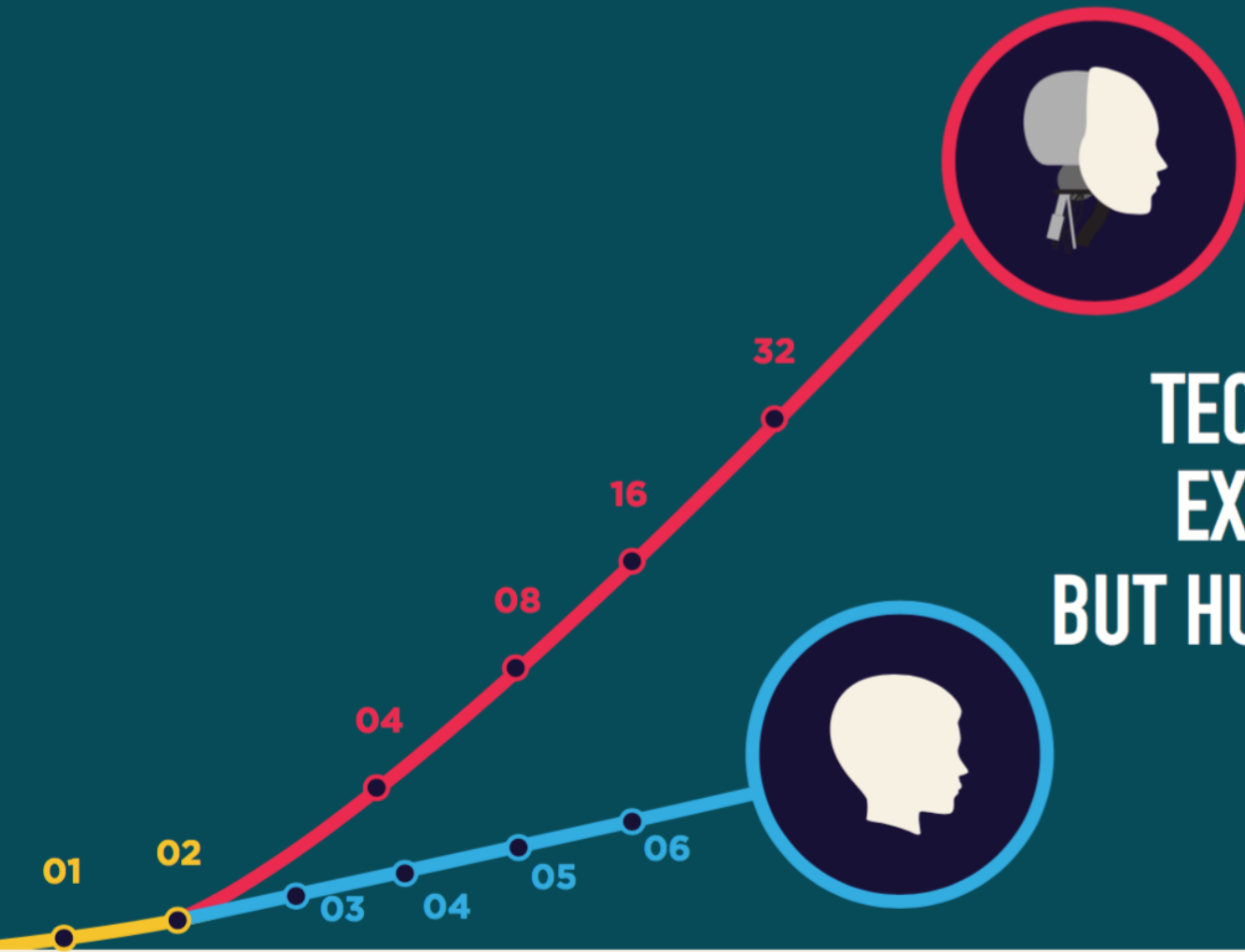
# My personal exponential



**1900-1910: 70%  
mortality rate**

**2012: <0.5%  
mortality rate**





**TECHNOLOGY IS  
EXPONENTIAL,  
BUT HUMANS ARE NOT.**

Credit: Gerd Leonhard

**When software touches things  
they disrupt.  
Software is now starting to touch  
EVERYTHING!**

# 10 years

2 billion  
smartphone  
users



# Radio Shack AMERICA'S TECHNOLOGY STORE

**PRESIDENTS' BIRTHDAY SALE!**



All-Weather Stereo  
**Cut 34% Off \$1188**  
Reg. \$1785

Realistic STEREO-MATE™ AM/FM personal receiver shrugs off hard weather. For real convenience.



AM/FM Clock Radio  
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Chromatonic™ 201 clock radio's compact size cuts neighborhood clutter. \$10.95.



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Realistic™ in-ear phones weigh just 0.8 ounces! With carry pouch. \$10.95.



Micro-Thin™ Calculator  
**39% Off \$488**  
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Radio Shack EC-413 is about the size of a credit card! Solar powered. No batteries.

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Mobile Cellular Telephone  
**Save \$100**  
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Tiny Dual-Superhet Radar Detector  
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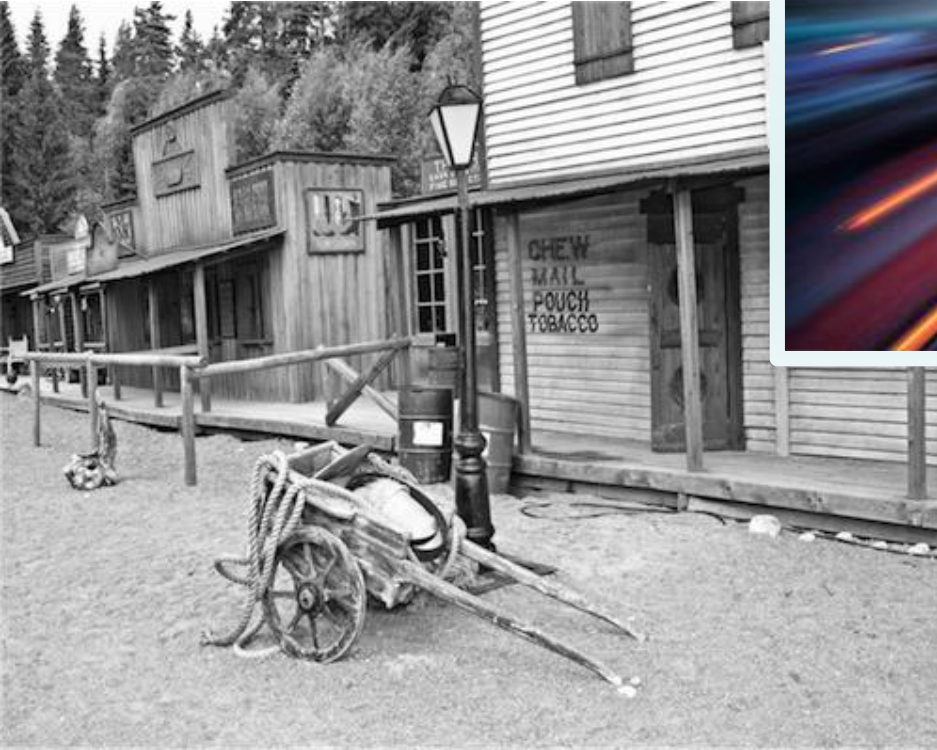
**20-Memory Speed-Dial Phone**

Cut 33% Off **299.95**

**Handheld Voice-Activated Cassette Tape Recorder**

40% Off **299.95**

**150 yrs in the past to  
now...**

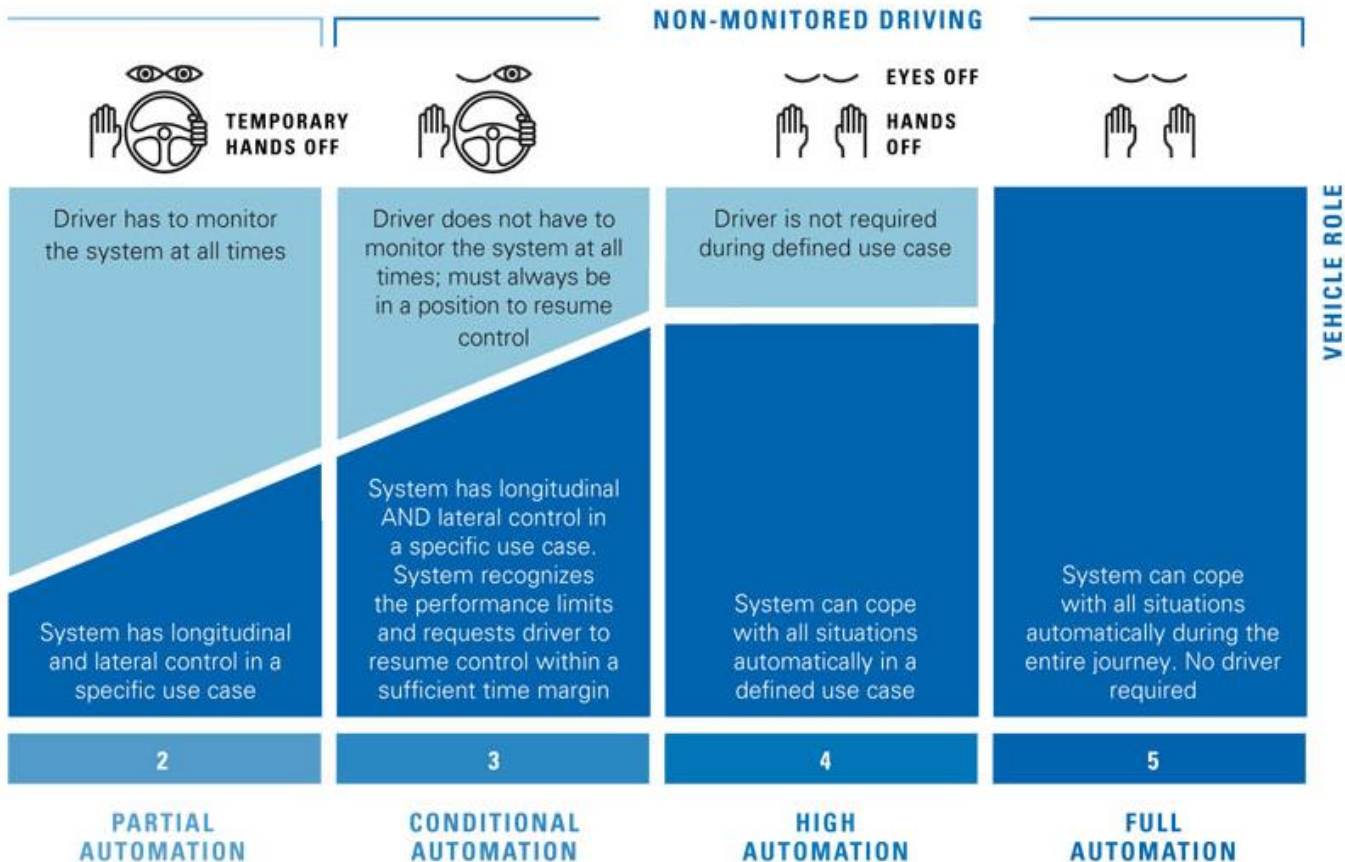


**...similar to now to  
25 yrs in the future**

# Technology Tidal Wave

- Exponential
- **Autonomous Vehicles**
- Future Trends
- New Societal Construct?

# SAE Levels 4 and 5





# Huge Impacts

- **Safety - 2,000 fatalities – save 80%? (3.9% GDP)**
- **Time – save 0.5 Bn hrs**
- **Shared TaaS**
- **Savings \$65bn/yr<sup>1</sup>**
- **Money flow >20%GDP?**

<sup>1</sup>Morgan Stanley est \$1.3Tn/yr for US

<sup>2</sup>CAVCOE estimate

# Suncor Autonomous Truck



Credit: Komatsu



**Tested in 2014. 150 ordered in 2015**

# 1<sup>st</sup> AV Service on Industrial Site, EDF Civaux, 2016



6 shuttles, 2k people save 20-25min & €3M/yr



## Lithuanian Driver's Test Q.:

“The robot intends to cross the road at a pedestrian crossing. Do you yield or give way to the robot?”

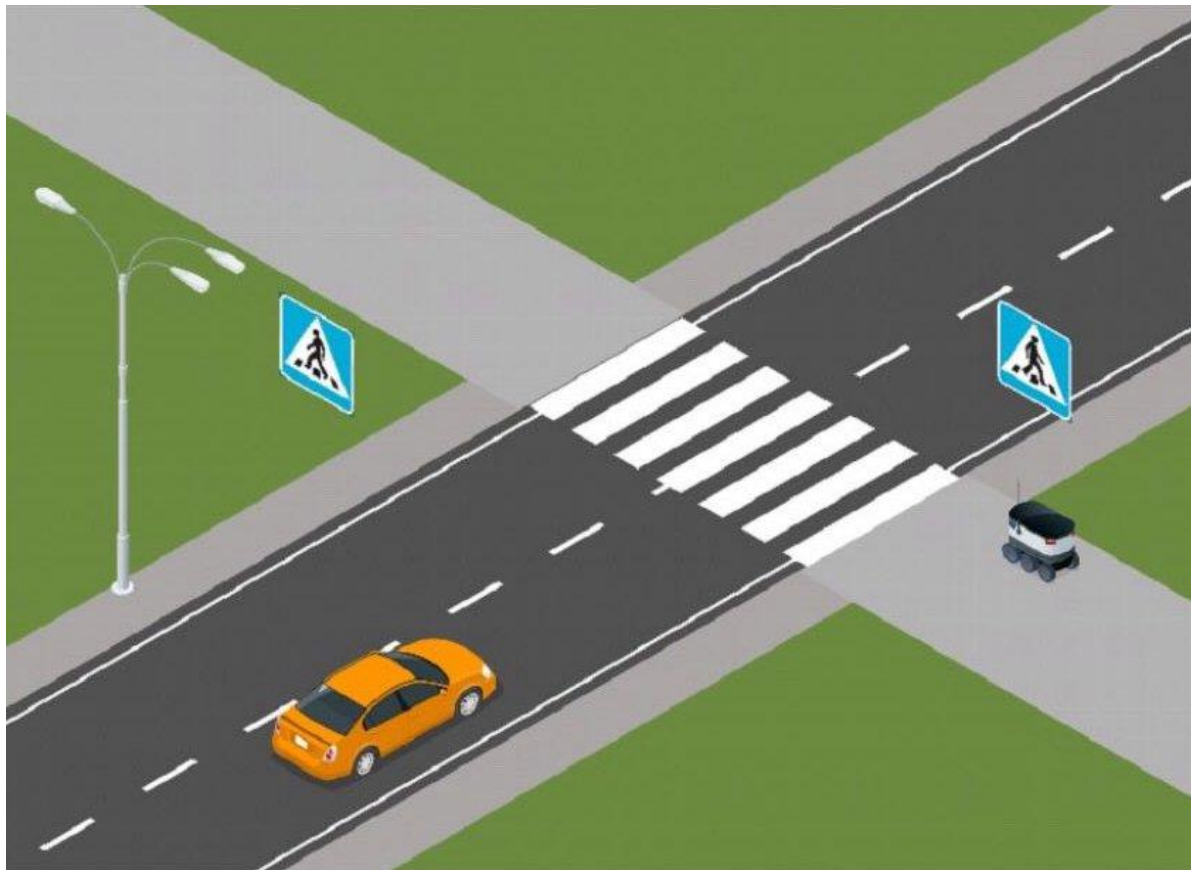
- Yes, let robot cross
- No, keep driving



## Lithuanian Driver's Test Q.:

“The robot intends to cross the road at a pedestrian crossing. Do you yield or give way to the robot?”

- Yes, let robot cross
- No, keep driving



# When? (2019-2021)





The Villages, FL  
125k residents  
750 miles roads  
3 downtowns  
40 sq. miles

# GM's Cruise Automation – 2019



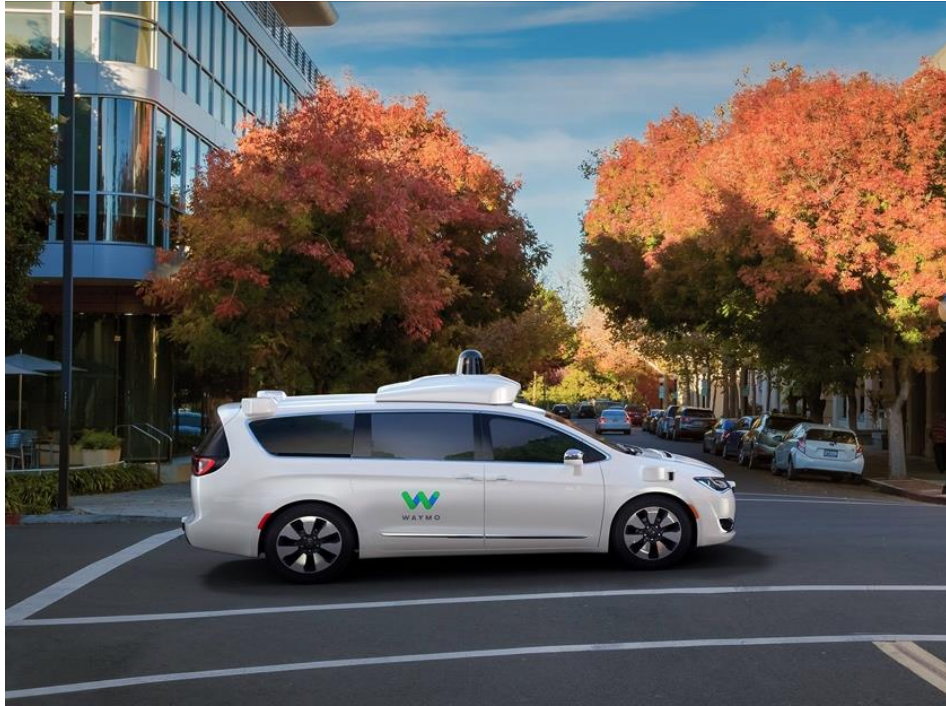
CRUISE

A GENERAL MOTORS COMPANY

# Cruise: Human Controls at Road Construction



# Waymo (from Google's SDC Project) – 2018





# Nuro.ai Local Goods Transportation





# 'Self-delivering' bicycle



- 'April Fools' from Google. Baidu & Uber working on this concept.
- Self-delivering - more sensible than self-driving

# Transport before the last paradigm shift



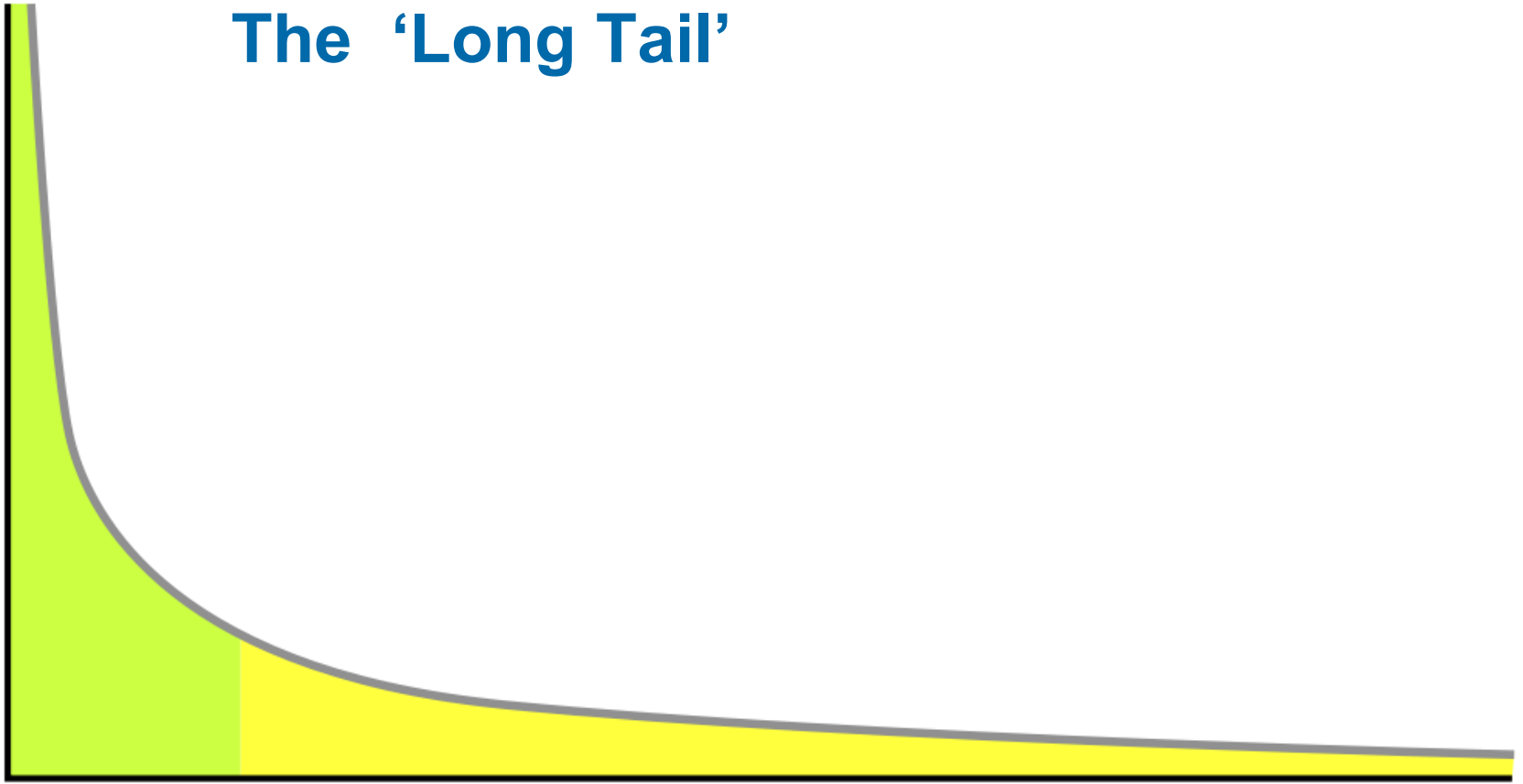
**New York City, 5<sup>th</sup> Ave, 1900**

# 13 years to disrupt transportation



New York City, 5<sup>th</sup> Ave, 1913

# The 'Long Tail'



**AVs won't just transport**

**People**

**Goods**

**But we will see a massive  
increase in the transportation of**

**Services**



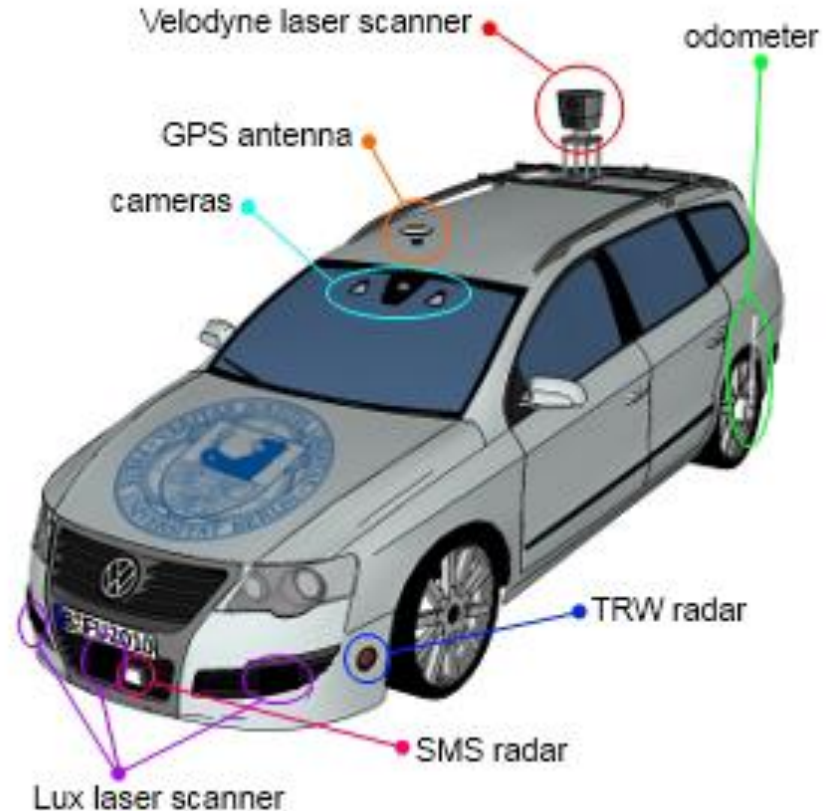
## Artefact: Aim Health Clinic

- Self guided diagnosis
- Telemedicine consults
- Common pharmaceuticals
- Emergency transport



# AV Characteristics – Sensors on Wheels

- Sensors typically:
  - LiDAR
  - optical
  - radar
  - infrared cameras
  - GPS
  - wheel encoder
- Combination
  - 360° view
  - Monitors movements in real time
  - Reacts in milliseconds



# Data Heaven, Data Hell

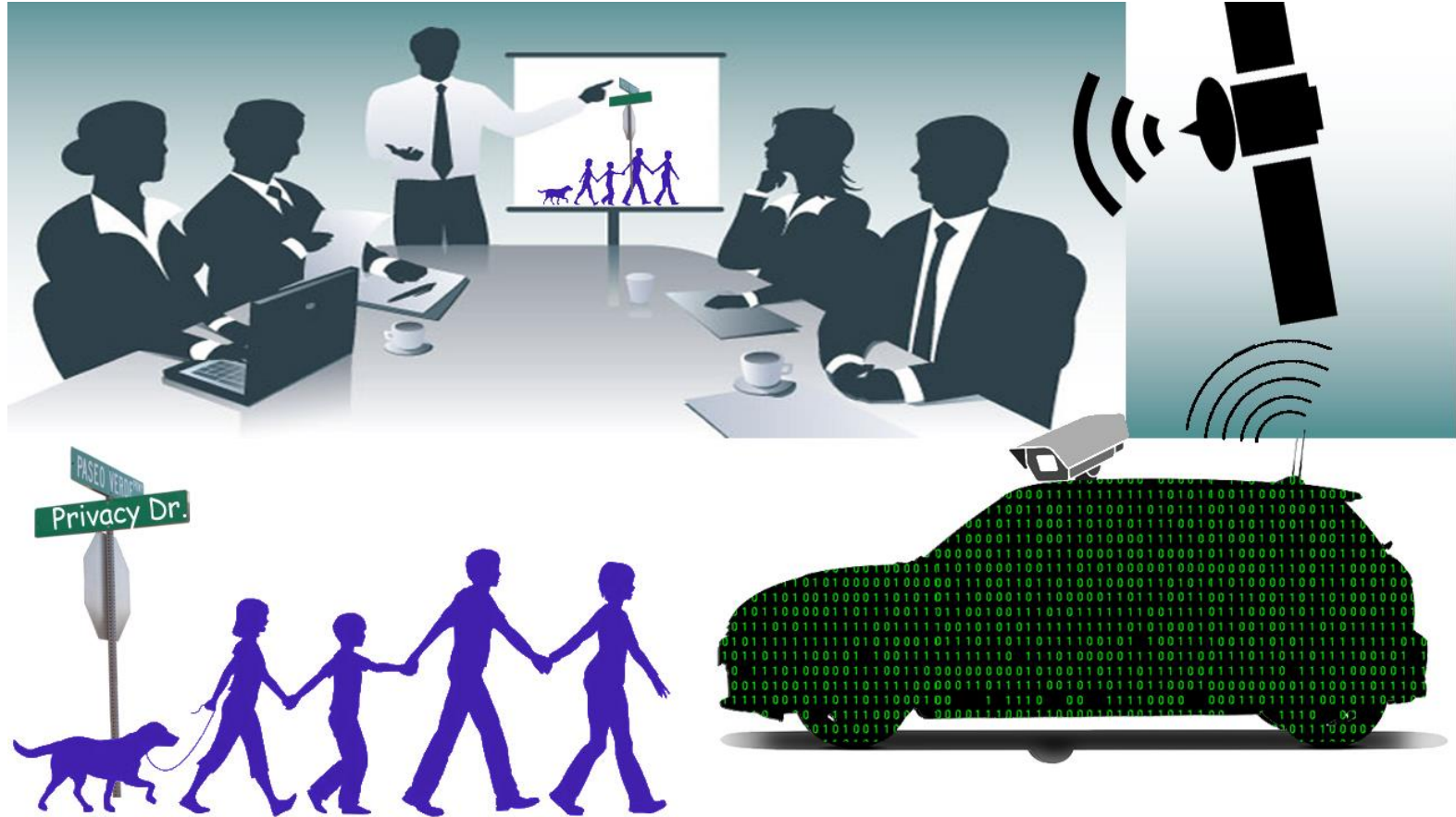


# Data on Occupants? Yes – just as CV



Also data on  
everything visible  
from street.  
**EVERYTHING.**

# Privacy Drive...



What are the potential societal benefits of AVs recording & reporting road safety events?

**We have never had a product like this...**

**When certified safe to drive unmanned:**

**can do work**

**make owners money**

**rapid market penetration**

# Transportation-as-a-Service (TaaS)?

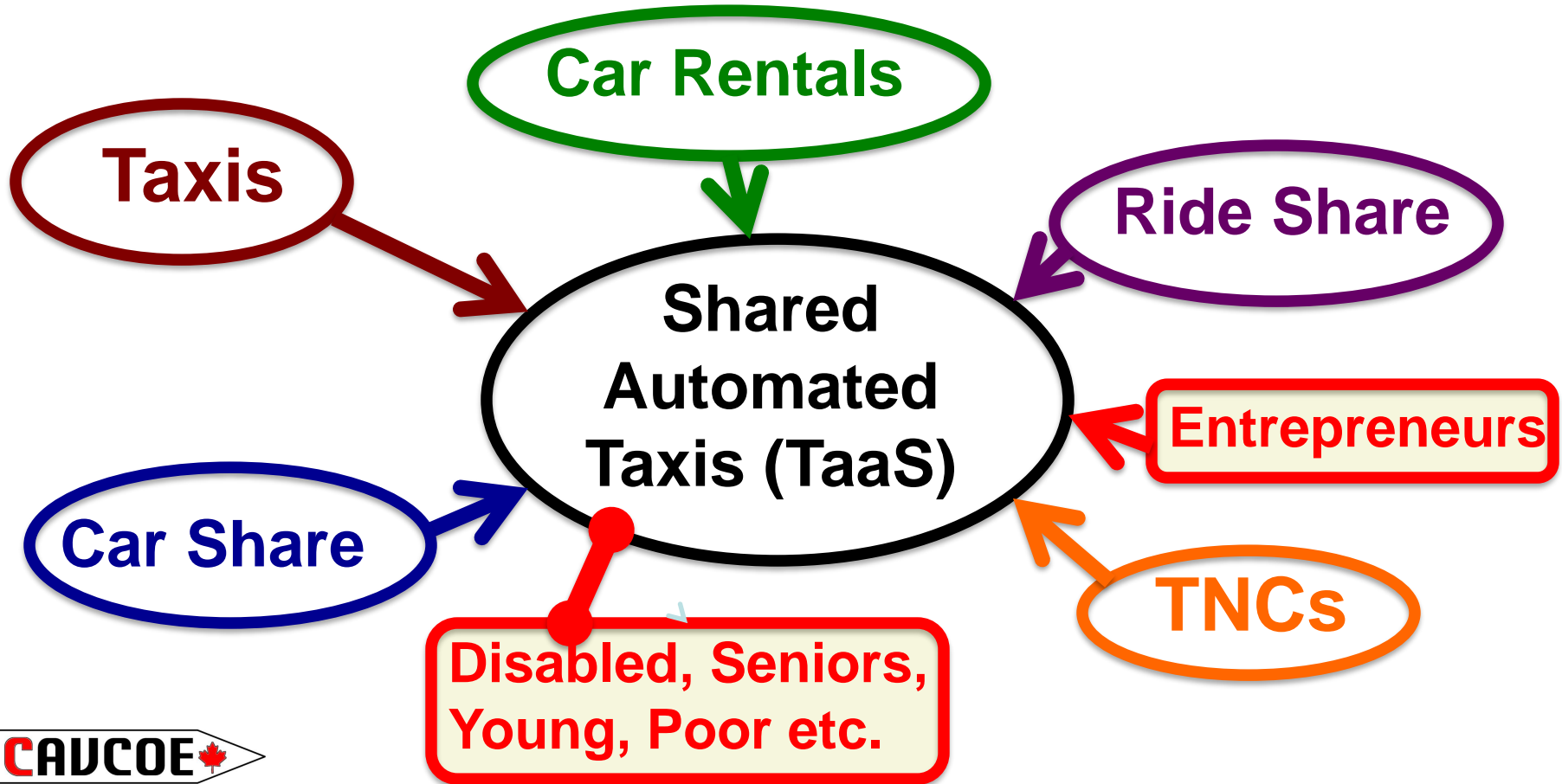
AV manufacturers won't sell the goose that lays the golden eggs.

Long term TaaS profits will be far more profitable.

Average Canadian family will be \$3,000/yr better off by not owning car, but using TaaS.



# Compelling Business Case



1.1



1.6



# Vehicle Emissions

## U.S.

**58,000 premature  
deaths/yr**

**12yr lifespan av.  
reduction**

MIT Study 2013

## CANADA

**Major health risk to the  
32% living within 500m of  
highways or 100m of major  
urban roads**

All air pollution causes  
21,000 premature deaths/yr

**“More effective to remove  
risk than treat 10 million  
people.”**

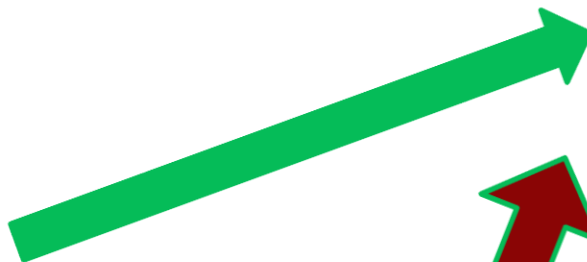
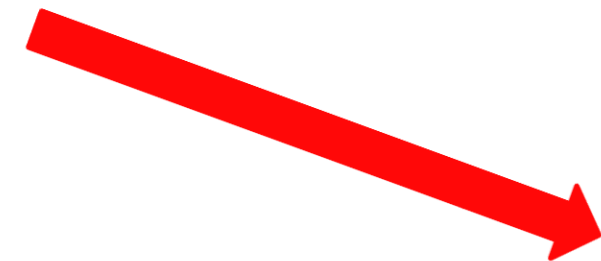
$$AV = EV^*$$

\*most of the time

**Automated  
Vehicles**

**Connected  
Vehicles**

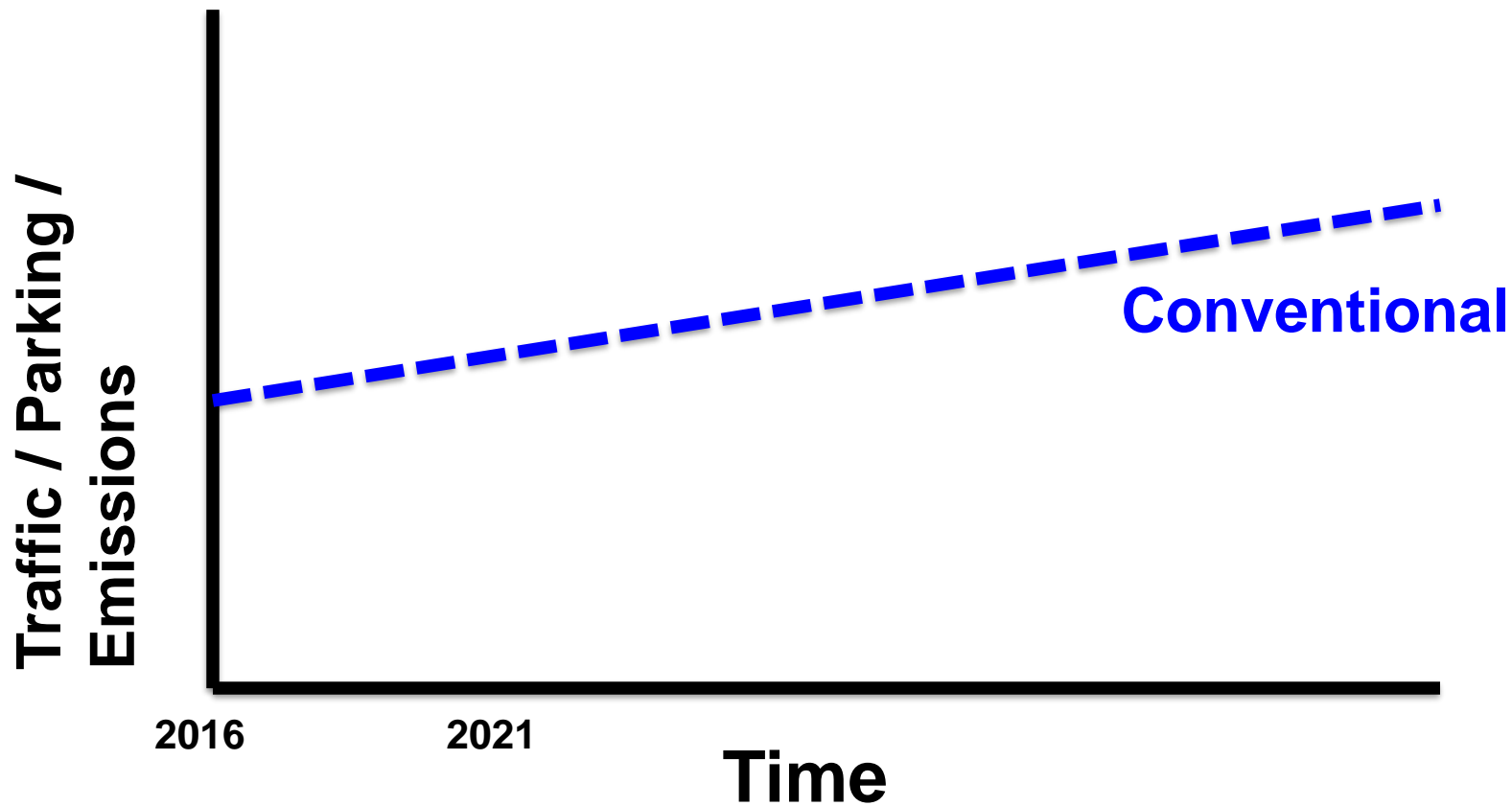
**Electric  
Vehicles**



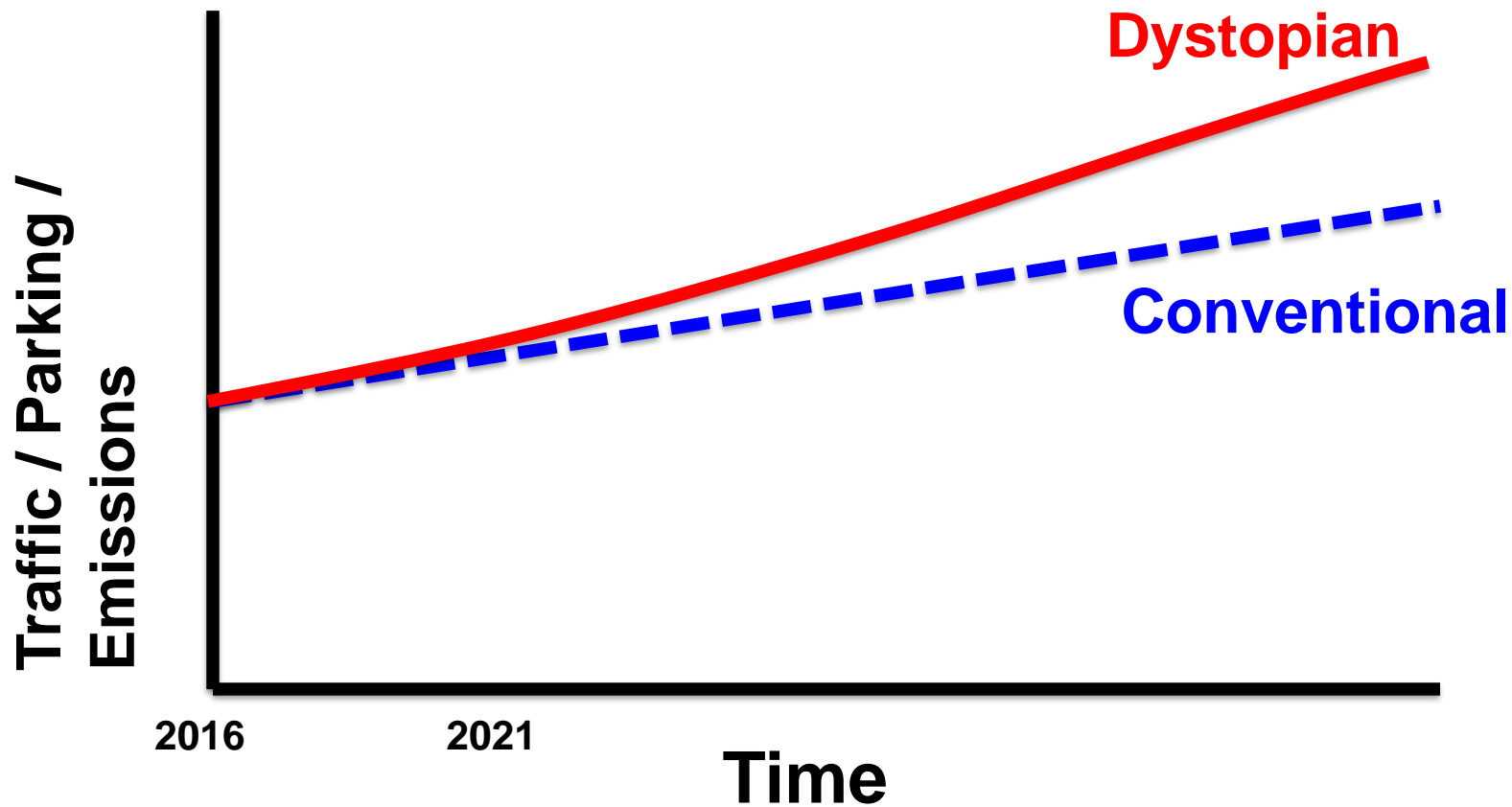
**ACE  
Vehicles**

**Sharing Economy**

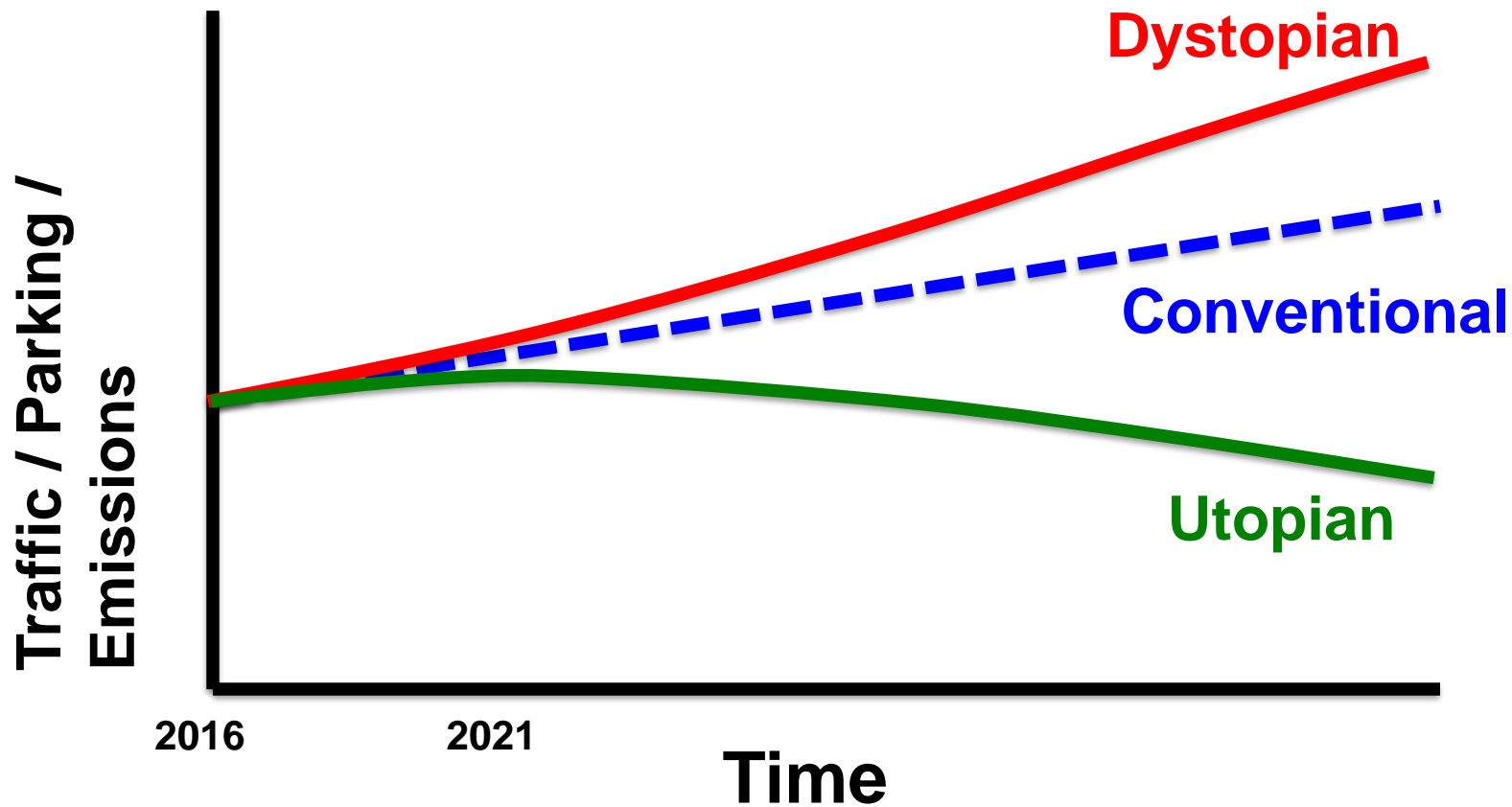
# Policies will steer future outcomes of AVs



# Policies will steer future outcomes of AVs



# Policies will steer future outcomes of AVs



**TIPPING**

**POINT**



# Why a big deal?

- An AV will do work moving people, goods, services
- An AV will make money for owner
- AV Demand > Supply
- Rapid Market Penetration
- Disruptive





**Affects all  
aspects of life**  
**Just like Car 1.0 ...**



# **Affects all aspects of life**

**Autonomous  
vehicles  
will change  
*how and where*  
we  
*live and and work***

**SECRETARY, R.T.A SONEPAT**

**सचिव, प्रादेशिक परिवहन प्राधिकरण सोनीपत**

**DRIVE CAREFULLY**

**90% of all People  
are caused by  
ACCIDENTS**

**सड़क सुरक्षा संगठन ( ह.पु )**

**M. 9813072976**

# TOTALS:

Road collisions  
are responsible  
for 1 in 5 admissions  
to trauma hospitals

2016

**11,486**  
trauma admissions

20%

#roadsafetyweek **Road Safety Week** 



Google SDC Project  
TTC 2.0 secs

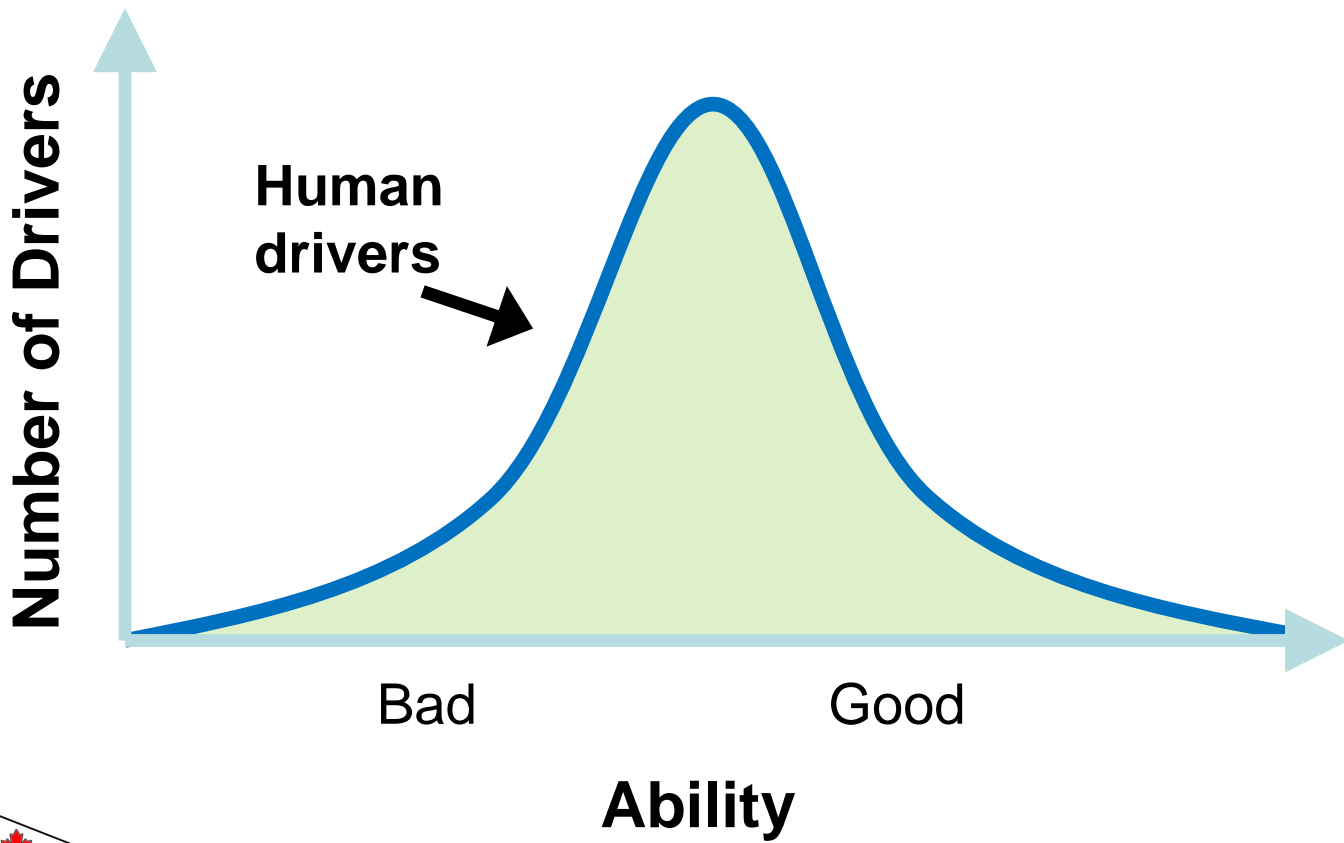
How Safe is  
'Safe Enough'?

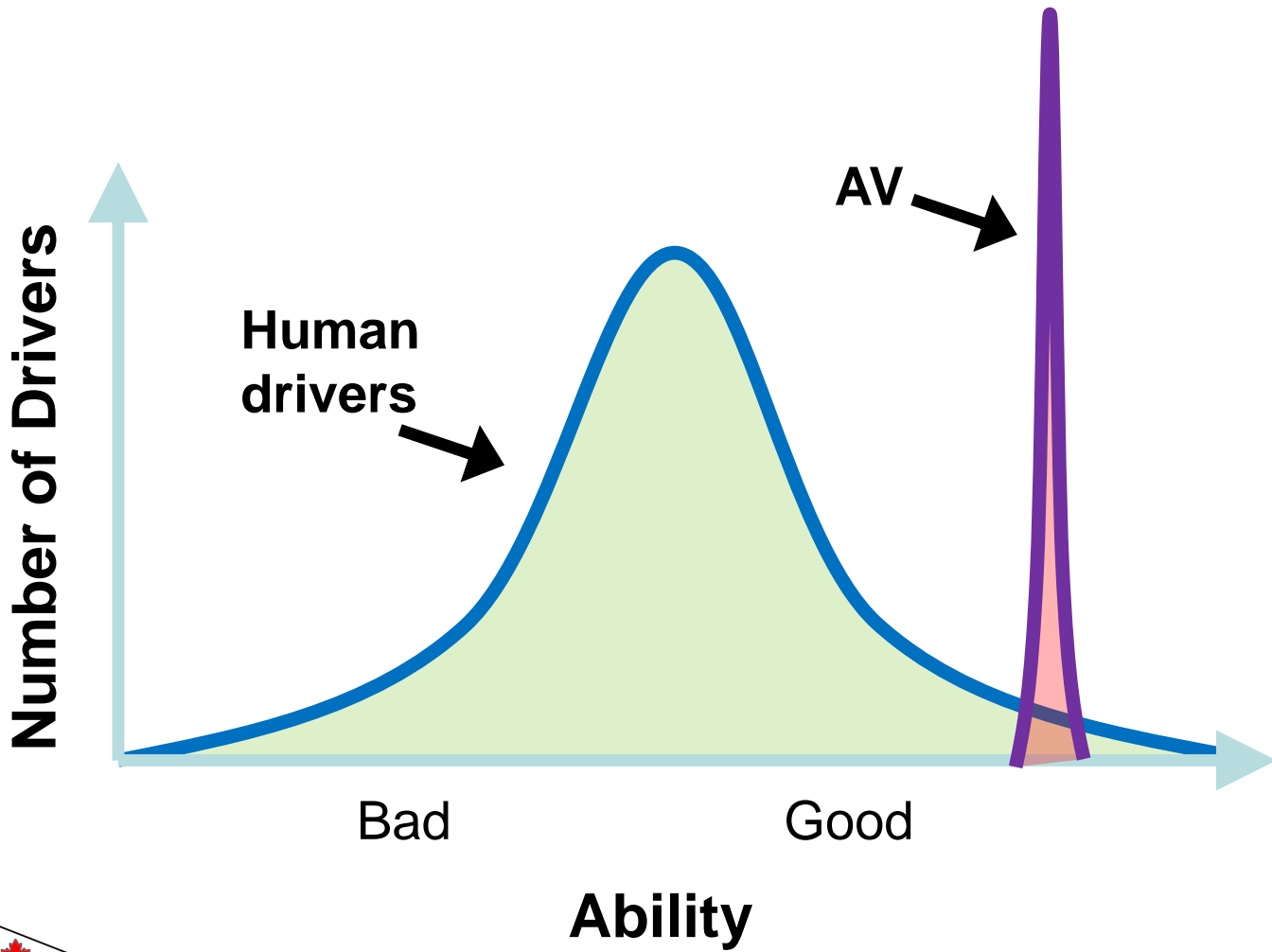
Three Years.

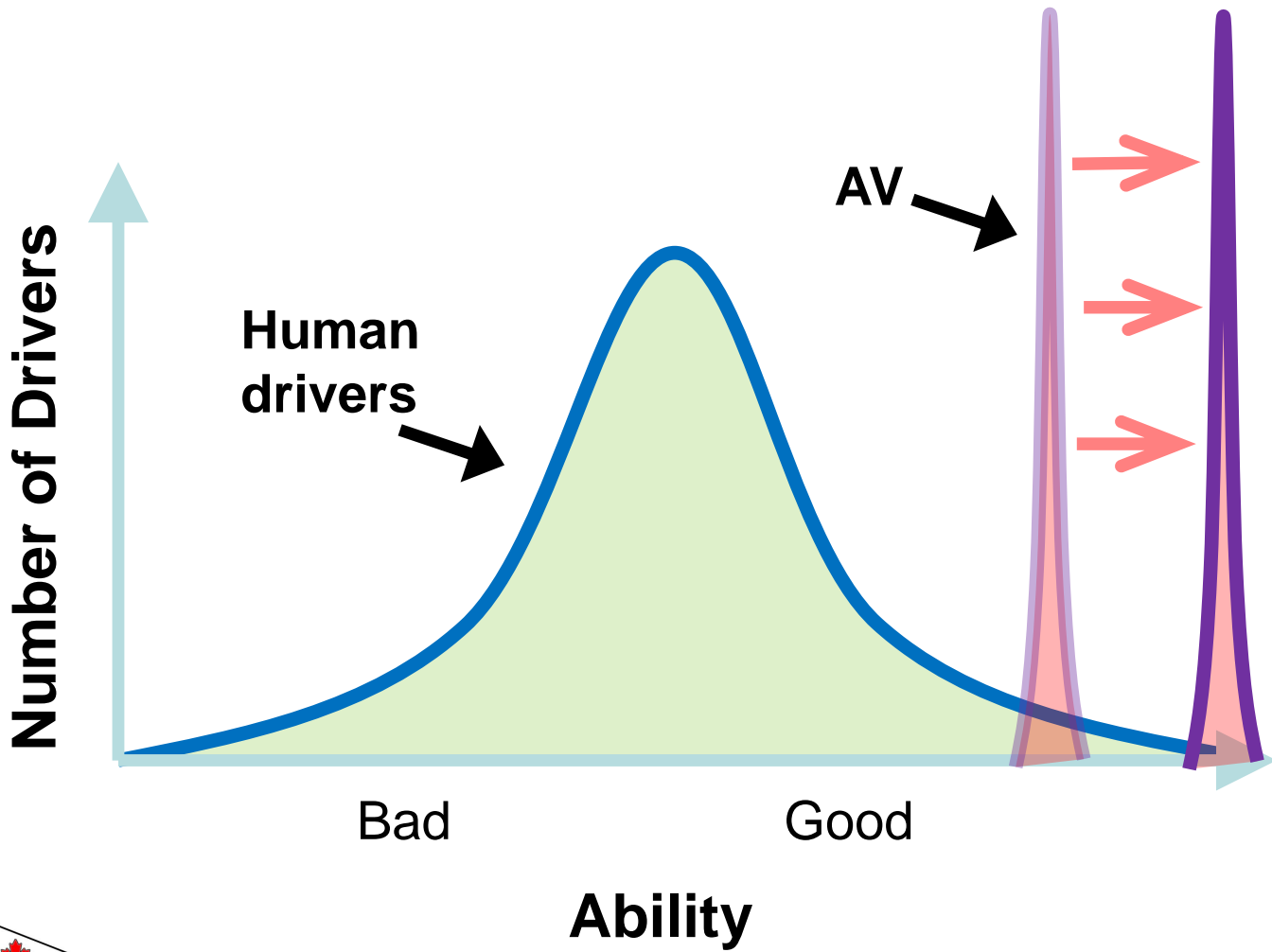
Waymo 25k miles/day  
= 2 human driving yrs  
experience/day.

8 million miles = 600 yrs  
human driving experience.

5 billion miles in simulation.









# Autonomous Vehicle Zones (AVZs)



Concept drawing of Landsdown Park in Ottawa. Copyright/Courtesy OSEG, Barry Hobin and Richard Brisban Architects, Canon Design and General Motors for the EN-V pods

*LA Mayor, Eric Garcetti, wants LA to be the first major city with a 'driverless car neighbourhood'*

- **Remove human drivers = Maximum Benefits ASAP**
- **Improve quality of life ranking in all categories**
- **Promote walkability and active transportation**
- **The 'forgotten 30%' – unlicensed, disabled, seniors etc**
- **Being discussed in LA, Singapore, Helsinki**

# Seniors Opportunities

- Accessible mobility
- Equitable
- Social / community
- Safer - less crashes
- ↑ Active lifestyles
- Age in place



# Seniors Challenges

- **Trust**
- **Affordable**
- **Accessible**
- **Service commitment**
- **Smart device essential**
- **Obesity**

# Recipe for success?

- **Advocacy**
- **Partnerships**
- **Regulations**
- **Inclusive**



## **Amara's Law:**

"We tend to overestimate the effect of a technology in the short run...

and underestimate the effect in the long run,"

## **Discuss:**

Because AVs can directly address the fact that >90% of road crashes involve human error, then...

## **Discuss:**

Because AVs can directly address the fact that >90% of road crashes involve human error, then...

**AVs will have a bigger impact on road safety than all other current technologies & safe systems combined.**

## Technology Tidal Wave

- Exponential
- Autonomous Vehicles
- **Future Trends**
- New Societal Construct?

# Key Disruptive Technologies

Human Progress

- VR & digitization
- Quantum computing
- AI
- IoT
- AVs
- Autonomous Robots
- Nanomaterials
- Biotech & pharmacology
- Energy





Boston Dynamics

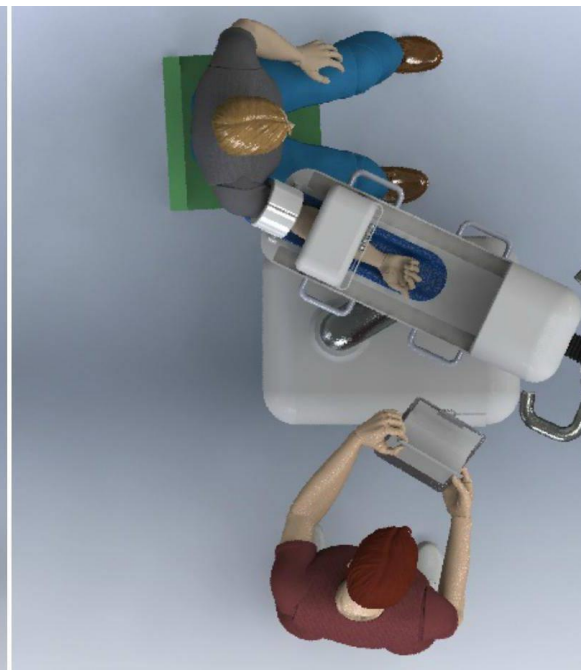
# China: Fully Automated Tooth Implant



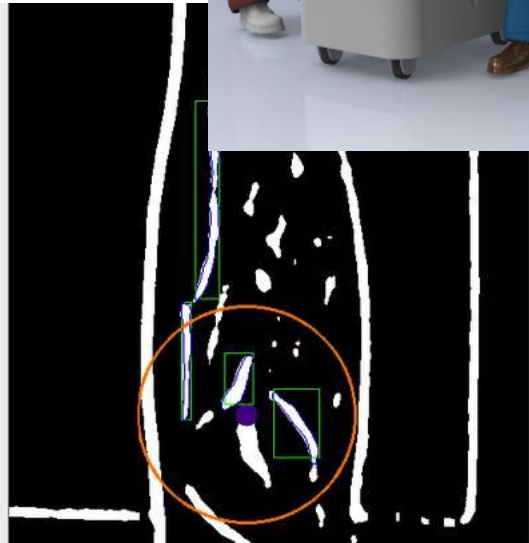
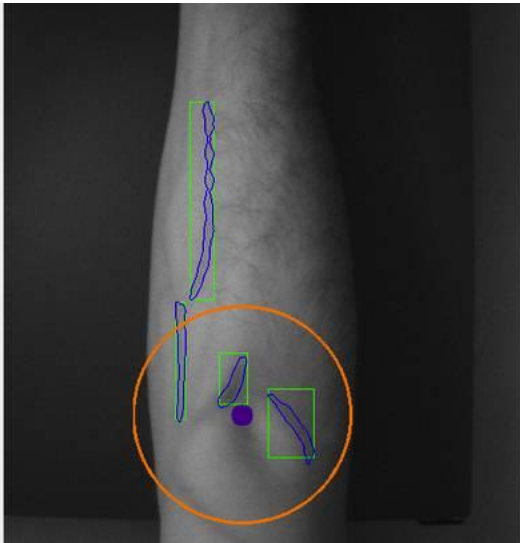
Credit: South China Morning Post

# Veebot: Automated Venipuncture

83% Accuracy – same as human  
Time 1 minute – several times quicker than human

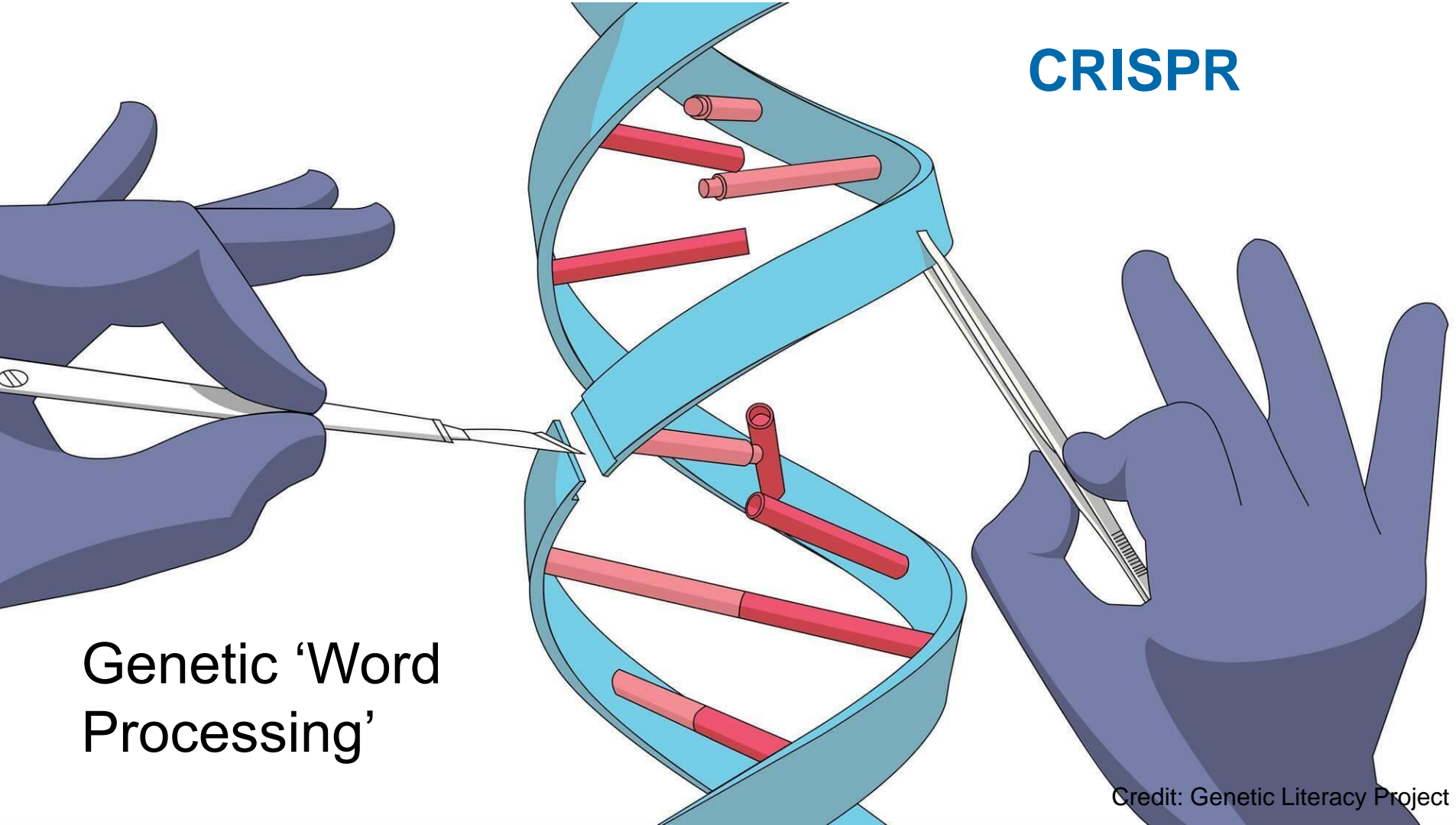


Source: [medicaldaily.com](http://medicaldaily.com), [blog-a-care.biz](http://blog-a-care.biz)



Source: [techcrunch.com](http://techcrunch.com)

# CRISPR

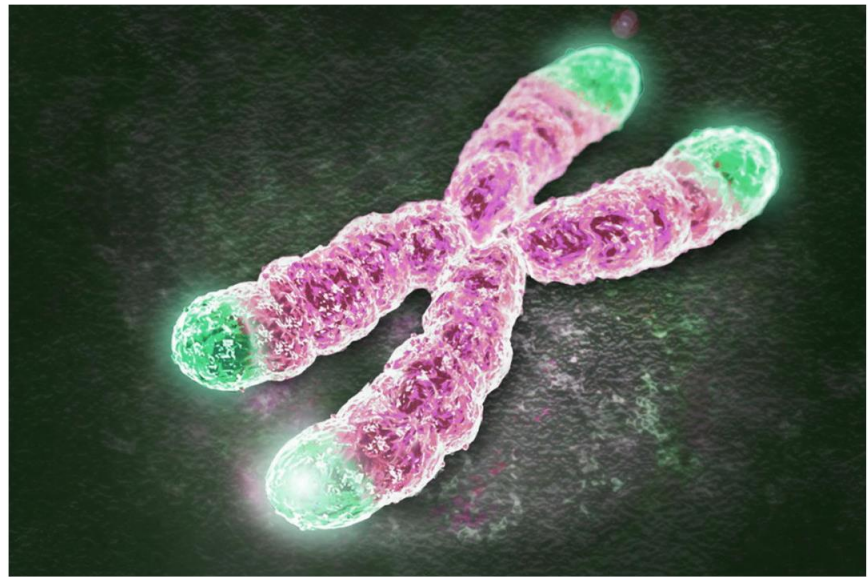


Genetic 'Word Processing'

Of 7 Aging  
Mechanisms,  
5 are seeing  
results.

Aging is a  
disease.....?

‘Yes’ = Fed funding



## **FIRST GENE THERAPY SUCCESSFUL AGAINST HUMAN AGING**

American woman gets biologically younger after gene therapies

Elizabeth Parrish, CEO of Bioviva USA Inc. has become the first human being to be successfully rejuvenated by gene therapy, after her own company's experimental therapies reversed 20 years of normal telomere shortening.

# DeepMind Mission



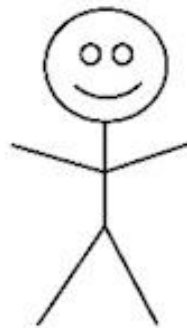
- 1 • Solve intelligence
- 2 • Use it to solve everything else

2011



**26% errors**

humans



**5% errors**

2016



**3% errors**

# Breast Cancer Metastasis Detection

## Detecting Cancer Metastases on Gigapixel Pathology Images

Yun Liu, Krishna Gadepalli, Mohammad Norouzi, George E. Dahl, Timo Kohlberger, Aleksey Boyko, Subhashini Venugopalan, Aleksei Timofeev, Philip Q. Nelson, Greg S. Corrado, Jason D. Hipp, Lily Peng, Martin C. Stumpe

*(Submitted on 3 Mar 2017 (v1), last revised 8 Mar 2017 (this version, v2))*

Each year, the treatment decisions for more than 230,000 breast cancer patients in the U.S. hinge on whether the cancer has metastasized away from the breast. Metastasis detection is currently performed by pathologists reviewing large expanses of biological tissues. This process is labor intensive and error-prone. We present a framework to automatically detect and localize tumors as small as  $100 \times 100$  pixels in gigapixel microscopy images sized  $100,000 \times 100,000$  pixels. Our method leverages a convolutional neural network (CNN) architecture and obtains state-of-the-art results on the Camelyon16 dataset in the challenging lesion-level tumor detection task. At 8 false positives per image, we detect 92.4% of the tumors, relative to 82.7% by the previous best automated approach. For comparison, a human pathologist attempting exhaustive search achieved 73.2% sensitivity. We achieve image-level AUC scores above 97% on both the Camelyon16 test set and an independent set of 110 slides. In addition, we discover that two slides in the Camelyon16 training set were erroneously labeled normal. Our approach could considerably reduce false negative rates in metastasis detection.

Comments: Fig 1: normal and tumor patches were accidentally reversed - now fixed. Minor grammatical corrections in appendix, section "Image Color Normalization"

Subjects: **Computer Vision and Pattern Recognition (cs.CV)**

Cite as: [arXiv:1703.02442](https://arxiv.org/abs/1703.02442) [cs.CV]

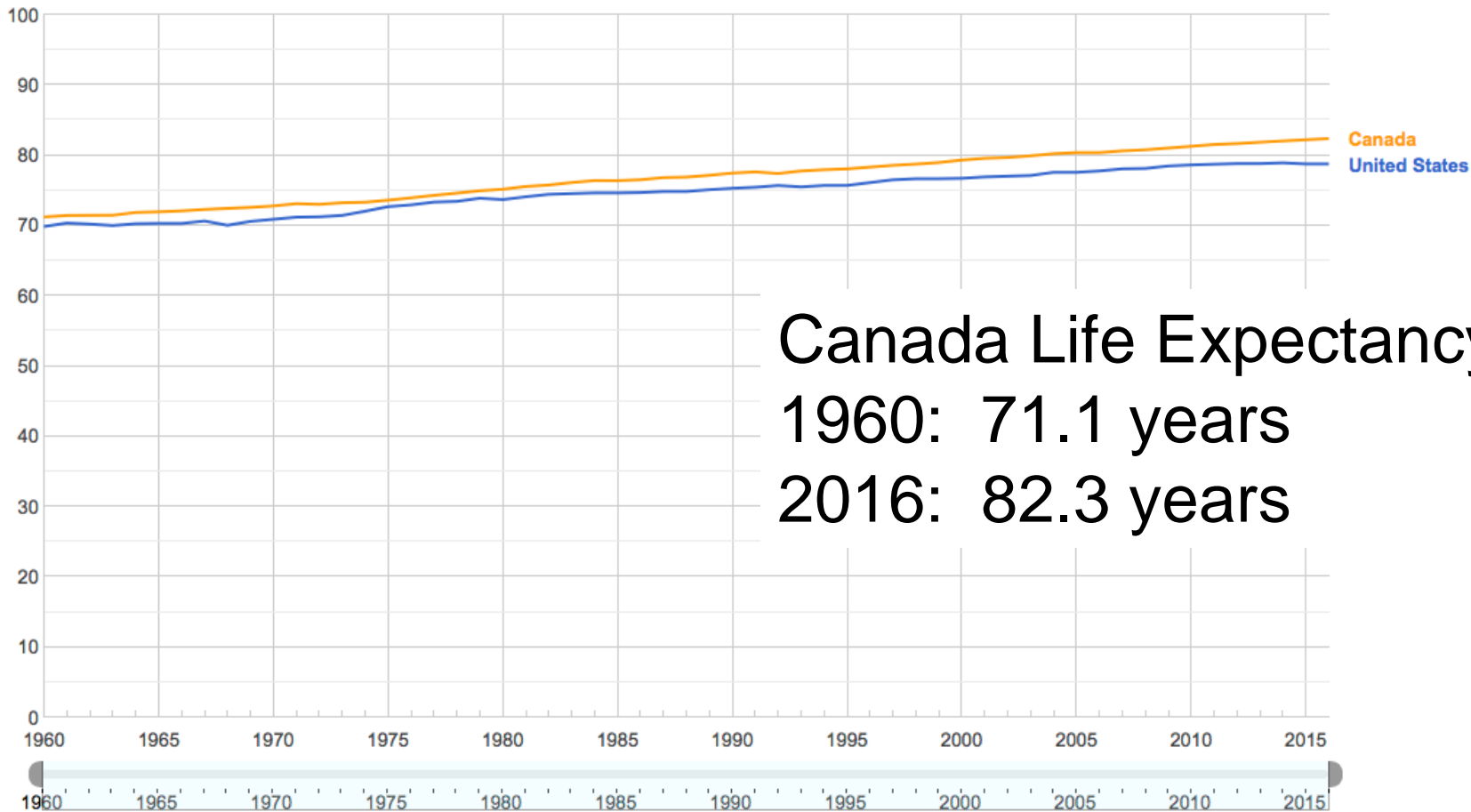
(or [arXiv:1703.02442v2](https://arxiv.org/abs/1703.02442v2) [cs.CV] for this version)

# Tumour detection:

Human 73.2%

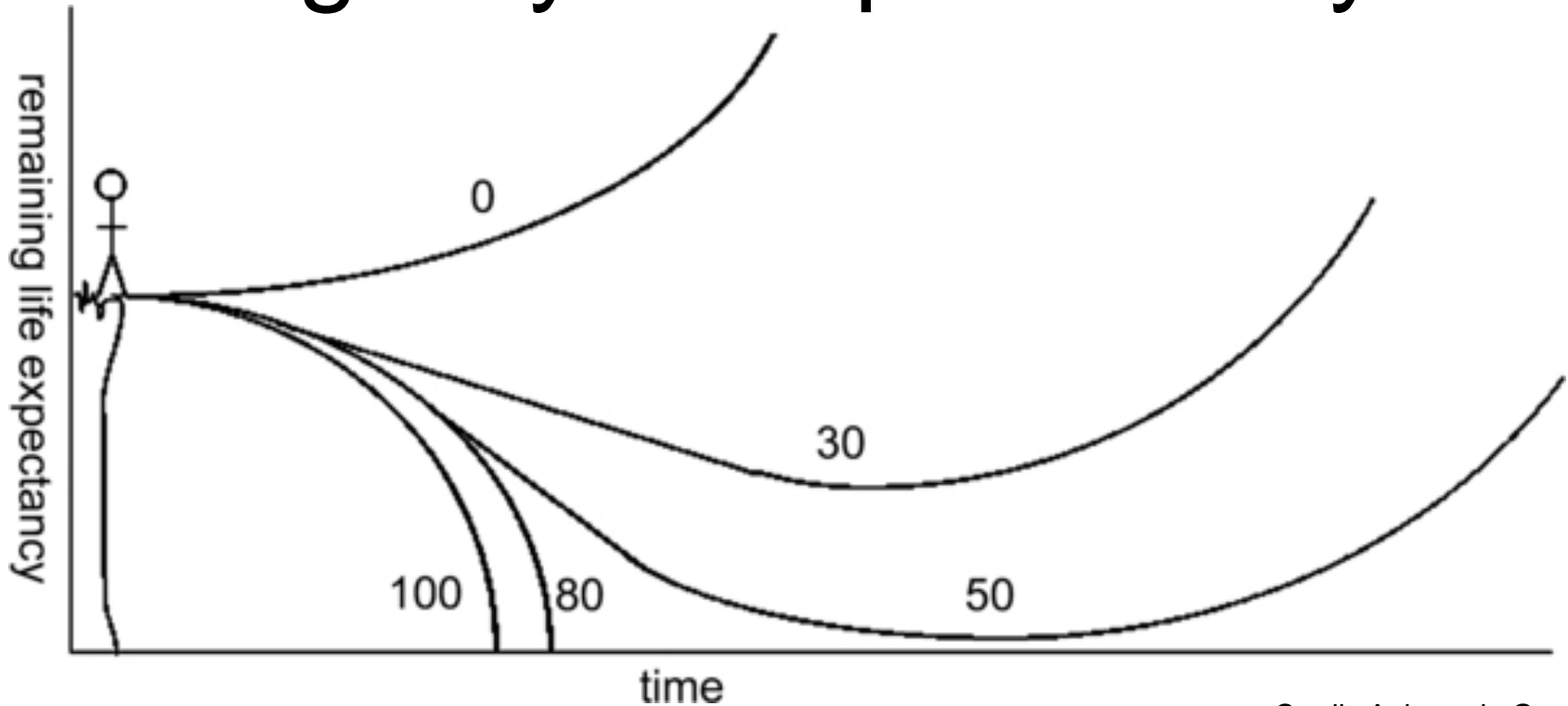
A.I. >97%

**& found errors in training set!**

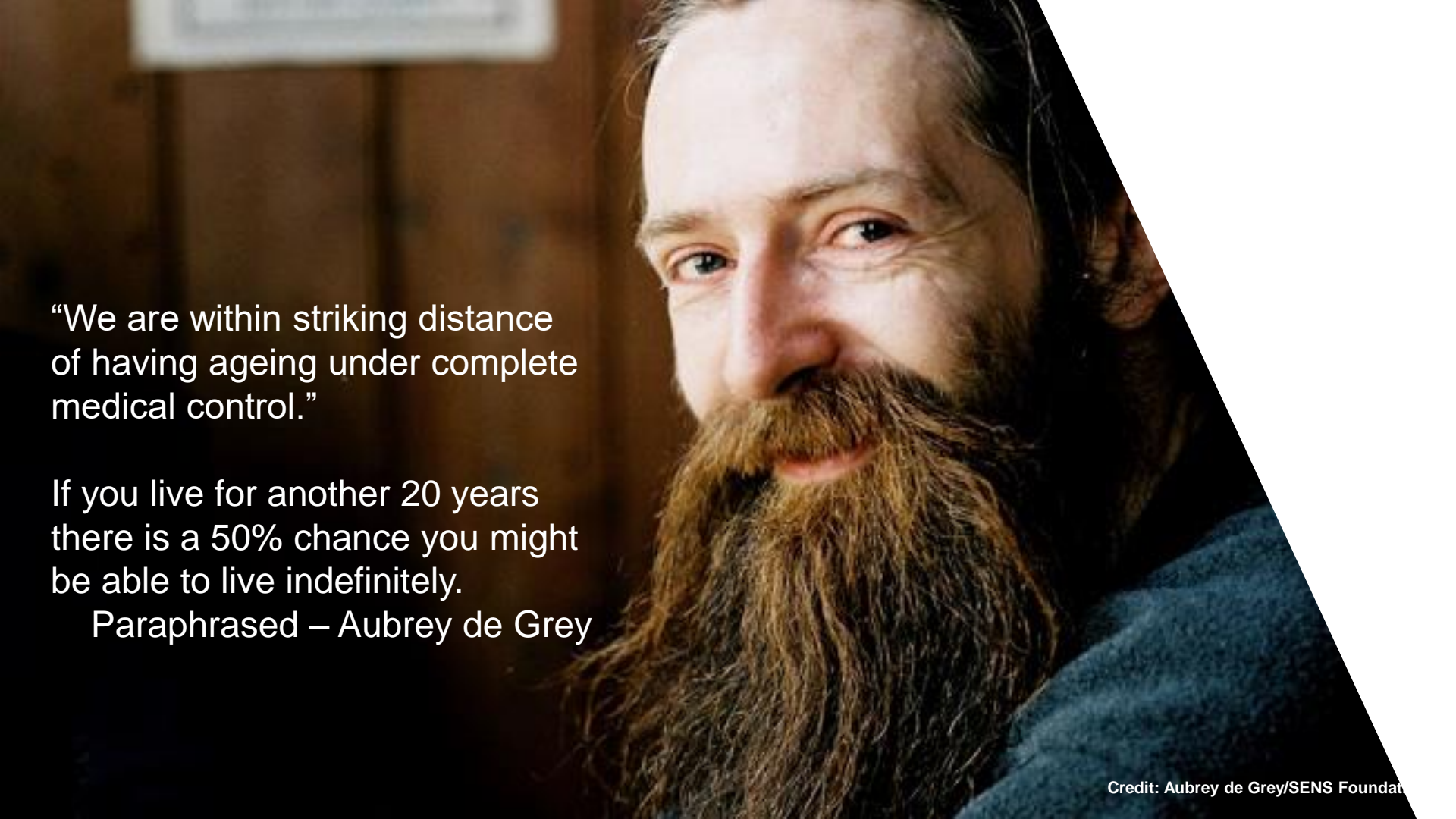


Canada Life Expectancy  
1960: 71.1 years  
2016: 82.3 years

# Longevity Escape Velocity



Credit: Aubrey de Grey?



“We are within striking distance  
of having ageing under complete  
medical control.”

If you live for another 20 years  
there is a 50% chance you might  
be able to live indefinitely.

Paraphrased – Aubrey de Grey

# Genetic researchers reverse wrinkles, gray hair and balding in mice, called 'unprecedented'

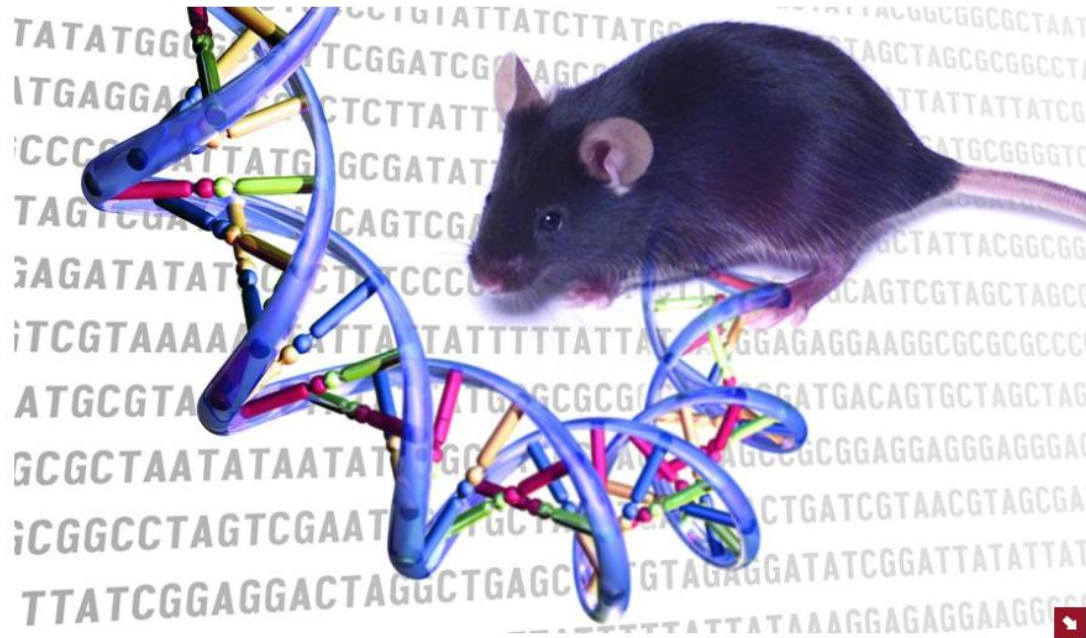


Image courtesy of the National Human Genome Research Institute, a federal agency within the National Institutes of Health (NIH). [more >](#)



Print

By Jennifer Harper - *The Washington Times* - Friday, July 20, 2018

Science has made mice look good by reversing age-related wrinkles and hair loss at the genetic level. Humanity could get a similar make-over in the future.



**CITIES**

2018 • CONFERENCE

**IPCC**

Cities &  
Climate Change  
Science  
Conference

MARCH 5 - 7, 2018

EDMONTON, ALBERTA, CANADA

**Climate migration has started:** Approx. 1 million Americans displaced from homes in 2017 by climate and weather events.

**#TransHumanism**

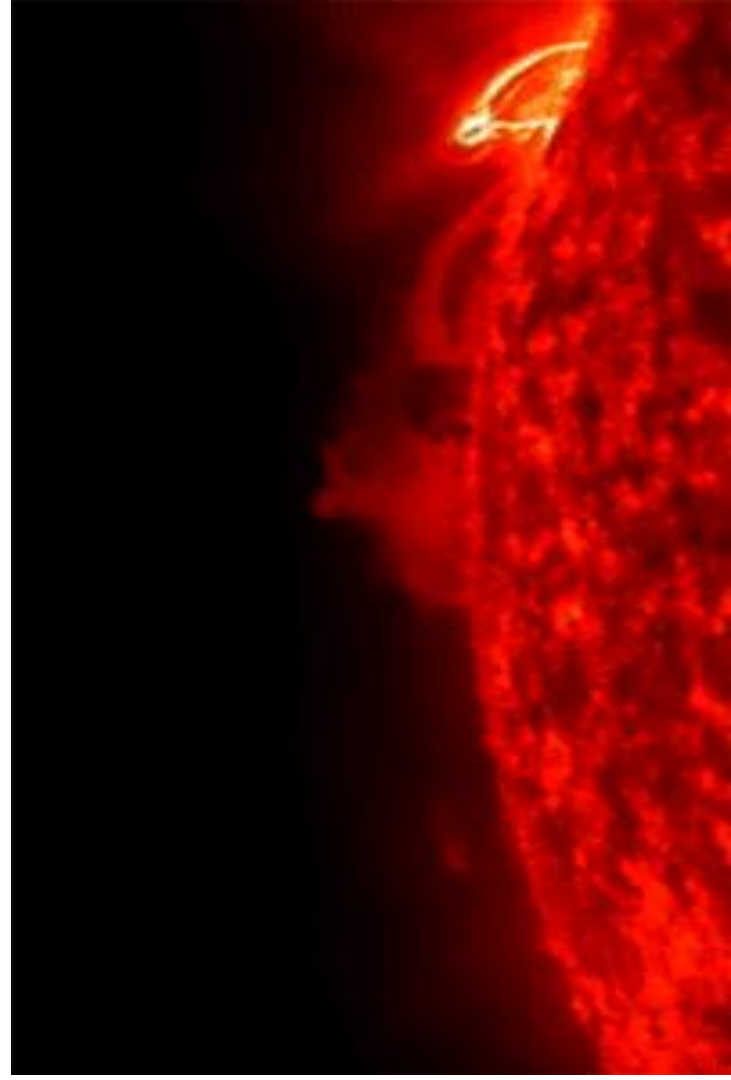




Elon Musk's new company, Neuralink, wants to connect our brains to computers

**SPACE**

**Explore, or face  
extinction**



BANGLADESH

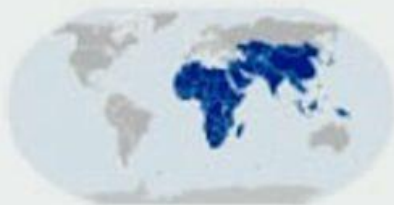


COSTA RICA



× 1.4

INDIA



NEPAL



× 1.9

UGANDA



FRANCE



× 2.5

UNITED STATES  
of AMERICA



× 4.1



# **The Singularity**

*“**2029** is the consistent date I have predicted for when an AI will pass a valid Turing test and therefore achieve human levels of intelligence.”*

*“I have set the date **2045** for the '**Singularity**' which is when we will multiply our effective intelligence a billion fold by merging with the intelligence we have created.”*

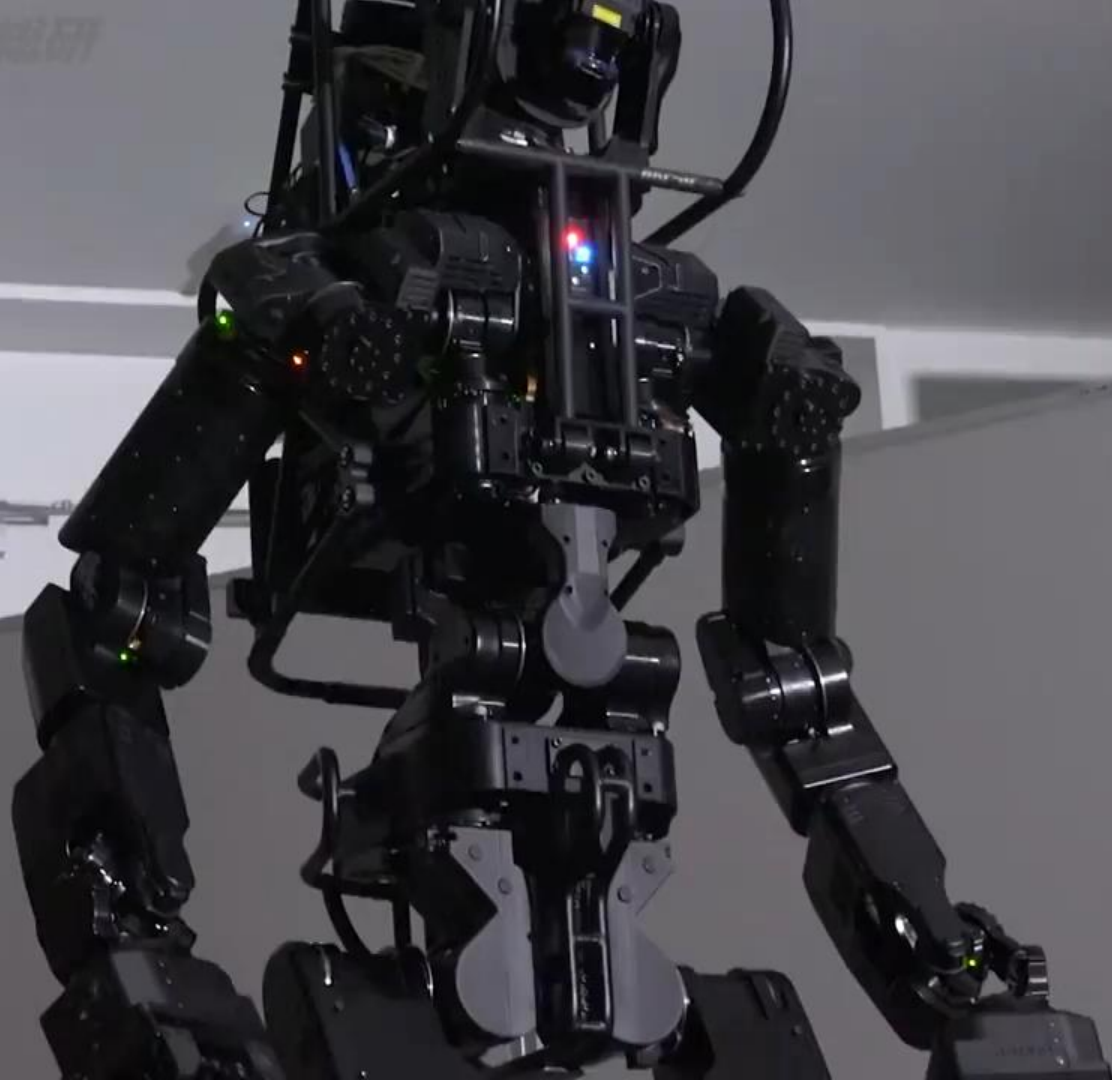
Ray Kurzweil

## Technology Tidal Wave

- Exponential
- Autonomous Vehicles
- Future Trends
- **New Societal Construct?**

**World's 62 richest  
people have the  
same wealth as the  
poorest 50%**

**1 : 61,000,000**



The rate that technology (esp. A.I.) is displacing people from jobs will become faster than our ability to re-train for the new jobs that will be created.

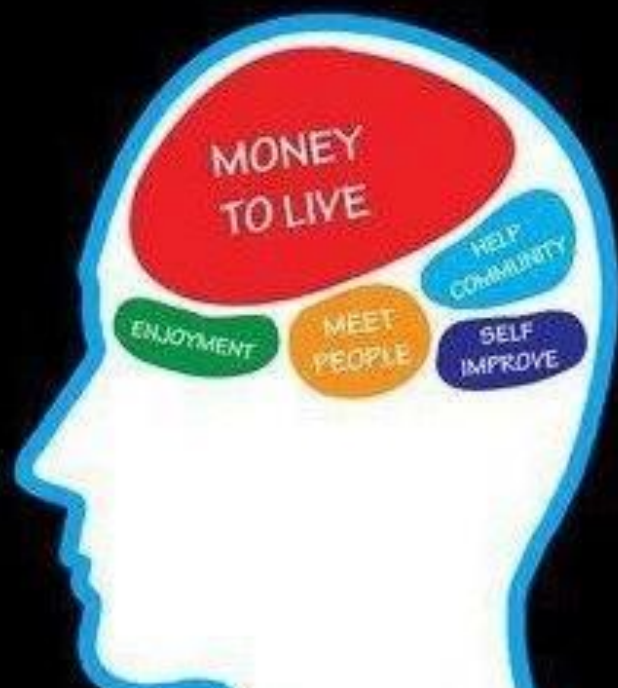
**New Social Construct**

**#BasicIncome ?**

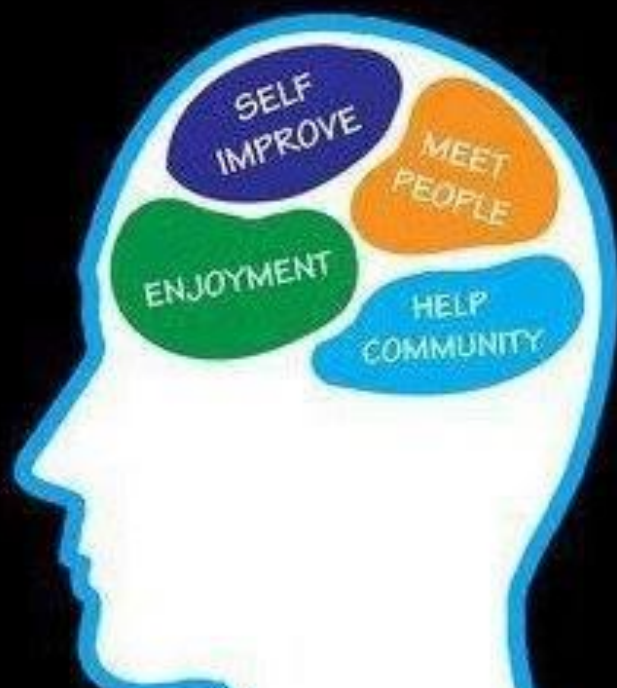
**(Negative Taxation)**

# HUMAN REASONS TO WORK

Before Basic Income



After Basic Income





Burning Man 2015. Love/Inner Child, by Alexander Milov. (Chris Smith / PD)



**Earning a living**

**to**

**Learning a living**

# Our Exponential Future

Robots will do 'Dull, Dirty & Dangerous' stuff

Artificial Intelligence will make us smarter

We will live longer – maybe indefinitely

We will become even closer to our tech

We could be freed to become artists, entertainers,  
creators, educators, scientists, engineers,  
imagineers etc.!

Maybe we won't pay tax!



***These technologies are coming like a freight train. If we're ready, great. If we're not, tough. They're coming anyway.***

- Paul Godsmark



# ‘Taxi!’ - Let’s prepare for the new paradigm

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