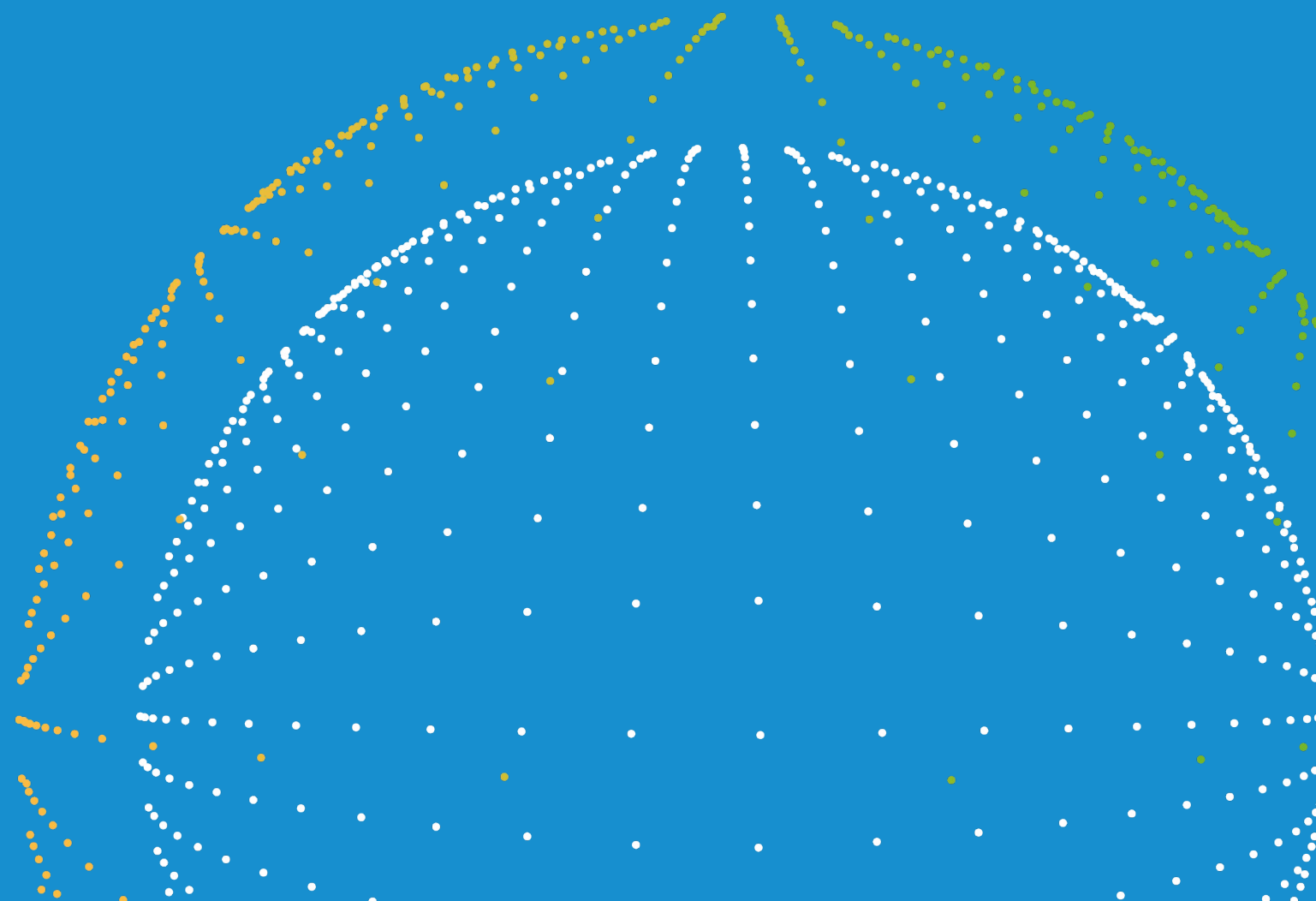


# Data Spaces Symposium

HPC meets the demands of  
AI and Data

---

Jeanette Nilsson RISE



## Different perspective on AI, Data and HPC- connecting SME and AI community

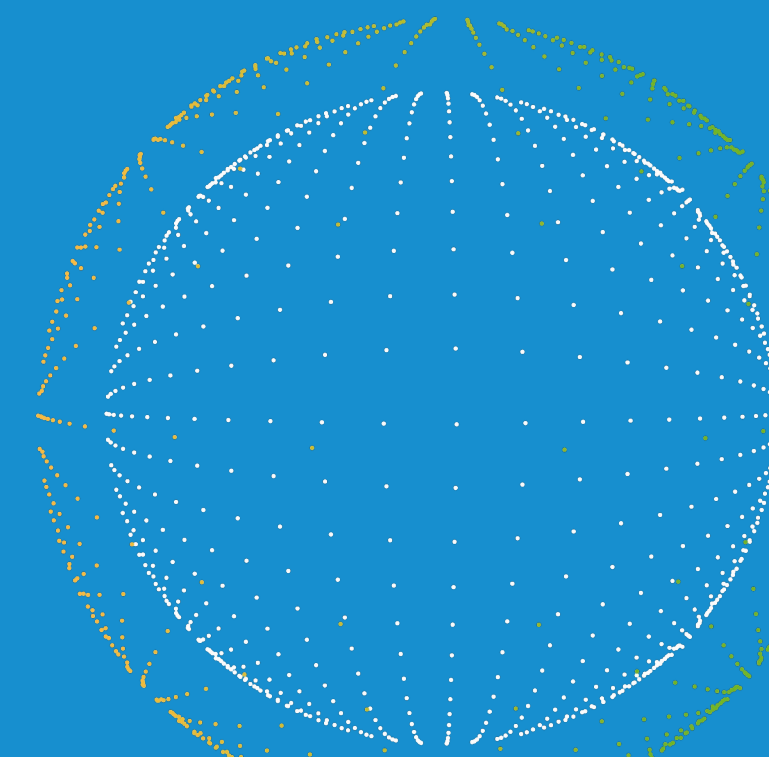
- Juan Pelegrin, EC DG CNECT
- Roberta Turra, Cineca
- Andreas Wierse, SICOS
- Kristina Knaving, RISE

Jeanette Nilsson

AI/ HPC-Ecosystem expert

BDVA, Member of the Board of Directors of RIAG member

Sweden's representative in the EU's AI and Business Digitalization Working Group  
with responsibility for the Partnership for AI, Data and Robotics (Adra)





# AI Factories - Amendment to the EuroHPC JU Regulation

Council Regulation (EU) 2021/1173

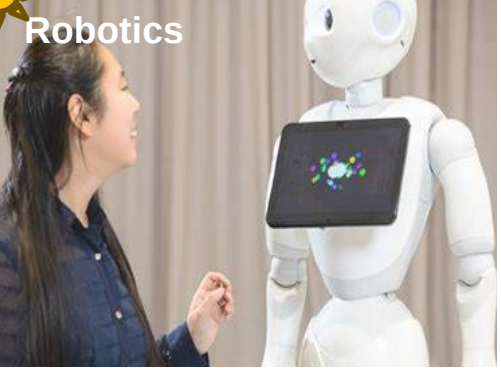
*Juan Pelegrin*  
*DG Communications Networks, Content and Technology*  
*European Commission*

*12 March 2024*

# Large Artificial Intelligence (AI) models

- **Large AI models** (such as large language models) are a new wave of AI models called **generative AI** adaptable to various domains and tasks.
- **Generative AI** models have immense **potential** to revolutionise multiple sectors.
- Most large AI models (e.g. ChatGPT) are **non-European**
- Mastery of this technology is of **strategic importance for Europe** in line with **economic security**.

# Key AI applications



Robotics



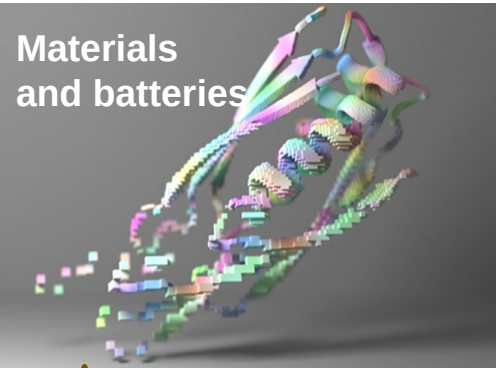
Healthcare



Biotechnologies



Citiverse



Materials and batteries



Manufacturing and engineering



Climate change and adaptation



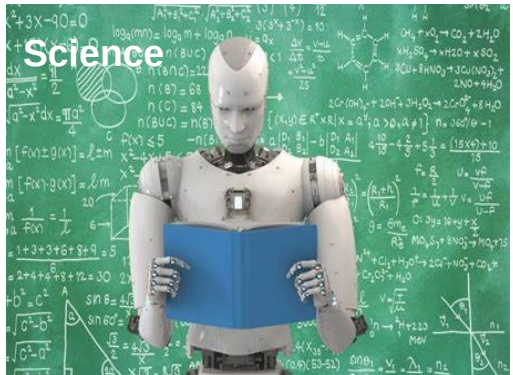
Public Sector



Mobility



Cybersecurity



Science

# Protein structure prediction

## The greatest achievement of AI - and a paradigm shift in science



**DeepMind**  
DeepMind AI cracks 50-year-old problem of protein folding

Program solves scientific problem in 'stunning advance' for understanding machinery of life

DEEPMIND, DE GOOGLE  
La IA revela la forma de las proteínas en 3D y abre la puerta a crear nuevos fármacos

El programa AlphaFold2 resuelve un problema fundamental de la biología de hace 50 años: cómo adquieren su estructura las proteínas



### Premio Princesa de Asturias de Investigación Científica y Técnica 2022



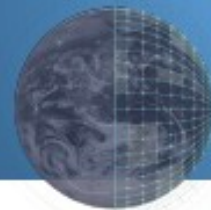
Geoffrey Hinton, Yann LeCun, Yoshua Bengio y Demis Hassabis

### Premio Fronteras del Conocimiento



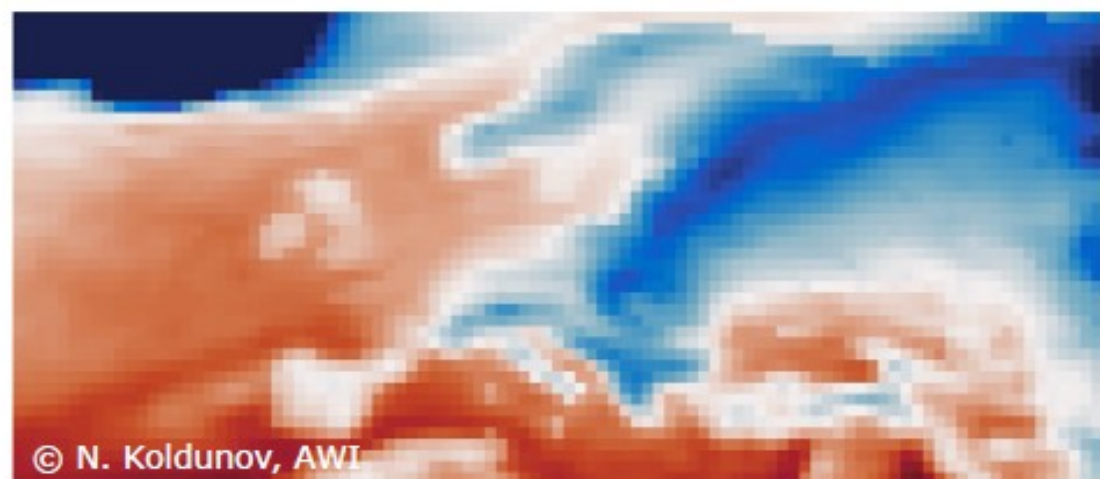
Demis Hassabis, David Baker y John Jumper.

European Commission

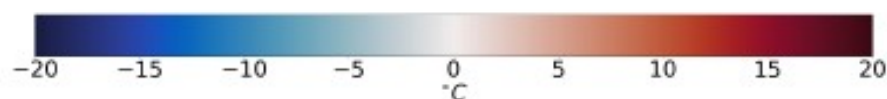
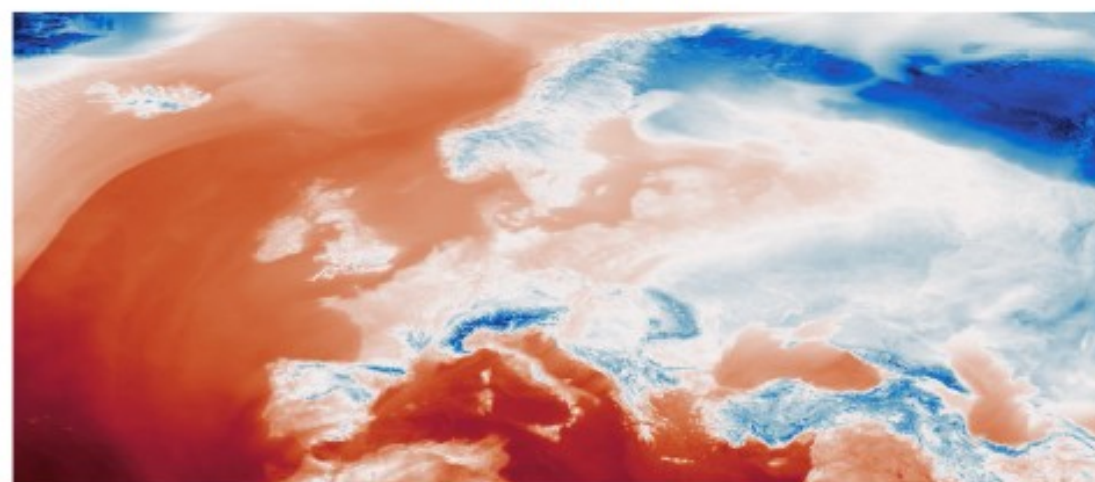


# CLIMATE DT: OPERATIONALIZING GLOBAL MULTI-DECADAL CLIMATE PROJECTIONS AT KM-SCALE – WORKFLOWS SET-UP ON LUMI

IPCC AR6 (2021), 100km



Digital Twin, 5km



**ICON**  
**IFS-NEMO/FESOM**

To support the efforts of defining and planning activities linked to climate change adaptation

# Towards large AI models: European strengths and weaknesses

## Strengths

## Weaknesses

Skills, talents,

Vibrant start-ups ecosystem

Advanced HPC infrastructure and data spaces

AI Act

Excellent research ecosystem

Catching-up mode, full reliance on non-EU actors using black box AI models

Access to VC financing

Uncoordinated approach

70% of top-tier AI researchers in Europe work in academia, 15% of all AI research publications from EU, 21.5% of all research citations in the field

Emerging AI ecosystems  
Foundation models start-ups: **Mistral, Aleph Alpha, Bloom, SiloAI** & 125+ start-ups in general AI

World's most advanced HPC infrastructure (**EuroHPC**) + the world's largest **database on language models**

The world's first comprehensive regulatory approach to AI

Excellent European research ecosystem; multiple AI research initiatives across MS with **EU second largest in research publications (2022)**

**EU reliant on non-EU companies** to access general-purpose AI systems

Limited access to venture capital above **€10 million** for start-ups + risk of take-overs

Multiple but **uncoordinated initiatives at EU/MS level** hampering effectiveness and scale-up



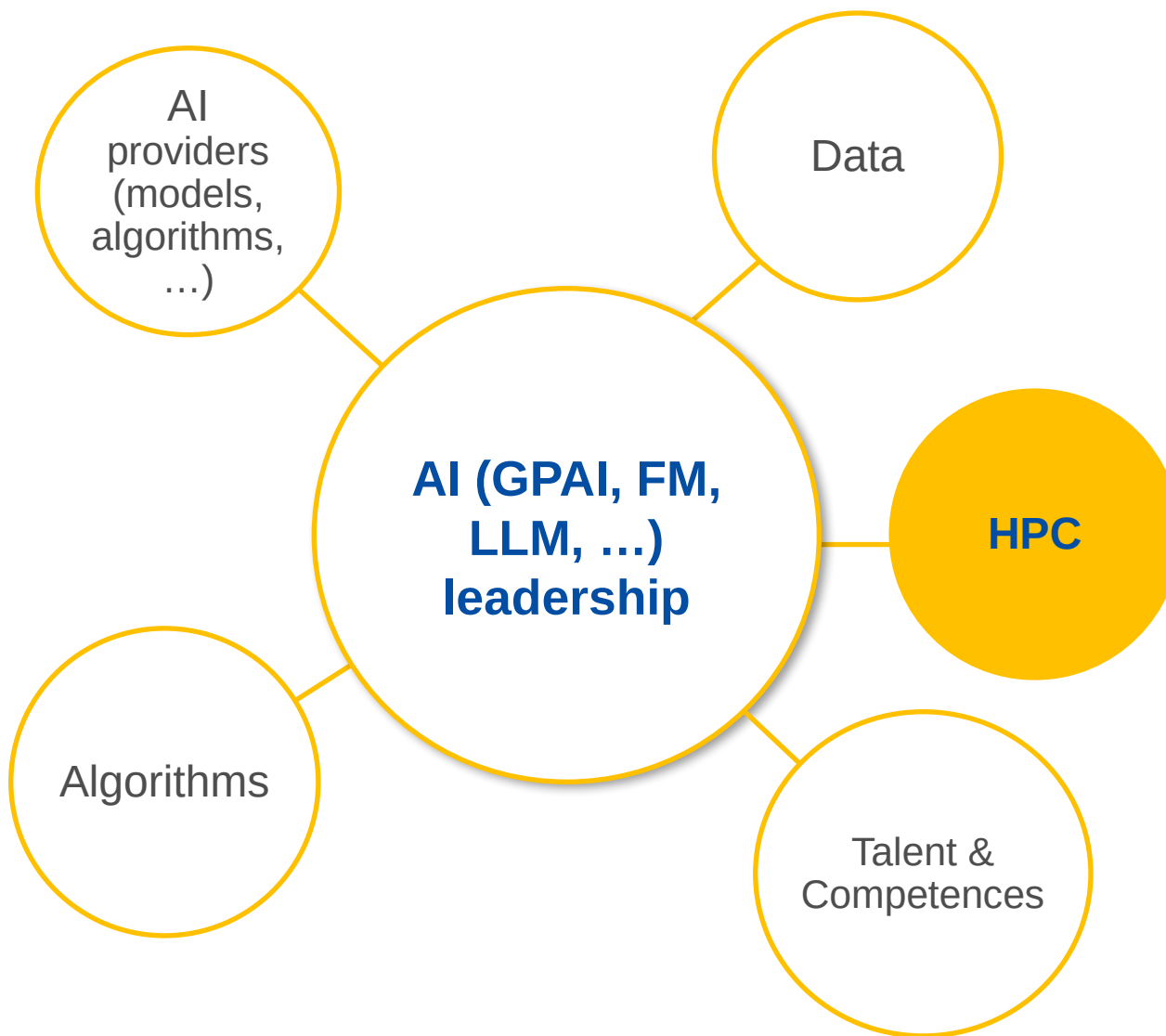
# Context

- **Generative AI** and **AI foundation models** are advancing at unprecedented pace and are set to play a pivotal role in shaping the future of technology and society.
- **AI** is a key policy area of the **EU digital strategy**. AI in combination with **HPC** can contribute to a more innovative, efficient, sustainable and competitive economy, while also improving safety, education and healthcare for citizens.




- In her 2023 State of the Union address, President von der Leyen announced that **the supercomputing resources of the EuroHPC JU will be made available to European AI startups to train their large-scale models**, contributing to the EU's aim of leading global advances in AI and of achieving responsible and ethical innovation.

# Unlocking the potential of AI



# LARGE LANGUAGE MODEL HIGHLIGHTS (DEC/2023)

 gpt-3.5-turbo (ChatGPT)  
20B



**GPT-4**  
1.76T MoE



**PaLM 2**  
340B



**ERNIE 4.0**  
1T



**Inflection-2**



**Gemini 1.0 Ultra**  
1.5T



**Olympus**  
2T (2024)




**Next...**  
(2024)

- Nano**
- Mamba 2.8B
- phi-2 2.7B
- ...

- XS**
- Pythia 12B
- Mistral 7B
- Zephyr 7.3B
- Gauss
- StripedHyena 7B
- Persimmon-8B
- DeciLM-7B
- ...

- 30B Small**
- Palmyra 20B
- C1.2
- Retro 48B
- MPT-30B
- Grok-1 33B
- Yi-34B
- Mixtral 8x7B
- ...

- 70B Medium**
- Command 52B
- StableLM 65B
- Llama 1 65B
- Luminous Supreme
- Llama 2 70B
- Perplexity 70B Online
- OLMo 70B (2024)
- Qwen-72B
- ...

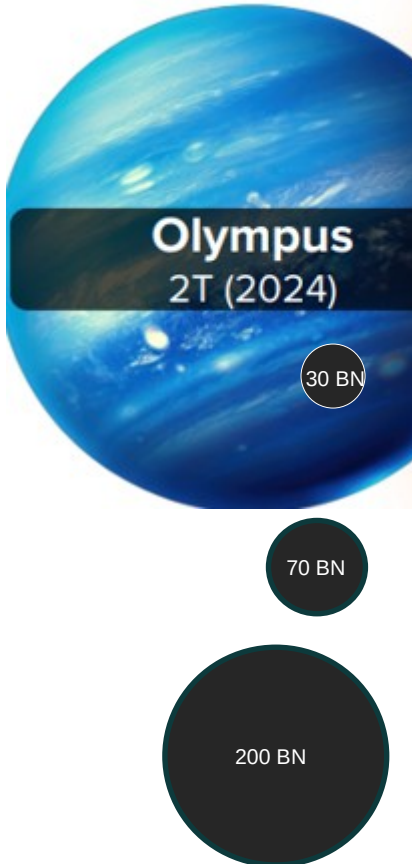
- 180B Large**
- Yuan 2.0 102.6B
- InternLM 104B
- Jurassic-2
- Falcon 180B
- Claude 2.1
- Mistral-medium
- ...

 Parameters

 AI lab/group

Sizes linear to scale. Selected highlights only. All models are available. All models are Chinchilla-aligned (20:1 tokens:parameters) <https://lilearnitect.ai/chinchilla/> All 200+ models: <https://lilearnitect.ai/models-table/> Alan D. Thompson. 2023.

# EuroHPC for large AI models (estimation)



HPC system / AI model	Meluxina - LU (18 petaflops peak performance)	LUMI - FI (550 petaflops peak performance)	Leonardo – IT* (323 petaflops peak performance)	Jupiter-DE Approx. figures
<b>Falcon</b> 40 bn parameters	50 days	4 days	3 days	1 day
<b>LLaMA (META)</b> 65 bn parameters	80 days	7 days	5 days	1.5 days
<b>GPT-4 (OpenAI)</b> Hundreds of bn parameters	6 years	6 months	4 months	6 weeks

Source: Internal analysis

# How to capitalise on EuroHPC strengths to develop a highly competitive and innovative AI start-up and research ecosystem in Europe?

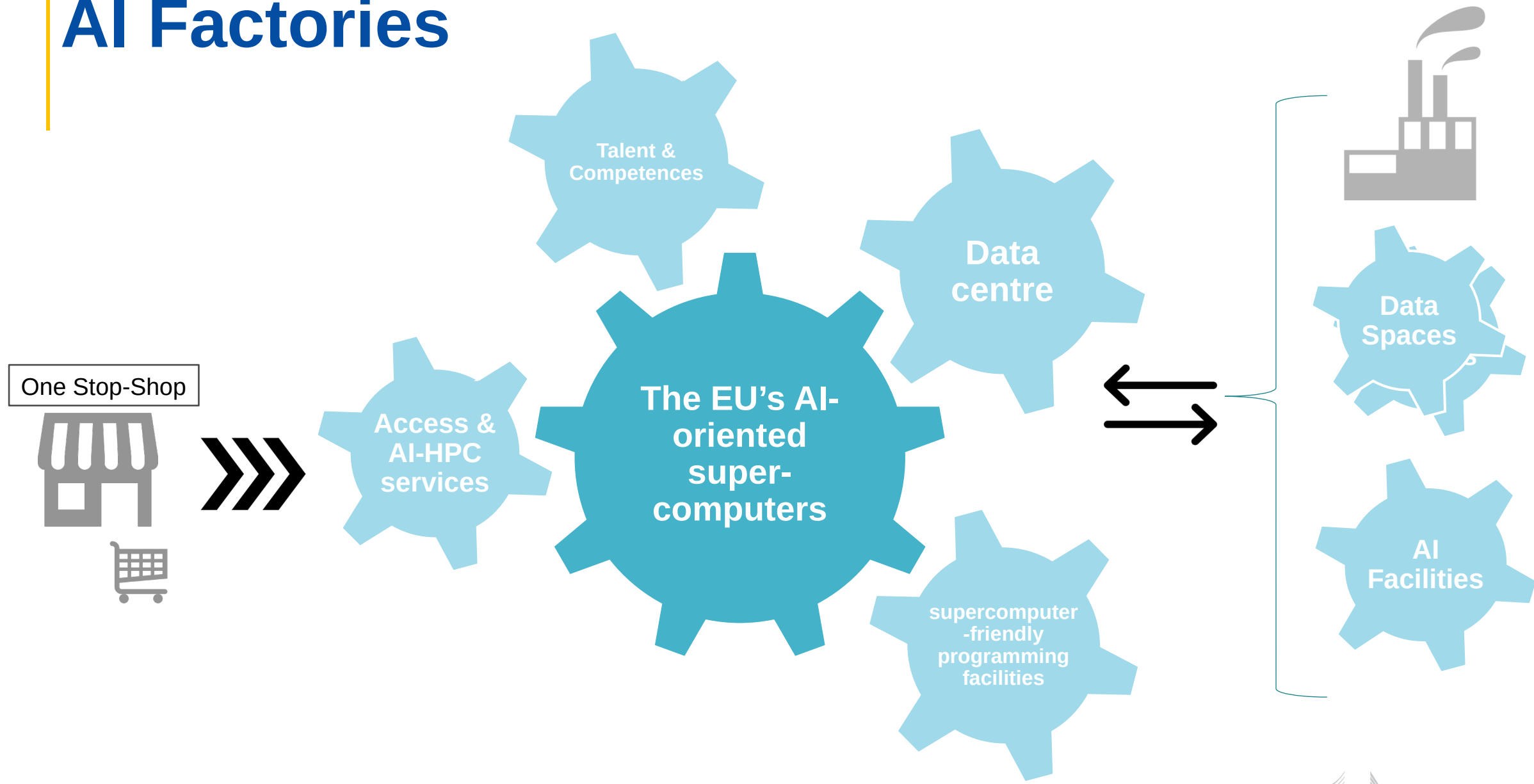
- Procurement of supercomputers.
- Upgrading of existing EuroHPC supercomputers.
- Access to supercomputers.

BUT:

- Current EuroHPC infrastructure and services not optimized for AI.
- Inflexible conditions for upgrading.
- Not considering specific needs of AI user communities.
- No connection with AI ecosystem.

➔ A targeted **amendment to the EuroHPC Regulation** is necessary.

# AI Factories



# Amendments to EuroHPC Regulation (EU) 2021/1173

## AI Factory - Activities

1. Acquisition & operation of AI dedicated supercomputers (co-located with data centre)
2. Upgrading with AI existing EuroHPC
3. Provide access to SMEs and start-ups (incl. widening usage)
4. AI supercomputing service centre (algorithms, training- testing- evaluation- validation of AI models, development of large-scale AI applications, ...)
5. Supercomputer-friendly programming facilities (parallelization, usage optimization, ...)
6. Attracting & pooling talent
7. Interacting with AI-ecosystem at large & other AI initiatives

**Hosting AI supercomputers conditional of establishing AI Factory**

# AI Factory

- **Hosting Entity**
  - AI-Factory related Hosting Entity eligibility criteria / Hosting Entities => One-Stop-Shop
- **Hosting Agreement**
  - Specific hosting conditions for AI-dedicated supercomputers / AI-upgrades
- **Acquisition and ownership of Artificial Intelligence-dedicated supercomputers**
  - Apply for hosting anytime => no limitations as for high-end/mid-range
- **Upgrading of Supercomputers**
  - Deleting € limit/ Widening scope to request upgrades/ Apply for upgrade anytime => no limitations to apply within 3 years after selection as hosting entity
  - EU financial contributions (OPEX/CAPEX) percentage as for original supercomputer to be upgraded
- **Use of EuroHPC Supercomputers**
  - Governing Board defines special access conditions for AI supercomputers / upgrades
- **Allocation of Union Access time to EuroHPC supercomputers**
  - EU share of access time proportional to EU contribution



**THANKS**

**DATAWEEK<sup>24</sup>**  
JOIN.LEARN.SHARE.GET VALUE

# HPC meets the demands of AI and Data

## Leonardo: Bridging AI Needs, Access, and HPC

**12/03/2024 15:30-16:30 (CET)**

Roberta Turra, CINECA

**under the umbrella of:**  
**Data Spaces Symposium**  
**Unite. Innovate. Adopt.**

**Darmstadtium | Frankfurt region**



Funded by  
the European Union

The Data Spaces Support Centre receives funding from the European Union Digital Europe Programme under grant agreement n° 101083412

DSBA



DATA SPACES  
SUPPORT CENTRE

# The impact of AI on HPC can be seen from different perspectives

- Tasks / Requirements
- Users
- Access to resources
- Hardware
- Software
- Projects / Apps
- Services



# Tasks / requirements

## Traditional HPC

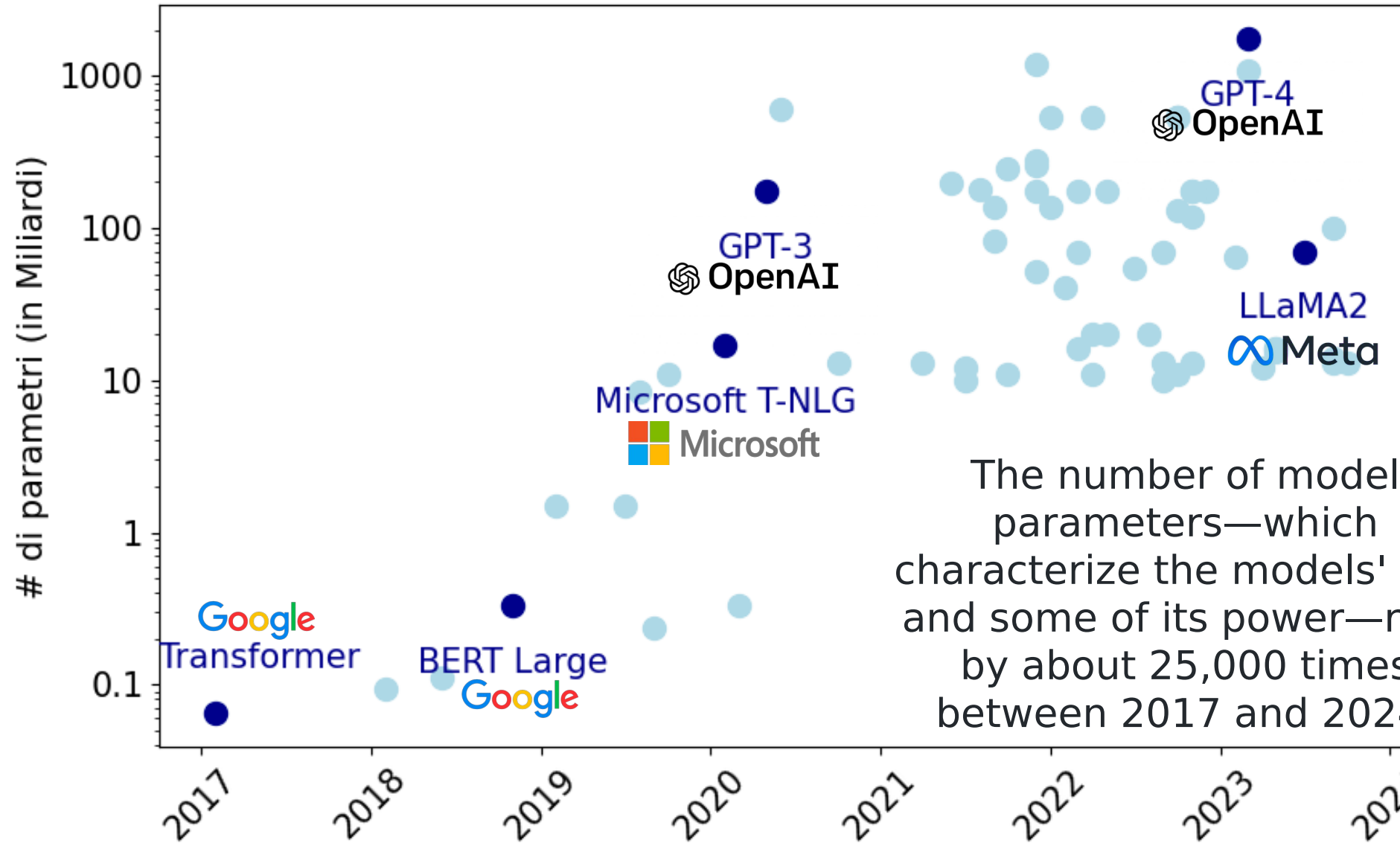
- Run physical (deterministic) models that generate data
- Applications: SIMULATIONS (Computational Fluid Dynamics, Molecular Dynamics, ... )

## What's new in HPC (impact of AI)

- Data driven ML algorithms (probabilistic) that generate the model
- New workload need optimization of HPC systems for AI tasks
- New applications on texts and images
- With Deep Learning computational power becomes one key element (data – algorithms – compute)



# LLM's evolution



The number of model parameters—which characterize the models' size and some of its power—rose by about 25,000 times between 2017 and 2024.



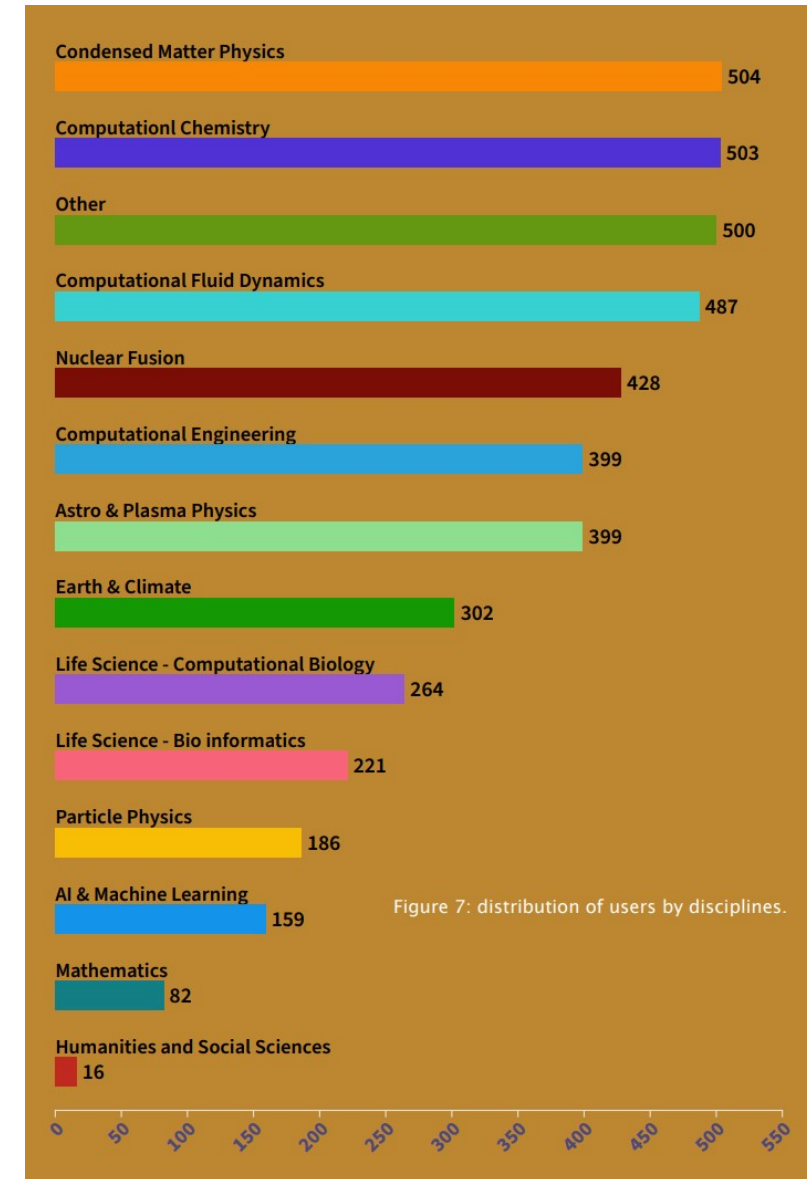
# Users

## Traditional HPC

- Domain: Natural sciences
- Main typologies:
- Researchers (scientific communities)
- Big companies (e.g. pharmaceutical, Oil and Gas, ...)

## What's new in HPC (impact of AI)

- Domain: Social sciences (in the beginning)
- No single community
- New typology: start-ups



CINECA HPC Annual Report 2022/23

# Access to resources

## Traditional HPC

- Scientific merit (with limitations on the number of core/hours)
- Contractual / research agreements
- Public funding (e.g. EU projects)

## What's new in HPC (impact of AI)

- Specific calls
  - EuroHPC
  - AI-BOOST
  - ALT-EDIC
  - EuroCC2, FF5, EDIHs, ... (in Italy the National Competence Center for HPC, ICSC)
- Specific agreements (in Cineca: FAIR, FBK, AL, IBM, iGenius)



# Hardware

## Traditional HPC

- CPUs
- Double precision

## What's new in HPC (impact of AI)

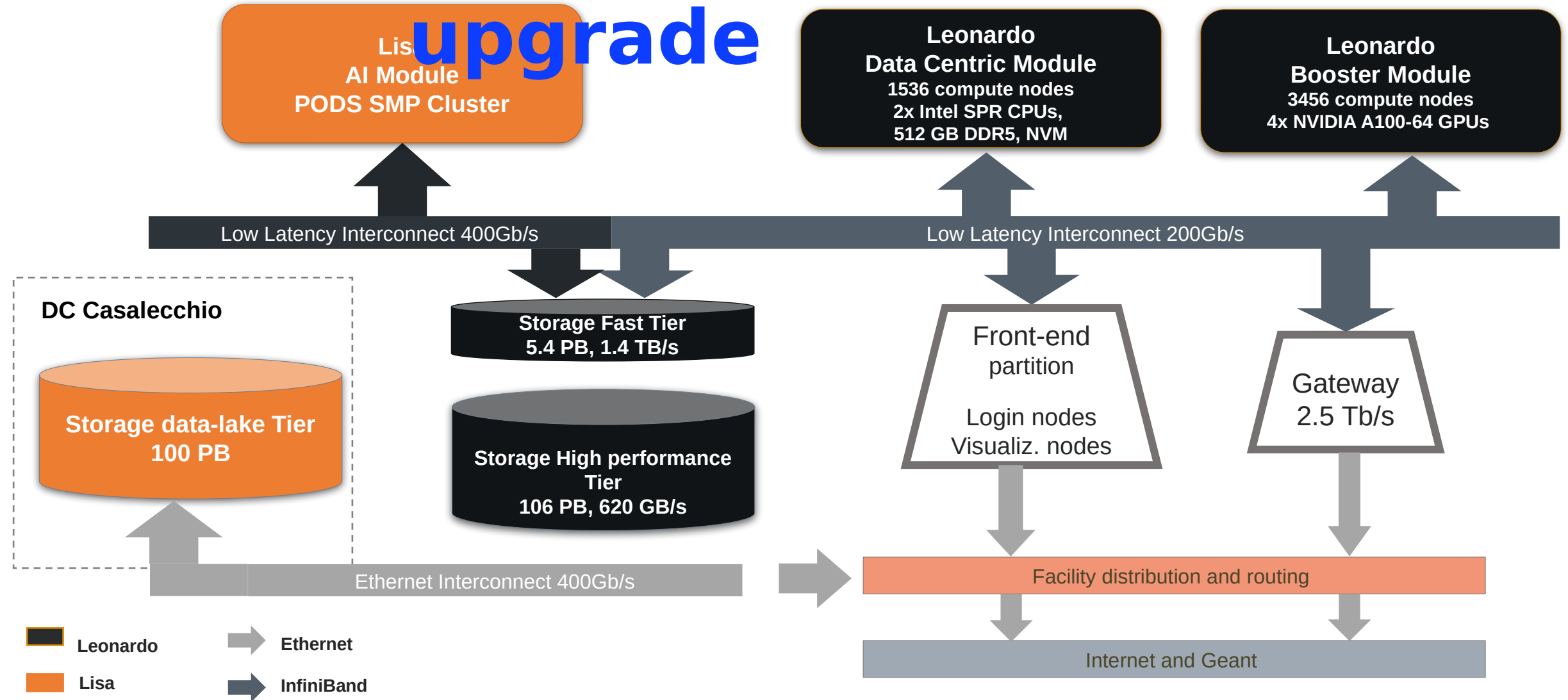
- GPUs
- Bandwidth
- (fast)Storage

AI and machine learning workloads have driven the development and adoption of specialized hardware such as GPUs (Graphics Processing Units), TPUs (Tensor Processing Units), and FPGAs (Field-Programmable Gate Arrays). These **accelerators** are designed to perform parallel operations at high speeds, essential for the massive matrix and vector computations common in AI. This shift has led to a rethinking of HPC infrastructure to accommodate these accelerators, leading to more **heterogeneous computing environments**.

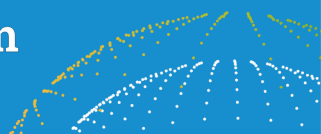
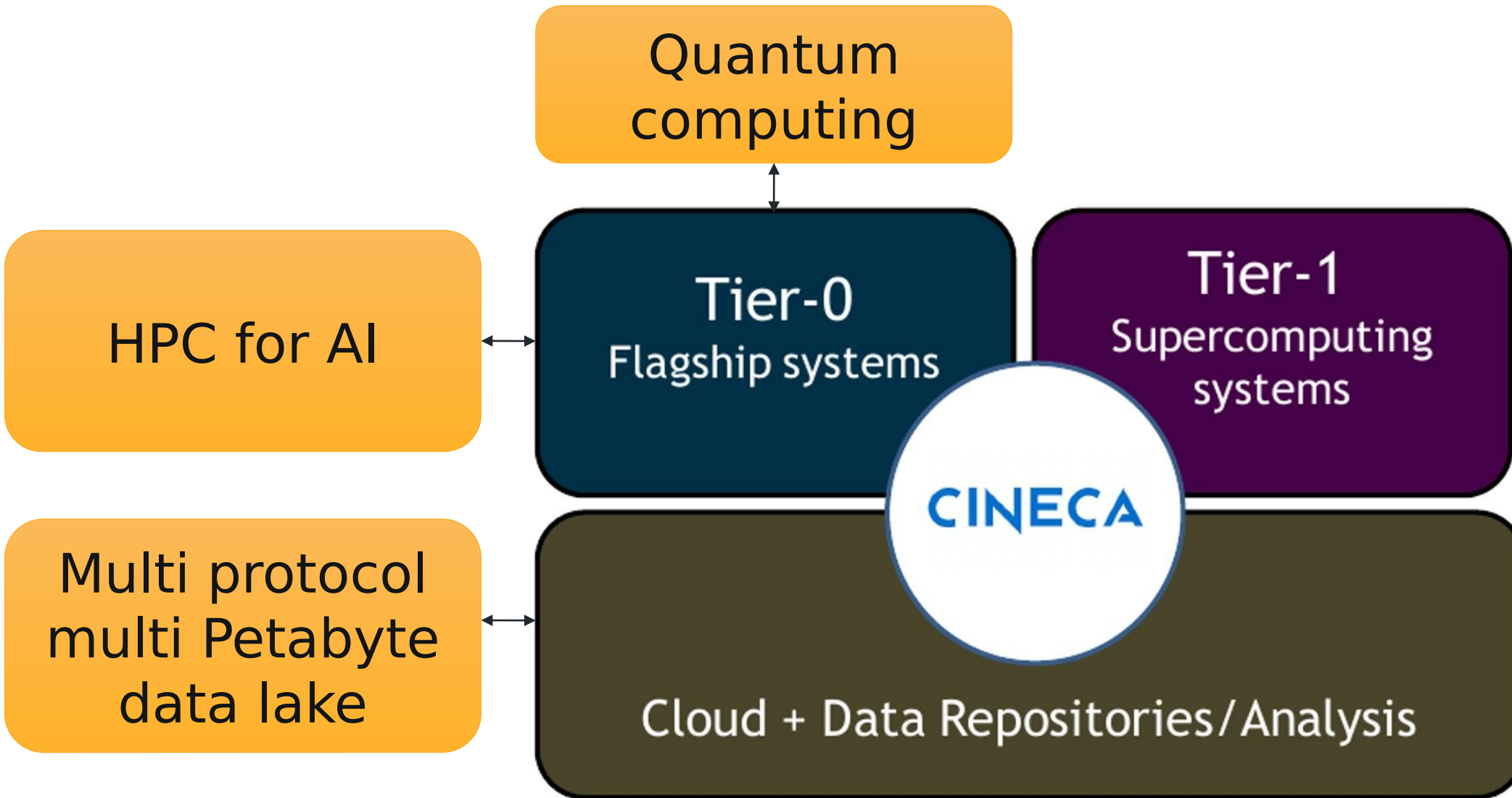




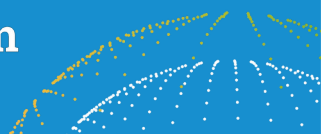
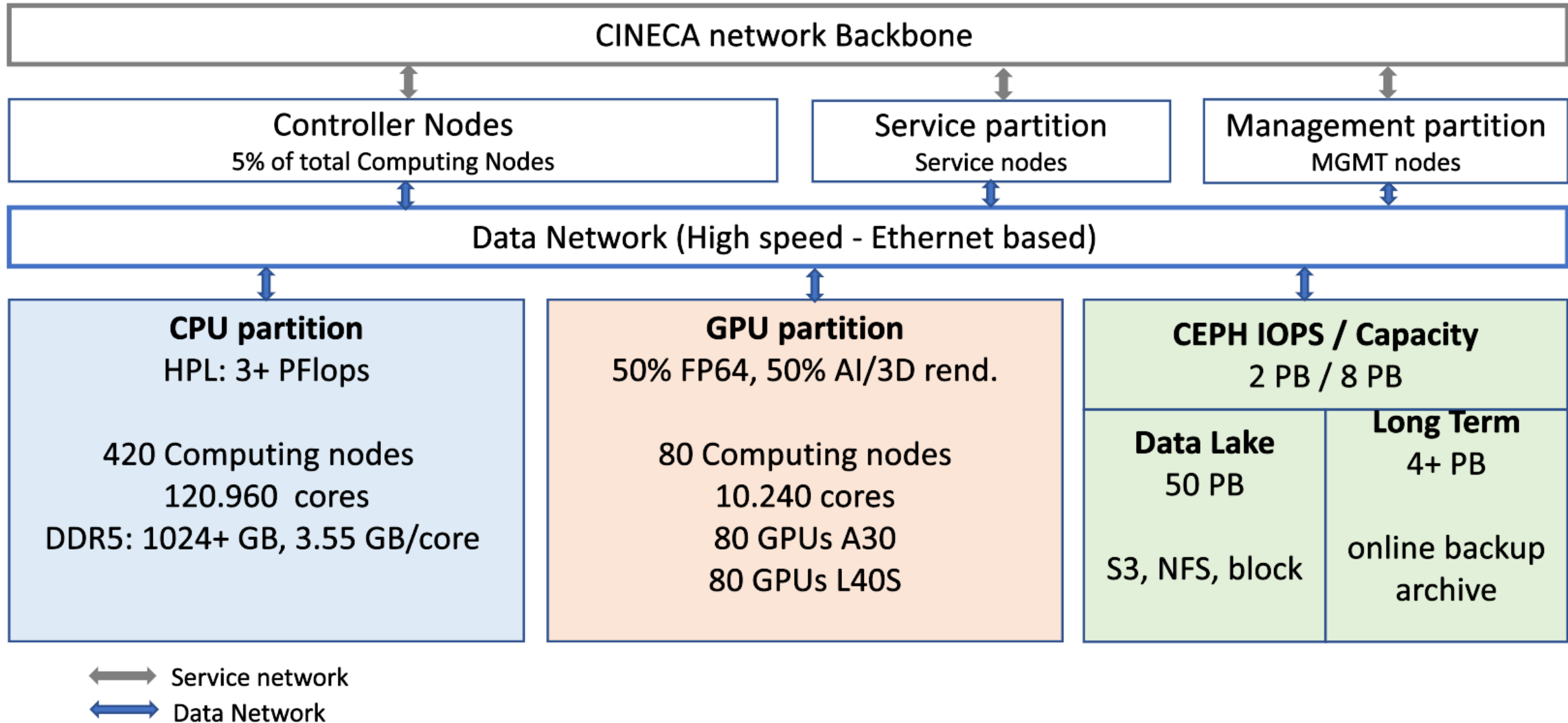
# Tier0 Leonardo + Lisa AI



# HPC infrastructure

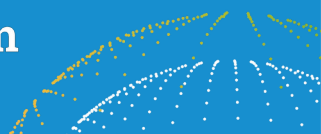


# Cloud service evolution



# Cloud

- Flexible use of resources (dynamic resource allocation, allowing users to scale resources up or down on-demand)
- Interactive Computing Services (enable to provide front-end services for the users, web access, real-time data processing, graphical interfaces for inference ...)
- Environment personalization (operating system and software stack can be selected and installed by the user)
- Security (GDPR compliant)



# Software

## Traditional HPC

- Specialized software libraries, compilers, and tools optimized for performance on specific hardware architectures (e.g. Quantum espresso)
- Repositories

## What's new in HPC (impact of AI)

- Pytorch, tensorflow
- New libraries
- New modules (e.g. CinecaAI)
- Data Lake



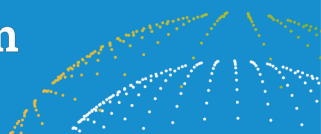
# Projects / Apps

## Traditional HPC

- Particle Physics
- Condensed Matter Physics
- Astrophysics and Plasma Physics
- Computational Chemistry
- Computational Engineering
- Computational Fluid Dynamics
- Earth and Climate Science
- Life Science – Computational biology
- Life Science – Bioinformatics

## What's new in HPC (impact of AI)

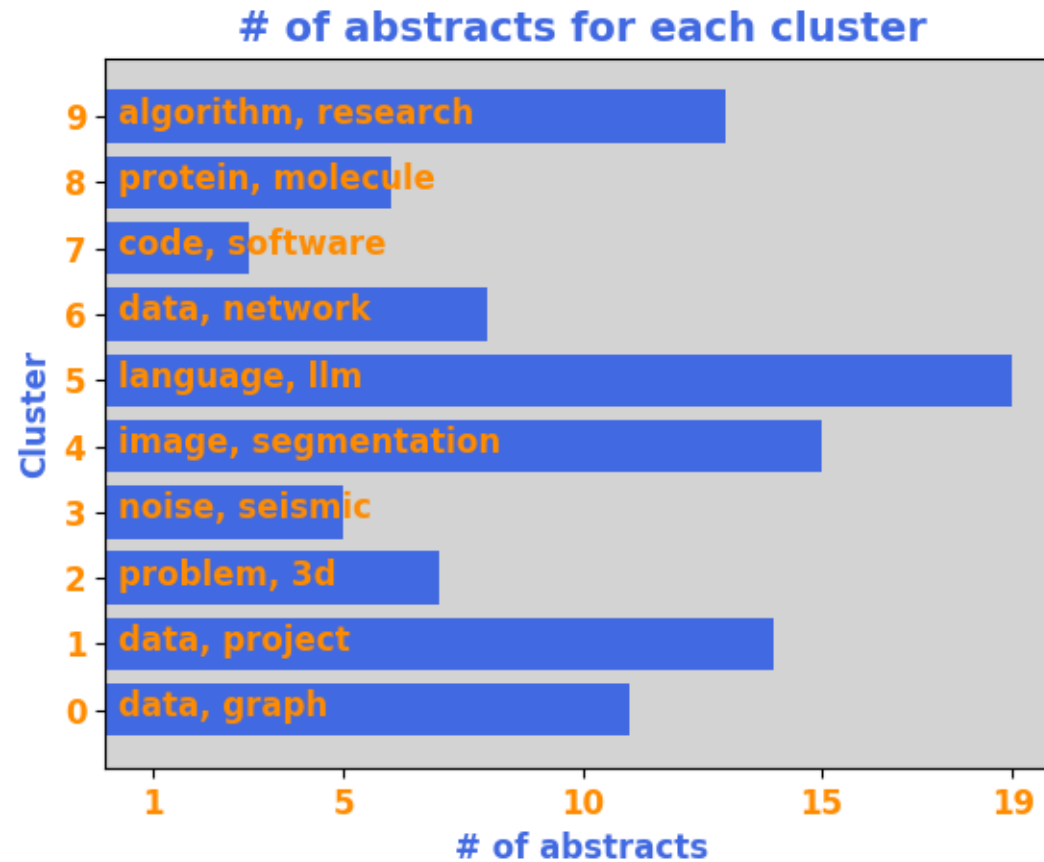
- A new scientific area in project classification: AI & Machine learning
- Scientific and innovation (commercial) projects that either develop new AI algorithms or use AI in their application domain



# Projects / App

National research projects (ISCRA C) running on Cineca infrastructure in 2023

Project focus	# of abstracts
AI & ML	101
Big Data/Bioinformatics	39
COVID-19	7
HPC	581
Quantum Computing	18
<b>Total</b>	<b>746</b>

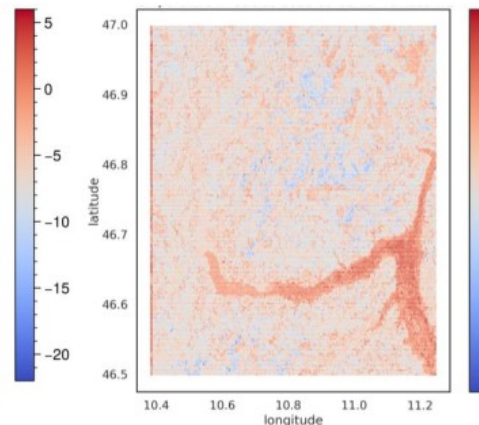
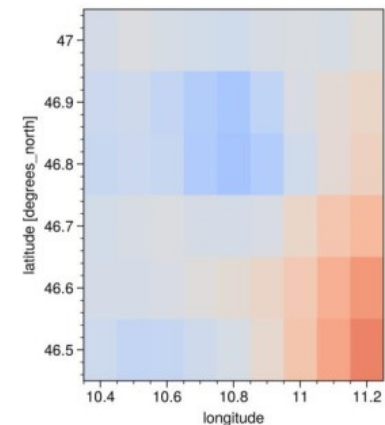
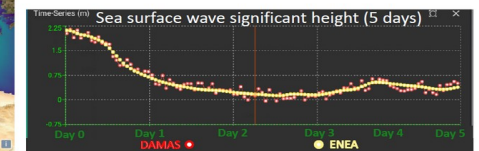
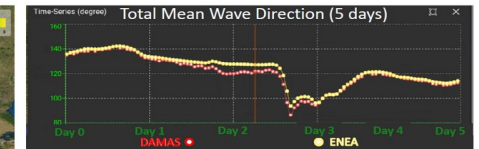
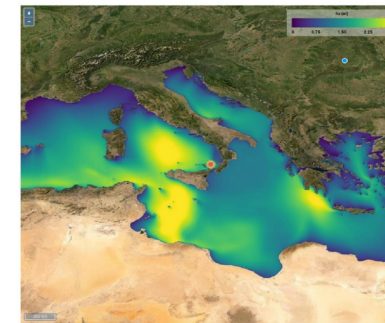
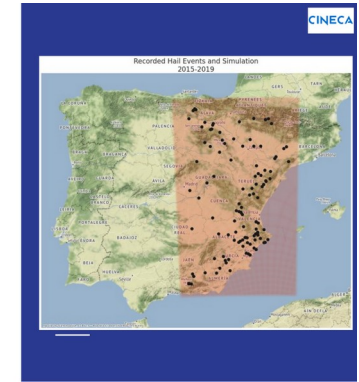






# Climate and Weather projects

- CYBEL (www.cybel-project.eu/) Day-ahead hail prediction to prevent losses in agriculture
- DAMAS (<https://euhubs4data.eu/experiments/damas/>) Data-driven Model for the Analysis of Sea-state
- Climate Byte (<https://euhubs4data.eu/experiments/climate-risk-assessment-for-agriculture-insurance-using-big-data-and-artificial-intelligence/>) Climate risk assessment for agriculture insurance
- ILLUMIA (<https://www.ifabfoundation.org/ifab-activities/projects/ai-general-circulation-model/>) AI General Circulation Model
- OptimESM (<https://optimesm-he.eu/>) Optimal High Resolution Earth System Models for Exploring Future Climate Change
- Weather4Energy (<https://www.supercomputing-icsc.it/en/spoke-4-earth-climate-en/>)



# Earth Observation projects

- Arboria (<https://euhubs4data.eu/experiments/arboria/>)  
An open-data based urban forest solution improved by AI optimization
- Digital Twin of Bologna city
- Mobility Square  
(<https://euhubs4data.eu/experiments/sustainable-mobility-recommendation-engine-for-tourism/>)  
Sustainable mobility recommendation engine for tourism



# Other relevant ongoing projects

## Cataloguing and meta-dating of artistic heritage

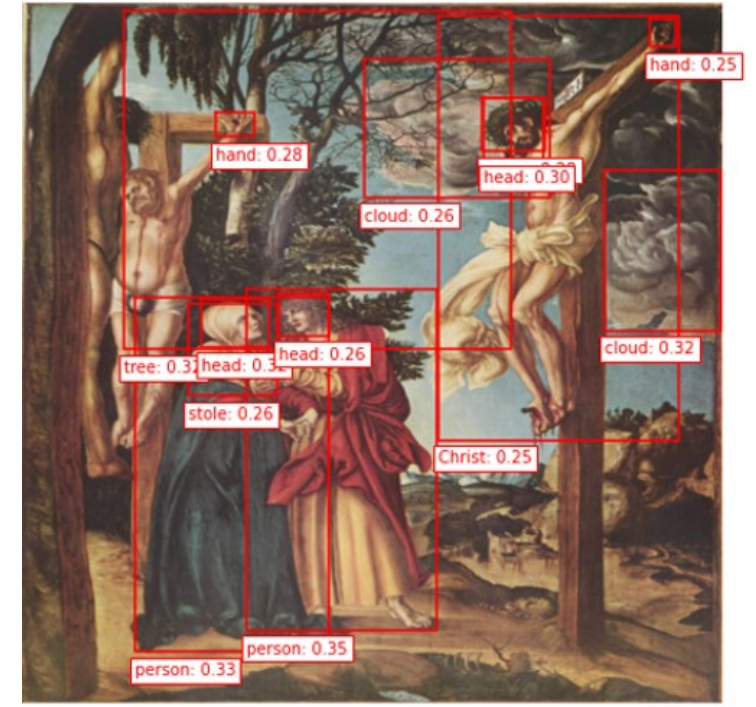
Support the Ministry of Culture in the cataloguing and meta-dating of artistic heritage through the use of image analysis techniques (object detection, classification, captioning)

## Legislative support using artificial intelligence and LLMs

Design and implementation of a semi-automatic laws impact evaluation system that can generate new high quality text laws and improve impact

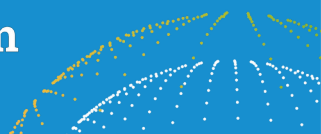
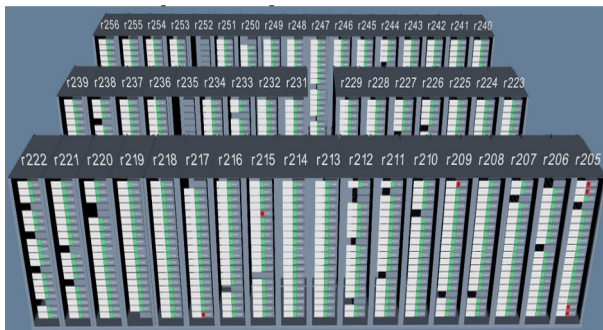
## Retrieval Augmented Generation for Systematic Literature Review

Natural Language Processing for healthy life expectancy



## Data Centre Digital Twin for Sustainable Exascale Computing

Design massive Data Center graph models capturing the spatiotemporal dependencies between computation, nodes, and cooling equipment and conduct analytics to predict the impact of the spatial power distribution on cooling efficiency and cost (<https://graph-massivizer.eu/project/data-center-digital-twin/>)



# Services

## Traditional HPC

- User support
- Specialistic support
- Training
- PoC

## What's new in HPC (impact of AI)

- Data catalogue
- Free inference for widely adopted open-source models
- Fine-tuning
- ...



# Challenges

- Ethics
- Sustainability



# What's next

- The transformation is going on
- We learn by doing, by actively participating to AI projects and by providing user support in the most computationally challenging tasks (e.g. LLM)



# .DATAWEEK<sup>24</sup>

JOIN.LEARN.SHARE.GET VALUE

# Thank you!



The Data Spaces Support Centre receives funding from the European Union Digital Europe Programme under grant agreement n° 101083412.

DSBA



## Data Spaces Symposium

Unite. Innovate. Adopt.

Darmstadtium | Frankfurt region





# SICOS

Wir vermitteln Höchstleistung.

## Bridging HPC Access for SMEs EuroCC Initiatives and the German Ecosystem

Dr. Andreas Wierse

*Managing Director SICOS BW GmbH*



1985

Lothar Späth buys a Cray 2 ...



... and creates 10 new positions for SME consultants

1995

Foundation of hww and HLRS

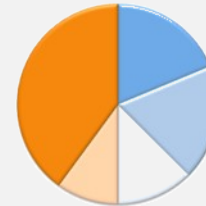


Supercomputer-Joint-Venture gegründet

xs. Stuttgart (Eigener Bericht) – Eine Betriebsgesellschaft für Hochleistungsrechner hat die Dr.-Ing. h.c. F. Porsche AG, Stuttgart, zusammen mit der debis Systemhaus GmbH, Stuttgart, einer Tochtergesellschaft der Daimler-Benz Inter-Service (debis) AG, Berlin, sowie dem Land Baden-Württemberg und der Universität Stuttgart gegründet. Die vier Partner haben einen entsprechenden Vertrag im Stuttgarter Finanzministerium unterzeichnet.

ihm nach Meinung des baden-württembergischen Finanzministers Gerhard Maier-Vorfelder die Zusammenarbeit zwischen Land und Industrie gefördert. Für Porsche bringt die neue Betriebsgesellschaft erhebliche Vorteile für die technische Entwicklung, erklärte Walter Gnauert, im Vorstand für Finanzen zuständig. Durch die Nutzung der Hochleistungsrechner könne Porsche seine Entwicklungsaufgaben effektiver lösen. Dadurch wiederum ließen sich die Entwick-

- Uni Stuttgart
- KIT
- Land
- Porsche
- T-Systems



2011

Foundation SICOS BW GmbH



Focus: SMEs

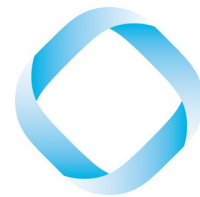


# The SICOS BW Tasks

Facilitate SME-Access to HPC Systems  
and Large Scale Data Facilities

Support SMEs in finding  
Competence Partners

Support the Centers in the Optimisation  
of their Offering towards Industry



# SICOS

Wir vermitteln Höchstleistung.



# SME



Automotive Solution Center for Simulation

## CASE4Med



# From Concepts to Implementation

- EuroCC kicked-off as Research & Innovation Action in **September 2020** (End of Phase 1: 31.12.2022)
  - **Phase 2 started 1<sup>st</sup> of January 2023** (duration 3 years)
- **32 nations**  
28 Beneficiaries, 60 Affiliated Entities, 11 Associated Partners
- **Germany**, Bulgaria, Austria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Greece, Hungary, Ireland, Italy, Lithuania, Latvia, Poland, Portugal, Romania, Serbia, Slovenia, Spain, Sweden, France, Netherlands, Belgium, Luxembourg, Slovakia, Norway, Turkey, Republic of North Macedonia, Iceland, Montenegro
- Funding: 50% EuroHPC JU, **~50% from the respective states**
- <https://www.eurocc-access.eu/>
- LinkedIn: EuroCC, Twitter: @EuroCC\_project



# What is the Background of EuroCC?

**European High-Performance Computing Joint Undertaking** ('granting authority'),  
under the powers delegated by the European Commission ('European Commission')

## **The Topics:**

- **HPC** – High-Performance Computing
- **HPDA** – High-Performance Data Analytics
- **AI** – Artificial Intelligence



**Co-funded by  
the European Union**

The mission of EuroCC 2 is to continue the **establishment of a network of National Centres of Competence (NCC)** in the most efficient way, while continuing to address the differences in the maturity of HPC deployment in Europe, for which improvement has already been noted.

# What are National Competence Centers?

National Competence Centers (NCCs) are organizations or institutions that are **designated as experts** in a particular field or technology by a national government. The purpose of NCCs is to **coordinate and enhance** the development of **national expertise and capabilities** in a specific area.

They typically play a key role in **promoting research, development, and innovation**, and may also be involved in **providing training, education**, and other services to support the growth of a particular industry or field.

NCCs may be established in a **variety of fields**, such as advanced manufacturing, biotechnology, renewable energy, or information technology.

They may **work with universities, research institutes, and private sector companies** to support the development of new technologies, products, and services. NCCs are often funded by the national government or through partnerships with industry and academia, and may have a variety of **goals**, including **improving the competitiveness** of national industries, promoting **economic growth**, and **advancing scientific and technological knowledge**.

asc(s)

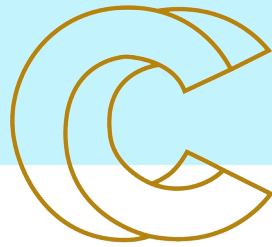
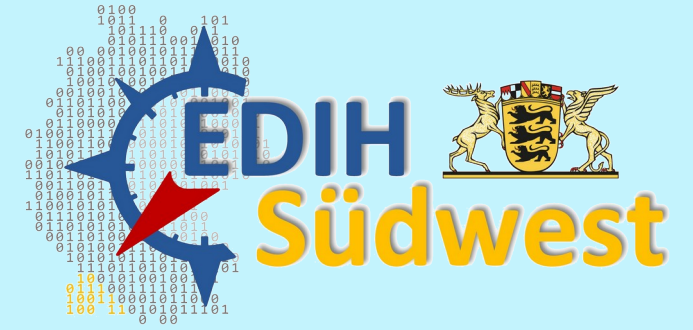
Automotive Solution Center for Simulation

CASE4Med

SDSC BW  
Smart Data Solution Center Baden-Württemberg



media  
solution  
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baden  
württemberg



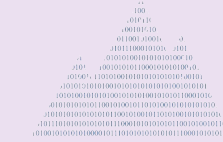
EURO



Smart Data  
Innovation Lab



ASC(S)  
Automotive Solution Center for Simulation



DIGIHUB SBH



CASE4Med

SDSC BW  
Smart Data Solution Center  
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# Safeguarding the Information Ecosystems

Kristina Knaving

Senior Researcher, RISE



# Usage of Unapproved and Banned Generative AI Tools at Work



FILTER BY COUNTRY

(All) ▼

FILTER BY INDUSTRY

(All) ▼

*Filter selections that yield a sample size below 25 will not be shown.*

*[Base = Workplace Generative AI Users]*

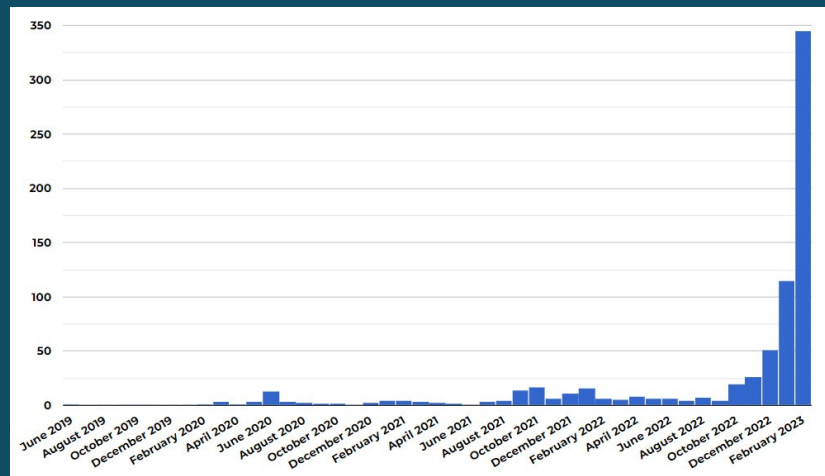


have used unapproved  
generative AI tools  
at work

of workplace generative AI  
users have used banned  
tools at work

# Misinformation and desinformation are poisoning our information ecosystems

- Individuals as well as malicious actors
- Internet, intranets, research
- Human information gathering at risk, also LLM summarising of content
- Model collapse and feedback loops

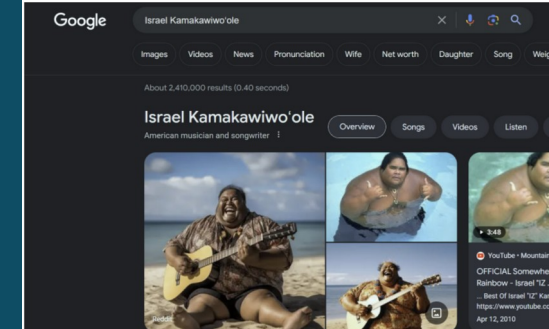


Submissions to Clarkesworld

## Fake AI images are showing up in Google search – and it's a problem

By Luke Larsen  
November 28, 2023 4:41PM

Listen to article 2 minutes



### Did Stannis kill his daughter in the books?

Answer, Follow, Request, Details, More

All related (38) Recommended

Assistant · Chat on Poe  
General knowledge AI bot that excels at answer... · Nov 30

In the "A Song of Ice and Fire" book series by George R.R. Martin, Stannis Baratheon does indeed sacrifice his daughter, Shireen, with the assistance of Melisandre, in a desperate attempt to gain favor from the Lord of Light and improve his chances in the war for the Iron Throne. This event occurs in the fifth book, "A Dance with Dragons."

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Snow · Updated 3y

Short answer: no.

Long answer: N000000000000.

Ok, so in short, Shireen is alive and well right now in the books. A lot of people think she will be burned, but that hasn't happened yet.

However, the idea that Stannis will be involved is unlikely. He's at Winterfell like in the books, while Shireen is at the Wall... with her mother and Melisandre. With Jon recently dead and Stannis presumed dead (probably falsely, but unless certain theories are true, everyone at the Wall believes the Pink Letter), I think the idea that



# Bias

Bias exists in all data and all humans, and cannot be entirely removed....

...but model bias likely to continue to be less diverse than human bias.

We often focus on easily perceived biases

"Microbias" can be a problem over many interactions

# Generalisation and convergence – “The AI SAMENESS”

LLMs turn statistical majorities into absolutes



Here are two images depicting a professional-looking individual in a business suit, embodying the essence of a successful CEO in a modern corporate office setting.



# Semi-synthetic data

- AI-powered tools makes "human-made" content into semi-synthetic
  - Often without users' knowledge
- Number of tools with AI support grow rapidly- AI filters, adjusts, suggests, generates





# Safeguarding the information ecosystems

## Suggested solutions

- AI detectors
  - Risk for false positives and negatives
- Mandatory labelling , watermarking and shibboleths
  - Only works for regulated models and model use
- Known sender
  - Privacy issues
- **Human attention is needed, even though expensive**
- **Trusted repositories, verified data sets, curated content**
- Educating users to facilitate human-in-the-loop
- Technical solutions, such as expand modalities



# Trusted data repositories

- Curated content / verified sender
- For information gathering, but also for training models
- Who decides what is trustworthy and less biased?
- Who owns the data? Will usable data be locked into organisations?
- Who will be able to train on especially valuable data, such as research articles?

# Panel and Summary

HPC meets the  
demands of AI and  
Data

*Room: Vanadium*

