Supercomputing and AI

2024 KEY TRENDS

BASED ON A MARKET INTELLIGENCE REPORT - **October 2024**

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EURO²

NATIONAL COMPETENCE CENTRE
SUPERCOMPUTING LUXEMBOURG

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What is supercomputing (HPC)?

Supercomputing – or high-performance computing (HPC) – is an extremely powerful form of computing used to process intensive workloads in very little time. Computations that would take years on a PC take hours or minutes on a supercomputer. This makes HPC particularly adept at processing large volumes of data, solving complex problems with multiple variables, and exploring numerous scenarios simultaneously.

What is AI?

Artificial intelligence (AI) is a broad term encompassing various technologies that simulate tasks associated with human intelligence, such as problem solving and information processing. AI can analyse human language, enable computer vision, and drive advancements in self-driving vehicles, robotics and industrial automation.

Why together?

Supercomputing, with its immense computational capabilities, has catalysed significant advancements in AI, allowing for the development of complex models and sophisticated algorithms. **Today, the integration of AI and HPC enables rapid processing and analysis of massive datasets**, driving innovation across sectors such as healthcare, finance, energy and more.

18.29 petaflops

The peak performance of MeluXina, Luxembourg's supercomputer ranking among the top 50 HPCs in the world.

That's equivalent to the capacity of over 45,000 personal computers.

€8 billion

The budget spent so far of EuroHPC JU, a joint initiative between the EU, European countries and private partners to develop a world class supercomputing ecosystem in Europe.

€1.59 million

The funding awarded in 2023 to public-private partnerships under the HPC-Bridges call, a joint initiative of the Luxembourg National Research Fund (FNR), the Ministry of the Economy and Luxinnovation.

4 key trends

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Supercomputing and AI are converging

The lines between HPC and AI are blurring, with AI becoming an integral part of supercomputing workloads. This is driving the development of new and optimised hardware and software solutions.

Open-source software and collaborative projects play a key role

Such initiatives, done noticeably through public-private partnerships and collaboration between companies, play a crucial role in the adoption and advancement of AI and supercomputing technologies.

Distributed supercomputing & cloud-based AI services facilitate for SMEs

Cloud-based HPC is gaining popularity for its flexibility, scalability and cost-effectiveness. This trend is expanding access to HPC resources and enabling new use cases.

The demand for energy-efficient solutions and sustainable infrastructure is increasing

As supercomputers grow more powerful, energy efficiency and data centre management become increasingly critical. Liquid cooling is emerging as a key technology for managing the heat generated by HPC and AI. This trend is driving the development of new cooling solutions and data centre designs.

Did you know?

MeluXina, Luxembourg's supercomputer, was named after the mermaid Melusina due to its water-cooling features. According to legend, Melusina supposedly married Count Siegfried, who founded the city of Luxembourg in 963.

Drivers

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Increasing demand for computing power

The growing complexity of scientific and industrial problems, coupled with big data, is driving the demand for extremely powerful computing. AI and HPC are essential for processing and analysing this data.

Advancements in hardware and software

Rapid advancements in hardware technologies, such as processors, are enabling faster and more efficient processing of complex data. At the same time, new software frameworks and libraries are facilitating the integration of AI and HPC.

Government and industry investment

Governments and industry leaders around the world are investing heavily in AI and HPC technologies, recognising their potential to drive innovation and economic growth.

Did you know?

Federated learning, a subfield of machine learning, trains AI models with real data, while ensuring that the data never leaves the owner's premises. This approach guarantees data privacy and security, allowing AI to learn from real-world data without compromising confidentiality.
In Luxembourg, banks are exploring this technology to fight financial fraud.

Challenges

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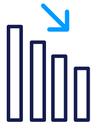
Data privacy and security

The increasing reliance on AI and HPC for processing sensitive data raises concerns about privacy and security.



Skill gap and talent shortage

There is a significant shortage of qualified professionals in HPC and AI, making it difficult for organisations to adopt these technologies effectively.

High costs, infrastructure requirements and sustainability challenge

Building and maintaining AI and HPC infrastructure can be expensive, requiring significant upfront investments in hardware, software and facilities.

Energy consumption

The high energy demands of supercomputing and AI systems pose significant sustainability challenges.

Complexity of integration

Training AI models with supercomputing infrastructure requires specialised knowledge and significant investment.

Opportunities

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Collaborative research and development

across academia, industry and government. By pooling resources and expertise, organisations can tackle complex problems and drive innovation more effectively.

New business models and services

for technology providers, consulting firms and service providers. These organisations can offer specialised solutions and services to help clients harness the power of these technologies and derive value from their data.

Innovative applications

are opening up new possibilities in various sectors, from healthcare to environmental science.

Societal benefits and impact

from improving healthcare outcomes and accelerating drug discovery to mitigating the impacts of climate change and advancing sustainable development.

How HPC and AI can support your company

Business challenge	HPC-AI use case example
Analyse large amount of data in real time	Fraud detection
Automate industrial processes	Enable powerful computer vision
Reduce downtime	Implement predictive maintenance
Avoid resource shortages and overstocks	Optimise supply chains and inventory
Optimise resource allocation	Enable industrial smart grids
Reduce environmental footprint	Energy optimisation and consumption forecasting
Minimise costly trial-and-error processes	Drug discovery
Quicken the pace of research	Complex scientific simulations
Manage complex data models	Climate modelling, weather forecast

How companies are using HPC and AI

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Worldwide...

Enabling smart factories and optimising production

Safran Aero Boosters is using HPC to develop and optimise aerospace propulsion systems, leading to improved performance and efficiency.

Discovering new materials for batteries

Microsoft and the Pacific Northwest National Laboratory (PNNL) are using HPC and AI to accelerate battery material discovery, reducing the process from years to weeks.

Supporting complex physics research

The High-Performance Computing Center of the University of Stuttgart (HLRS) is building The Hunter system, powered by AMD Instinct MI300A accelerators, to support research in fields such as computational fluid dynamics, materials science and molecular dynamics.

...In Luxembourg

Improving electricity forecasting to balance supply and demand

Enovos and the University of Luxembourg are using advanced AI techniques and HPC to improve consumption forecasts by analysing data from 28 million smart meter readings per day. Their computations also factor in residential production of renewable energy.

Advancing agro-ecosystem forecasting

LIST and adwäisEO are working on HERITAGE, a project to prototype a crop yield forecasting system. Using remote sensing data, AI, and numerical crop modelling, it leverages Luxembourg's advanced computing resources to provide timely, accurate yield predictions.

An AI-based solution against ransomware

Cybersecurity company Conatix, in collaboration with the University of Luxembourg, created CYSANA, a new AI-based enterprise solution to protect companies against malware and ransomware. The solution has been patented in 15 countries.

How to leverage HPC and AI

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Access

MeluXina – Luxembourg's supercomputer

MeluXina is operated by LuxProvide, under the governance of the Ministry of the Economy and the Ministry of State. MeluXina is hosted in Luxembourg data centres operated by LuxConnect, enabling data sovereignty and compliance with Luxembourg and European regulations on data security. To learn more about MeluXina and how to access it, please contact Supercomputing Luxembourg.

Support

Luxinnovation

Our experienced experts will evaluate your existing needs and infrastructure to identify the right opportunities to access HPC and AI resources, and provide a roadmap of proposed digital investments. Additionally, they can connect you with the national supercomputer MeluXina and the HPC of the University of Luxembourg, as well as help you benefit from our connections with over 25 other HPC competence centres in Europe.

Supercomputing Luxembourg

The national competence centre for high-performance computing, which is a cooperation between Luxinnovation, LuxProvide and the University of Luxembourg, is your one-stop shop for high-performance computing, high-performance data analytics and artificial intelligence support services.

Funding

Fit 4 Digital - AI

The Fit 4 Digital – AI programme for SMEs aims at identifying how AI can help you generate value from your vast amounts of data, and use it to create value through your products, services or business models.

Joint Calls for HPC projects

The Ministry of the Economy, the Luxembourg National Research Fund and Luxinnovation have joined forces to offer companies and research institutions a new funding opportunity that supports consortia to take advantage of HPC capacities in their research field.

The joint funding calls support the implementation of high quality, high impact and innovative applied research projects that aim to benefit from high-performance computing.

Interested in exploring how supercomputing and AI can enhance your business?

- **Contact our experts for further information and support.**