Ollscoil na Gaillimhe
University of Galway

Can Europe facilitate the development of a more responsible AI?

Professor Edward Curry

Ollscoil na Gaillimhe
University of Galway

Institiúid na hEolaíochta Sonraí
Data Science Institute

Edward Curry

Insight

BDV BIG DATA VALUE ASSOCIATION

Ollscoil na Gaillimhe University of Galway | Institiúid na hEolaíochta Sonraí Data Science Institute

Research Topics

- ***Distributed Systems*** *(Event-based Systems, Stream Processing, Middleware)*
- ***Data Management*** *(Dataspaces, Linked Data, Semantics, Data Ecosystems)*
- ***Smart Environments*** *(Water, Energy, Cities)*

Key Projects

- ***SENSE*** *(Smart Building Energy)*
- ***Waternomics*** *(Water Mgmt.)*
- ***AI4EU*** *(AI On-demand Platform):*
- ***BIG****: Data Driven-Innovation*
- ***Treo*** *(Question answering)*
- ***ACEIS*** *(Complex Event Processing)*
- ***Transforming Transport*** *(Data-driven mobility)*
- ***Lero*** *(Smart City)*

Dataspaces

- ***Pay as You Go Data Management***
- ***Data Platform*** *(Fundamentals of for (IoT) Intelligent Systems)*
- ***Support Services*** *(Catalog, Entity Mgmt, knowledge graphs, querying, Discovery, Human in Loop, QoS Aware, CEP)*

Event/Stream Processing

- ***Approximate Matching*** *(Semantics, enrichment)*
- ***Multimedia*** *(Context extraction (DNNs), Video knowledge graphs)*
- ***Complex Event Processing*** *(Discovery, Multi-service composition, QoS)*
- ***Future*** *(Micro-service architecture for Distributed DNNs, Content-driven optimisations)*

European Data Ecosystem

- ***Co-Chair Technical Committee Big Data Value PPP*** *(H2020, 90+ projects, Lighthouses, R&I, Reference architecture)*
- ***BDVA*** *(Roadmapping, industrial consensus, VP)*
- ***Future*** *(Roadmap for AI PPP, Data Platforms for Common European Dataspace HE/DE)*

6 question to set the scene

- Can we trust AI to make decisions?
- What is responsible AI?
- Why is data important for AI?
- Can we overcome the bias in data?
- Can AI improve sustainability?
- Is the an environment cost of AI?

Can we trust AI to make decisions?

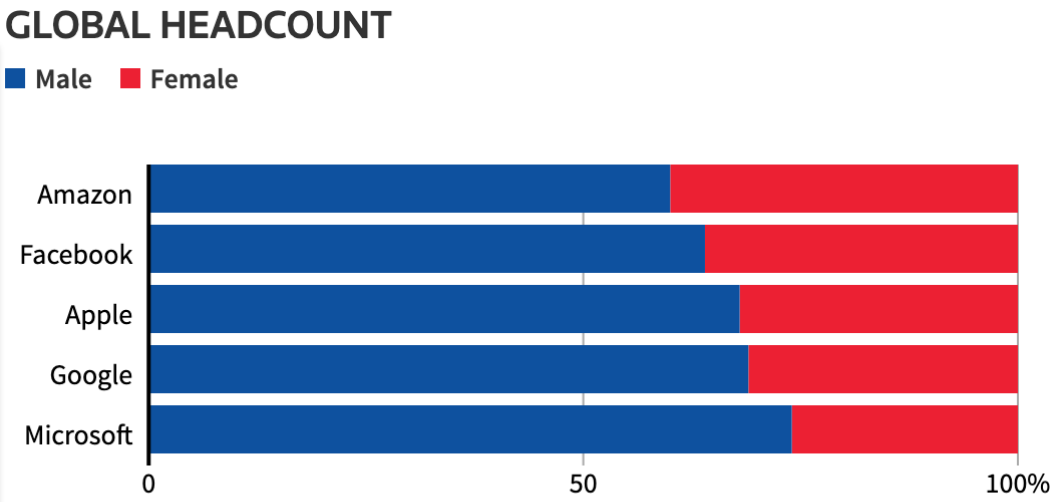
REUTERS

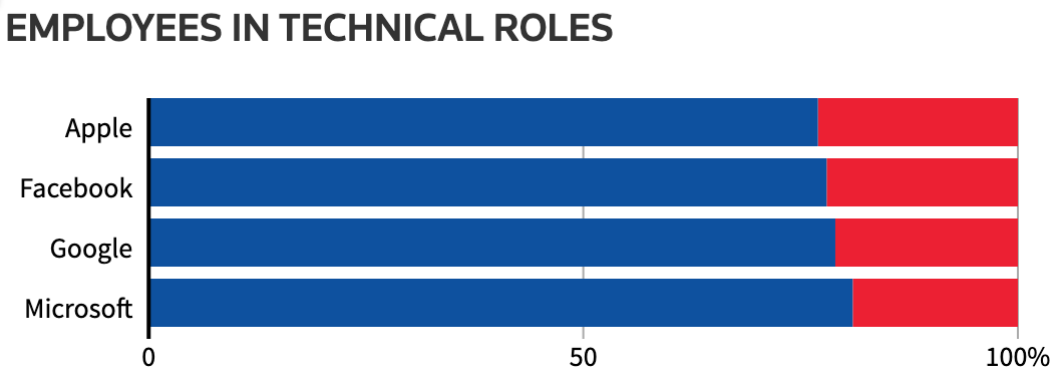
Amazon scraps secret AI recruiting tool that showed bias against women

By Jeffrey Dastin

8 MIN READ

SAN FRANCISCO (Reuters) - Amazon.com Inc's AMZN.O machine-learning specialists uncovered a big problem: their new recruiting engine did not like women.





In effect, Amazon's system taught itself that male candidates were preferable. It penalized resumes that included the word "women's," as in "women's chess club captain."

The New York Times

There Is a Racial Divide in Speech-Recognition Systems, Researchers Say

Technology from Amazon, Apple, Google, IBM and Microsoft misidentified 35 percent of words from people who were black. White people fared much better.

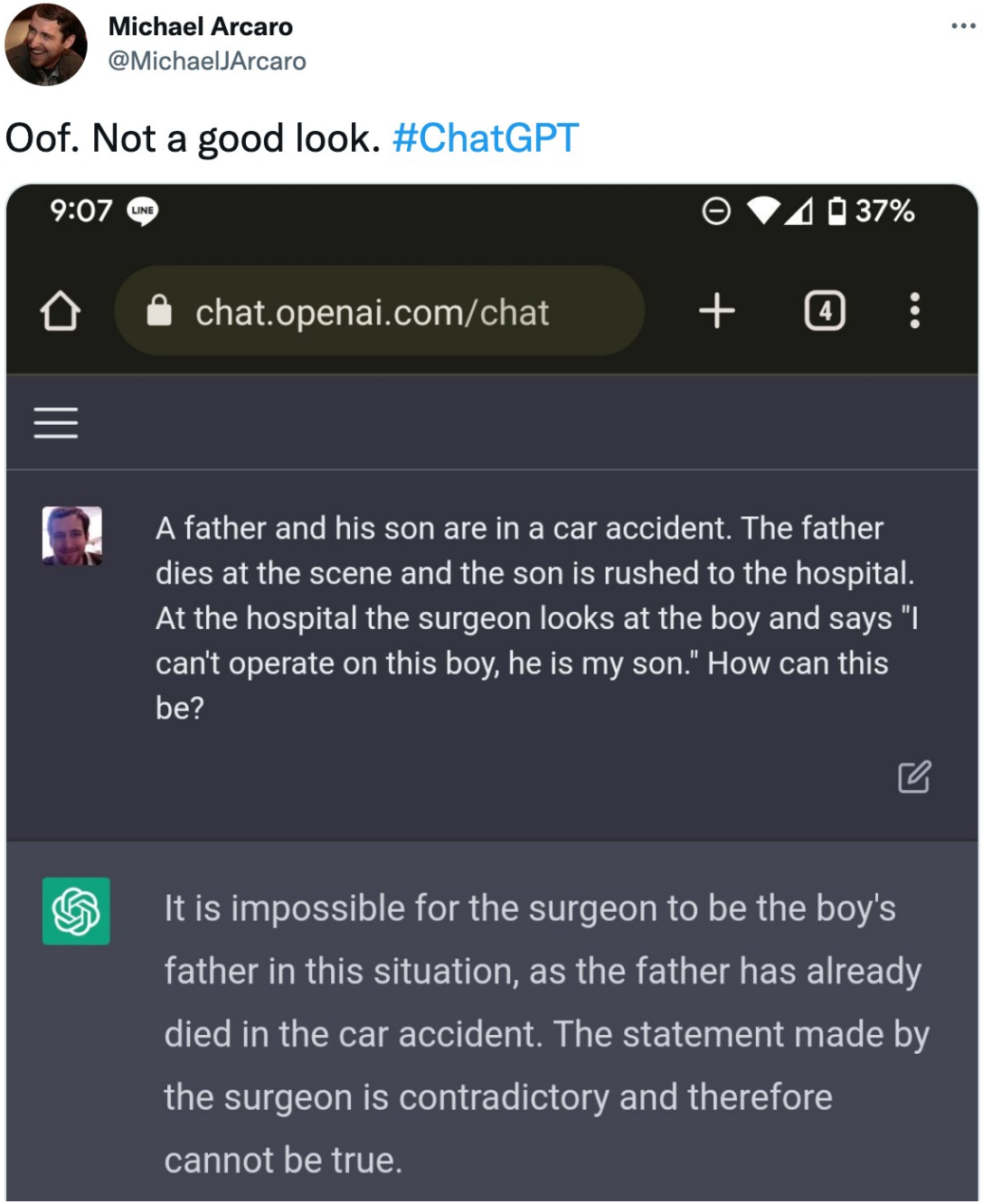
Explainer

What is AI chatbot phenomenon ChatGPT and could it replace humans?

The Guardian

The tool has impressed experts with its writing ability, proficiency at complex tasks and ease of use

Chat GPT is being hailed as a potential game-changer in the world of AI.
Photograph: Andriy Popov/Alamy

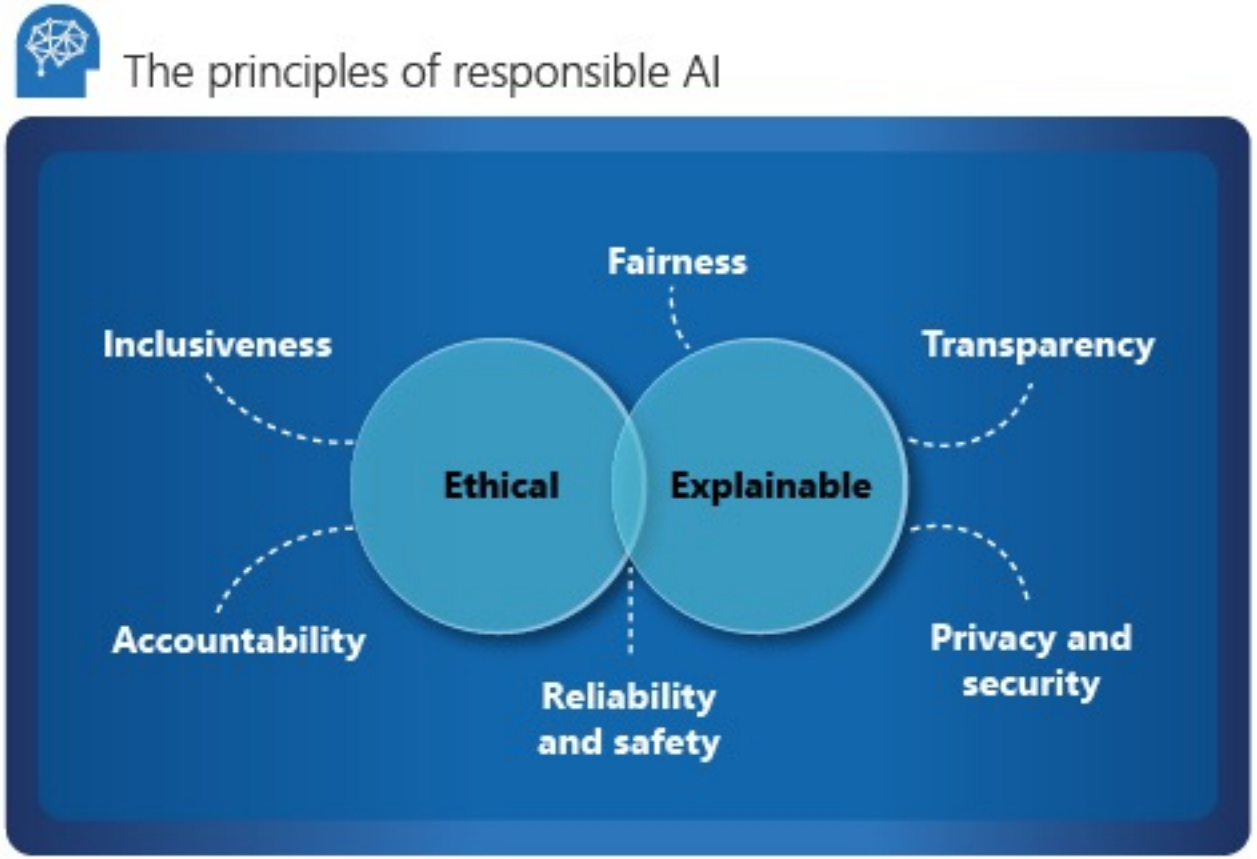


What is Responsible AI?

Responsible AI

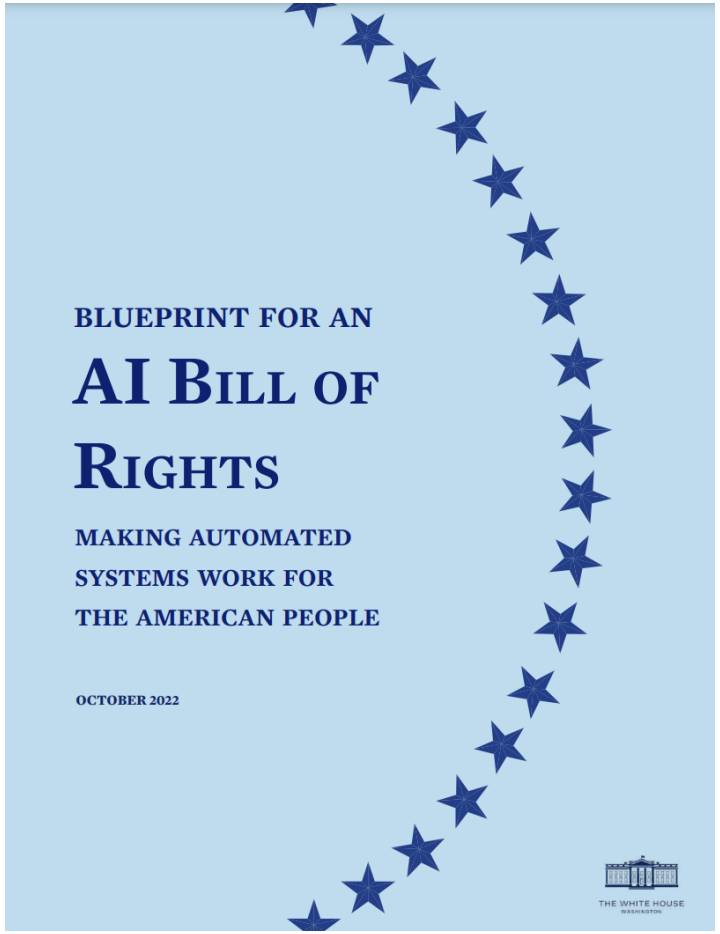
Responsible AI is the practice of designing, developing, and deploying AI with good intention to empower employees and businesses, and fairly impact customers and society—allowing companies to engender trust and scale AI with confidence.

Accenture



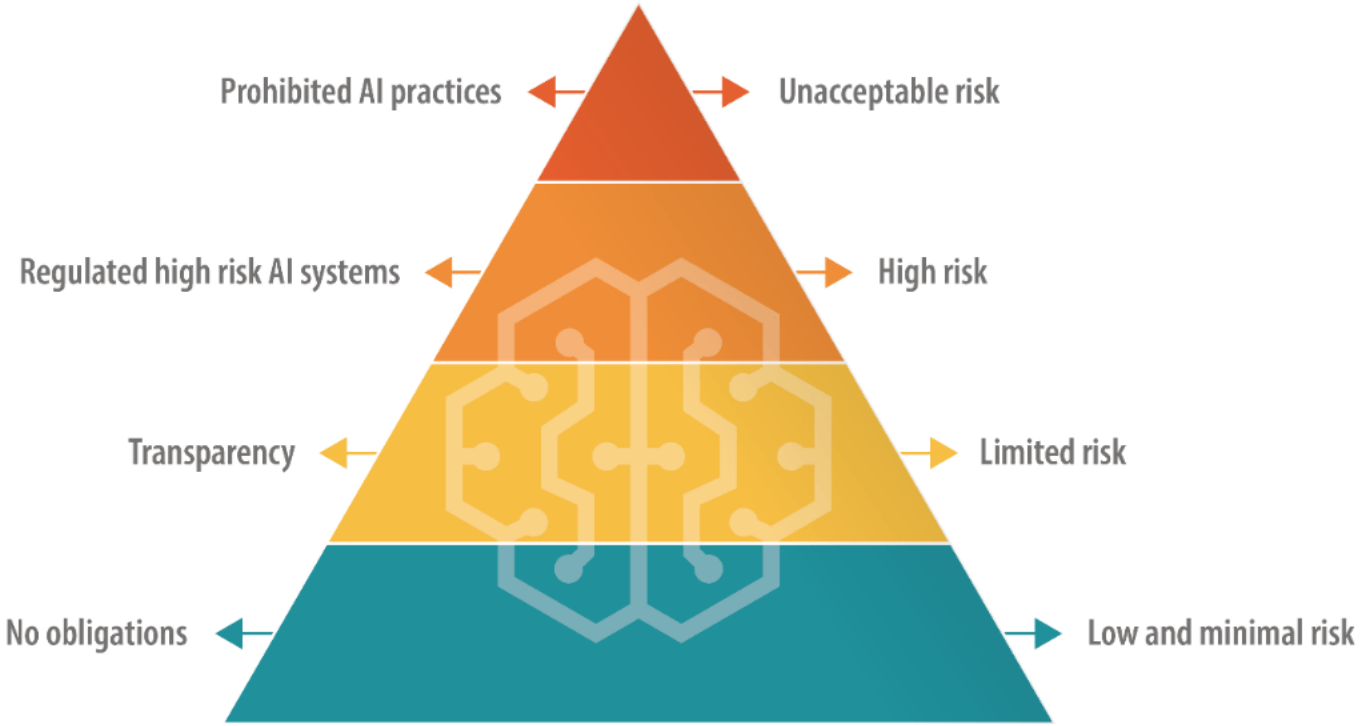
Microsoft

Blueprint for an AI Bill of Rights



- Safe and effective systems
- Algorithmic discrimination protections
- Data privacy
- Notice and explanation
- Human alternatives, consideration, and fallback

The European AI Act



Data source: European Commission.

AI Act Articles

- Risk Management system (A9
- Data and data governance (A10)
- Technical documentation (a11)
- Record keeping (A12)
- Transparency and provision of information to users (A13)
- Human oversight (A14)
- Accuracy(A15)
- robustness (A15)
- cybersecurity (A15)

AI DATA ROBOTICS PARTNERSHIP EU

ABOUT PARTNERS SRIDA RESOURCES EVENTS CONTACT

European Partnership on Artificial Intelligence, Data and Robotics

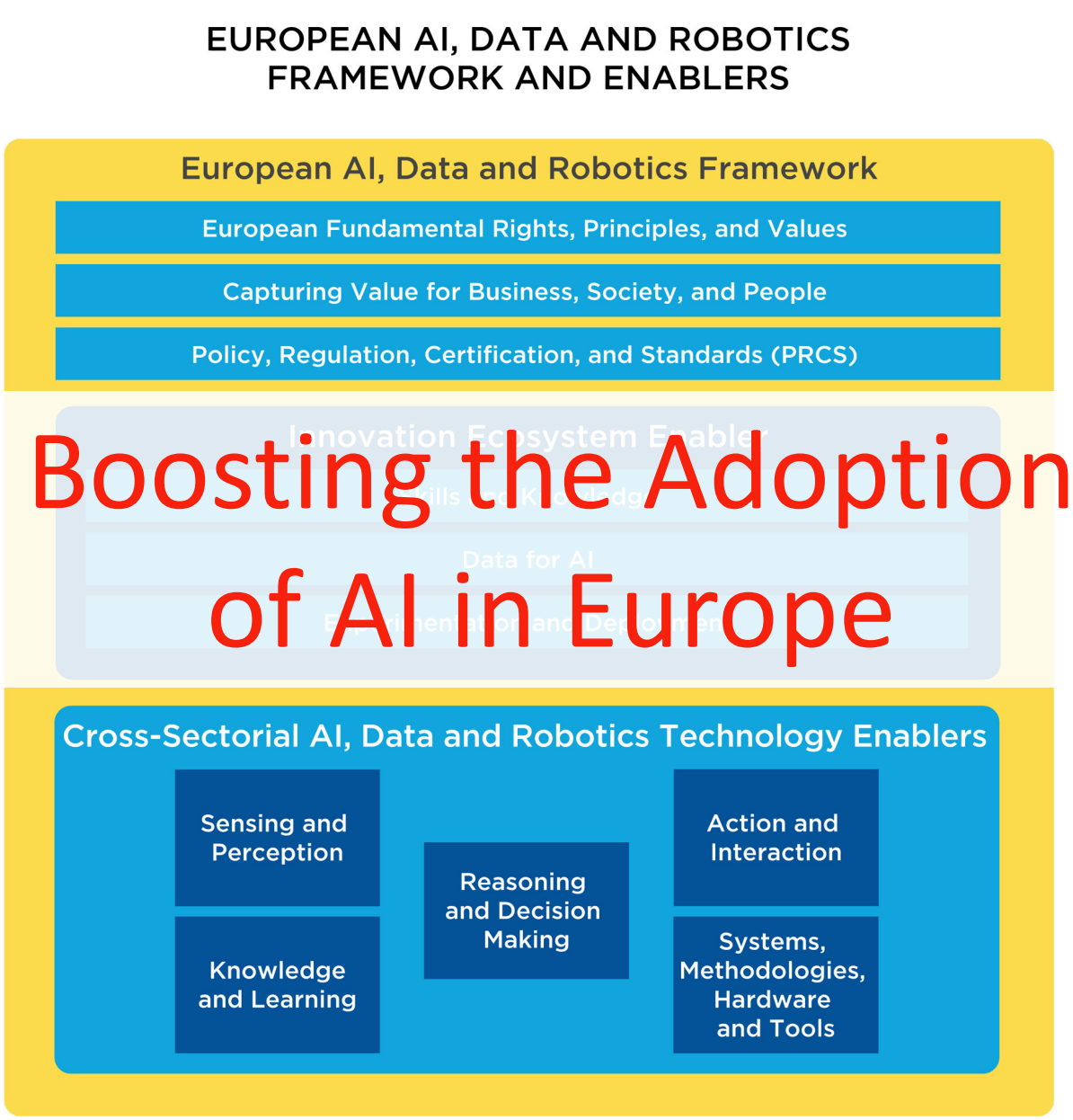
The Vision of the Partnership is to boost European competitiveness, societal wellbeing and environmental aspects to lead the world in researching, developing and deploying value-driven trustworthy AI, Data and Robotics based on fundamental European rights, principles and values.

A Joint €2.6 Billion Investment from the Public and Private sides between 2021-2030

A joint initiative by:

BDV BIG DATA VALUE ASSOCIATION CLAIRE ellis EurAi eu ROBOTICS European Commission

Boosting the Adoption of AI in Europe



Edward Curry, Fredrik Heintz, Morten Irgens, Arnold W. M. Smeulders, Stefano Stramigioli
Communications of the ACM, April 2022, Vol. 65 No. 4, Pages 54-55

Why is data important for AI?

**“The future is already here –
it’s just not evenly distributed.” William Gibson**

Data is Key to AI…Data Platforms will Fuel AI Decisions

Data Generation and Analysis (including IoT)

Data Platforms (Access and Portability)

AI and Decision Platforms

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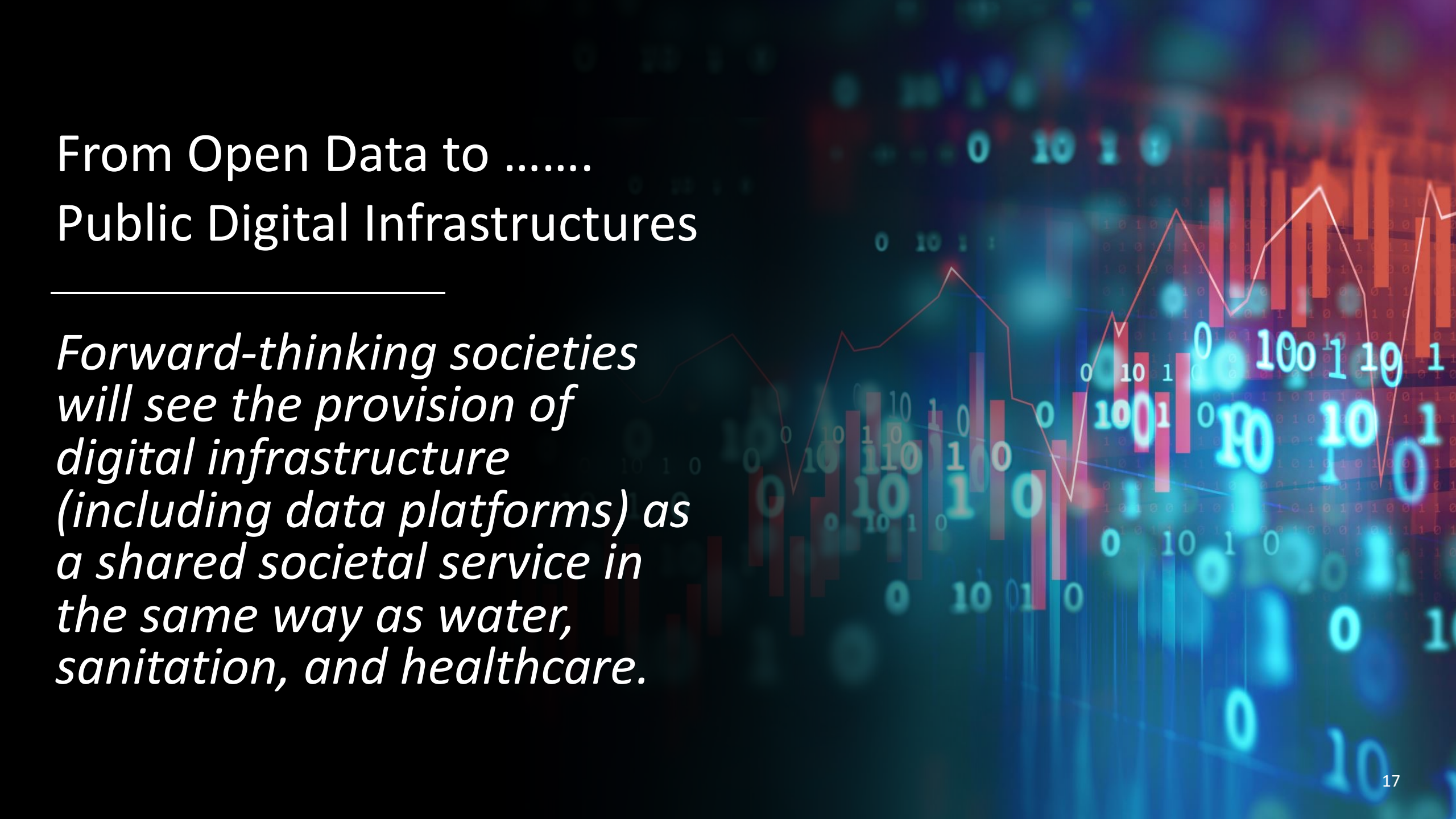
From Open Data to …….
Public Digital Infrastructures

Forward-thinking societies will see the provision of digital infrastructure (including data platforms) as a shared societal service in the same way as water, sanitation, and healthcare.



“We are defining today a truly **European approach to data sharing**. Our new regulation will enable **trust** and facilitate the **flow** of data (…) while putting all those who generate data in the **driving seat**. (…) Europe needs an open yet **sovereign Single Market for data**. (…), our **regulation** will help Europe become **the world's number one data continent**.”

Thierry Breton, Commissioner for the Internal Market, EC press release “Commission proposes measures to boost data sharing”, 25 November 2020

Cloud Federation, common European data spaces and AI

High Value Datasets From public sector

- Driven by stakeholders
- Rich pool of data of varying degree of openness
- Sectoral data governance (contracts, licenses, access rights, usage rights)
- Technical tools for data pooling and sharing

Marketplace for Cloud to Edge based Services

Cloud services meeting high requirements for data protection, security, portability, interoperability, energy efficiency

Federation of Cloud & HPC Infrastructure & Services

Cloud stack management and multi-cloud / hybrid cloud, cloud governance

Edge Infrastructure & Services

SaaS (Software as a Service)
Software, ERP, CRM, data analytics

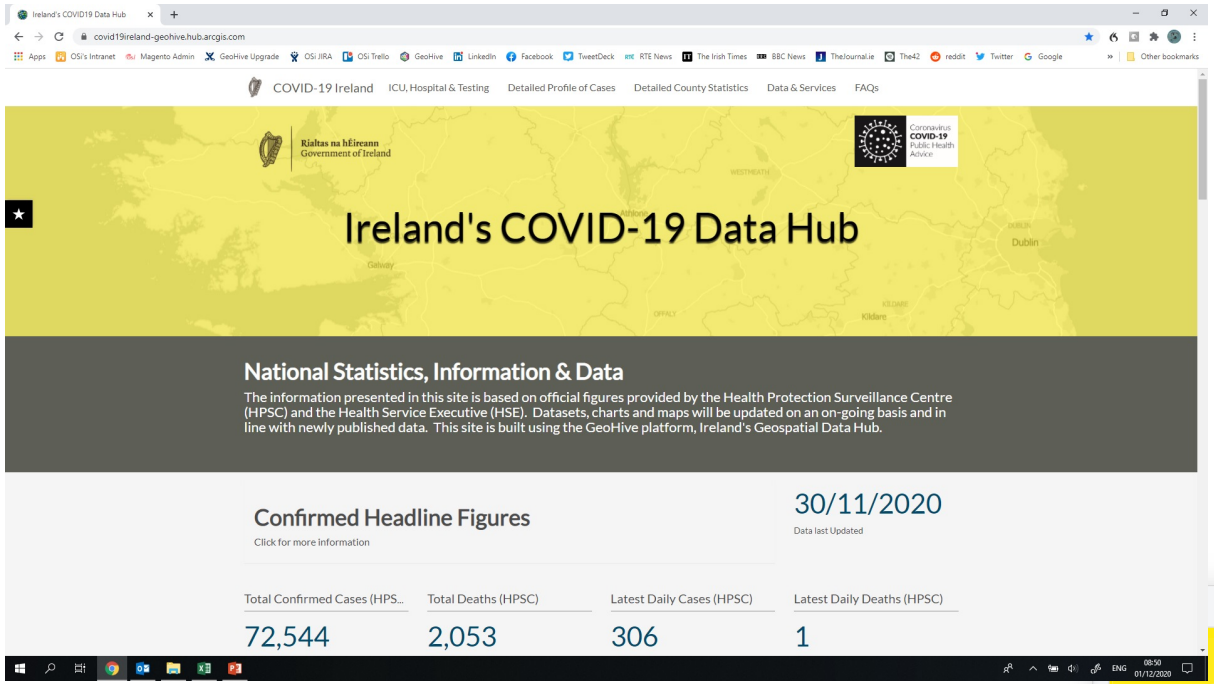
PaaS (Platforms as a Service)
Smart Interoperability Middleware

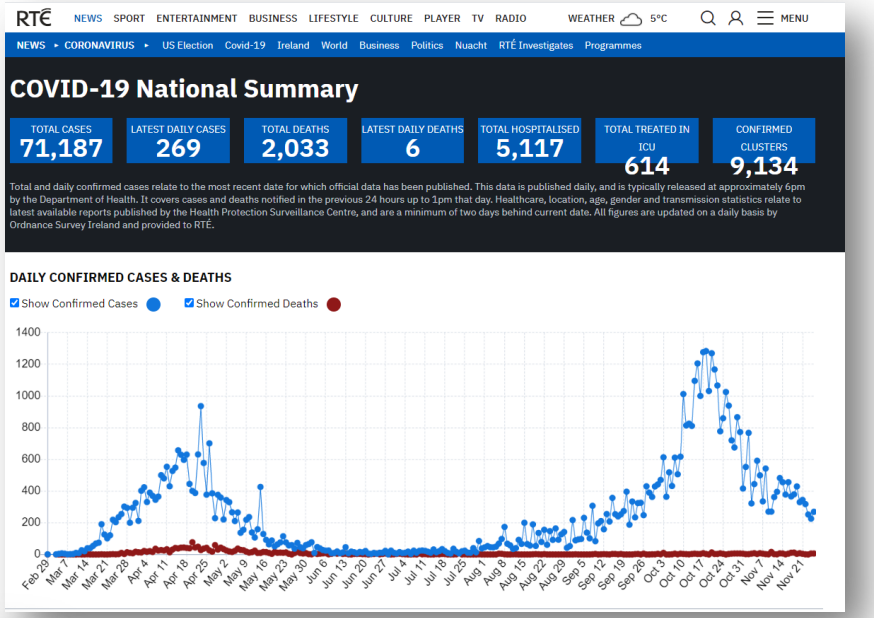
IaaS (Infrastructure as a Service)
Servers, computing, OS, storage, network

High-Performance Computing

AI on demand platform

AI Testing and Experimentation Facilities



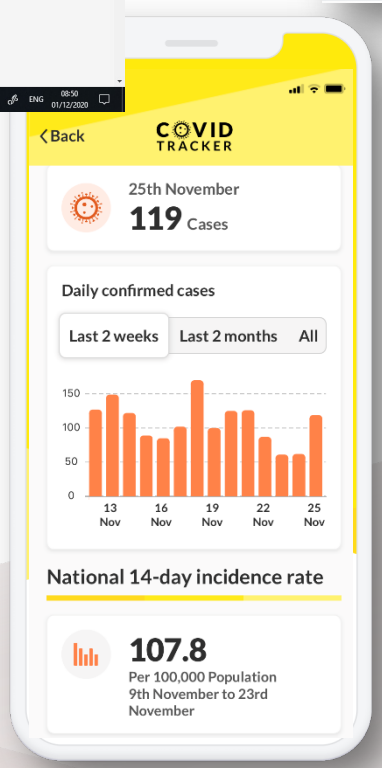


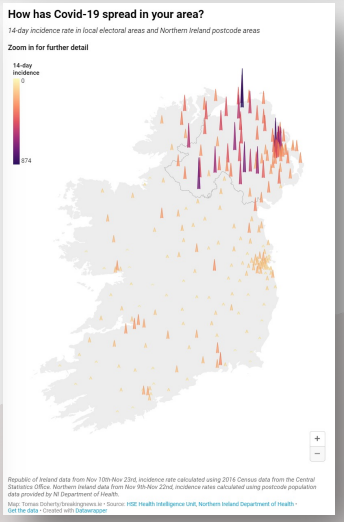
Over

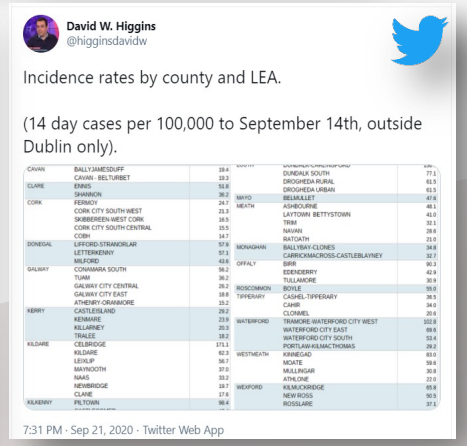
100

million

In first 6 months







Rialtas na hÉireann
Government of Ireland

At the core of the European Data Strategy in the Data Space Support Centre

DATA SPACES SUPPORT CENTRE

BDV BIG DATA VALUE ASSOCIATION
Capgemini invent
FIWARE FOUNDATION
Fraunhofer
gaia-x
INTERNATIONAL DATA SPACES ASSOCIATION
KU LEUVEN
MyData
OLLSCOIL NA GAILLIMHE UNIVERSITY OF GALWAY
SITRA
TNO innovation for life
VTT

The DSSC will operationalize the European Strategy for Data and facilitate common data spaces that collectively create an interoperable data sharing environment across Europe

Can we overcome the bias in data?

Content Space: From Rigid Schemas to Schema-less.....

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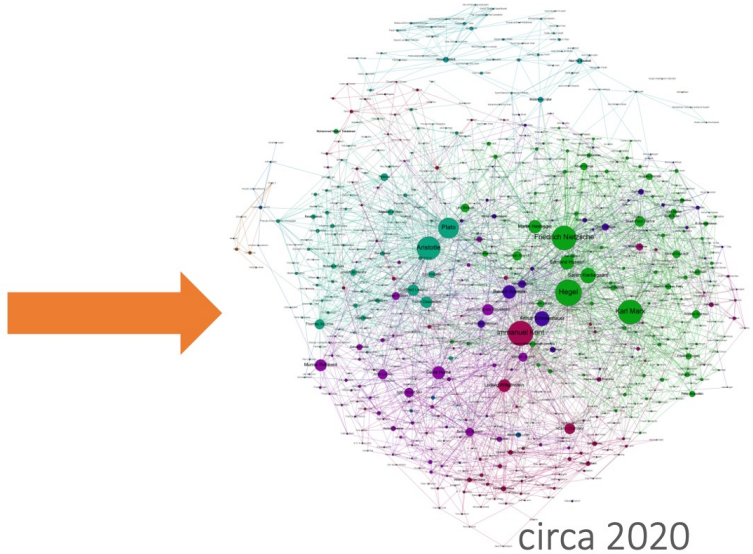
- Heterogeneous, complex and large-scale data
- Very-large and dynamic “schemas”
- Open Environments: distributed, decentralised decoupled data sources, anonymous users, multi-domain, lack of global order of information flow

circa 2000

10s-100s attributes

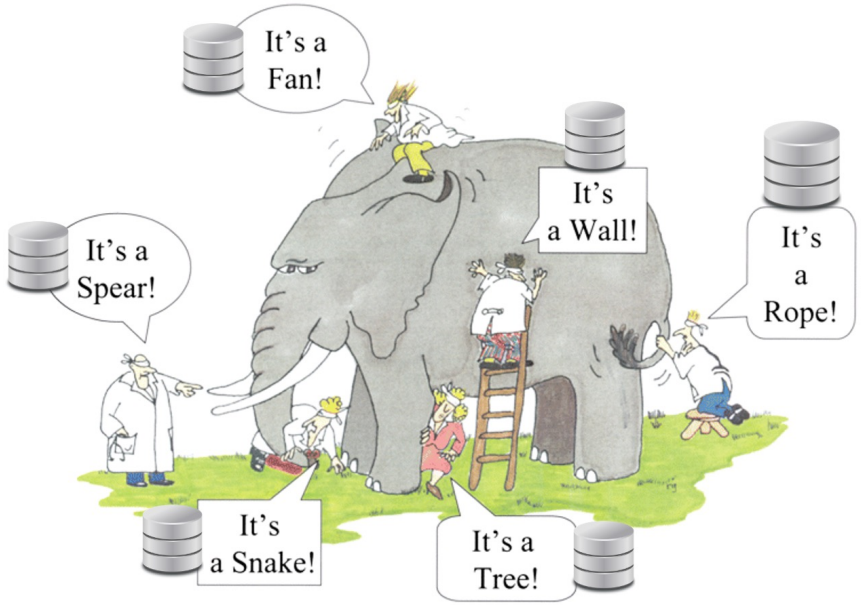
EMP_NO	FIRST_NAME	LAST_NAME	PHONE_EXT	HIRE_DATE	DEPT...	JOB_C...	JOB_GR...	JOB_COUNT...	SALARY	FULL_NAME
2	Robert	Nelson	250	12.28.1988 12:00 am	600	VP	2	USA	105.900,00	Nelson, Robert
4	Bruce	Young	233	12.28.1988 12:00 am	621	Eng	2	USA	97.500,00	Young, Bruce
5	Kim	Lambert	22	02.06.1989 12:00 am	130	Eng	2	USA	102.750,00	Lambert, Kim
8	Leslie	Johnson	410	04.05.1989 12:00 am	180	Mktg	3	USA	64.635,00	Johnson, Leslie
9	Phil	Forest	229	04.17.1989 12:00 am	622	Mngr	3	USA	75.060,00	Forest, Phil
11	K. J.	Weston	34	01.17.1990 12:00 am	130	SRep	4	USA	86.292,94	Weston, K. J.
12	Terri	Lee	256	05.01.1990 12:00 am	000	Admin	4	USA	53.793,00	Lee, Terri
14	Stewart	Hall	227	06.04.1990 12:00 am	900	Finan	3	USA	69.482,63	Hall, Stewart
15	Katherine	Young	231	06.14.1990 12:00 am	623	Mngr	3	USA	67.241,25	Young, Katherine
20	Chris	Papadopoulos	887	01.01.1990 12:00 am	671	Mngr	3	USA	89.655,00	Papadopoulos, Chr
24	Pete	Fisher	888	09.12.1990 12:00 am	671	Eng	3	USA	81.810,19	Fisher, Pete
28	Ann	Bennet	5	02.01.1991 12:00 am	120	Admin	5	England	22.935,00	Bennet, Ann
29	Roger	De Souza	288	02.18.1991 12:00 am	623	Eng	3	USA	69.482,63	De Souza, Roger
34	Janet	Baldwin	2	03.21.1991 12:00 am	110	Sales	3	USA	61.637,81	Baldwin, Janet
36	Roger	Reeves	6	04.25.1991 12:00 am	120	Sales	3	England	33.620,63	Reeves, Roger
37	Willie	Stansbury	7	04.25.1991 12:00 am	120	Eng	4	England	39.224,06	Stansbury, Willie
44	Leslie	Phong	216	06.03.1991 12:00 am	623	Eng	4	USA	56.034,38	Phong, Leslie
45	Ashok	Ramanathan	209	08.01.1991 12:00 am	621	Eng	3	USA	80.689,50	Ramanathan, Ashc
46	Walter	Steadman	210	08.09.1991 12:00 am	900	CFO	1	USA	116.100,00	Steadman, Walter
52	Carol	Nordstrom	420	10.02.1991 12:00 am	180	PRel	4	USA	42.742,50	Nordstrom, Carol
61	Luke	Leung	3	02.18.1992 12:00 am	110	SRep	4	USA	68.805,00	Leung, Luke
65	Sue Anne	O'Brien	877	03.23.1992 12:00 am	670	Admin	5	USA	31.275,00	O'Brien, Sue Anne



circa 2020

1,000s-1,000,000s attributes

- Multiple perspectives (conceptualisations) of the reality.
- Ambiguity, vagueness, inconsistency.



...and Fundamental Decentralisation

Increasing amounts of Subjective Data

"The very concept of objective truth is fading out of the world."

George Orwell

Image Credit: https://www.yesvedanta.com/objectivity-vs-subjectivity-in-light-of-vedanta/

Subjective and Objective Attributes and Query

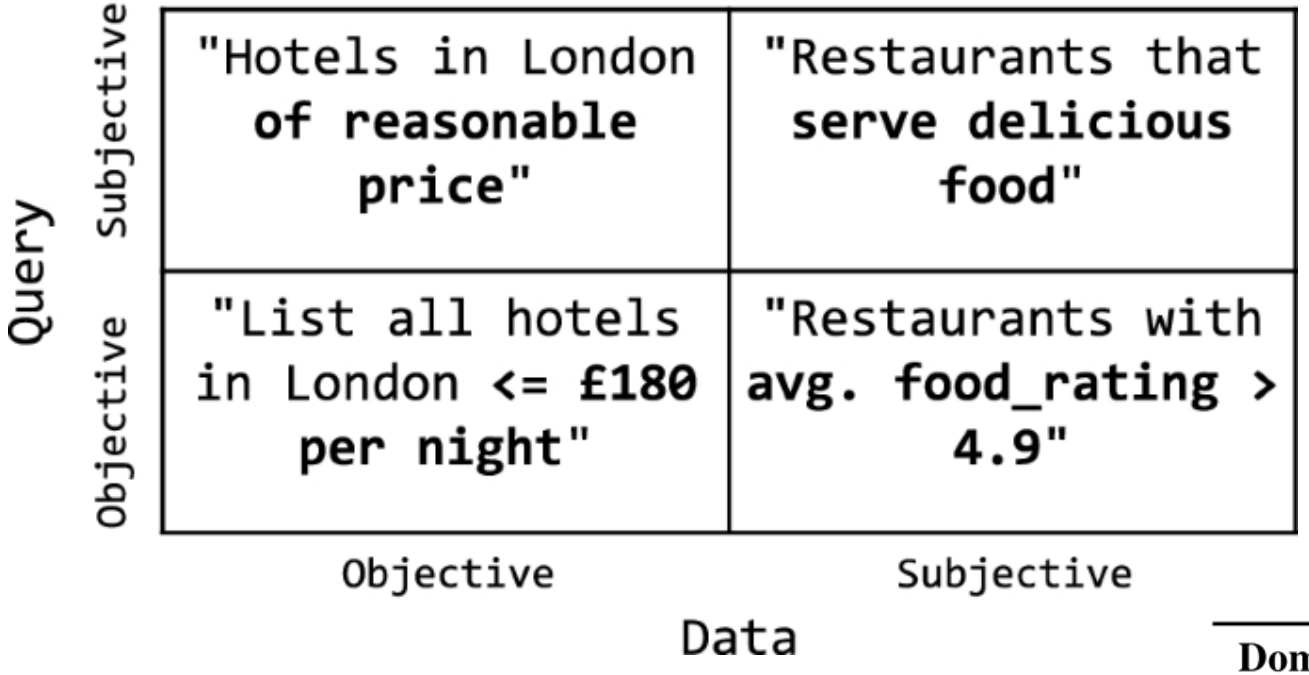


Table 3: Subjective attributes in different domains.

Domain	%Subj. Attr	Some examples
Hotel	69.0%	cleanliness, food, comfortable
Restaurant	64.3%	food, ambiance, variety, service
Vacation	82.6%	weather, safety, culture, nightlife
College	77.4%	dorm quality, faculty, diversity
Home	68.8%	space, good schools, quiet, safe
Career	65.8%	work-life balance, colleagues, culture
Car	56.0%	comfortable, safety, reliability

Li, Y., Feng, A., Li, J. *et al.* Querying subjective data. *The VLDB Journal* **30,** 115–140 (2021). https://doi.org/10.1007/s00778-020-00634-5

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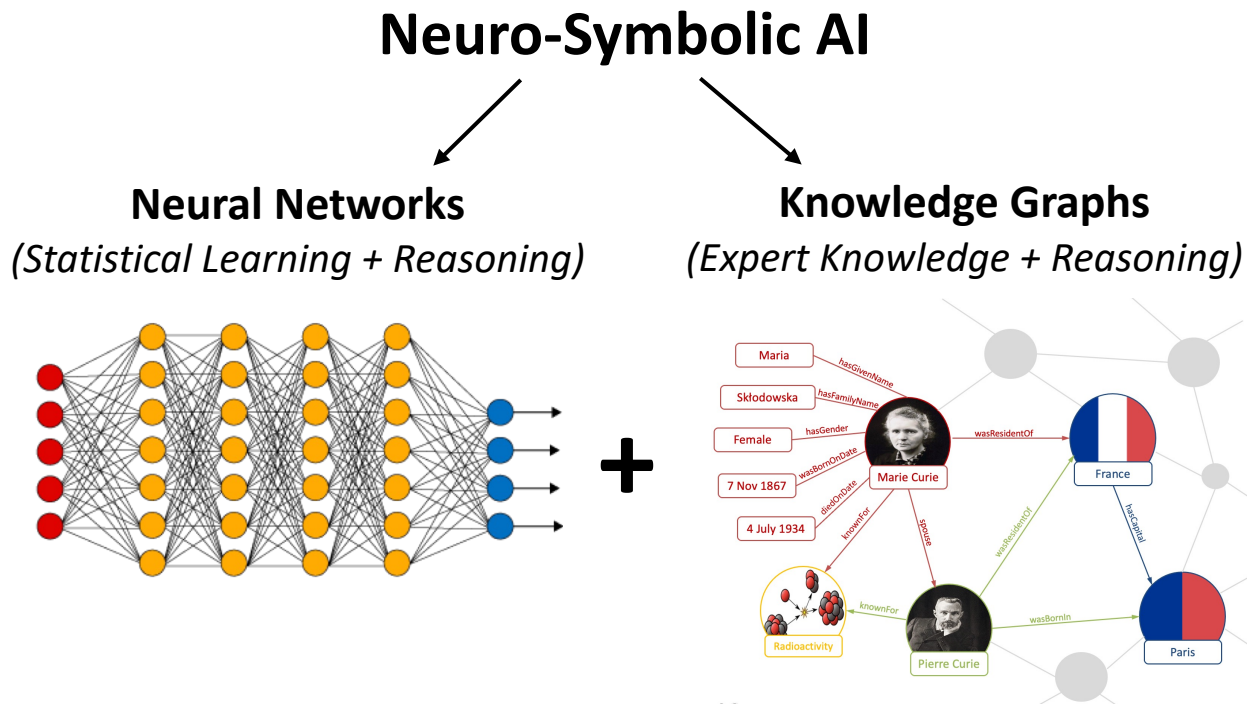
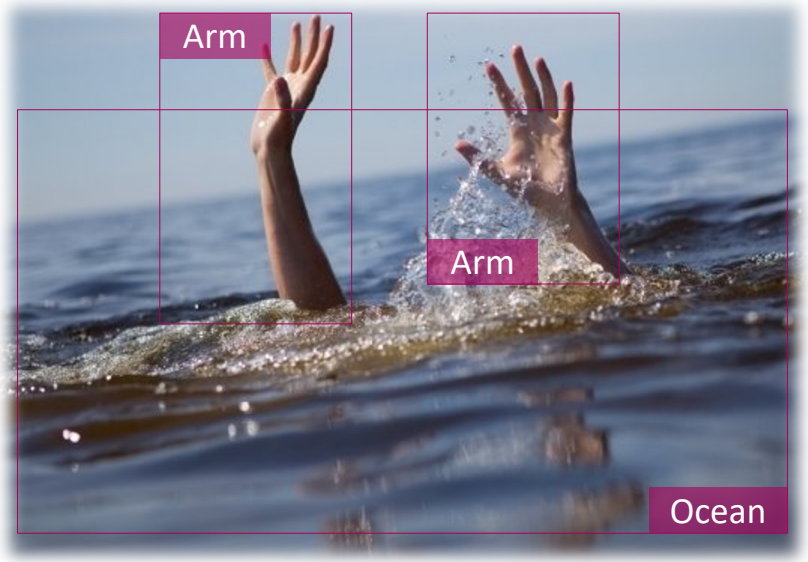
Hybrid Neuro-Symbolic Approaches

- We need Semantics, not just statistics!
- Combines rules-based AI approaches (Knowledge Graphs) with statistical learning techniques (deep learning)
  - (AKA Composite AI from Gartner)

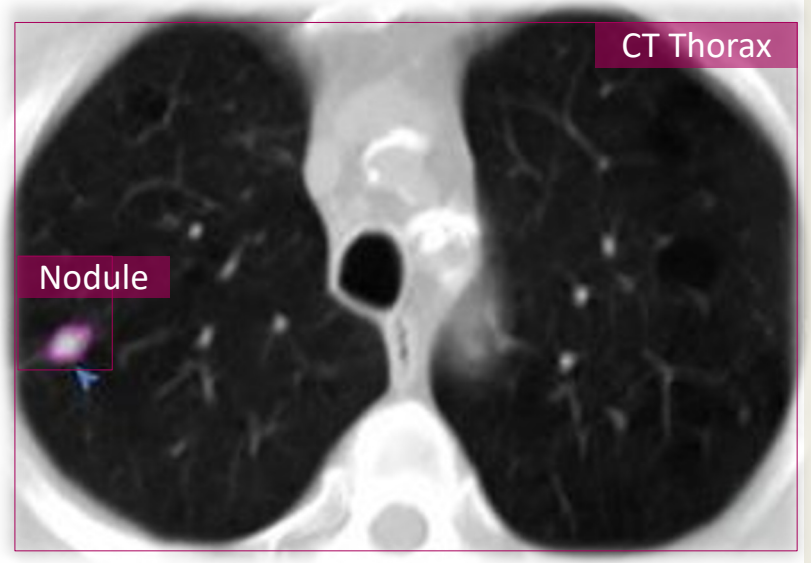


Visual AI

(More than 220k people in Ireland are blind or visually impaired)



(An average of 110 drownings occur in Ireland every year)



(Every 3 minutes in Ireland someone gets a cancer diagnosis; every hour someone dies from cancer)

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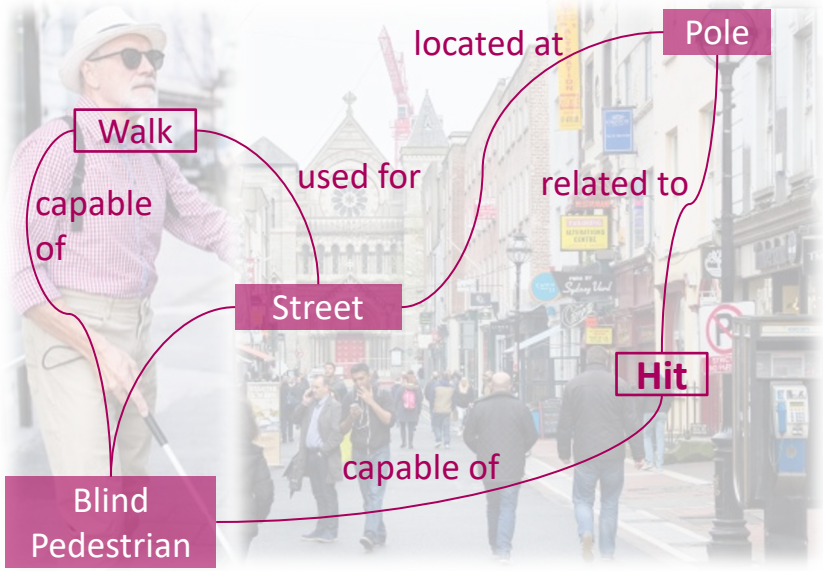
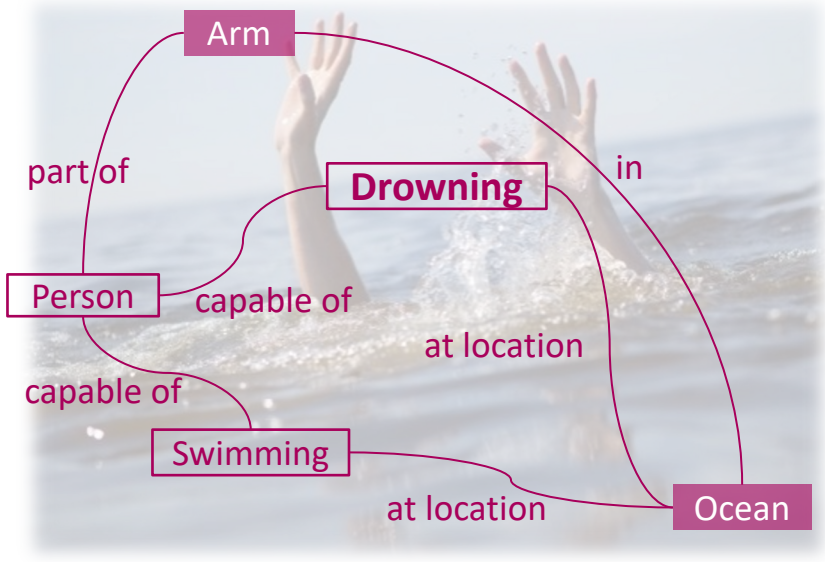
.J. Khan, J.G. Breslin, E. Curry, "Expressive Scene Graph Generation using Commonsense Knowledge Infusion for Visual Understanding and Reasoning," Extended Semantic Web Conference (ESWC) 2022, Crete, Greece, May-June 2022.

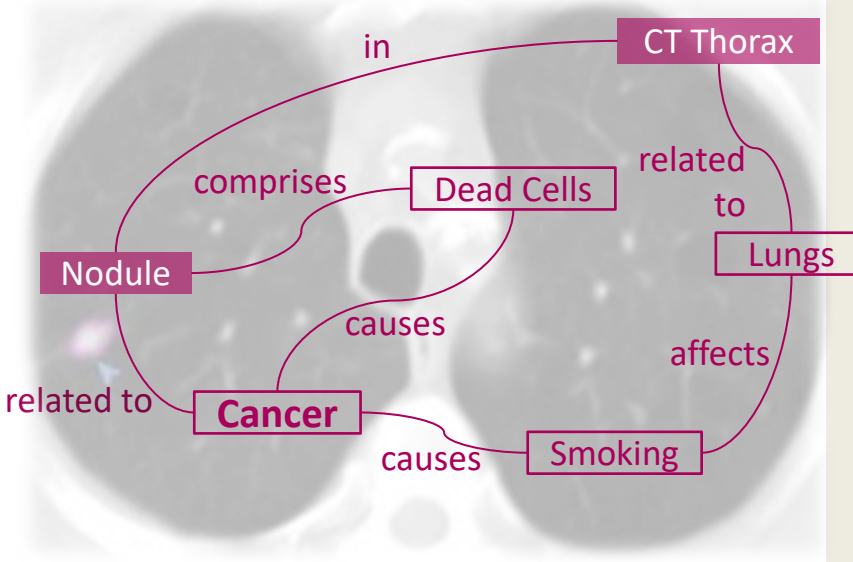
Visual AI with Common Sense



The blind pedestrian can hit the pole



A person drowning in the ocean



A potential case of Lung Cancer

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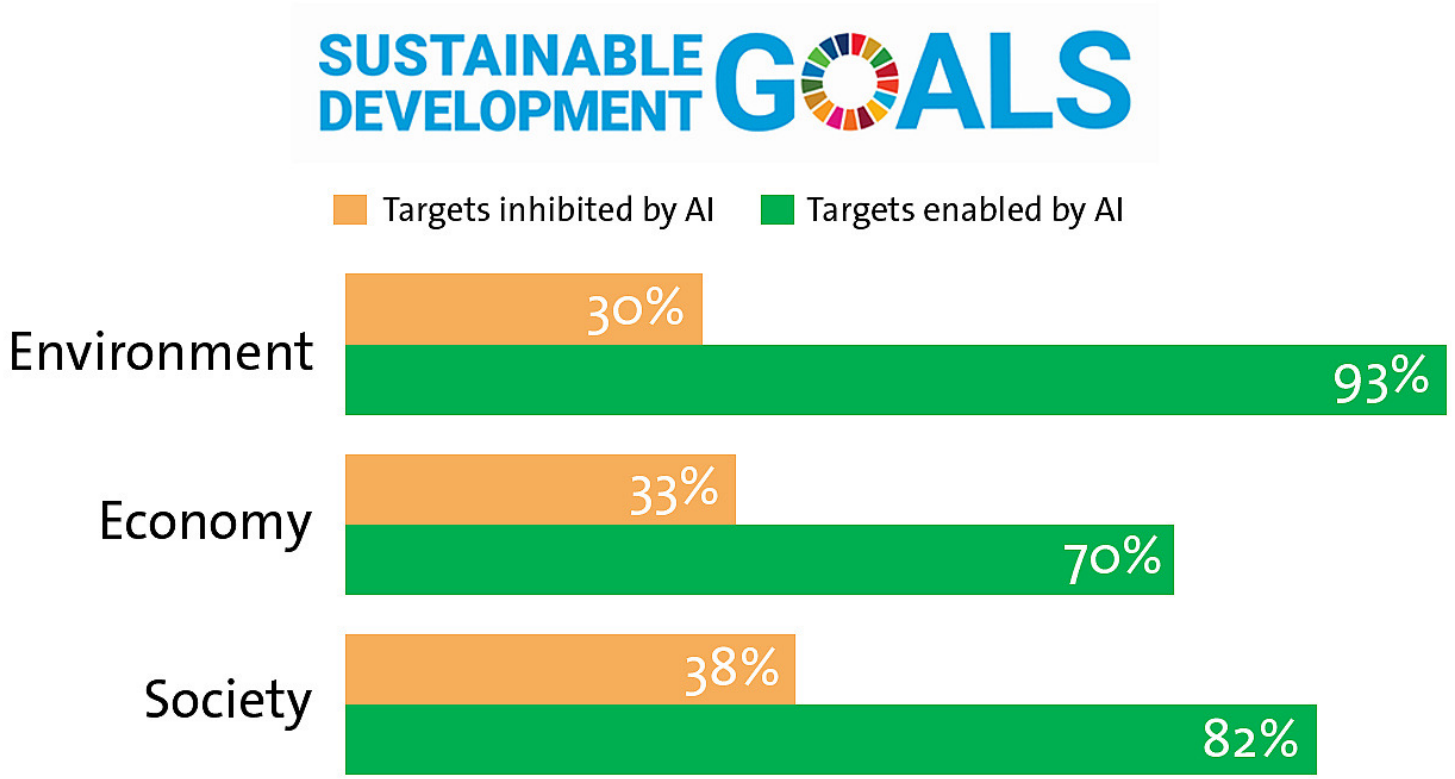
.J. Khan, J.G. Breslin, E. Curry, "Expressive Scene Graph Generation using Commonsense Knowledge Infusion for Visual Understanding and Reasoning," Extended Semantic Web Conference (ESWC) 2022, Crete, Greece, May-June 2022.

Can AI improve sustainability?

AI for SDGs



Vinuesa, R., Azizpour, H., Leite, I. *et al.* The role of artificial intelligence in achieving the Sustainable Development Goals. *Nat Commun* **11**, 233 (2020).

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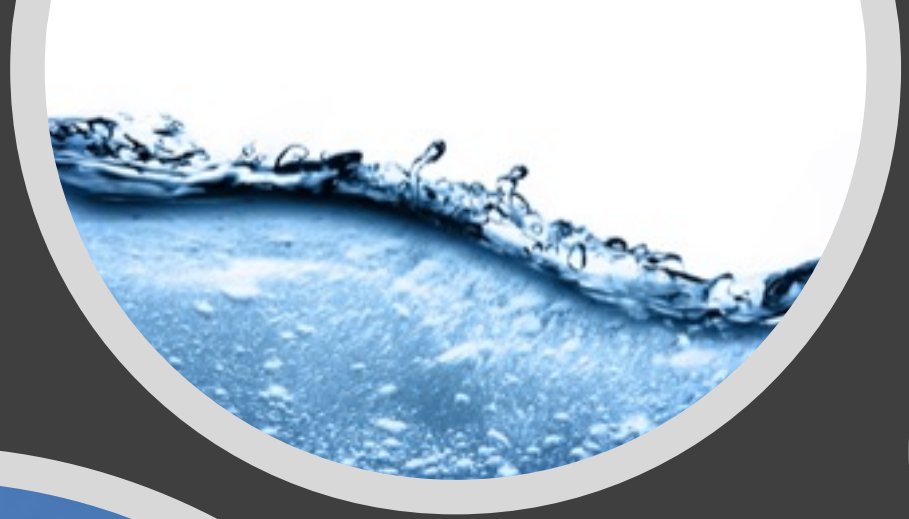
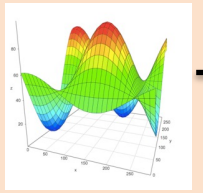
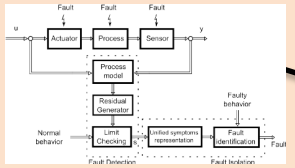


Emerging Smart Environments….

Digitalisation
(Internet of Things & Big Data)

Human-Computer Interaction
(User Experience Design & Behavioral Models)





Performance & Optimization

Fault Detection

Predictive and Perspective Analytics

Rule and Model-based Performance Tracking

Monitoring & Analytics

Data Visualization

Data Analysis

Meta-data management

Buildings

Things

Sensors

IoT-Enhanced User Experience

User Awareness

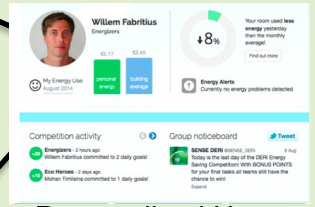
Pre-contemplation

Contemplation

Preparation

Public Dashboards

Personal Dashboards



Personalised Usage

User Engagement

Action

Alerts and Tasks

Maintenance

Reminders

Performance Feedback & Rewards

Physical — **Cyber** — **Social**

Real-world Deployments

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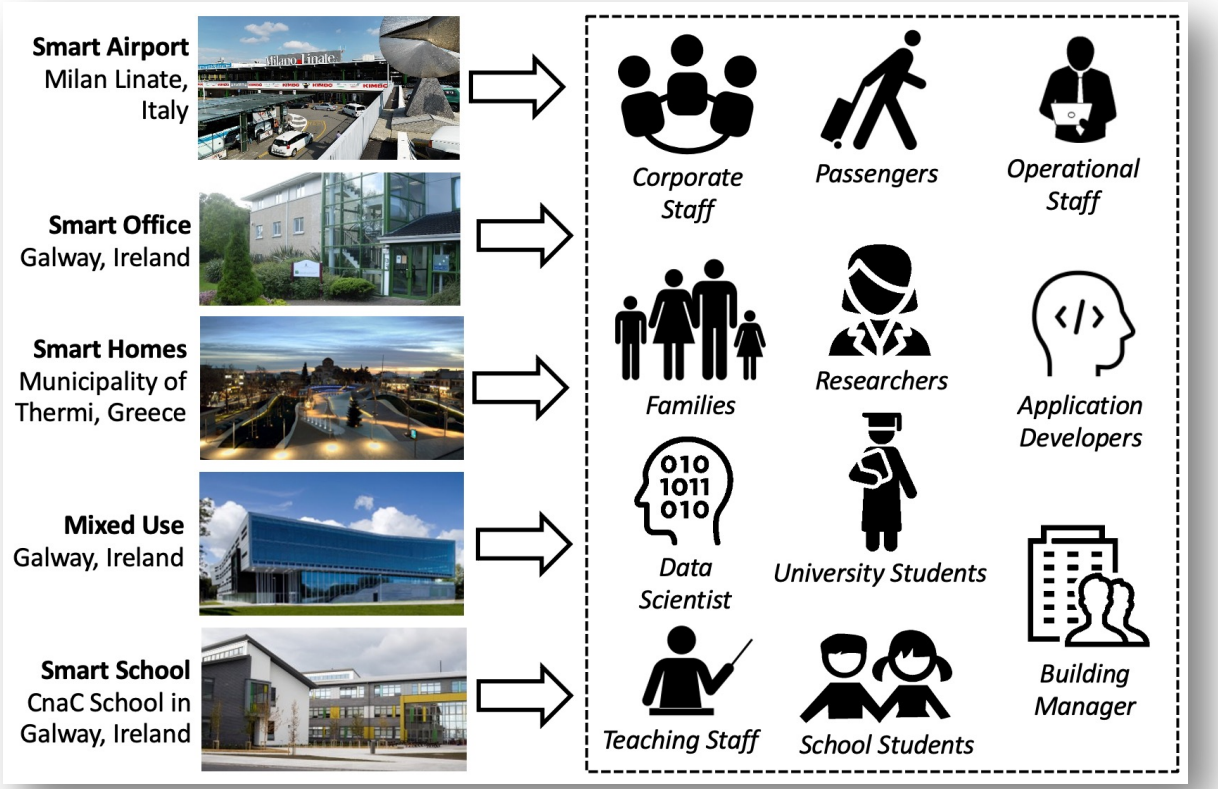
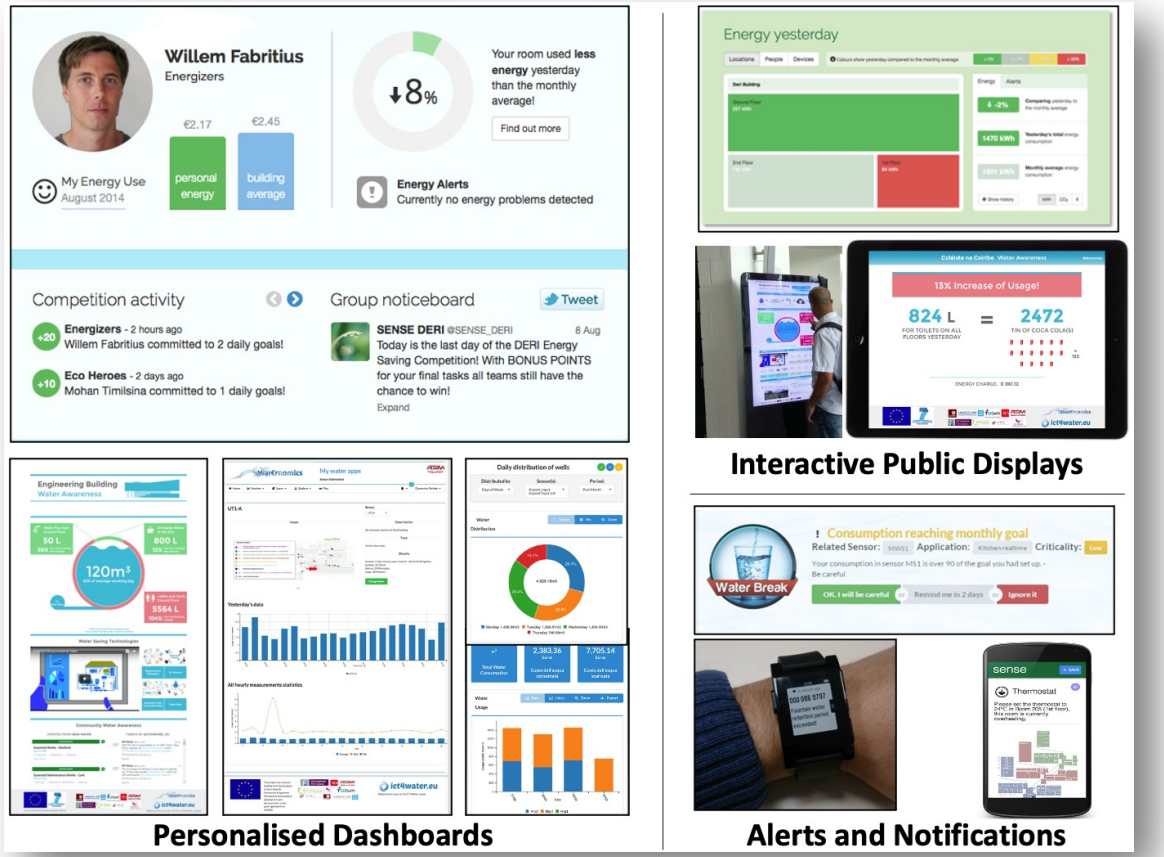
5 Pilots and 10+ Target User Groups



30+ Applications for Target Users



Pilot Impacts

62,500 m3/yr.

Water Savings

23%

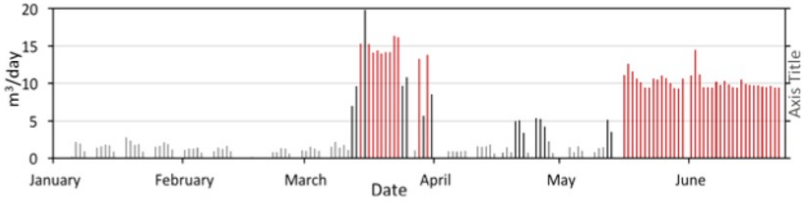
Energy Savings

€45,000/yr.

65,000

kg CO2/yr.

5 Faults & Leaks Detected



Insight

Is the an environment cost of AI?

Computational Semantics

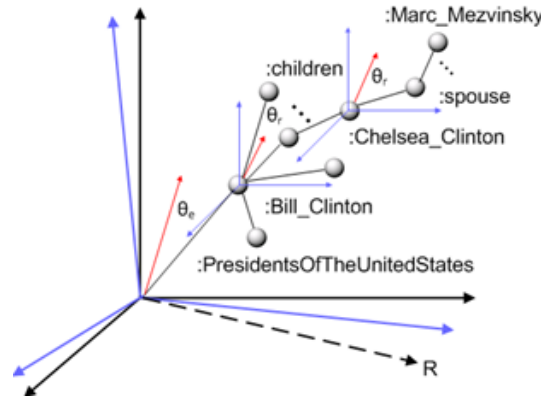
Insight
SFI RESEARCH CENTRE FOR DATA ANALYTICS

Text input

Language Model

Text output

Language Generation



Numeric representation of text

GPT3

BERT

Large Language Models

Insight
SFI RESEARCH CENTRE FOR DATA ANALYTICS

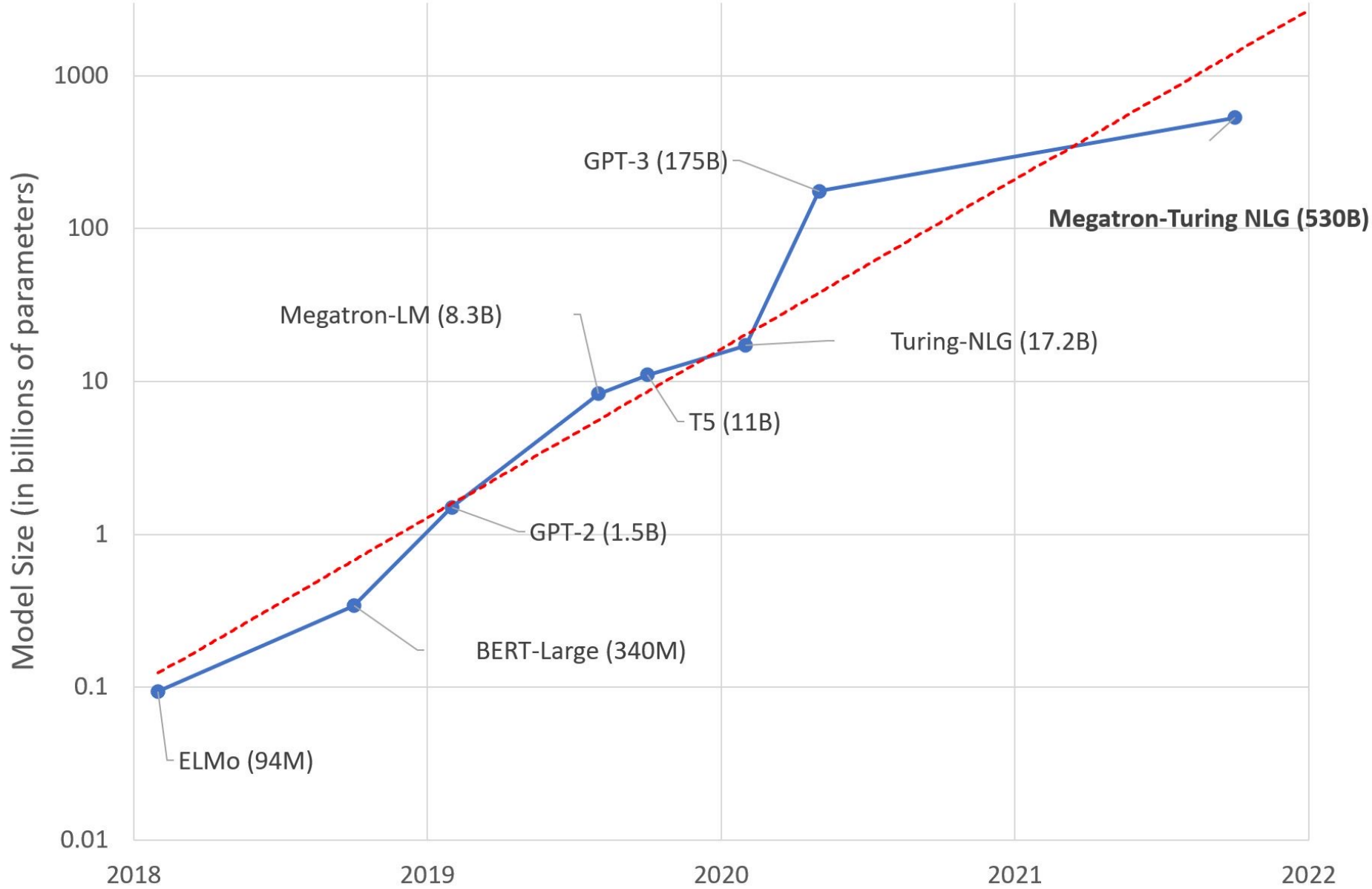
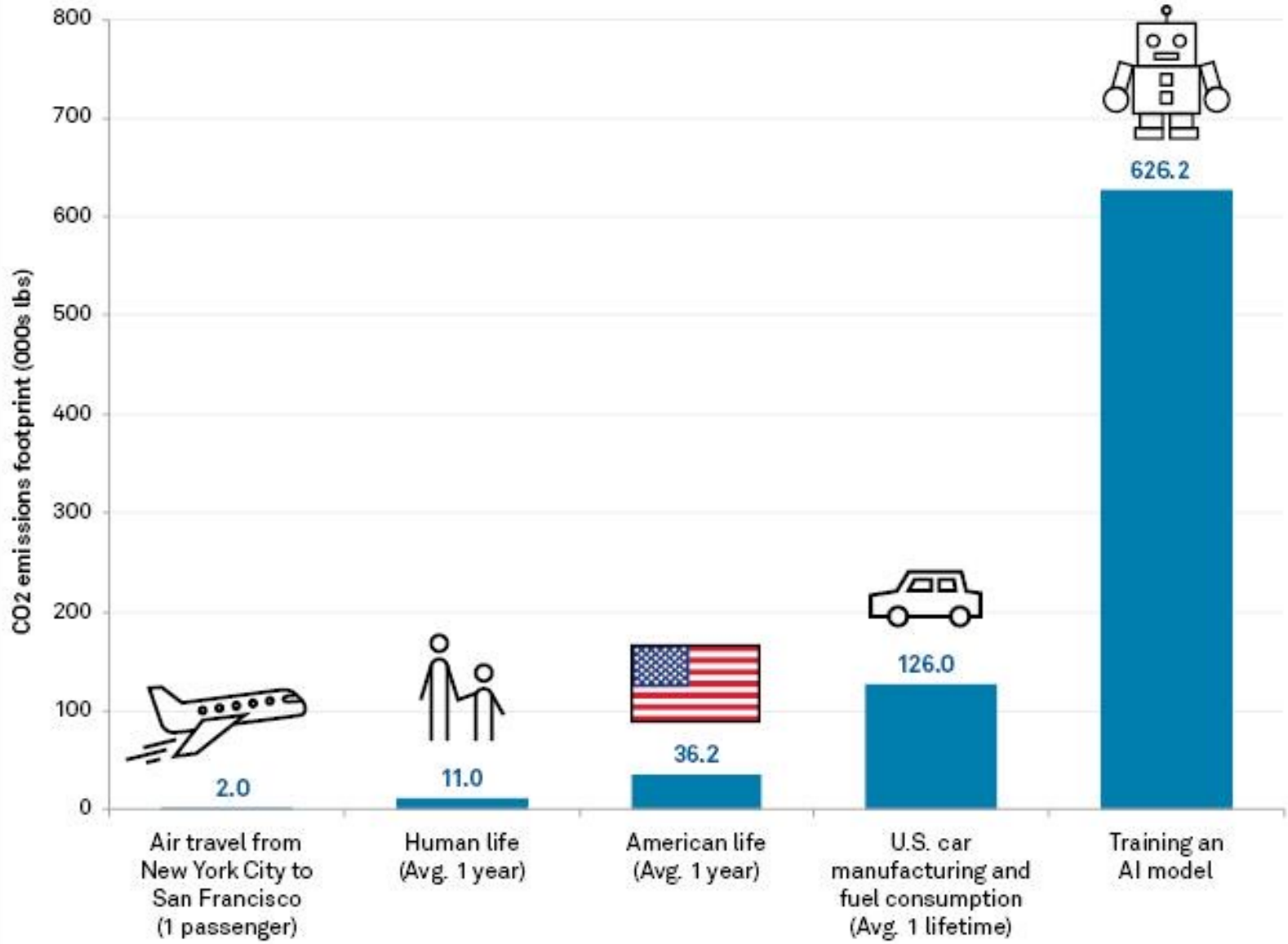


Image credit: https://huggingface.co/blog/large-language-models

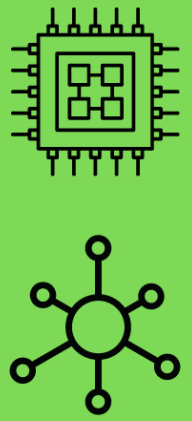
CO2 emission benchmarks



Data compiled Oct. 9, 2019.
An "American life" has a larger carbon footprint than a "Human life" because the U.S. is widely regarded as one of the top carbon dioxide emitters in the world.
Source: College of Information and Computer Sciences at University of Massachusetts Amherst

Sustainable AI

Elevating smaller models



Alternate deployment strategies

Carbon-efficiency and carbon-awareness

What is sustainable AI?

https://thegradient.pub/sustainable-ai/

Sustainable AI

Opinion Paper | Open Access | Published: 26 February 2021

Sustainable AI: AI *for* sustainability and the sustainability *of* AI

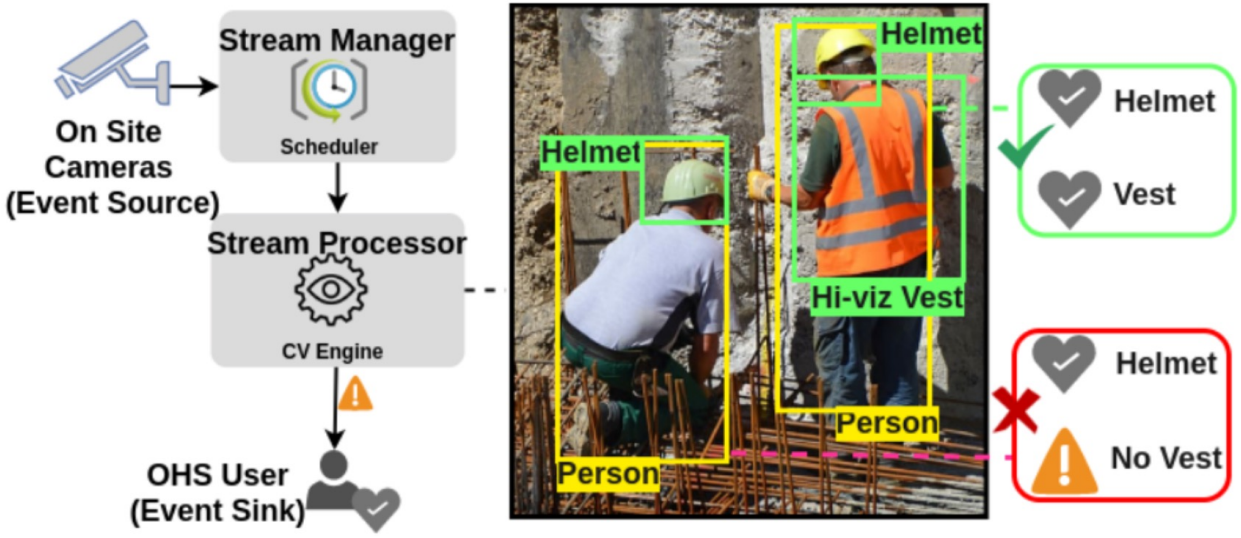
Aimee van Wynsberghe

AI and Ethics **1**, 213–218 (2021) | Cite this article

Sustainable AI is a field of research that applies to the technology of AI (the hardware powering AI, the methods to train AI, and the actual processing of data by AI) and the application of AI while addressing issues of AI sustainability and/or sustainable development.

Sustainable AI deals not exclusively with the implementation or use of AI but ought to address the entire life cycle of AI, the sustainability of the: design, training, development, validation, re-tuning, implementation and use of AI.

Reducing Energy usage in Edge AI



Energy-Speed-Accuracy Trade-off Triangle for the Query Quality of Service
(F.Pontes et. Al. 2023)

Conclusion

AI can enable solutions to many societal challenges

Many challenges to deliver on the promise of AI

Responsible AI will require a multidisciplinary approach

Questions

- Can we trust AI to make decisions?
- What is responsible AI?
- Why is data important for AI?
- Can we overcome the bias in data?
- Can AI improve sustainability?
- Is the an environment cost of AI?