



European Strategies and Regulations on AI

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Thanks to Michela Milano for some slides

BSC, Barcelona, 22/6/2022

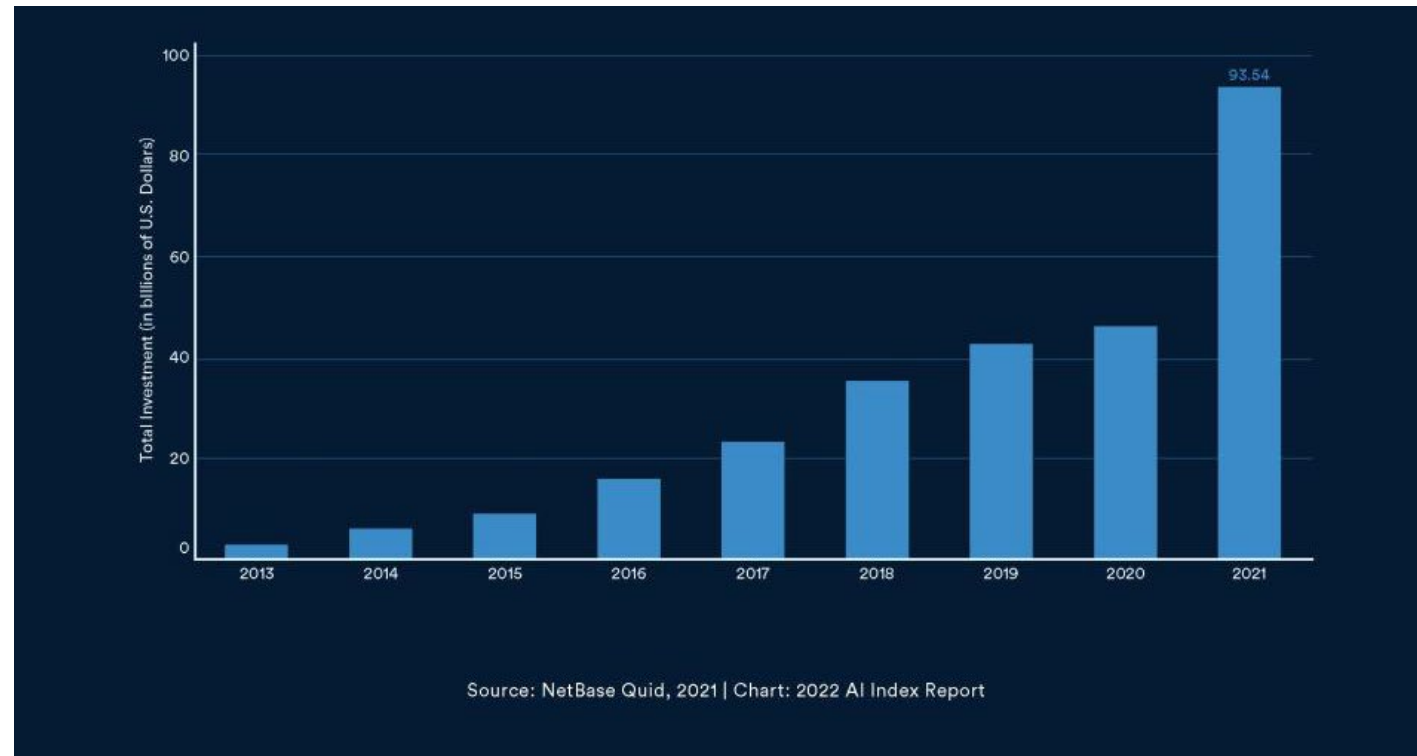
Impact of AI

- No more than 5 years ago the words “Artificial Intelligence” **never appeared** in EU official documents
- Now **everybody talks about AI** and a **product** to be **fancy** must use it
- **Research in AI** grows at an unprecedented pace (300 papers/day on Arxiv)
- **Private investments in AI** have reached \$ 100B in 2021 ([AI Index Report](#))
- AI offers huge **opportunities and challenges**
- **AI will disrupt industry** and affect the labor market
- Information Technology and AI raise **social, economic, ethical and political issues**
- **Europe** wants to have a **leading role** in Artificial Intelligence
- Member states have set **National Strategies on AI**



Adaptive shoes

Private Investments in AI




Artificial Intelligence in Europe

Artificial intelligence refers to **systems** that **display intelligent behaviour** by **analysing their environment** and **taking actions** – with **some degree of autonomy** – to achieve specific goals.

Brussels, 25.4.2018
«Artificial Intelligence for Europe»
European Commission

...the strategy places people at the centre of the development of AI — **human-centric AI**. It is an approach to **boost the EU's technological and industrial capacity** and AI uptake across the economy, prepare for socio-economic changes, and **ensure an appropriate ethical and legal framework**.

Brussels, 8.4.2019
«Building Trust in Human-Centric AI»
European Commission



mobilise resources to achieve an 'ecosystem of excellence' along the entire value chain, starting in research and innovation, and to create the right incentives to accelerate the adoption of solutions based on AI, including by small and medium-sized enterprises (SMEs).

Artificial Intelligence in Europe

**The AI Landscape
Communication on AI for
Europe**
Nominated HLEG
Draft AI Ethical Guidelines
Policy and Investments
Recommendations

Apr 2018

Coordinated plan on AI

Dec 2018

Ethical Guidelines of AI

Apr 2019

**White Paper on Artificial Intelligence:
a European approach to excellence
and trust**

Feb 2020

European AI Act

Apr 2021

White Paper on AI

- A European approach to excellence and trust, 2020.
- Sets out policy options on how to achieve the **twin objective** of promoting the **uptake of AI** and of addressing the **risks associated** with certain uses of such technology:
 1. Coordinated Plan on AI and EU Council 2020 Conclusion
Invest > 20% of the Recovery and Resiliency Facility to 6 objectives, including: fostering the European development of the next generation of digital technologies, including supercomputers and quantum computing, blockchain, and **human-centred Artificial Intelligence**
 2. AI Act

Objection

Placing AI among a full bunch of other technologies seems to miss a major point:

AI, differently from all others, is a **General Purpose Technology**, i.e. a technology that pervades and **affects all fields** of human activity, **drastically altering societies** through its impact on pre-existing economic and social structures

https://en.wikipedia.org/wiki/General-purpose_technology

European Initiatives on AI

- AI-on-demand platform: one stop shop for AI:
 - Catalogue of assets
 - Experimentation platform
- Follow up projects ICT49
- Networks of excellence ICT48
- [ADRA](#), [PPP on AI, Data and Robotics](#)

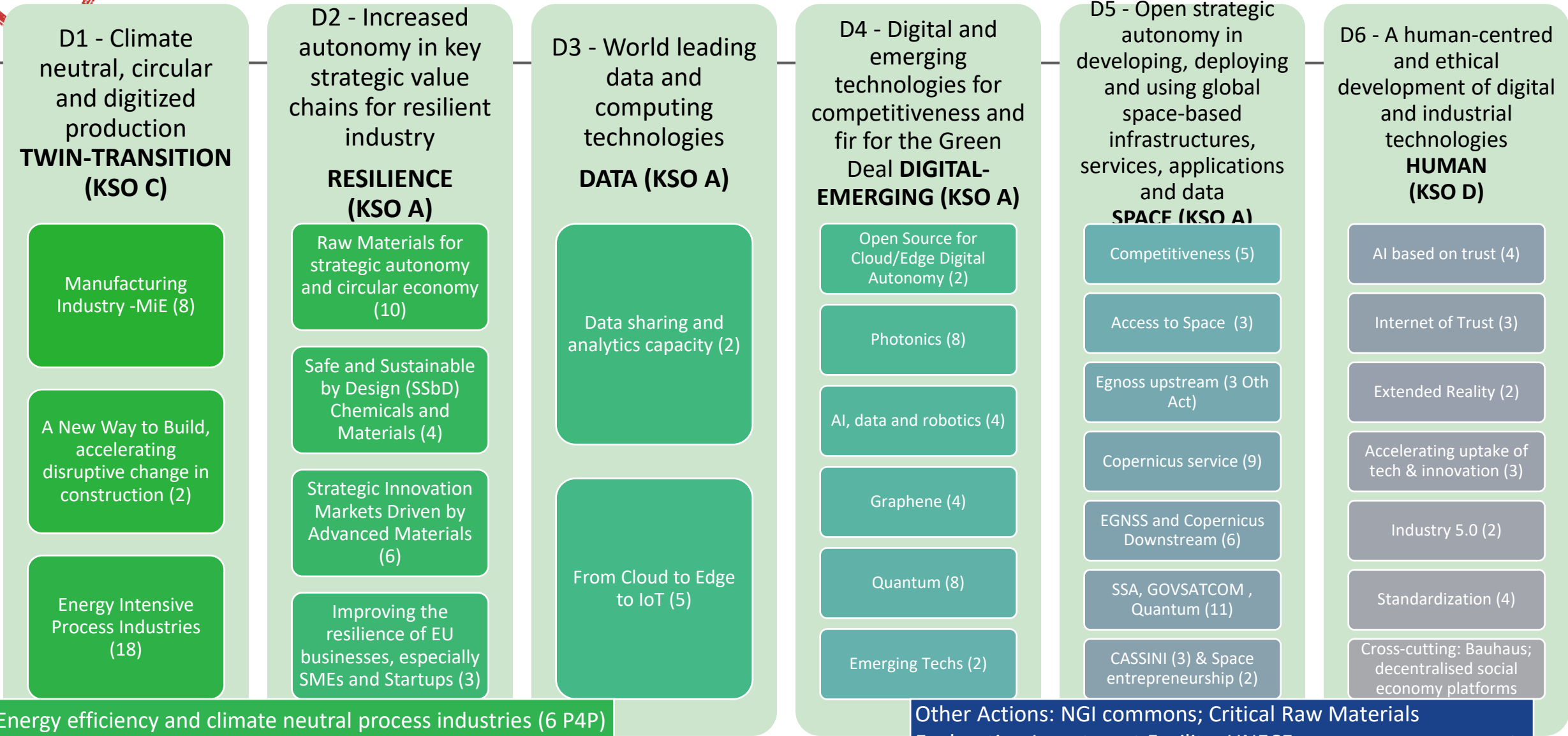
Future

- CSA on Horizon Europe
- Preparatory action on Digital Europe
- [European AI Lighthouse](#)
- Many calls in Cluster4
- Connections with related fields:
 - HPC, IoT, Cybersecurity, Data Analytics, 5G





Cluster 4 -Workprogram 2023-24



Energy efficiency and climate neutral process industries (6 P4P)
 Circularity and Zero Pollution in process industry (6 P4P)
 Clean Steel (6 CS)

Other Actions: NGI commons; Critical Raw Materials Exploration Investment Facility; UNECE resource management system; JRC & Action Plan on Critical Raw Materials; Raw Materials events; Support to Hydrogen

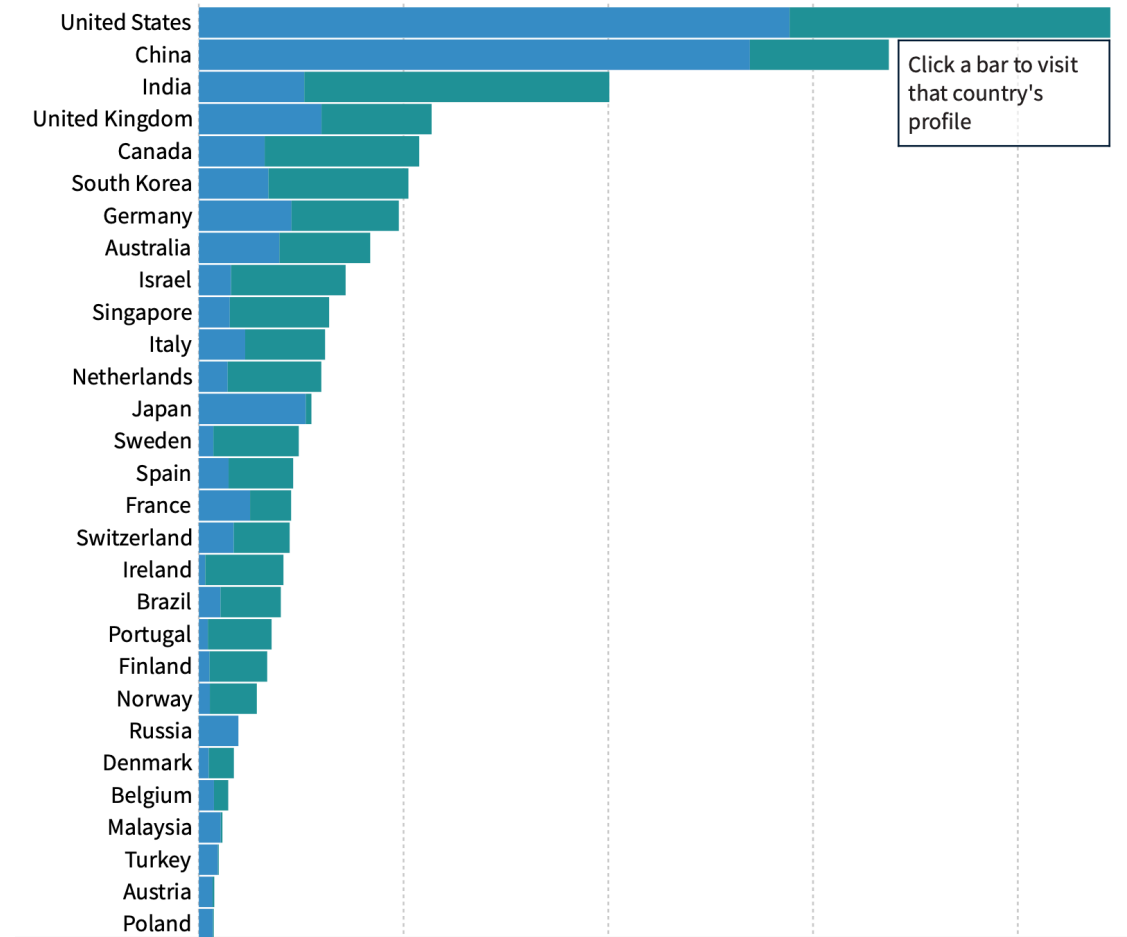


STRATEGY EFFECTIVENESS



AI Index: 2021 Global AI Vibrancy Ranking

Weighted Index Scores in Research and Development and Economy



Who Is Winning the AI Race: China, the EU or the United States?

1. China has surpassed the EU as the world leader in AI publications.
2. The quality of its AI research has generally trended upward year to year.
3. Its software and computer services firms have increased their R&D spending.
4. China now has nearly twice as many supercomputers ranked in the top 500 for performance as the United States

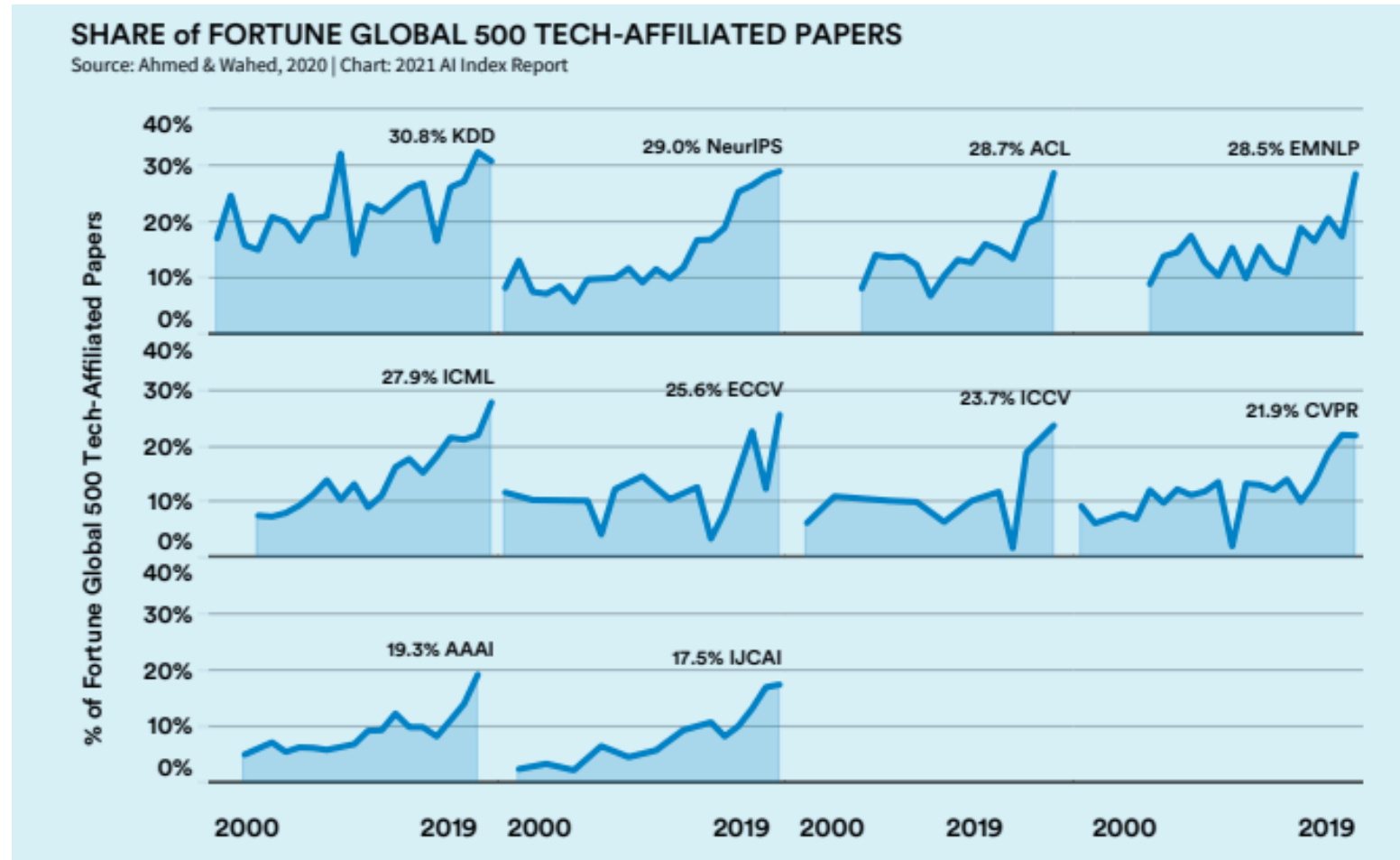
<https://datainnovation.org/2021/01/who-is-winning-the-ai-race-china-the-eu-or-the-united-states-2021-update/>

Category	China	European Union	United States
Talent	3	2	1
Research	3	2	1
Development	3	2	1
Adoption	1	2	3
Data	1	3	2
Hardware	2	3	1

Research goes private

Compute divide: only large companies have adequate compute and data resources

Number of European papers at NeurIPS 2022 are less than those just by Google





NATIONAL STRATEGIES



AI Research Centers

- Germany:
 - DFKI largest in Europe, just added a 4th one
- France:
 - Report on AI for Humanity by Cédric Villani
 - Created 4 Interdisciplinary Institutes for Artificial Intelligence

AI Research in Italy

1975 long historic tradition

Several Scientific Associations: AIXIA, GULP, SIREN, IEEE Italian Chapter

1984 ECAI in Pisa

1987 IJCAI in Milan

Recently

2017: Libro Bianco by AgID on **AI in Public Administration**

2018: **National CINI Laboratory Artificial Intelligence and Intelligent Systems**

2019: “**Proposals for an Italian Strategy on AI**” by “High-level working group on AI” from Ministry of Economic Development

2021: **Programma Strategico per l’Intelligenza Artificiale 2022-2024**

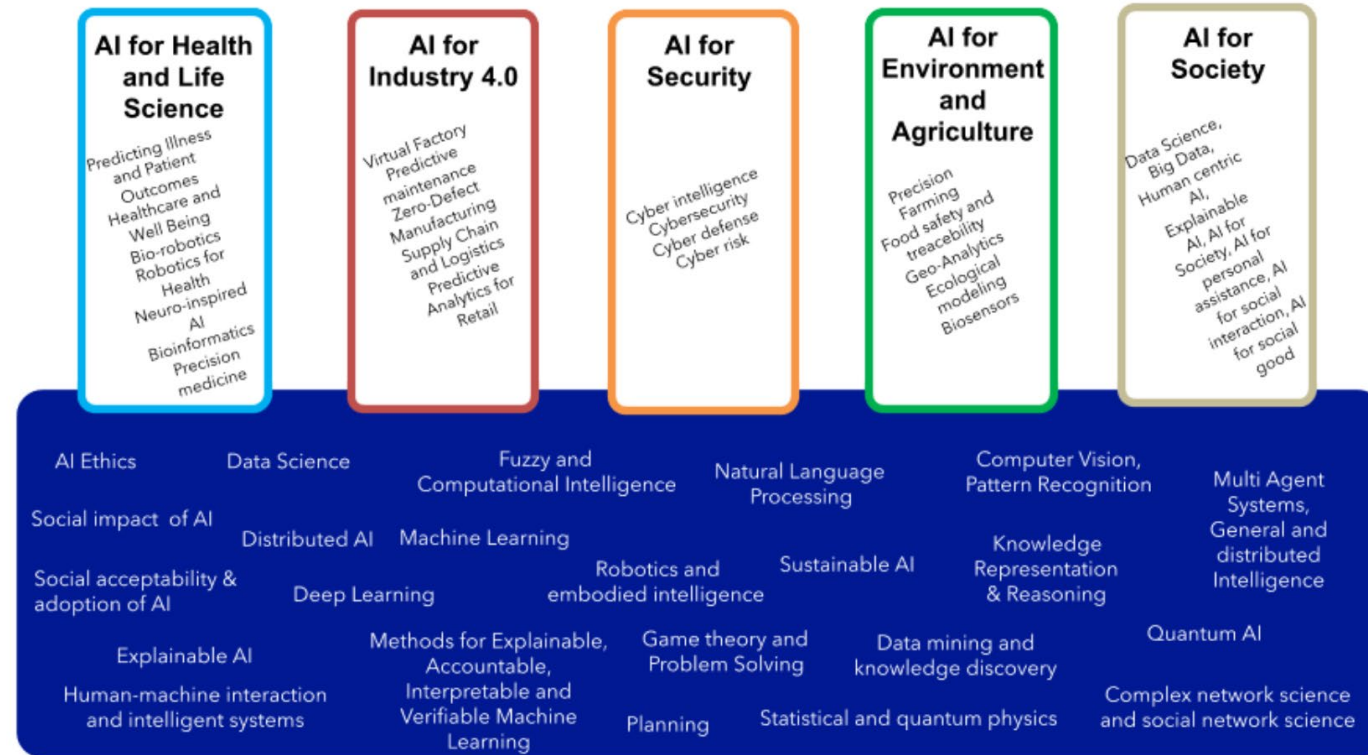
(<https://assets.innovazione.gov.it/1637777289-programma-strategico-iaweb.pdf>)

2021: First **National PhD School in AI**



National PhD School in AI

- 5 PhD clusters
- First year 2022:
 - 560 applications
 - 170 grants
- 61 universities and 19 research institutes



Italian Government

Strategic Programme on
Artificial Intelligence

2022-2024

<https://assets.innovazione.gov.it/1637777513-strategic-program-aiweb.pdf>



Italian AI Strategic Program

Guiding principles

Italy's AI is a **European AI**

Italy will be a **global research and innovation hub of AI**

Italy's AI will be **human-centred, trustworthy and sustainable**

Italian companies will become **leaders of AI based research, development and innovation**

Italy's **public administrations will govern with AI and will govern AI**

Objectives

Advance frontier research AI

Reduce AI research's fragmentation

Develop and adopt human-centred and trustworthy AI

Increase AI-based innovation and the development of AI technology

Develop AI-driven policies and services in the public sector

Create, retain and attract AI talent in Italy

Strategic Areas of Intervention and policies

Talent and Skills

Research

Applications



Priorities of the Italian Strategy

11 priorities

- Industry
- Education system
- Agri-food
- Culture and tourism
- Health
- Environment
- Banking, Finance
- Public administration
- Smart cities
- National security
- IT

Priority sectors



Industry and Manufacturing. AI will enable the Italian manufacturing sector, the second largest in Europe and seventh largest in the world, to introduce innovative processes, products and business models to the market while maintaining (or increasing) its global competitive edge.



Education system. As artificial intelligence is transforming every aspect of our lives we need to educate all people to this technology through a new education and training plan to understand, reinforce, integrate and disseminate AI technology. AI should be an important topic at all education levels. At the same time, it can constitute a powerful instrument for a fruitful transformation of the national education system to develop personalized learning plans while ensuring fairness and trustworthiness.



Agri-food. Through AI, Italy's thriving agri-food sector has the potential to increase further its competitive position by developing precision agriculture, thus avoiding overproduction and waste, increasing food safety and reducing emissions from land and agriculture.



Culture and tourism. Advanced technologies will further increase Italy's touristic attractiveness by creating new synergies between cultural and creative industries, producers, managers and users of Italy's vast cultural heritage. These technologies enable, for instance, continuous monitoring and preventive restoration of cultural heritage, monitoring and alert system for landscape heritage, customisation of services to better meet demand, virtual tours of tourist destinations to allow for better informed choices of travel destination, simultaneous translators for the description of places and monuments visited, geolocalised services for tourists.



Health and wellbeing. In the field of healthcare, AI applications boost product and process innovation by exchanging and aggregating information that is currently scattered in a multitude of public and largely underused databases. AI applications will help meet the new needs arising from an ageing Italian population. Moreover, they will have a significant impact on the population at risk of severe diseases such as degenerative, oncological, and viral diseases, and increase social inclusion of disadvantaged groups. A few application examples are medical devices and services in screening and diagnostic areas such as omics and medical imaging, new drugs and vaccines, tracking and treating people, supporting patient care (diagnosis and prognosis), and predictive models of healthcare needs.



Environment, infrastructures and networks. AI solutions will have a significant impact on preserving resources, reducing emissions, better managing traffic flows and related risks, strengthening the circular economy and better preventing natural disasters. More generally, AI will be a fundamental ally in accelerating the ecological transition, a pillar of Italy's recovery and resilience plan and European Union's recovery efforts. In addition, AI may have an enabling role also in the highly strategic development of 5G networks as it can help improve network performance as well as reduce capital expenditures associated with its infrastructure deployment/management. A few application examples are monitoring and intelligent management of networks and consumption, monitoring and predictive management of the waste cycle, situational and predictive analysis of hydrogeological instability.



Banking, Finance, and Insurance. Modern AI technologies will allow banks and insurers to improve in at least two ways. First, they will increase the quality of services offered to customers and reduce their costs through a higher level of personalisation and security of transactions. Second, AI applications will strengthen fraud prevention systems and simplify the fulfilment of intermediary obligations through the adoption of mechanisms for detecting suspicious behaviour and analysing data and documents.



Public Administration. In the near future, AI will optimise bureaucratic processes, offering better services to citizens and businesses and reducing costs for better services and performance.³⁴ Furthermore, with its databases and innovative tools for purchasing, investment and regulation, the PA is called upon to play an active role in the AI revolution in the private sector for the benefit of the community (e.g. open data, geolocation tools, purchase of AI products and services, funds for AI, experimentation of AI solutions). The PA could benefit from AI solutions concerning flow management, virtual assistants and chat-bots, predictive analysis of business risks and support for the examination of incentive applications, support in the fight against tax evasion and other forms of illegality, evaluation of past policies and impact analysis of experiments.



Smart cities, areas and communities. The COVID -19 pandemic has shown that the digital ecosystem is essential to support all citizens, whether they live in cities or rural areas. AI will enable Italian residents, wherever they live, to gain access to communities and services, while reducing costs. Finally, AI technologies will enable Italy to reduce traffic and limit congestion thus also contributing to reining in the effects of one of the most polluting activities in the country. A few examples are smart parking, traffic management and signage control, self-driving vehicle management systems, lighting management and optimisation of public transport, as well as monitoring of bridges and buildings, home automation for buildings.



National Security. The importance of AI for the National Security of a country has been growing steadily in the last five years. Hence, Italy is fully committed to investing in AI applications that ensure the security of its citizens. This includes individual and national cybersecurity, where AI has been contributing to the development of new-generation detection and resolution software.



Information Technologies. The success of applications of AI in the sectors described above strongly depends on a high level of innovations in IT crucial fields impacting AI, such as Sensing, Reasoning and Search, Natural Language Processing, Computer Vision, Human-AI interaction, and Edge Computing. The broad field of IT³⁵ has a crucial role in ensuring a high level of innovation for implementing competitive AI in all different applications. For this reason, a special effort will be devoted to supporting the birth and growth of Italian IT companies.



Strategic Areas



1

Talent and Skills

Development of human resources with AI skills.

a. AI Training and Skills

invest holistically in AI training and skills development for citizens with a view to retaining/increasing technological readiness and preparing the workforce for the new opportunities.

2

Research

Research initiatives focused on both fundamental and challenge-driven AI.

b. Fundamental research

invest in fundamental AI methods, algorithms and research on human-centred AI.

c. Challenge-driven AI research

invest in key areas relevant for the priority sectors.

3

Applications

Innovation initiatives, aimed at accelerating AI adoption in priority sectors and at strengthening the AI technology production ecosystem.

d. AI for more competitive enterprises.

e. AI for a more modern public administration.

Spanish AI Strategy

Investment: 500M €

- Introduction and extension of **AI technologies** in the Spanish economy and society
- Development of the regulations to allow **regulatory sandboxes** to test the application of AI in different areas
- Establishment of an advisory process that allows to analyze and verify the safety and reliability of AI technologies, and regulations for compliance with ethical and social principles.

Areas

- Fostering **scientific research** and technological development in AI
- Fostering national **talent** and attracting global talent in the field of AI
- Development of **data platforms** and **technological infrastructures** to support AI
- Integration of AI into value chains to **transform the economy**



SUGGESTIONS



What is needed to foster AI in Europe

1. AI architectures and models
2. Computing power and storage
3. Data, applications and ... experts



A CERN for AI

- Would address all three
- Moreover:
 - Overcome **limited uptake** in industry (SMEs in particular) and in the public sector
 - Address big research challenges, e.g.
 - Learning with less data **models of the world**
 - Learning to **reason and act**
 - **Transfer** between System 1 and System 2
 - Learning to **generalize across tasks**
- **US National AI Research Resource**
 - shared computing and data infrastructure that will provide AI researchers with access to compute resources and high-quality data, along with appropriate educational tools and user support

<https://www.ai.gov/strategic-pillars/infrastructure/>

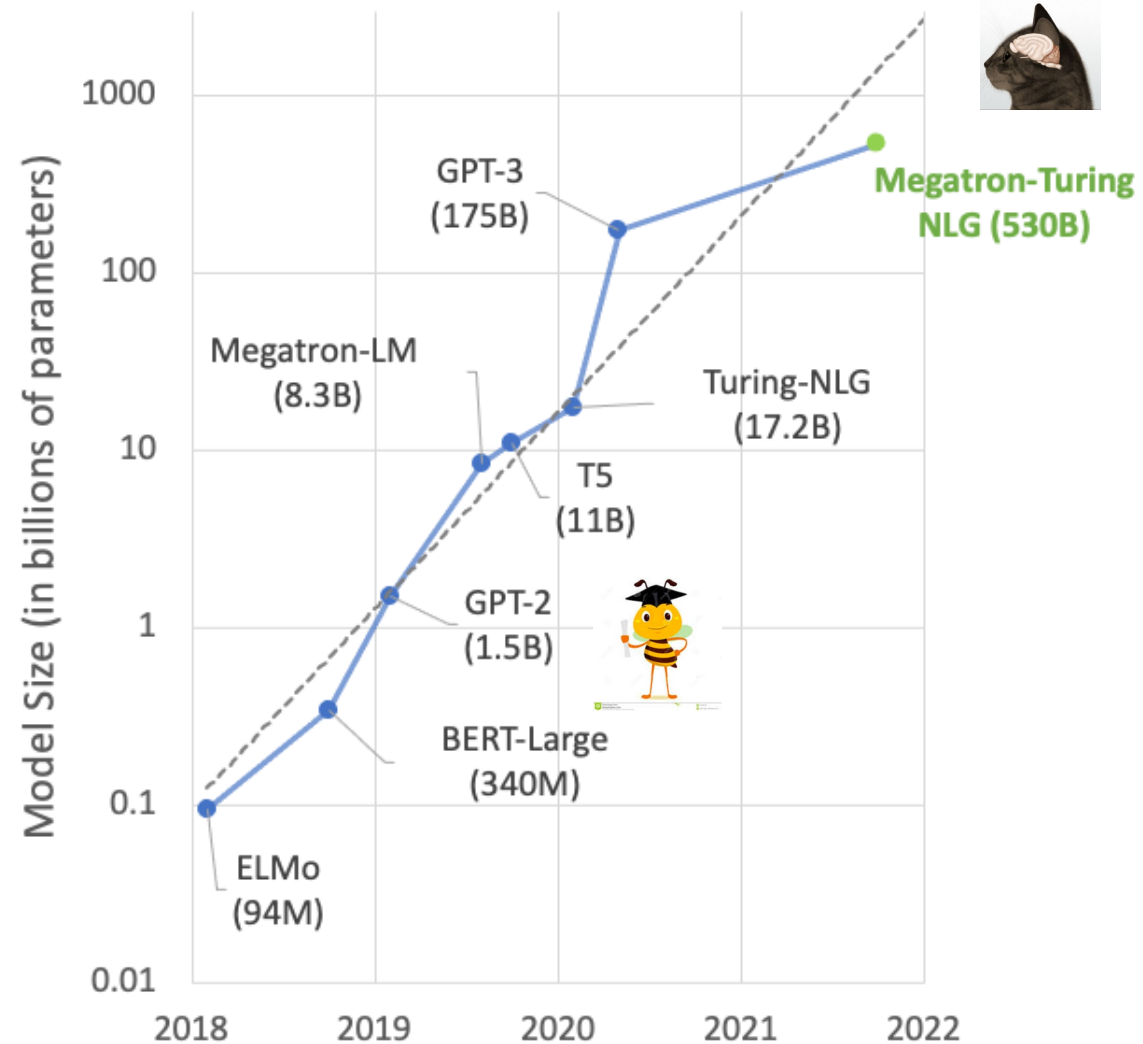
Exponential Growth of LLMs

aka Foundation Models



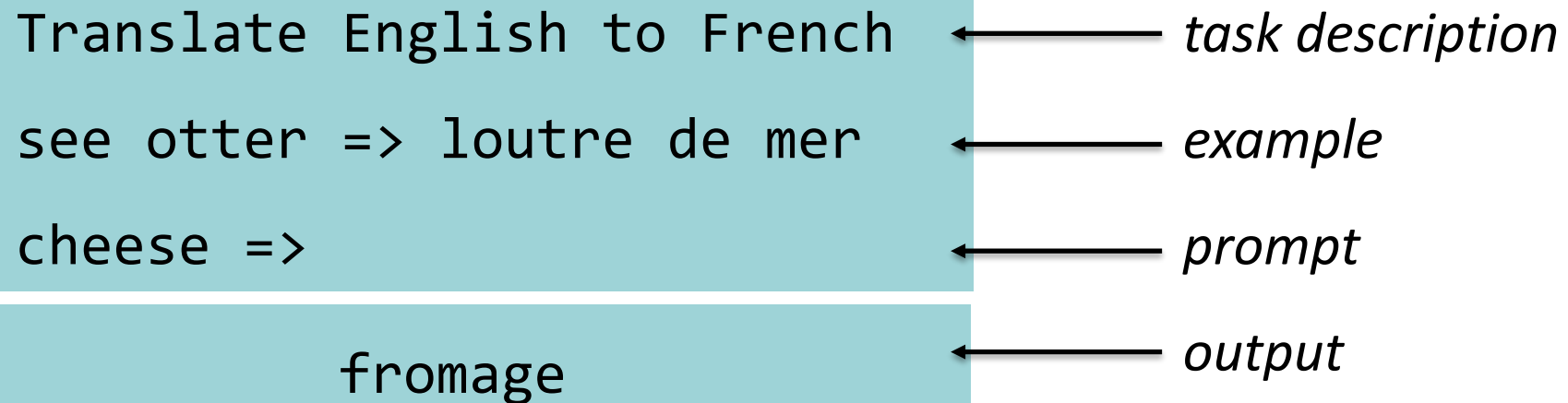
Evolving paradigms:

- Feature engineered models
- Pretrained Models
- Fine-tuning Pretrained LLM
- Prompt-tuning LLM
- Zero-shot Reasoners



Model Prompting

Provide to the Language Model a **task description**, one **example** of the task, and the **prompt** for the answer



Zero-shot Chain of Thought

Q: A juggler can juggle 16 balls. Half of the balls are golf balls, and half of the golf balls are blue. How many blue golf balls are there?

A: **Let's think step by step.**

(Output) There are 16 balls in total. Half of the balls are golf balls. That means that there are 8 golf balls. Half of the golf balls are blue. That means that there are 4 blue golf balls. ✓

Foundation Models

- **Third breakthrough** in Deep Learning in just 10 years:
 1. ConvNets on GPUs
 2. Pretrained Word Embeddings
 3. Transformers with Attention
- Transformers are proving surprisingly versatile
 - Applicable to text, vision a.w.a. **multimodal** tasks

A New Way to See

For years, convolutional neural networks (CNNs) have been the dominant method of processing and classifying images. Now, transformers are performing as well as CNNs in many tasks. The two have different approaches to computer vision.

CNN

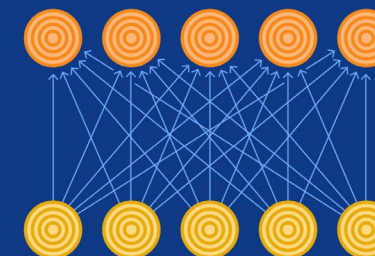
A CNN repeatedly filters small portions of an image, using mathematical computations to map features and build up a fuller, more complex picture.



Artificial neurons →

TRANSFORMERS

A transformer instead starts by connecting every element to every other element, creating a global, if incomplete, representation from the first layer.



Model Training Capabilities

- Only Big Tech have the capabilities to build them:
 - OpenAI (GPT-3), Google (T5, PaLM, LaMDA), Microsoft (Megatron)
- Meta is offering free access to [OPT-3](#) 175B model, acknowledging that “full research access [to LLMs] is still limited to only a few highly resourced labs”
- HuggingFace [BigScience](#) project collaboration at LHC scale

European Directive on Artificial Intelligence Regulation

EUROPEAN ARTIFICIAL INTELLIGENCE ACT

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0206>

Objectives

- ensure that AI systems placed on the Union market and used are **safe and respect existing law** on fundamental rights and Union values;
- ensure legal certainty to **facilitate investment** and innovation in AI;
- enhance governance and effective **enforcement** of existing law on fundamental rights and safety requirements applicable to AI systems;
- facilitate the development of a **single market** for lawful, safe and trustworthy AI applications and prevent market fragmentation

Definition of AI

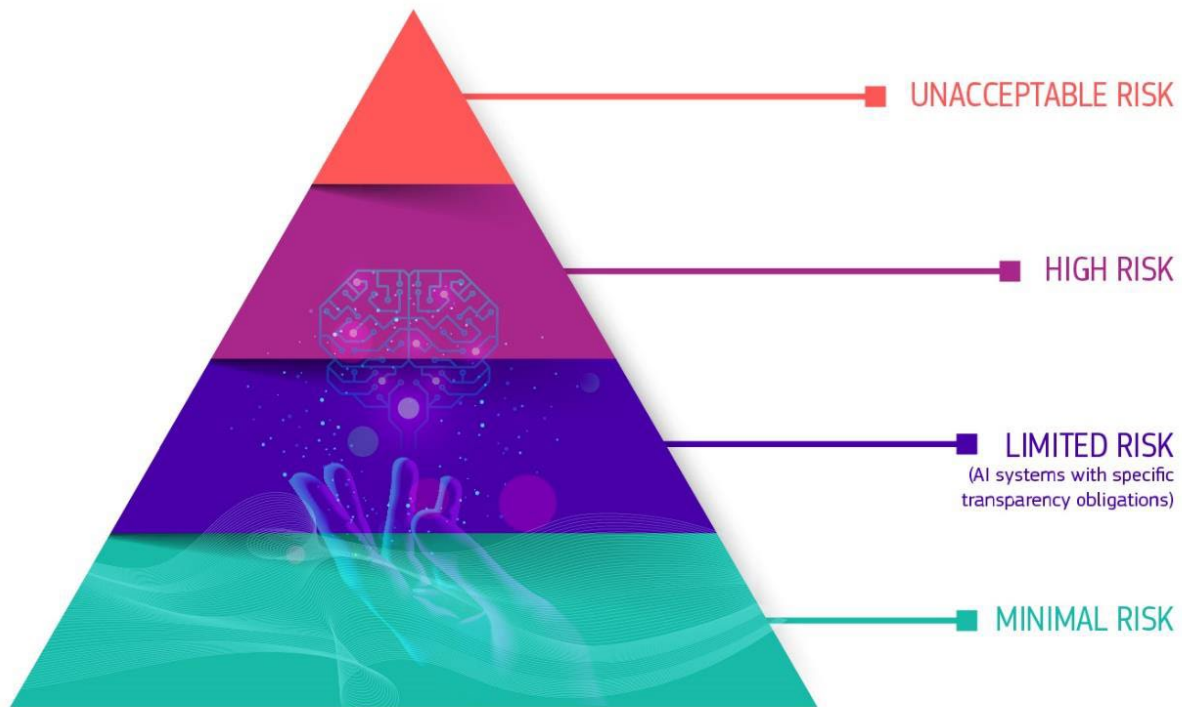
Article 3, Point 1.

‘**artificial intelligence system**’ (AI system) means **software** that is **developed** with one or more of the techniques and **approaches** listed in Annex I and can, for a given set of human-defined objectives, generate outputs such as content, predictions, recommendations, or decisions **influencing the environments** they interact with.

Annex I

- a) **Machine learning** approaches, including supervised, unsupervised and reinforcement learning, using a wide variety of methods including deep learning;
- b) **Logic- and knowledge-based** approaches, including knowledge representation, inductive (logic) programming, knowledge bases, inference and deductive engines, (symbolic) reasoning and expert systems;
- c) **Statistical** approaches, Bayesian estimation, search and **optimization** methods.

The European AI Act in a Nutshell

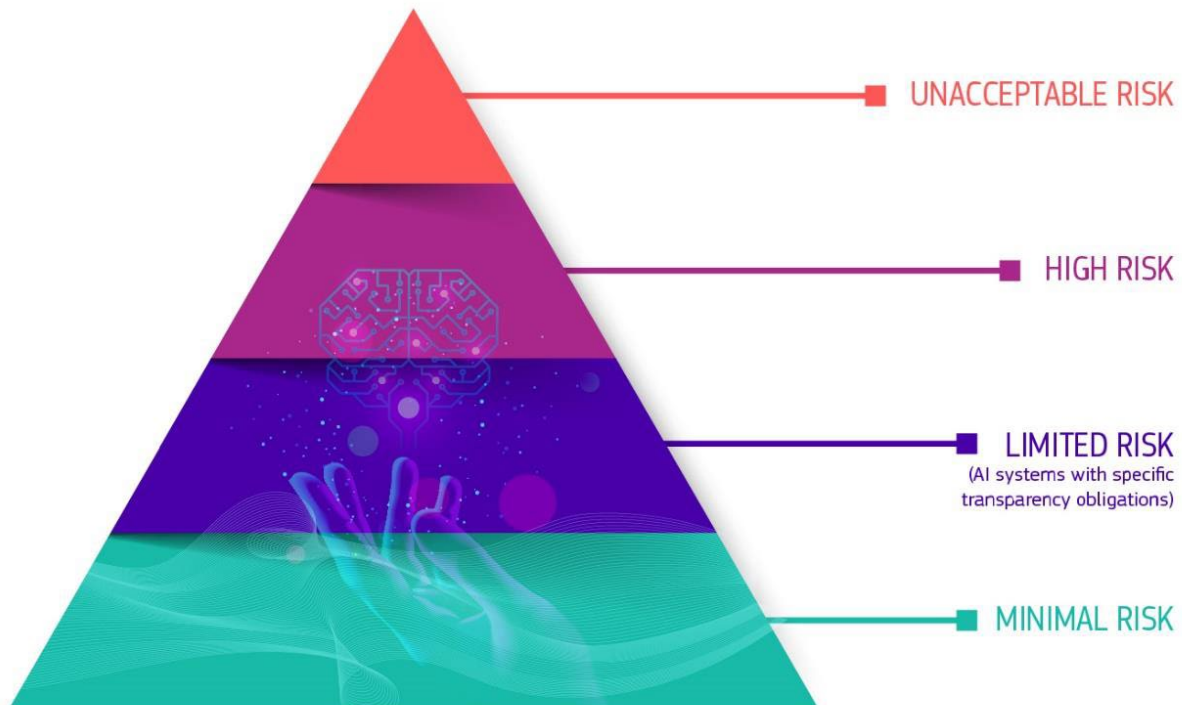


- **Unacceptable Risk.** Divided into 4 categories: 2 concern **cognitive behavioral manipulations** of people; 2 are **social scoring** and **biometric identification** systems.
- **High Risk.** Prior to market entrance: 1) **internal ex ante AI Impact Assessment and Codes of Conduct** overseen by inclusive, multidisciplinary teams; 2) must undergo an **approved conformity assessment and continuously comply** with AI requirements during their lifecycle (benchmarking, monitoring and validation); 3) **registration** of the AI system in a dedicated EU database; 4) a **declaration of conformity** must be signed and the Hi-Risk AI system must carry the **CE marking**.

High-Risk AI Systems

1. Biometric identification and categorisation of natural persons
2. Management and operation of critical infrastructure
3. Education and vocational training
4. Employment, workers management and access to self-employment
5. Access to and enjoyment of essential private services and public services and benefits
6. Law enforcement
7. Migration, asylum and border control management
8. Administration of justice and democratic processes

The European AI Act in a Nutshell



- **Human Oversight Requirement.** A human person should be able to oversee a Hi-Risk AI system.
- **Limited Risk.** Introduces specific **transparency obligations** for both users and providers of AI systems, such as bot disclosure. These apply also to automatic emotion recognition systems, biometric categorization and deepfake/synthetic disclosure.
- **Minimal Risk.** Exempt from transparency obligations.

The EU AI Body

- Enforcement

- The draft regulation provides for the installation of a new enforcement body at the Union Level: the **European Artificial Intelligence Body** (EAIB).
- At member level, the EAIB will be flanked by national supervisory authorities, each with “**sufficient technological expertise and human and financial resources**”.
- Fines for violations of the rules can be up to 6% of global turnover, or 30 million € for private entities.

Sandboxes

- To prevent the rules from **stifling innovation** [*no kidding*] and hindering the creation of a flourishing AI ecosystem in Europe, the draft establishes **AI regulatory sandboxes**.
- Regulatory sandboxes aim to to foster AI innovation by establishing a **controlled environment** to test innovative technologies for a limited time

Concerns by CLAIRE

- Concern 1:** The proposed "single future-proof definition of AI" is **deeply flawed**.
- Concern 2:** Such problematic definitions is likely to have **detrimental consequences** for the development, uptake and use of AI by European companies.
- Concern 3:** The notion of **quality of data** (and data sets) remains unclear or even impossible to meet.
- Concern 4:** **Lack of focus** on the proper intended behaviour of AI systems. The responsibility and accountability for ensuring proper intended behaviour is not clearly defined.
- Concern 5:** The proposed regulation is **vague on citizens' rights** and has important exceptions that negatively impact these rights.
- Concern 6:** The proposed regulation will **erode European competitiveness** in the area of AI.

Concerns by CLAIRE

Concern 7: Even if European regulation succeeds in setting global standards, most R&D may end up taking place elsewhere. This will erode European sovereignty in the area of AI technology.

Concern 8: **Funding** for AI research and innovation is **insufficient and poorly distributed**. It risks further increasing the fragmentation of the European AI ecosystem.

Concern 9: In the **absence of effective mechanisms and incentives**, the cooperation required for success at the European level will not be achieved.

Concern 10: Europe is **losing the competition for AI talent** with the US and China. Europe critically needs to stop the AI brain drain at all levels.

Concern 11: A distributed version of the **European lighthouse for AI** will be **ineffective** and inconsequential. Instead a joint **CERN for AI** could be a major success story for European AI, a powerful symbol and nexus for the ambition of "AI made in Europe", and a global attractor of talent.


Concern 12: The actions foreseen under the plan are scattered and unlikely to substantially move the needle on AI research or innovation in the global context or to lead to game-changing AI capabilities.

My criticism


- Discriminating on the basis of techniques used in the development of software (ML no, Randomized algorithms yes) is weird
- It is outrageous that the regulations do not apply to “AI systems developed or used exclusively for military purposes”
- Applying ex post controls to AI systems viewed as black boxes does not help improving or spreading the technologies. Public institutions should invest more on research and development of technologies for use by everybody.

Specific Issues

- Art. 10, comma 3. It is impossible to guarantee that “training, validation and testing data sets shall be [...] **free of errors and complete**”
- Art. 11, comma 6. “Appropriate data governance and management practice shall apply for the development of high-risk AI systems other than those that make use of techniques involving the training of models in order to ensure that those high-risk AI systems comply with paragraph 2.”
Then **any high-risk system**, not just AI, must be subject to regulations.
- Art. 14, comma 3(e). “interrupt a system through a ‘**stop button**’”. It is well known that such mechanisms leads to paradoxical effects
(<https://medium.com/@shivamohan07/stop-button-paradox-in-agi-69c3d008ae93>)
- Art. 15. Comma 1. High-risk AI systems shall be designed and developed [...] achieve [...] an **appropriate level of accuracy**. What is appropriate?



USA designs and markets,
China builds,
Europe regulates.

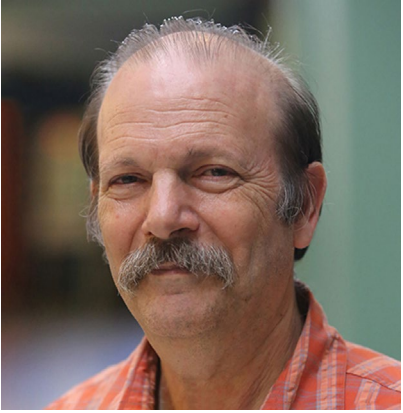




WIDENING THE HORIZON



Technology Is Driving the Future, but Who Is Steering?



Moshe Vardi

Gödel Prize Lecture 2021

<https://informatics.tuwien.ac.at/news/2040>

- Computing brings not only societal **benefits** but also significant **societal costs**, such as labor polarization, disinformation, and digital addiction.
- The typical reaction is to frame it as an “**ethical issue**”.
- The **ethical lens is too narrow** since the real issue is how to deal with technology’s impact on society.
- Ethics is about **individual responsibility**, **Public Policy** is about **societal responsibility**
- We need to regulate not just technologies, but **how companies exploit technologies**

Concentration

They are also the largest investors in AI and use it to **expand** to new sectors

Crucial issue for economy

10 Largest Corporations by Market Capitalization 4th quarter 2020



● GAFAM and other Big Tech

● Other business sectors (finance, automotive, etc.)

Elements of comparison:

- entire CAC 40: ~\$1800B
- GDP of France: ~\$2600B

Source: List of public corporations by market capitalization from Wikipedia

Conclusions

- The European strategy on AI is disappointing
- Too little and too **fragmented**
- Too much focus on **regulations**
- Too much focus on specific aspects (**explainability, trustworthiness**)
- Lack of investments in broadly accessible critical **infrastructures**
- Funding by **short term projects** rather than for **long ranging challenges**
- AI is making big strides in technology every day: **Europe risks to lag behind** in technical advances and deployment
- The major goal should be to **democratize AI**, making it available to all, not to slow down its adoption

Thanks

