

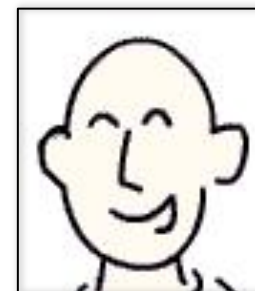
intelligent machines smart and resilient infrastructure

Ross Smith
Director of Customer Engineering



Ted and Ross

Ted Zoli
HNTB



Ross Smith,
Director, Skype for Good







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Principles of Resilience Thinking

- Maintain Diversity and Redundancy
- Manage Connectivity
- Manage Slow Variables and Feedbacks
- Foster Complex Adaptive Thinking
- Encourage Learning
- Broaden Participation
- Promote Polycentric Governance

Maintain diversity and redundancy



Manage Connectivity



Manage Slow variables and Feedbacks



Foster Complex
Adaptive Thinking



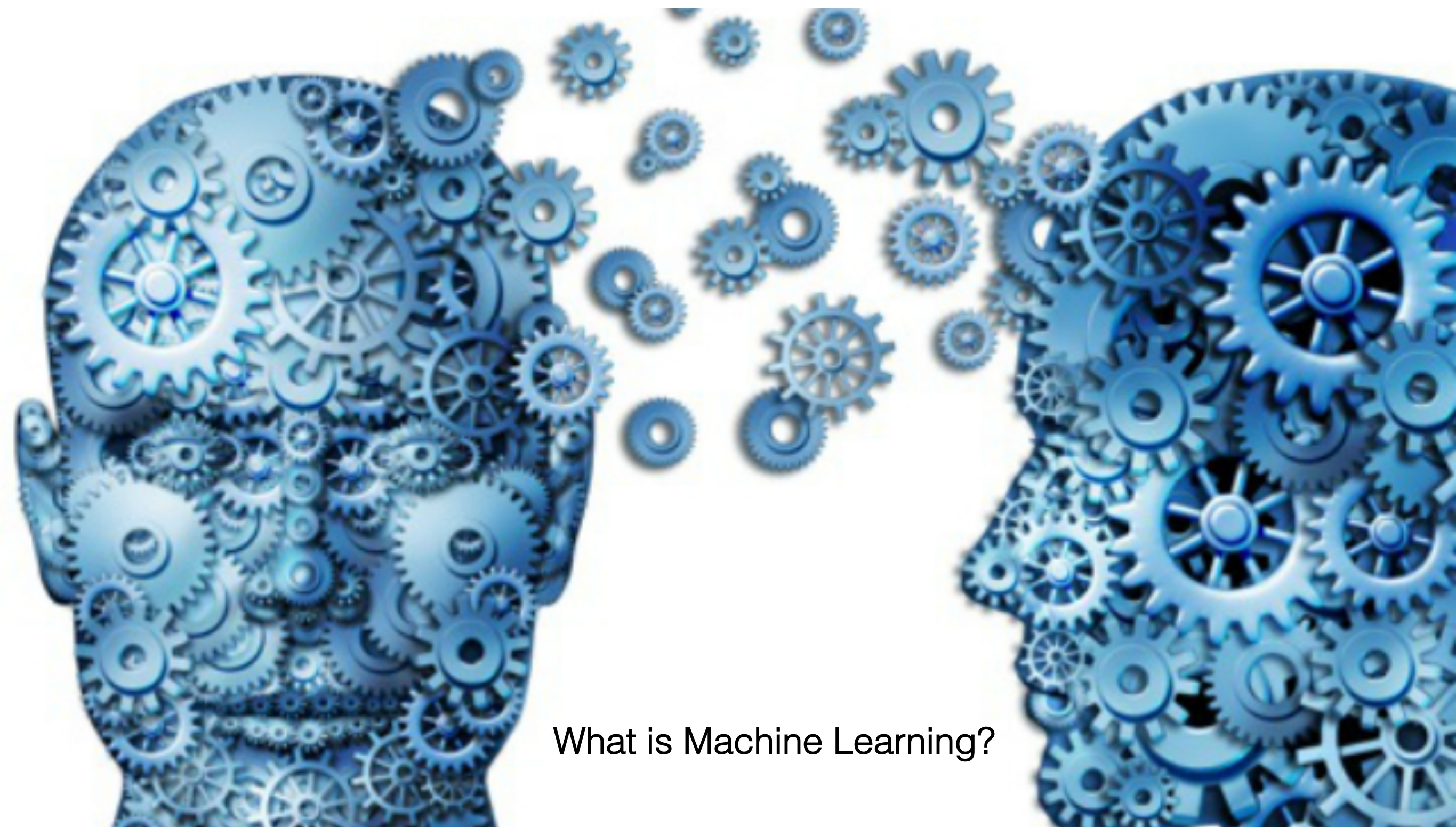


Broaden Participation





Promote Polycentr



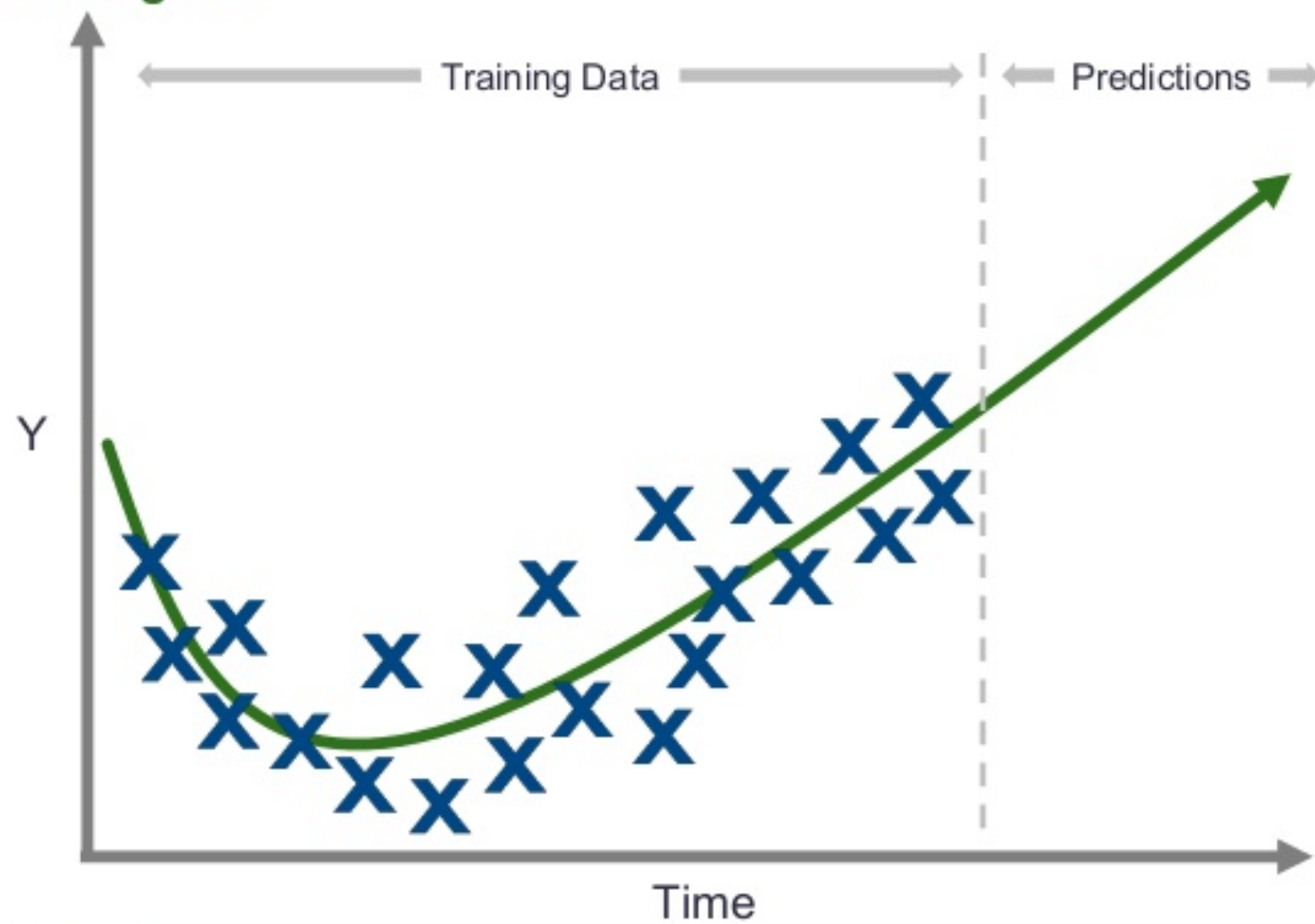
What is Machine Learning?

Principles of Machine Learning

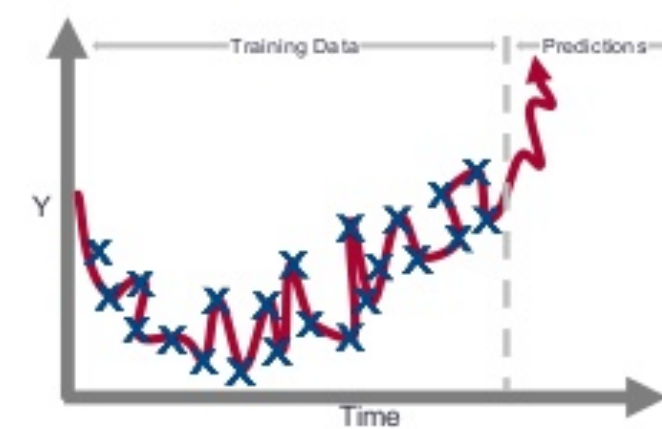
- Generalization
- No Free Lunch
- Occam's razor
- More Data is better than more complex algos
- Cross Validation
- Algorithmic Diversity

Generalization

Strong Fit



Overfitting (High Variance)



Underfitting (High Bias)









More Data is
better than
more
Complex
Algorithms

Cross Validation



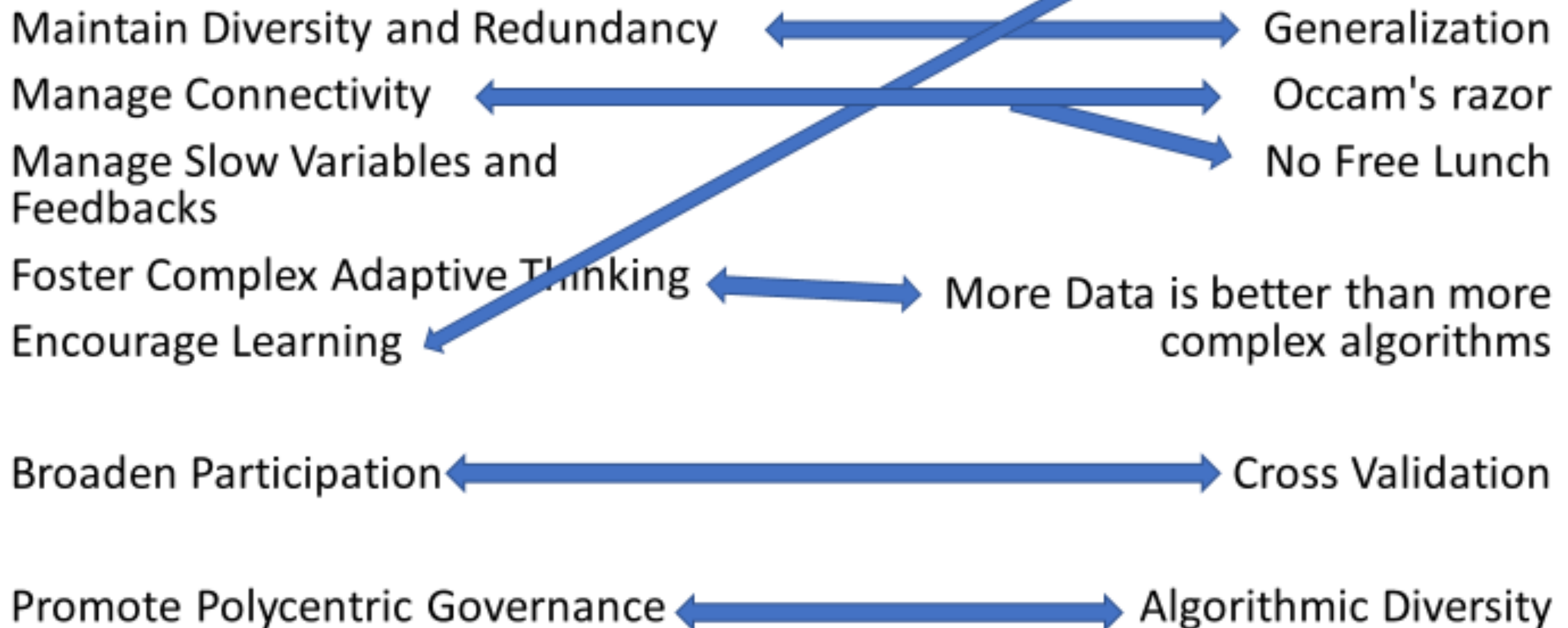


Algorithmic Diversity

Mapping the Principles

Resilience

Machine Learning

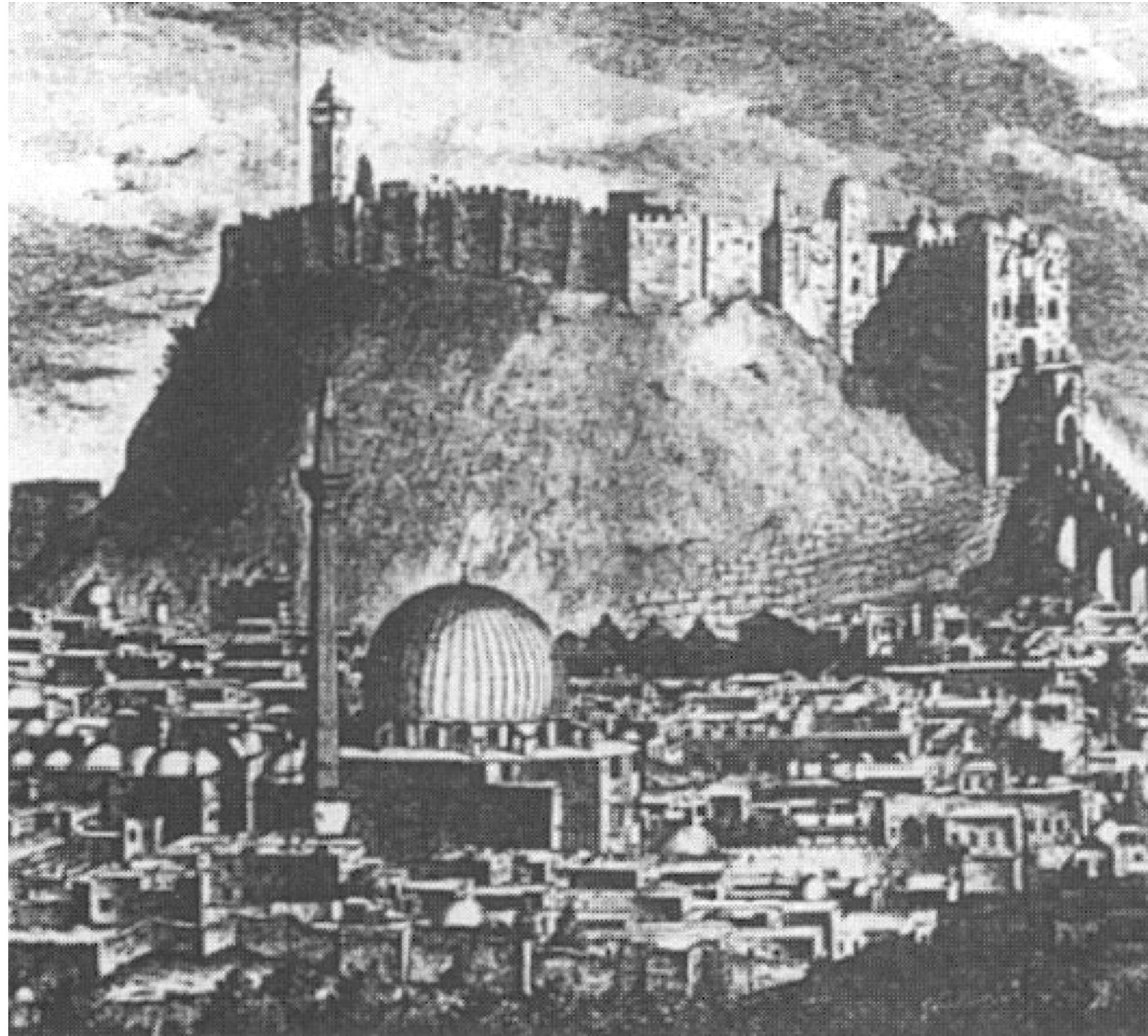


Examples of Disasters using Principles

- 1138 Aleppo earthquake
- 2010 Haiti Earthquake
- 1666 Great Fire of London
- 1920 Haiyuan earthquake
- 526 Antioch earthquake
- Coringa cyclone of 1839 hit the port city of Coringa
- The Central China Floods of 1931
- 1977 Tenerife Airport Disaster
- 1917 Halifax Explosion
- 1984 Bhopal
- 27 AD Fidenae Ampitheatre Collapse
- 1952 Banqiao Dam Collapse
- 2001 Enron
- 1929 Stock market crash
- 2007 Subprime mortgage lending and Lehman Bros
- 1347 – Bubonic Plague
- 2002 SARS
- 1940 Tacoma Narrows Suspension Bridge Collapse.
- 1937 West Nile Virus
- 2700 BC – Malaria
- 1989 San Francisco Earthquake

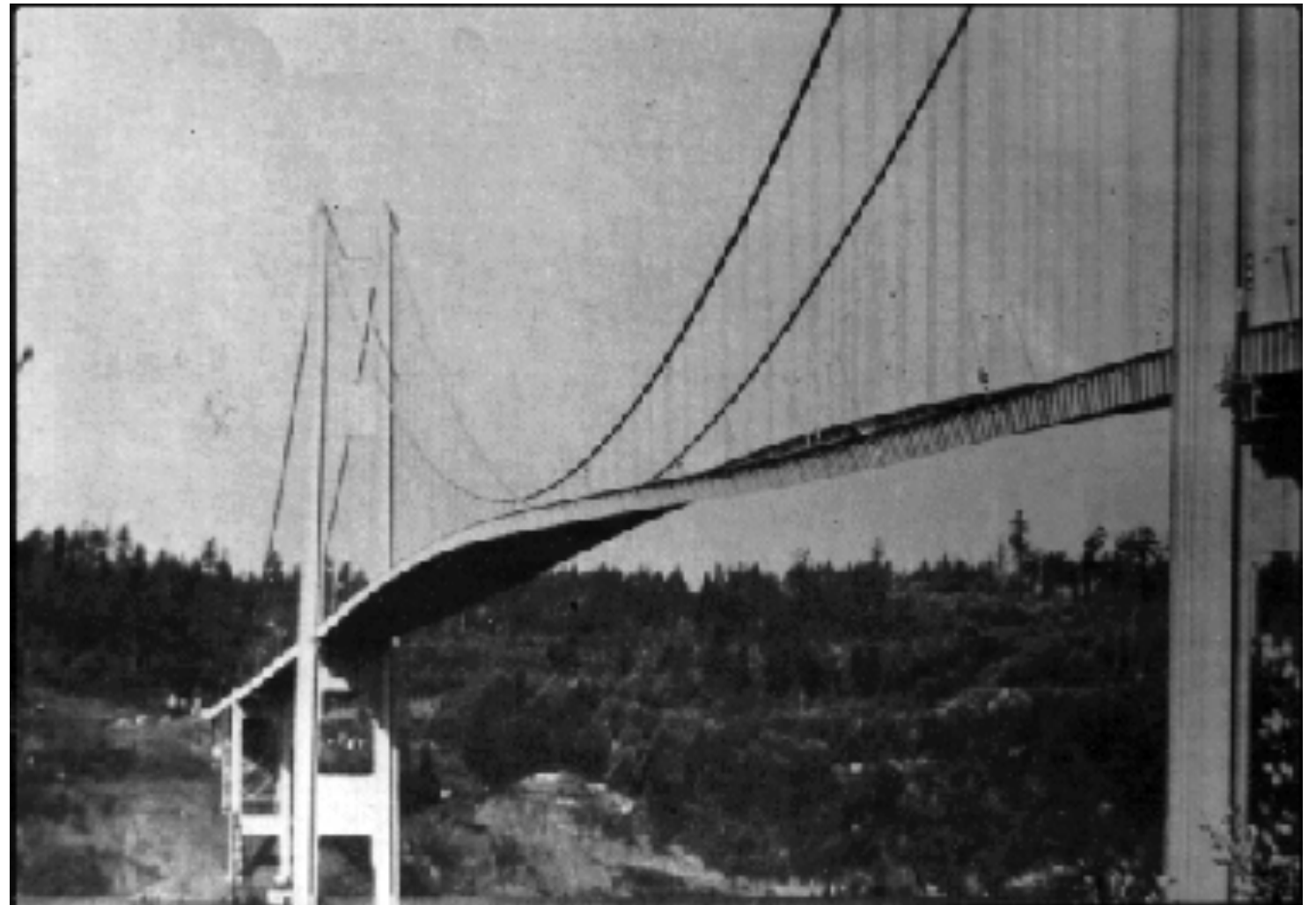
1138 Aleppo (Syria) Earthquake

Manage Slow
Variables and
Feedbacks



1940 Tacoma Narrows Suspension Bridge Collapse.

Managing Slow
Variables and
Feedback



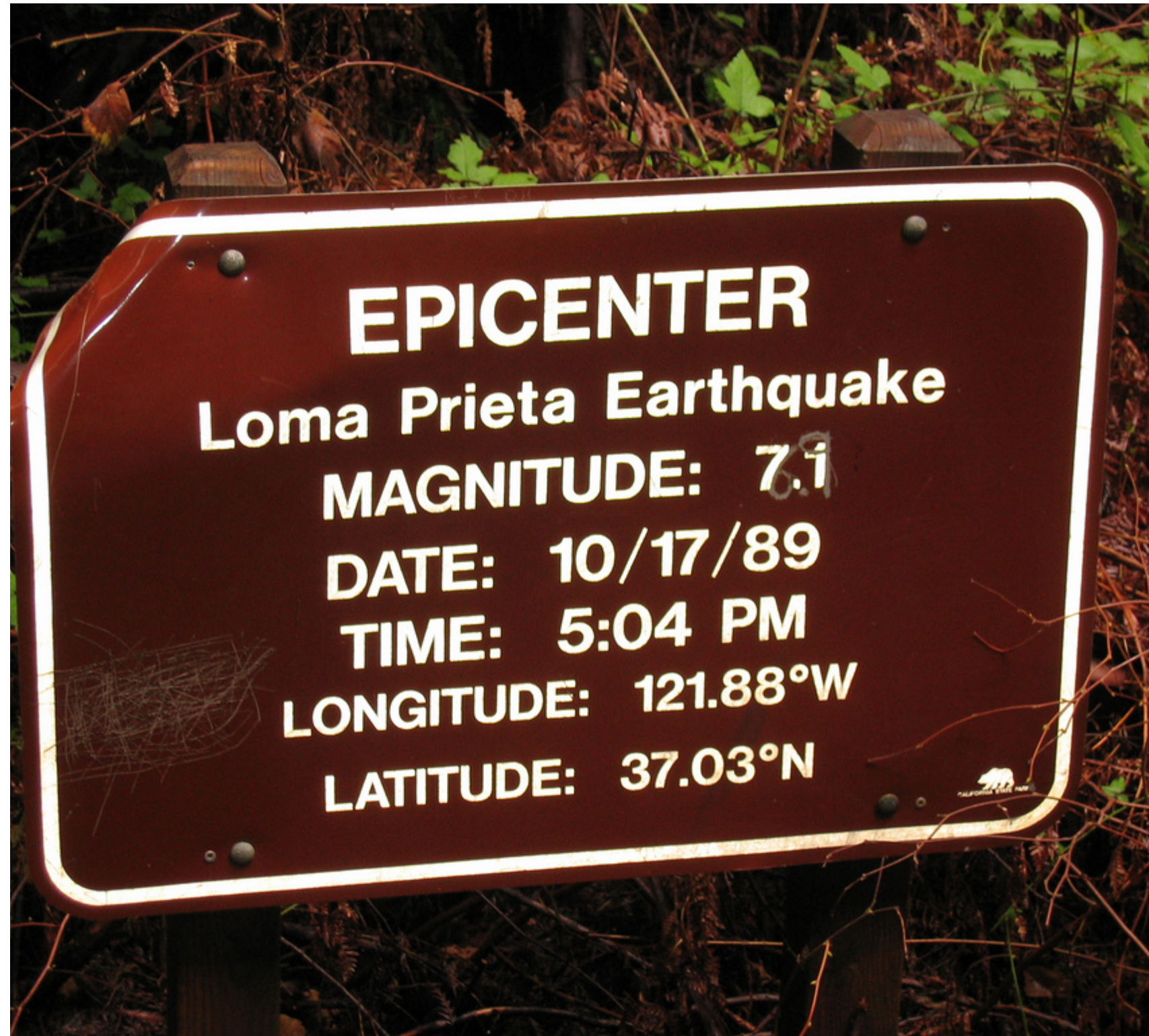
2010 Haiti Earthquake

Occam's Razor



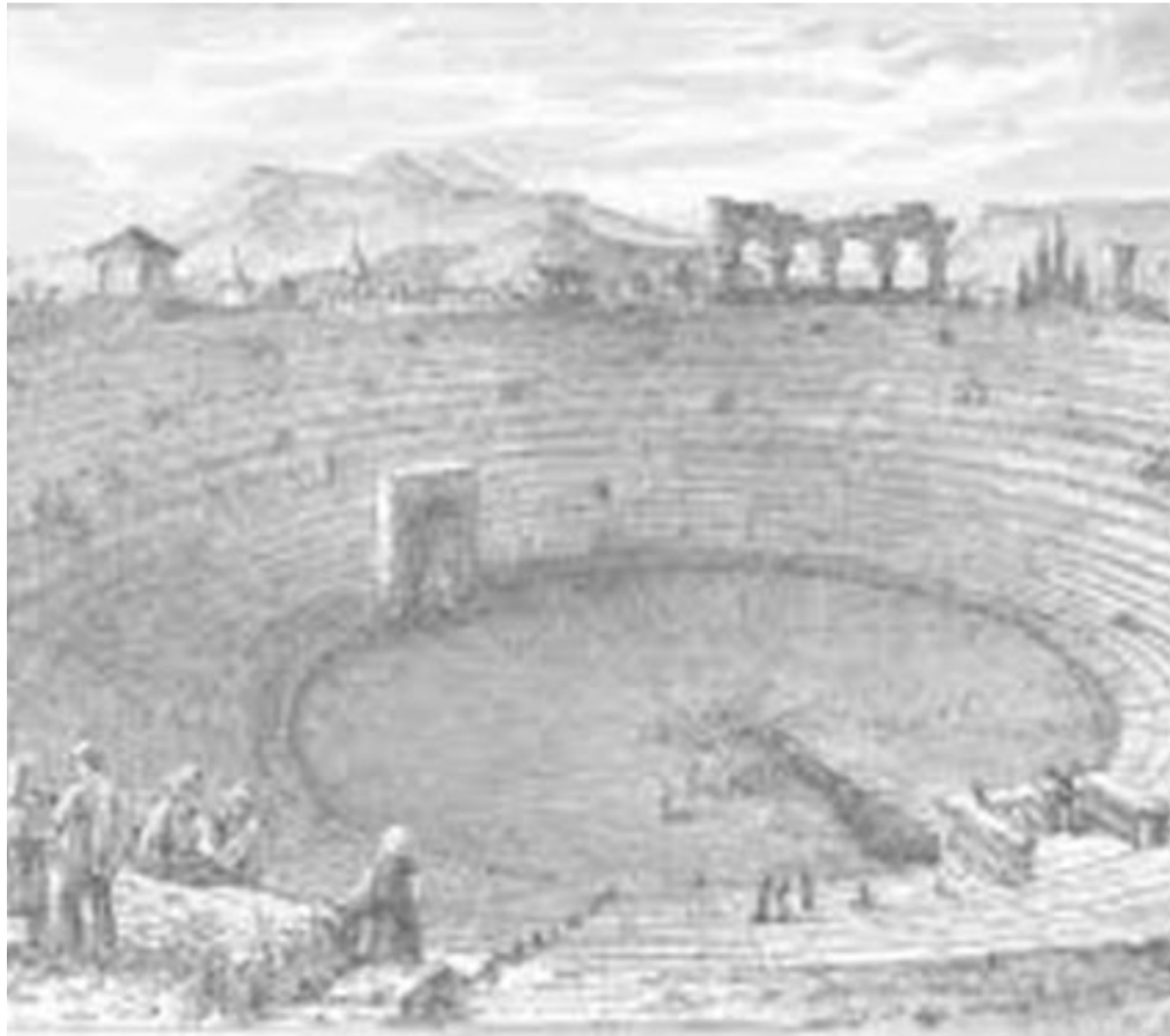
1989 San Francisco Earthquake

Encourage
Learning and
Algorithmic
Diversity



27 AD Fidenae
Amphitheatre Collapse

Cross Validation



SARS — Severe Acute
Respiratory Syndrome

Polycentric
Governance



1984 Bhopal Gas Leak Disaster

Encourage Learning



1975 Banqiao Dam Collapse

Maintain
Diversity and
Redundancy



1929 Stock Market Crash

Manage Slow Variables and Feedbacks



learning from the
past to think about

the future

Ada Lovelace 1842

"The Analytical Engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform. It can follow analysis; but it has no power of anticipating any analytical relations or truths."

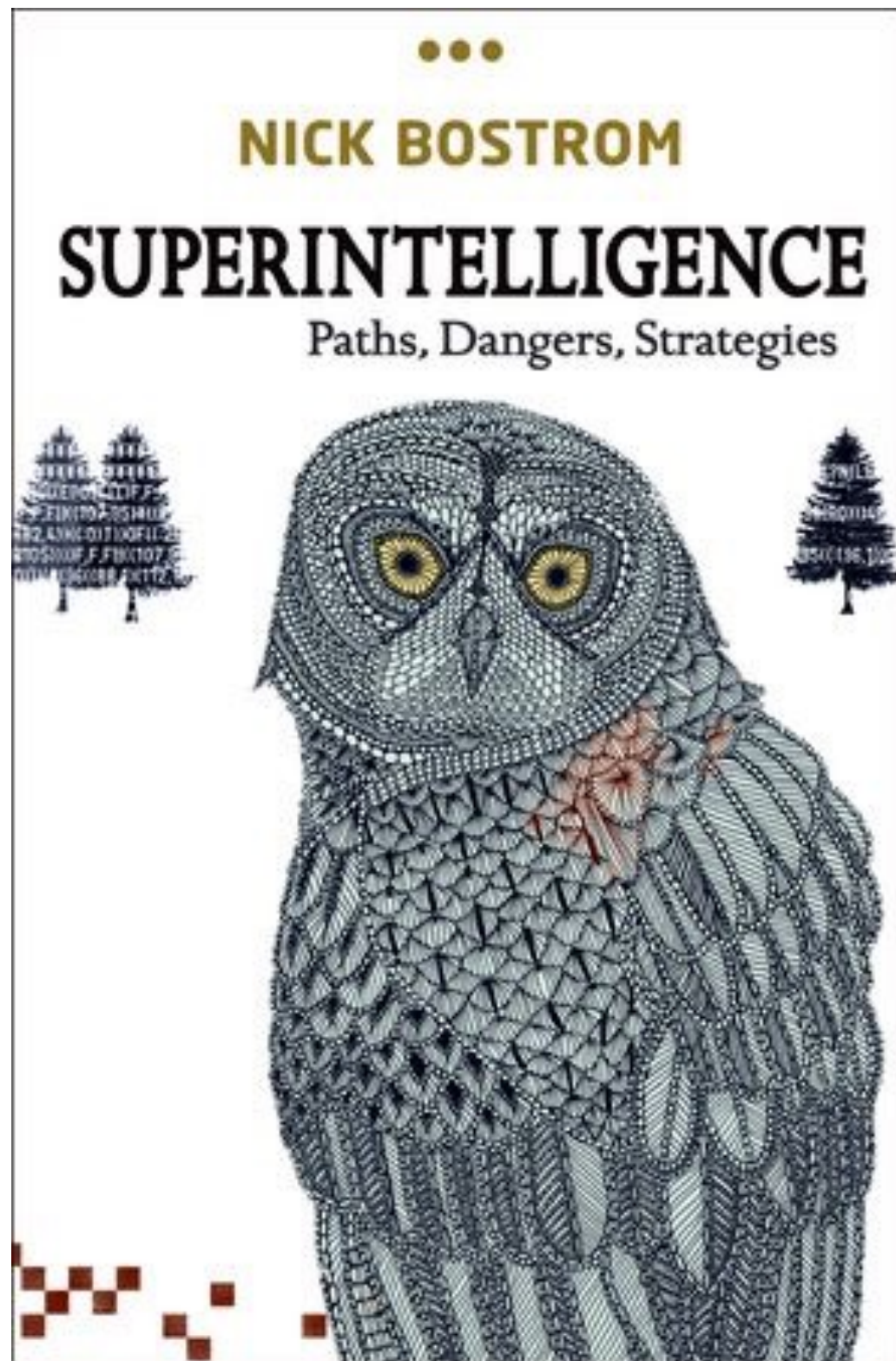


Turing test

Turing wrote, with regard to Ada Lovelace, “which might be taken to mean that her position was that machines could not learn, or create anything original.”

Alan Turing proposed that a human evaluator would judge natural language conversations between a human and a machine that is designed to generate human-like responses.





Nick Bostrom

- Human Level Machine Intelligence
- Super Human Machine Intelligence

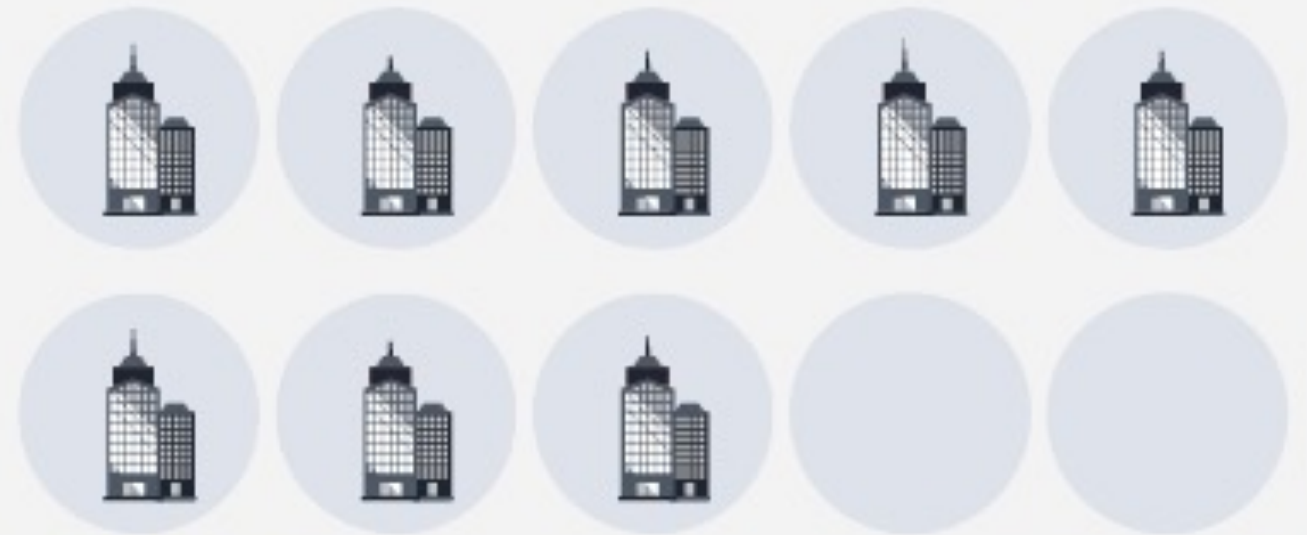
Concerns



Ever-widening skills gap

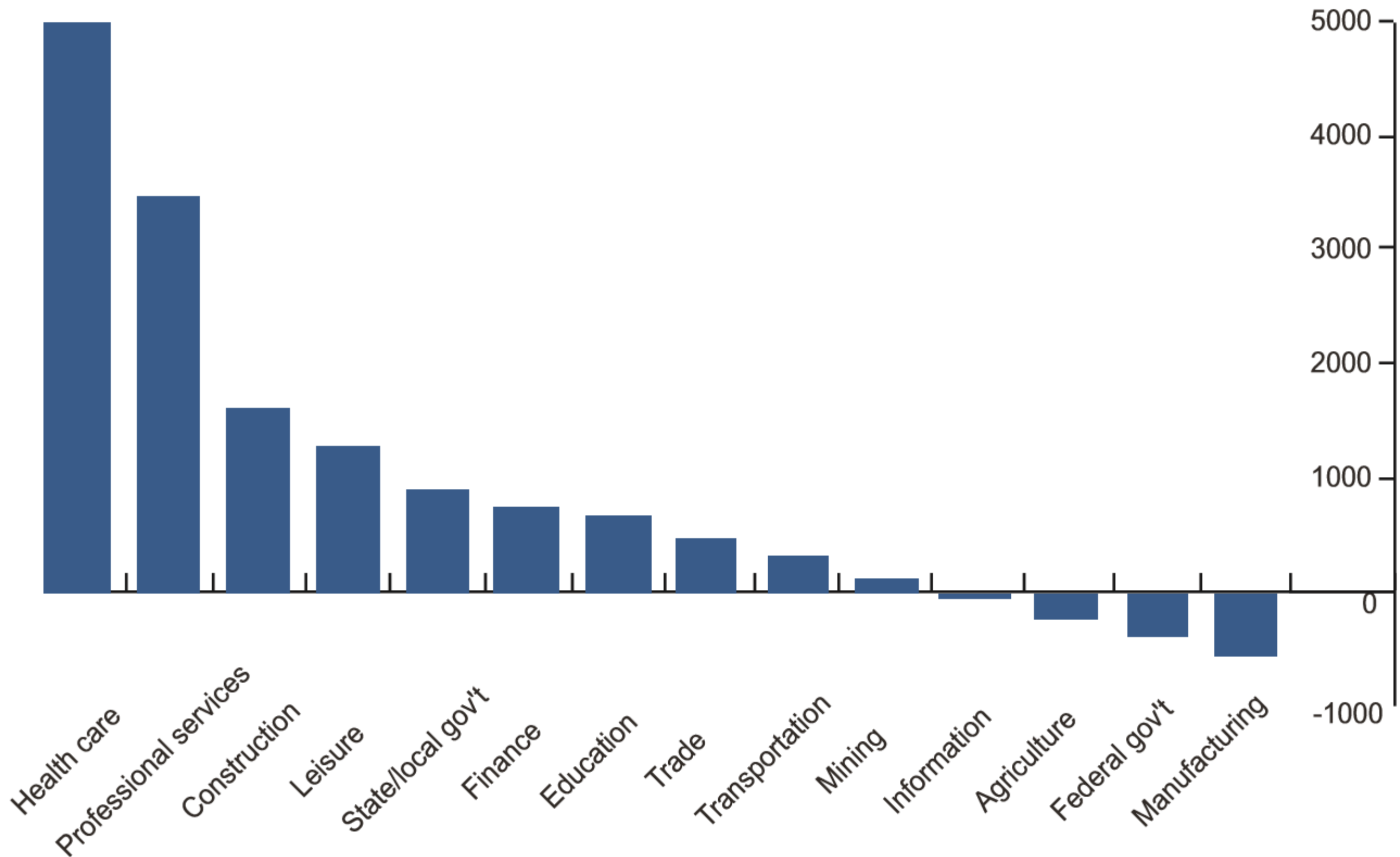


>50%
CANNOT FIND
QUALIFIED
CANDIDATES



8 IN 10 HAVE DIFFICULTY FILLING POSITIONS

Future employment projections by sector, 2012-2022 (in millions)



jobs to be replaced by machines

- Bank Teller
- Cashier
- Receptionist
- Telephone Operator
- Mail Carrier
- Travel Agent
- Mathematical technician
- Typist
- Reporter
- Data Entry
- Telemarketer
- Title Examiner
- Insurance Underwriter
- Pharmacist
- Lawyer and Paralegal
- Driver – Truck and Taxi
- Astronaut
- Store Clerk
- Soldier
- Babysitter
- Rescuer
- Cargo and Freight Agent
- Account Clerk
- Dental Technician
- Real Estate Broker
- Data-entry specialist

* 99% probability

47% of US workers have a high probability of their jobs automated by 2035

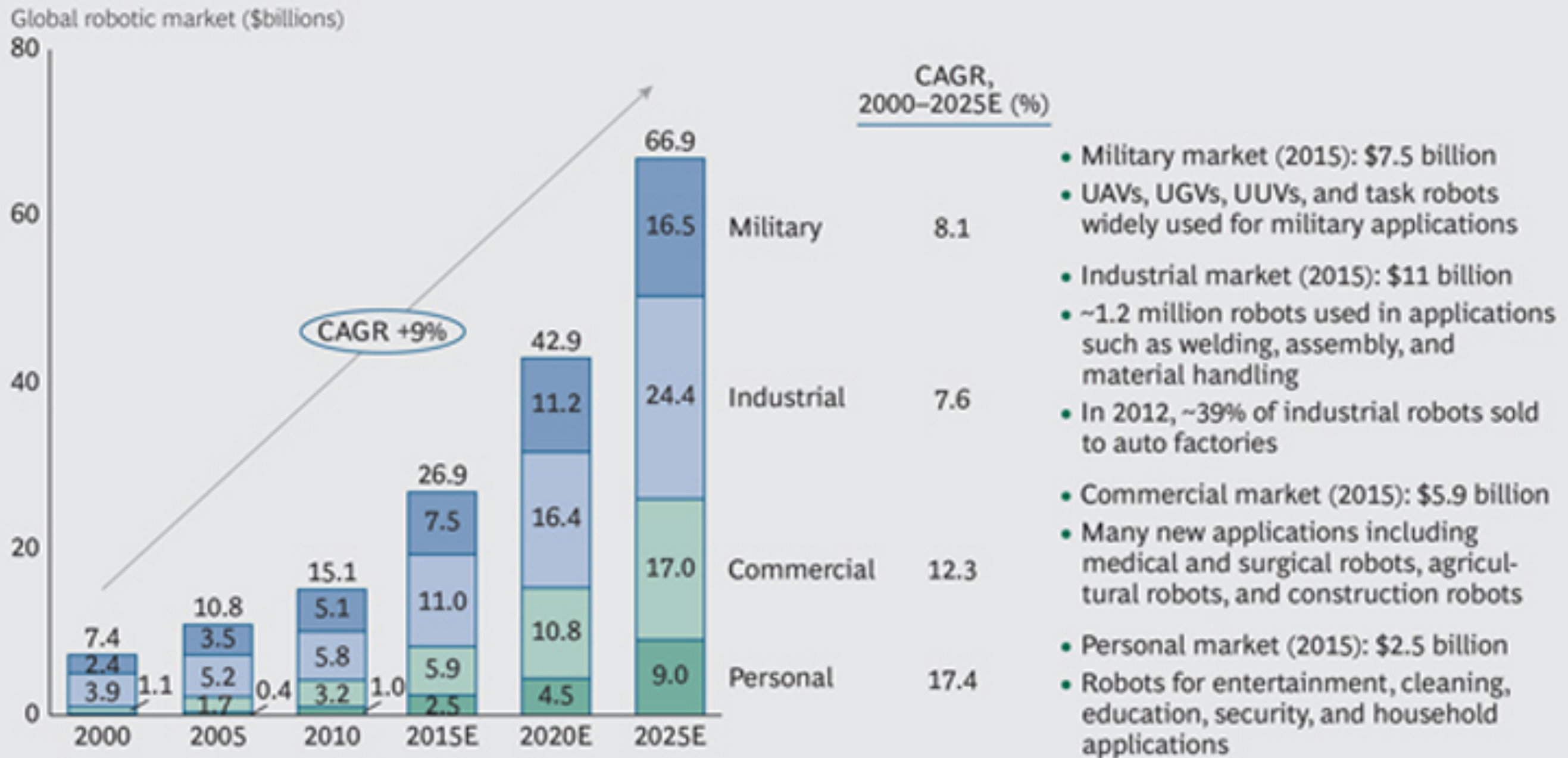
Estimated annual worldwide supply of industrial robots 2009-2017 and 2018*-2021*



*forecast

Source: IFR World Robotics 2018

Worldwide spending on robots



Sources: International Federation of Robotics, Japan Robot Association; Japan Ministry of Economy, Trade & Industry; euRobotics; company filings; BCG analysis.

Note: UAV = unmanned aerial vehicle; UGV = unmanned ground vehicle; UUV = unmanned underwater vehicle. Estimates do not include the cost of engineering, maintenance, training, or peripherals.

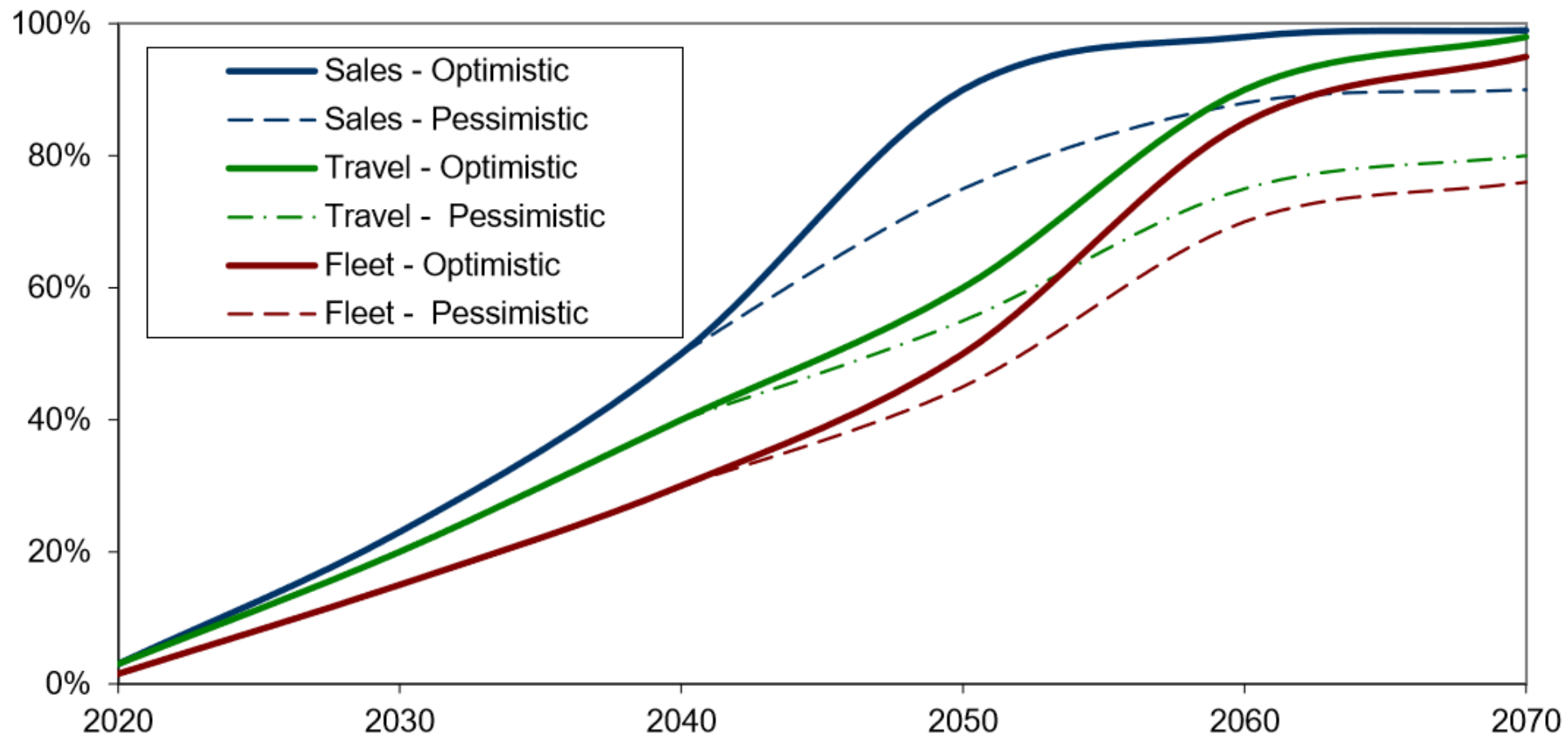
Autonomous Vehicles

Exhibit 13 Autonomous Vehicle Implementation Projections

Stage	Decade	Vehicle Sales	Veh. Fleet	Veh. Travel
Available with large price premium	2020s	2-5%	1-2%	1-4%
Available with moderate price premium	2030s	20-40%	10-20%	10-30%
Available with minimal price premium	2040s	40-60%	20-40%	30-50%
Standard feature included on most new vehicles	2050s	80-100%	40-60%	50-80%
Saturation (everybody who wants it has it)	2060s	?	?	?
Required for all new and operating vehicles	???	100%	100%	100%

Autonomous vehicle implementation will probably take several decades.

Exhibit 14 Autonomous Vehicle Sales, Fleet and Travel Projections (Based on Exhibit 13)



If they follow previous vehicle technologies autonomous vehicles it will take one to three decades to dominate vehicle sales, and one or two more decades to dominate vehicle travel, and even at saturation a significant portion of vehicle travel may continue to be human operated, indicated by the dashed lines

Autonomous Trucking

Udelv Drives Forward With Autonomous Delivery Vans, Expands Service



OCTOBER 18

Autonomous delivery company Udelv has made more than 1,000...

[Read More](#)

Wabco Highlights Plans for Autonomous Truck Technologies



SEPTEMBER 27

Trucking supplier Wabco introduced an array of new...

[Read More](#)

U.S. Army Deploying Autonomous Trucks Faster Than Expected



SEPTEMBER 26

The U.S. Army is deploying 60 autonomous trucks...

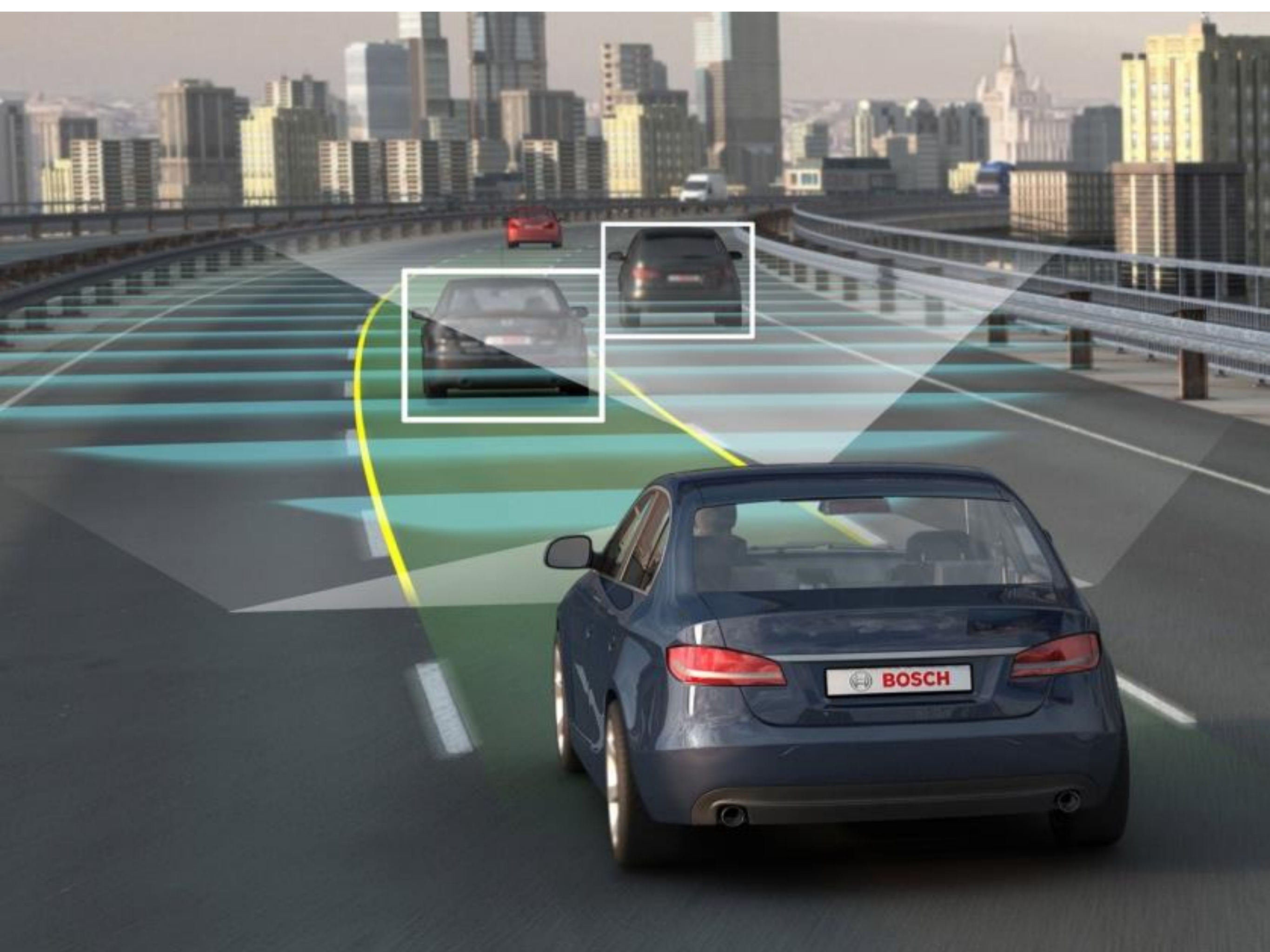
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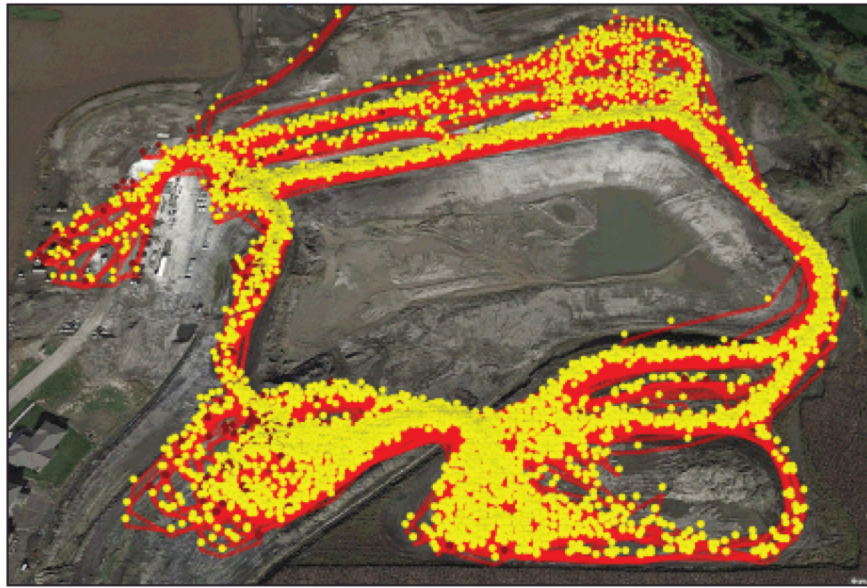
Questions to Ponder





Smart Infrastructure



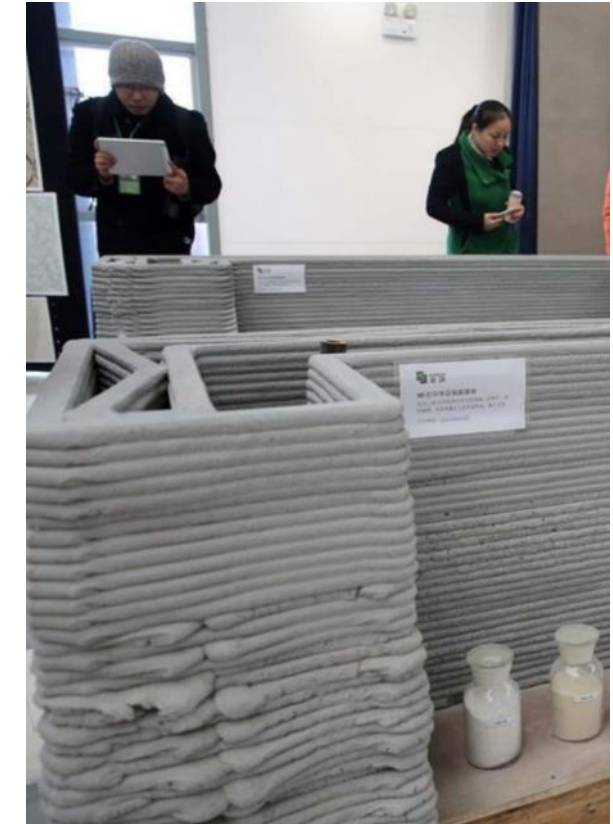


Position information collected from haul truck operation (5 days) at earthwork site.



Caterpillar has deployed a fleet of 45 self-directed, fully automated 240-ton "793F mining trucks" in Australia

3D Printed Building



3D Printed Roads & Bridges

[video](#)



Drone-based Construction





V2P and V2I

Vehicle to Pedestrian
Vehicle to Infrastructure
Communication

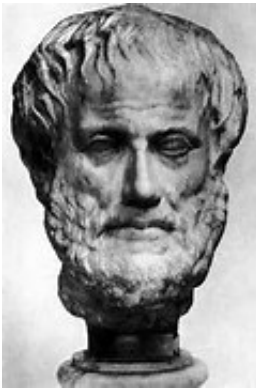
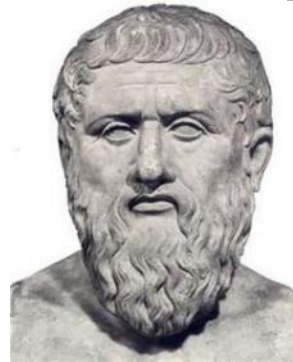
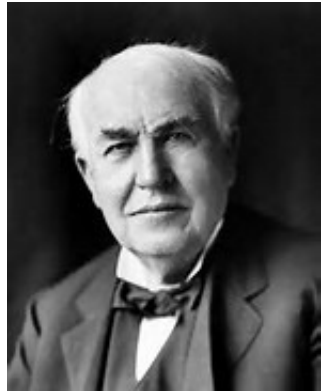
ITS

<http://www.its.dot.gov/index.htm>

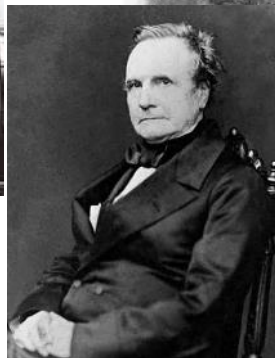
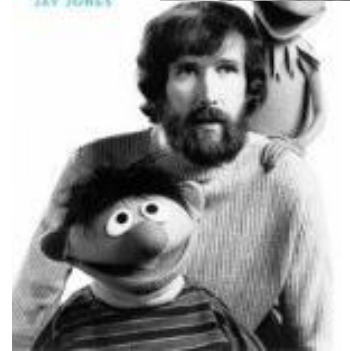


It's coming... the 2nd machine age...





disruptors



Isaak N



Galileo Galilei.



Conclusion



people first
intelligent machines
smart and resilient infrastructure
thank you

Ted info

rosss@microsoft.combb



/42projects



@42projects



rosss42



Further Reading

[Studying the Impacts of Autonomous and Robotically Controlled Road-Building Equipment](#)

[AUTOMATION AND ROBOTICS FOR ROAD CONSTRUCTION AND MAINTENANCE](#)

[The Dawn of Autonomous Vehicle Technology in Construction](#)

[Drones in Construction](#)

[The Long Road to Autonomous Construction](#)

[World's First 3D Printed House](#)

[Uber Self Driving Fleet arrives in Pittsburgh](#)

[Intelligent Transportation Systems](#) – US DOT

<https://towardsdatascience.com/principles-of-artificial-intelligence-machine-learning-122be27d33a4>

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